ENCYCLOPÆDIA BRITANNICA

1768

The Encyclopædia Britannica is published with the editorial advice of the faculties of the University of Chicago and a committee of members of Oxford, Cambridge and London Universities.

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"LET KNOWLEDGE GROW FROM MORE TO MORE AND THUS BE HUMAN LIFE ENRICHED"

ENCYCLOPÆDIA BRITANNICA

A New Survey of Universal Knowledge

Volume 16

MUSHROOM to OZONIDES

ENCYCLOPÆDIA BRITANNICA, LTD

CHICAGO · LONDON TORONTO

PRINTED IN GREAT BRITAIN

FOUNDED A.D. 1768

ENCYCLOPÆDIA BRITANNICA

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Volume 16

MUSHROOM to OZONIDES

MUSHROOM. The well known, edible, umbrella-shaped fungus which is grown for the market and commonly served as a delicacy is called by many people "the mushroom." Botanically it is known as *Agaricus campestris,* or by some authors as *Psalliota campestris.* In the temperate regions of the earth it is often found growing wild, in pastures, lawns, golf courses, etc., where the grass is kept short and the ground is enriched by manure. Restriction of the name mushroom to this fungus alone is not in accordance with the terminology accepted by botanists, nor in most regions does it correspond with popular usage. Hundreds of other umbrella-shaped fungi occur in nature and are to be found in numbers unbelievable to those who have not made a deliberate search for them. These differ from *Agaricus campestris* in minor characters of form, structure, and colour. Many of them are edible, a few are deadly poisonous, others are too tough or unpalatable to serve as food. The botanist calls all of these mushrooms. Such umbrella-shaped fungi in most cases bear on the under side of the expanded upper portion or cap (*pileus*) a number of flat, knife-blade shaped parts (*gills*) which radiate like the spokes of a wheel from the handle or stalk (*stipe*) to the margin of the cap. Possession of these radiating gills marks a fungus as a member of the family Agaricaceae, these fungi being commonly called "agarics." Other closely related umbrella-shaped fungi outside this family lack gills. In the Boleti, for example, there may be seen on the under side of the umbrella, myriads of tiny pores which are the mouths of cylindrical tubes, while in members of the family Hydnaceae pendent spines occur instead. Still other related fungi lack the typical umbrella-shape, and show wide variation in form. The coral fungi (Clavariaceae) have the aspect of delicately coloured coral, and may be much branched like a deciduous tree. Others occurring on the sides of stumps, fallen logs, or trees are known as the bracket fungi and have the aspect of little shelves overlapping one above the other. The hundreds of species of all these various sorts of fungi possess, for the most part, a soft texture or flesh and the whole aggregation are commonly termed the "fleshy fungi." The application of the name mushroom to all of them accords with professional and popular usage for the most part. Some people use the term mushroom only for the edible members of this great group, and call those which are not edible toadstools. Although botanists recognize the word toadstool they regard it as synonymous with mushroom and write at times "edible toadstool" or "poisonous mushroom." In general they avoid the term toadstool.

The Agaricaceae, characterized as noted above, by the possession of gills on the under side of the pileus, embrace more than fifty different genera. These constitute five groups differing in the colour of the dust or powder which falls from the gills at maturity. This dust, composed of many thousands of tiny, unicellular spores, which float downward in such quantity as to form a noticeable deposit on the grass or earth beneath the fungus, may be easily caught for examination if a sheet of paper be placed directly beneath the cap. The colour of this spore dust in some genera is white. In others it is pink, purple-brown, rusty brown or black. The group characterized by possession of purple-brown spores contains about ten genera, one of which is Agaricus. The well known mushroom of commerce, *A. campestris,* is only one of a dozen or more species composing this genus. Some genera contain many dozens of species. In any given genus the species all possess in common certain prominent features of form, colour or structure which serve to distinguish them from those of other genera. Within a genus the species differ from one another in more minor characters of the same sort, it being necessary in many cases to take note of microscopic points of dissimilarity. Consideration of the genus Agaricus in this connection will serve to illustrate this situation concretely. All the species of the genus have purple to purple-brown spores, and the gills, which are white when young, change gradually through pink and successive shades of deepening brown as the spores reach maturity over their surface. The ends of the gills nearest the stipe are not attached to it and are not disturbed when the stipe is torn from the pileus. On the under side of the pileus of the young opening umbrella there is a chamois-skinlike membrane stretching from the stipe to the margin of the pileus and hiding the gills from view. A little later this membrane (*veil*) detaches itself from the margin of the pileus and falls to form a ring (*annulus*) around the stipe. In the other genera having purple-brown spores the gills are attached to the stipe and an annulus is lacking. The characters which serve for the identification of the genus Agaricus are thus seen to be few and readily recognized.

In the group of white-spored forms the genus Amanita is very important, because to it belong all the deadly poisonous mushrooms. Though a few of its species are regarded as edible, most of them are definitely dangerous, and some are capable of causing death. It is necessary, therefore, that the characters which separate this genus from others be clearly understood. As an annulus is present and as the gills are free from the stipe, there is a pronounced resemblance in form to Agaricus. However, the spore powder is white, and the gills are never brown. In most species they are white, and remain so even in old specimens. Though a young individual of Agaricus in which the gills are still white may be easily confused with one of Amanita, there is present in the latter an additional structure which, if not overlooked, will serve as a danger signal. While yet in the young more or less globose stage the plant in Amanita is completely enveloped in a definite sheath similar in character to the membrane which forms the annulus. This outer layer of enveloping tissue is called the *volva.* As the young plant grows and enlarges it bursts this membrane, emerges from it, elongates upward, and opens out into the umbrella shape. In some species of Amanita the entire volva persists thereafter at the base of the plant as a bag or cup surrounding the base of the stipe. This "death-cup" is not well formed in all cases, and even when present may be overlooked by careless individuals who fail to pick the entire plant including its base. Furthermore, in other species of the genus the rupture of the volva occurs equatorially in such a fashion that approximately the whole upper half of it remains attached over the upper surface of the pileus and is carried upward, the portion left at the base being insufficient to form a definite cup. In these cases the part carried up on the surface of the pileus is later broken up there into loosely adherent, flake-like scales by the expansion of the tissue beneath as the pileus opens into the umbrella form and increases in lateral diameter. The presence of such loosely attached, flake-like scales on the pileus should hold a fungus under suspicion until study of its other features proves it to be in fact not an Amanita. Though in many edible species in other genera scales occur on the pileus they are more firmly attached in character, and can be seen to have resulted from cracking or fraying of the tissue of the pileus itself. Specimens suspected of being Amanita should be examined carefully in the young state if possible, for the presence of the volva is then more readily noted. Questionable plants should be discarded.

There have been many well authenticated cases of illness and death from mushroom poisoning. In most of these instances poisonous species of Amanita were undoubtedly involved. However, records of symptoms of poisoning, and even death, exist in cases in which the plants consumed were apparently recognized as edible forms. Such cases have probably arisen from the eating of specimens already in a state of decay. Collectors should avoid all fungi which are not in a wholly fresh and wholesome condition. Old, wormy or semiputrid ones may well contain poisons similar to those present in rotting vegetables and meats. When poisoning by mushrooms is suspected it can not be too strongly urged that a competent physician be summoned with the least possible delay. The poisonous element is not the same in all species of Amanita. In *A. muscaria,* the fly agaric, it has been considered to be chiefly because of the alkaloid muscarine, but more recent work indicates that it may actually be one of the derivatives of muscarine. Symptoms of poisoning with muscarine usually appear in from one-half to two hours. Vomiting and diarrhoea, pronounced flow of saliva, suppression of the urine, dizziness, derangement of vision and loss of confidence in ability to make ordinary movements are succeeded by drowsiness, stupor, cold sweating and marked weakening of the heart's action. In fatal cases stupor persists for two or three days, and death follows the gradual weakening of the pulse. Treatment for this poison consists chiefly in the prompt removal of the unabsorbed mushroom material from the alimentary canal and the giving of subcutaneous injections of some powerful heart stimulant such as atropine. The poison phallin, present in *A. phalloides* and related species, is albuminous in nature and more deadly than muscarine. Preliminary symptoms of poisoning do not appear, unfortunately, until about ten hours after the mushrooms are eaten. Then severe abdominal pains are associated with cramps in the limbs and convulsions. Weakening of the pulse, vomiting, and extreme diarrhoea are followed by death in two to four days. The fundamental injury to the body is due to direct attack on and rapid dissolution of the blood corpuscles. The undigested mushroom material in the stomach and intestines should be removed as promptly as possible. Though it is usually stated that there is no known antidote for phallin, a report from the Pasteur Institute in Paris records preparation there of an antiphallinic serum which has proved so effective that the French Government requires a supply of it to be kept available for use by physicians.

In picking wild mushrooms for the table it is necessary to avoid not only the extremely poisonous Amanitas, but also the more or less poisonous and distasteful species of other genera. Such forms exist in genera whose other members are in all respects wholesome. Consequently, it is necessary to know the specific identity of every plant eaten. There is no royal road to this knowledge. Careful observation of the details in which one species differs from another, combined with the study of pictures and descriptions in some standard book on mushrooms will enable the amateur student to recognize with certainty at least a few desirable forms. All others should be avoided. One species often differs from another in various minor features of form or colour, and only critical observation will enable the collector to recognize a given species with certainty and assure him that it is not a somewhat similar, perhaps poisonous one.

The tiny spores which fall in countless thousands from the gills of mushrooms, float about in the air currents and are disseminated over a wide area. They are analogous to the seeds of higher plants and function in propagating the species. Each spore is a microscopic, more or less globose or ovoidal, cell, composed of a bit of protoplasm surrounded by a thin wall. Though capable of remaining quiescent for a time, it finally undergoes renewed growth, and if it finds adequate moisture and food in the spot where it has fallen it germinates. The side of the spore bulges outward and forms a cylindrical tube-like outgrowth which gradually lengthens and develops into a system of branching threads. These permeate the elements of the substratum, and are readily visible to the unaided eye as a network of delicate strands, usually white, though in some species of other colours. Strands arising from different spores may merge, and threads as heavy as ordinary twine may result. The tips of these heavy cords at the surface of the substratum in time enlarge into more or less globose bodies, commonly termed buttons. Each button is in fact a young mushroom, and by increase in size and internal differentiation of tissues, the umbrella-like mature plant gradually comes into being. It will be understood then that this umbrella is not the whole plant but merely the above ground fruiting portion of it. The mycelium below ground is the vegetative or feeding portion. In some wild species it occurs in the soil, in others in leaf mould, in rotting wood, or in any other material from which the fungus may obtain its food. The mushroom of commerce, *Agaricus campestris,* is grown in beds of specially prepared manure to which soil, straw, or other materials are sometimes added. In this mixture the mycelium grows luxuriantly. The grower calls manure in which the mycelium is abundantly present *spawn.* Old spawn is mixed into the manure in the preparation of new beds, and flakes of spawn or bricks of it are sold. Horse manure has been preferred to other sorts, and the coming of the automobile era has reduced the amount available while increasing its price. Efforts have been made to make use of other materials. Research has shown that the application of urea to mixtures of straw and other composting elements gives satisfactory results. Much more investigation is desirable.

Not uncommonly, commercial mushroom beds are invaded by the mycelium of other species of fungi. In these cases the reduction in the crop necessitates the removal of the infested material, sterilization of the beds, and the use of new spawn.

Like all widely spread and much-cultivated plants, the mushroom of commerce has developed a number of recognized varie-

PAINTED FOR THE ENCYCLOPÆDIA BRITANNICA BY HELEN DAMROSCH TEE VAN

MUSHROOMS

Thousands of kinds of mushrooms grow widely throughout the world. While many are highly prized table delicacies, others, comparatively few in number, are deadly poisonous. At certain stages in their growth—*See* the article Mushroom—the most dangerous kinds closely resemble some of the finest edible forms, so that in the selection of wild mushrooms for food extreme care is absolutely necessary

1. Chanterelle (*Cantharellus cibarius*), edible. 2. Barometer Earth Star (*Geaster hygrometricus*), edible. 3. Warty Puffball (*Scleroderma vulgare*). 4. Pine Flammula (*Flammula sapinea*). 5. Bitter Boletus (*Boletus felleus*). 6. Jack-my-lantern (*Clitocybe illudens*), luminescent, poisonous. 7. Net-bearing Dictyophora (*Dictyophora duplicata*). 8. Stink Horn (*Ithyphallus impudicus*), offensive. 9. Honey Agaric (*Armillaria mellea*), edible. 10. Coral Milky Cap (*Lactarius torminosus*). 11. Pungent Russula (*Russula emetica*), poisonous. 12. Peppery Milky Cap (*Lactarius piperatus*). 13. Fly Agaric (*Amanita muscaria*), deadly poisonous. 14. Reddish Agaric (*Amanita rubescens*). 15. Death Angel (*Amanita phalloides*), deadly poisonous. 16. Yellow Amanita (*Amanita velatipes*)

MUSIC

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EUROPEAN MUSICIANS, 16TH–20TH CENTURY

1. Giovanni Pierluigi da Palestrina (1525/6–1594), Italian
2. Georg Friedrich Handel (1685–1759), German
3. Johann Sebastian Bach (1685–1750), German
4. Joseph Haydn (1732–1809), Austrian
5. Wolfgang Amadeus Mozart (1756–91), Austrian
6. Ludwig van Beethoven (1770–1827), German
7. Nicolo Paganini (1784–1840), Italian
8. Franz Peter Schubert (1797–1828), Austrian
9. Frédéric François Chopin (1810–49), Polish
10. Robert Alexander Schumann (1810–56), German
11. Franz Liszt (1811–86), Hungarian
12. Richard Wagner (1813–83), German
13. Johannes Brahms (1833–97), German
14. Joseph Joachim (1831–1907), German
15. Johann Strauss, The Younger (1825–99), Austrian
16. Maurice Ravel (1875–1937), French
17. Claude Achille Debussy (1862–1918), French
18. Richard Strauss (1864–1949), German
19. Giacomo Antonio Puccini (1858–1924), Italian
20. Igor Stravinsky (1882–   ), Russian

ties, and in different regions and under different modes of culture it shows differences as do the various garden plants. There is always the desire to obtain even more attractive or productive varieties. Toward this end research work in various laboratories has been carried on, and pure cultures obtained from single germinating spores have been prepared and tested. Such pure cultures are in some cases maintained under laboratory conditions and made available to the grower on request.

Mushrooms are grown in caves, in abandoned coal mines, in dark cellars, and in specially built mushroom houses. They are not allowed to reach the fully expanded condition, but are harvested in the large button stage while still very firm, and before the discolouring spore dust begins to fall from the gills. They are usually packed neatly in attractive containers. Though they are being grown in increasingly large quantities, they are still expensive and constitute a delicacy rather than a staple article of food. Though nutritious, their food value is not as great as their extremely high protein content would indicate. *See* FUNGI; MOREL; PUFF-BALL; TRUFFLE.

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MUSHROOMS, COOKERY OF. Edible mushrooms contain some nitrogenous food and about 90% water. Eaten with other foods they are of great service in the diet on account of their flavouring properties. It is dangerous to eat mushrooms which have been gathered by anyone who has not studied the different kinds.

Among the most familiar kinds are the common meadow mushroom (*Agaricus campestris*); button (immature) mushrooms employed chiefly for garnishing purposes and as an addition in high-class dishes; and truffles (underground fungi).

To prepare ordinary mushrooms for cooking, pick over and wipe with a flannel dipped in salt. Peel and remove stalks where necessary. The latter may be used for flavouring stews, soups, sauces, etc.

Mushrooms may be grilled (broiled) and served with maître d'hôtel or plain butter, etc.; baked in the oven under glass (or in a shallow dish); stewed in a casserole with other foods, *e.g.*, Italian pastes, rice, or in a well-flavoured sauce; or, they may be used in stuffings for turkey, poultry and game; they are also employed for garnishes in making galantines, etc.

Stewed Mushrooms.—Place the mushrooms in a stewpan with 2 oz. of butter, salt, a squeeze of lemon juice and a blade of mace. When cooked, stir in a white liaison of flour and butter blended together. Stir well and serve either as an entrée, or on toast as a savoury. This dish may be varied by adding other ingredients and may be served as a cream by adding a sauce of cream and beaten-up eggs.

Fried Mushrooms.—These are frequently added as an addition to a mixed grill. Frying should be done in a frying pan and not in a deep pan of fat. It is best to use good margarine or butter.

Grilled Mushrooms.—Large mushrooms should be chosen for grilling. Grease the gridiron before cooking. Place flesh side uppermost on the gridiron.

Stuffed Mushrooms.—Good-sized mushrooms are needed for stuffing. Any well-flavoured forcemeat can be used though certain flavours blend better with mushrooms than others, *e.g.*, game. To stuff, remove the stalks and pile the forcemeat in the centre of each mushroom. Squeeze lemon juice over and cover with buttered paper or place under glass. Bake in the oven for half an hour.

Mushroom Ketchup.—Sprinkle salt freely over large meadow mushrooms and leave them to stand for a few hours, then mash them in a mortar and set aside for 48 hours. Stir from time to time. Press through a colander and place in a pan. Boil up, skim carefully and simmer for an hour. Strain into a pan and leave until the next day. Then strain again leaving the sediment at the bottom of the basin and add one ounce of black peppercorns, a blade of mace, half an ounce of allspice, one quarter of an ounce of ginger and half an eggspoonful of grated lemon rind to each quart of liquor. Boil up and reduce to half the quantity Bottle and store in a dry place.

MUSIC. The Greek μουσική (*sc.* τέχνη) from which this word is derived was used comprehensively for all the arts of the Nine Muses. Contrasted with γυμναστική (gymnastic) it included the culture of the mind as distinguished from that of the body. Thus the singing and setting of lyric poetry formed but a small, if a central, part of a "musical" education which ranged from reading and writing to the sciences of mathematics and astronomy besides all the arts of literature. The philosophers valued music both in the ancient general sense and in our restricted sense, chiefly as an educational element in the formation of character; so that we obtain little light from them on the pure aesthetics of the Greek art of musical sounds.

1. INTRODUCTION

The present article deals mainly with the musical art-forms matured by European civilization since the 14th century. More ancient music is discussed frankly as beyond our power of appreciation except in the light of prehistoric origins. Our Western art of music stands in the unique position that its language has been wholly created by art.

Music owes but little to nature in the form of acoustic science, and still less to the sounds that occur outside works of art. It is already a mature musical art that selects the acoustic facts, just as in painting it is art that determines the selection of optical facts. Wise critics have, since Ruskin's day, abandoned the attempt to settle *a priori* how much of nature an aesthetic system ought to digest; and music differs only in degree from literature and the plastic arts as to independence of nature.

Yet the difference is often important. Perspective existed as a science before it was taken up by painters, and as a human experience before it became a science. The naïve Western spectator has seen enough of it in pictures to make him resent its neglect, whether in modern art or in the masterpieces of China and Japan. In music the nearest analogy to perspective is the system of tonality developed by the great composers from Alessandro Scarlatti to Wagner. (*See* HARMONY.) Every step in its evolution has been fiercely contested; and even twenty years after the end of Wagner's long career not every responsible musician was ready to admit Wagnerian tonality as a legitimate enlargement of the classical system.

If we set aside language and the organized art of music, the power of distinguishing sensations of sound is no more complex than the power of distinguishing colours. On the other hand sound is the principal medium by which most of the higher animals both express and excite emotion; and hence, though until codified into human speech it does not give any raw material for elaborate human art, it suffices for bird-songs that are as long prior to language as the brilliant colours of skins, feathers and flowers are prior to painting. Again, sound as a warning or a menace is an important means of self-preservation; and it is produced instantly and instinctively.

All this makes musical expression a pre-human phenomenon in the history of life, but is unfavourable to the early development of musical art. Primitive music could mysteriously re-awaken instincts more elemental than any that could ever have been appealed to by the deliberate process of drawing on a flat surface a series of lines calculated to remind the eye of the appearance of solid objects in space. But the powers of music remained magical and unintelligible even in the hands of the supreme artists of classical Greece. We may be perfectly sure that if the Greeks had produced a music equivalent to the art of Palestrina, Bach or Beethoven, no difficulty of deciphering would have long prevented us from recovering as much of it as we have recovered of Greek literature. Some enthusiasts for Oriental lore assure us that long ago the Chinese knew all about our harmonic system but abandoned it after they had exhausted it. This need not worry us. The Oriental aristocrat conceals in his politeness a profound contempt for our efforts to patronise his culture; and that contempt is justified when we show such ignorance of our own music as to suppose that a music of similar calibre could have utterly

disappeared from a living nation whose most ancient plastic art and literature commands our respect and rewards our study. When we trace the slow and difficult evolution of our harmonic system we cease to wonder that it was not evolved sooner and elsewhere, and we learn to revere the miracle that it was evolved at all.

2. NON-HARMONIC AND GREEK MUSIC

Music before the rise of a harmonic system is of two kinds, the unwritten or extemporaneous, and the recorded or scientific. At the present day the music of races that have not acquired Western harmony often pleases us best when it seems most extemporaneous. Tradition can go far to fix the forms and even the details of a performance that may, without the aid of words or dance, last for hours. With words or dance, music becomes more capable of being fixed by writing; but the first musical problems are as far beyond conscious reasoning as the origins of language. Birds solved them before human beings; and folk-music can show real beauty when the systematic music of its day is arbitrary and uncouth. Moreover, folk-music, together with the present music of barbarous races and Oriental civilization, can give us materials such as anthropology uses in reconstructing the past from its vestiges in the present.

For us the music of ancient Greece is by far the most important branch of musical archaeology. Unfortunately the approach to this most difficult subject has been blocked by lack of co-ordination between scholarship and musicianship; and the ascertained truth is less instructive to the general reader than the history of opinions about it. These opinions begin to be interesting when they are expressed by musicians whose music we can understand. The natural tendency of such musicians was to suppose that Greek music was like their own; and each advance in knowledge is marked by disillusion. The first difficulty presented by ancient Greek writers was sufficiently disconcerting. The Greek terms for "high" and "low" were found to be reversed. Our own meaning seems founded in nature; and science confirms it. Our "high" or "acute" notes demand tense vocal cords and correspond to vibrations of "high" frequency. A great 16th century composer, Costanzo Porta, inferred a mystery here, and argued that the Greeks had mastered the art of a totally invertible polyphony, such as Bach afterwards displayed in two fugues in *Die Kunst der Fuge.* Porta accordingly wrote a 4-part motet (*Vobis datum est cognoscere mysterium*) which could be sung upside down: and his contemporary Vincentino composed 4-part motets in each of the three Greek *genera,* diatonic, chromatic and enharmonic. (*See* Hawkins's *History of Music,* i. 112, *seq.*) They are as good as any other music written on *a priori* principles, and the enharmonic motet may be commended to some of our modern experimenters in quarter-tones. But they represent as much knowledge of Greek music as we possess of the inhabitants of Mars.

The truth must be sought by other methods and by far the most promising is the study and comparison of the present scale of nations, whether barbarous or cultured, who have not come into contact with the classical harmony of the West.

A readable account of musical origins may be found in Parry's *Evolution of the Art of Music.* Following the researches of A. J. Hipkins and A. J. Ellis, Parry illustrates the fact that most of the primitive scales, notably the pentatonic scales prominent in Scottish and Chinese music, are built around the interval of a downward 4th (as from C to G) which was probably the first melodic interval to become fixed in the human mind as being simple enough but not too wide. A scale would begin to form by the accretion of other notes near the bottom of this interval. Now take another 4th with similar accretions below the former, either conjunctly (as G to D below the C–G) or disjunctly (as F–C). The resulting scale will either fill or include an octave, it does not matter which; for the filled octave of the conjunct tetrachord contains in another position the notes of the included octave of the disjunct tetrachords, as can be seen in the combined series C, A, F, G, E, D, C, A, G. And the octave was recognized from the outset as a limit after which a musical series repeats itself.

The Greeks had three *genera* of scale: the diatonic, the chromatic and the enharmonic. Of these the diatonic divides the tetrachord most evenly, as E, D, C, B:A, G, F, E. This gives us our diatonic scale in what Palestrina would call the Phrygian mode. The Greeks found that all its notes could be traversed (as a knight's move can traverse our chessboard) in a series of intervals which they called concords. (They thought of them only as successions, not combinations of sound.) These were the 4th (in the ratio 4:3); the 5th (3:2); and the octave (2:1). (Our own "perfect concords" are in these ratios.) Scales with chromatic tetrachords (E, C♯, C♮, B:A, F♯, F♮, E) could also be traversed by the concordant intervals, but not so easily. The enharmonic tetrachords, which only the most accomplished singers could sing, were beyond the reach of perfect concords; and for us they would need a special notation, as E, C, B′, B ; A, F, E′, E♮; where B′ and E′ signify something like quarter-tones above the B♮ and E♮. Yet this difficult scale was said to be the oldest of all; which seems not unlikely when we observe that it gathers three notes closely to the bottom of the tetrachord, leaving a gap of a major 3rd from the top. Eliminate the quarter-tones, and there remains a pentatonic scale E, C, B:A, F, E, which is more likely to be the earliest filling out of the downward 4th than the scales in which the auxiliary note is a whole tone away. And if this nucleus had the prestige of a mystic antiquity musicians would feel a pious pride in mastering the difficulty of filling it up like the other genera.

If authorities on Greek music would abandon their habit of writing scales and reckoning intervals upwards, their results, whether correct or not, would become much more lucid. For, as Parry points out, it is only our harmonic system which makes us think of scales as normally rising; and when a musician applies the term "cadence" to chords that rise from dominant to tonic he contradicts the literal meaning of the word.

Until the most recent times classical scholars have ruthlessly closed the door upon all hope of further light from the comparison of Greek data with the phenomena of extant non-harmonic folk-song and Oriental scales. If such a comparison is to have any meaning we must assume that the now universal phenomena of modes existed in ancient Greece. Modes, as far as non-harmonic melody is concerned, are various cross-sections of a standard scale. Thus, Scottish music shows very clearly five pentatonic modes. Adding the 8ve to complete the scale, these are, 1. C, A, G, F, D, C; 2. D, C, A, G, F, D; 3. F, D, C, A, G, F; 4. G, F, D, C, A, G; 5. A, G, F, D, C, A. In the article HARMONY the ecclesiastical modes of pure polyphony are given with their fondly-imagined Greek names. Pre-harmonic music without modes is contrary not only to our Western prejudices but to the whole trend of anthropological research. In these circumstances classical scholars, under the guidance of D. B. Monro, crushed all hopes by deciding that the Greeks had no modes at all, but that either their ʽαρμονίαι or their τονόι (the terms, whatever they mean, are not synonymous) were mere transpositions of the three genera into various pitches, just as our "keys" are transpositions of our pair of major and minor modes.

When Monro published his *Modes of Ancient Greek Music* in 1894, musicians had learnt too well the lesson that Greek music must not be expected to make sense. They would never dispute a point of classical scholarship; and it did not occur to them that Monro might be just so innocently familiar with modern music as not to realize that he might as well impute high-church tendencies to Alcibiades because of "the splendour of his liturgies" as impute to the ancient Greeks a system of keys related by mere transposition. But musicians only thought that even the most unprejudiced anthropological comparison of extant scales could prevail no more than Macfarren's Victorian assumptions could do in a dispute with Monro. Fortunately in 1916 Mr. G. H. Mountford, in a degree thesis, satisfied classical scholars that Monro was in error and that the Greek modes were modes in the universal and proper sense of the term.

Miss Kathleen Schlesinger has found, by experiments with a monochord, a means of producing modes on mathematical principles. Certainly the Greeks did measure musical intervals mathe-

matically on a string; certainly Miss Schlesinger's system is among the very first things that could have happened in that way; and its results produce many phenomena that ought to have occurred in ancient Greek music. There is, for instance, a remarkable passage in Plato's *Republic* (VII., 531) where Socrates gibes at the pedantries of the merely practical musicians who spend hours in arguing whether this and that note are too near to allow another note between them. And Miss Schlesinger's various scales comprise between them notes quite close enough to explain how the practical musician could get into difficulties about what was obvious to the philosopher. Miss Schlesinger has, moreover, tuned a pianoforte on the basis of her theory, and the result is acoustically very interesting. So much then, for *a priori* theory and practical experience. If Miss Schlesinger's results are not Greek they ought to have been.

The other line of approach is through the experience of setting the choruses of Greek tragedy to a modern music which confines itself to a strict representation of the metre and sets strophe and antistrophe to the same melody. The composer should not attempt Greek modes, on whatever theory, or he will achieve nothing better than an effect of singing "We won't go home till morning" on the supertonic of a minor key and with a beat missing. Instead of thus warping his imagination the composer should translate all that modern culture enjoys in Greek poetry into a music that he can enjoy; restricting himself mainly to one note to a syllable and, while making his instrumental accompaniment as beautiful as he likes, straying into no by-paths of musical tone-painting other than the most natural symbolisms. The Greek rhythmic forms prove musically fascinating, and there is full scope for fine melody within them. The strict correspondence of strophe and antistrophe causes difficulties which reveal much. Even a unisonous accompaniment, such as the Greeks had, can glide over a difference of punctuation or indeed a running on of the sense between strophe and antistrophe, as at the end of the enormous first chorus of *Agamemnon;* and the technique of such compromises closely resembles that of Schubert and Brahms in strophic songs, and has the subtlety of Greek simplicity. Aristophanes, in the *Frogs,* laughs at the interlinear *θραττο θραττο θρατт* (or "plunketyplunk") of the Aeschylean lyre. The passage seems to indicate something more extensive than a merely connective tissue; but exaggeration is not unknown in comedy.

More difficult and therefore still more instructive are the occasional contrasts of sentiment between strophe and antistrophe. In another chorus in *Agamemnon* the pretty ways of a lion-cub are to be sung to the same music as the tale of disaster that befell the man who adopted it when, on growing up, it behaved as might be expected. The highest point of pathos in the first chorus, one of the supreme things in poetry, is the moment where the description of the sacrifice of Iphigeneia turns into a reminiscence of her singing in her father's halls and then runs on into the antistrophe, with the words "The rest I saw not, nor will I tell." After which the same music has to express the pious hope that the queen who now approaches shares the wishes of the chorus for the welfare of the land she holds in trust.

From Plato we learn that musicians degraded themselves by imitating the roaring of lions and the whistling of winds. But what was the Greek criterion for the singing voice? Certainly very different from ours; for Aristotle says that certain high-pitched modes (but what is "high" in this context?) are suited to the voices of old men. An age-limit is the only criterion the heartless modern critic has for the voices of old men. Be this as it may, the safest inference from it is that every educated Greek was expected to sing well as an integral part of the art of speaking well. Perhaps our modern contrast between the singing and the speaking voice did not exist. Nowadays it is not uncommon to find a high soprano speaking normally around the A or G below the treble staff.

(*See* also Aristoxenus; Euclid; Pythagoras.)

3. HARMONIC ORIGINS

The latent harmonic sense of the Greeks is shown in the fact that their diatonic scale was amenable to the Pythagorean science of harmonic ratios. And we cannot suppose that no notice was taken of the combined sounds resulting from reverberation in halls and caverns, or from striking several strings of the lyre at once. Yet the fact remains that outside the orbit of our own Western music of the last six centuries we know of no harmonic system that has advanced beyond drones below the melody and cymbals (our Authorized Version is right in reading "tinkling cymbal") or bells above it.

Music, as we now understand it, consists in the interaction of three elements as inseparable (but not as interchangeable) as the three dimensions of Newtonian space. The Greeks knew two, rhythm and melody, which are as ancient as human consciousness and evidently have their meaning for some other animals. But non-harmonic melody is a very different thing from melody that implies harmony. (*See* Melody exs. 1 and 2 with their discussion.) When we hear an unaccompanied folk-song we involuntarily think of it as the top line of a series of harmonies. If it is really pre-harmonic it will prove unamenable to that interpretation, and then we shall think it quaint. Neither the quaintness nor the harmonic interpretation ever entered into its intention. Life is too short for Western musicians to devote much of it to the violent mental gymnastics of thinking away the harmonic ideas that have made Western music enjoyable throughout five centuries. We may perhaps widen our experience by going back another two centuries; for it was agreed by all the musicians in Vienna that a concert of "Gothic" music was their most interesting musical experience of the year 1928.

In the article Harmony the main steps are indicated by which mediaeval musicians advanced from doubling melodies in 4ths and 5ths (as the unoccidentalised Japanese are said to be doing now) to an aesthetic system of polyphony that demands complete independence in its melodic threads and forbids consecutive 5ths and 8ves as barbarous. The details of this evolution are abstruse; but two main issues may be mentioned here. Polyphony could not have been established without fixed scales and a repository of known melody for composers to work upon.

The scale was set in order in Graeco-Roman times by Ptolemy the astronomer, who flourished A.D. 130 and from whose time the history of the "ecclesiastical modes" becomes continuously traceable until the records of music are secured by the art of printing.

The necessary repository of melody was supplied by the ancient plain-songs of the church, many of which claimed to have come uncorrupted from the music of Solomon's temple and certainly had a continuous history reaching back to early Christian services in the catacombs of Rome. In A.D. 384 a large body of these "tones" was set in order by St. Ambrose. According to a tradition accepted, after some "historic doubts," by good authorities, St. Gregory revised and enlarged the Ambrosian collection; and the whole corpus of Gregorian music undoubtedly familiarizes Roman Catholics of to-day with a music enormously more ancient in its origin than any harmony. This music forms the principal melodic foundation of Palestrina's polyphony; but by his time it had become corrupted, and we must look to the Solesmes edition of 1904 for the text and method of singing plain-song in the perfection it is held to have attained shortly after the death of St. Gregory. The essential difference between the Ratisbon tradition (which we may loosely call Palestrinian) and that of Solesmes is that the Palestrinians impatiently curtailed the flourishes of the plain-song much as Palestrina did with the Gregorian themes he used in polyphony; whereas the Solesmes method restores the free speech-rhythm which makes the flourishes (or melismata) possible in a rapid delivery. Some of these melismata are very extensive, and the Palestrinians (who gradually developed the modern organist's habit of providing each note of a Gregorian melody with a separate chord) had some excuse for mistaking them for corruptions of style.

The Gregorian tradition did not stand alone. There was an ancient Visigoth (or "Spanish") tradition; and there are the traditions of the Eastern Church. Professor J. J. W. Tillyard has shed much light on Byzantine music (*q.v.*), including a promising opening in the deciphering of the earliest *Neumae,* diacritical signs above the words, supposed to indicate musical notes.

He uses the method of interpreting the past from vestiges of primitive usage in the present. Controversies as to the number of modes, whether 8 or 12, raged till late in the 16th century. The *Dodecachordon* of Glareanus settled the question in favour of twelve, as its name implies. Meanwhile composers developed polyphony by ear and got no help whatever from the theorist. Quite independent of modes and entirely practical was the hexachord scheme (*see* HEXACHORD) developed in the 11th century by Guido of Arezzo (*q.v.*).

The general reader may learn something of the hexachord system very pleasantly from the music-lesson in *The Taming of the Shrew.* Hortensio's gamut says "Gamut am I, the ground of all accord . . . D sol re, one clef [*i.e.,* sign, or key], two notes have I: E la mi: show pity or I die." "Gamut" is a survival of Greek tradition; for the bottom note of the Greek scale was identified with the bass G, and this "ground of all accord" is an octave below the Ut of the hard hexachord. Hence it is Gammaut. D is Sol in the hard hexachord $\left\{\begin{matrix} G, & A, & B, & C, & D, & E \\ Ut & Re & Mi & Fa & Sol & La \end{matrix}\right\}$ and Re in the natural hexachord $\left\{\begin{matrix} C, & D, & E, & F, & G, & A \\ Ut & Re & Mi & Fa & Sol & La \end{matrix}\right\}$. It has two names but only one position or "clef," unlike B which has to be flattened in the soft hexachord (F to D). (Morley writing in 1597, calls A flat the B clef.) E is La in the hard hexachord and Mi in the natural hexachord.

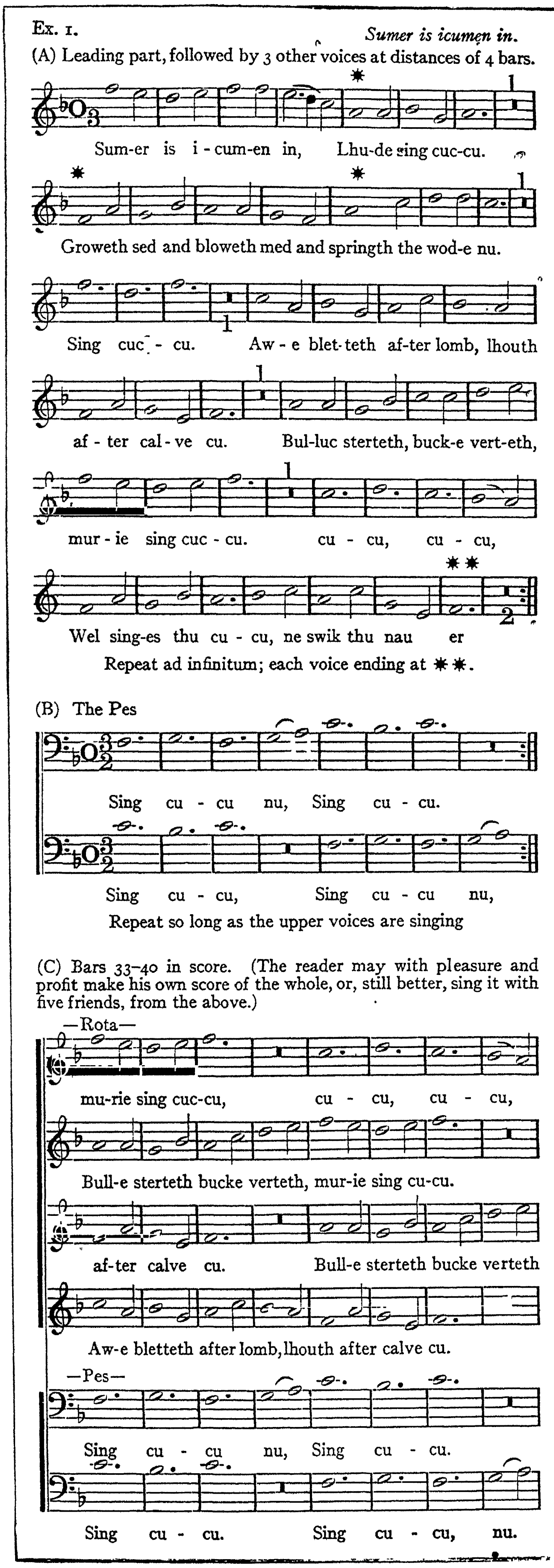
Between Fa of the natural hexachord and Mi of the hard hexachord a dissonant tritone 4th exists. It gave great trouble to mediaeval musicians, who assigned it to the devil. *Mi contra Fa est Diabolus in Musica.*

To the early harmonic and contrapuntal processes alluded to in the article HARMONY some details must be added. The famous unwritten songs of the aristocratic troubadours or *trouvères* of the 12th and 13th centuries undoubtedly set the fashion in melody, and probably set it in the direction of *Sumer is icumen in;* that is to say, in the Ionian mode (that *modus lascivus* that is identical with our major scale) and in a lilting trochaic rhythm

Sumer is icumen in contains no technical feature that has not been found in other compositions of its period, but nothing within two centuries of it achieves either its euphony or its easy handling of canon in four parts on a canonic bass in two. Its consecutive 5ths which sound licentious to us were in its own day the sole justification of the scheme.

It confirms other evidence that the imperfect concords (3rds and 6ths) must have obtained squatter's right in music in spite of theorists; for a very early practice known as ghimel or gymel consisted in singing in 3rds. This is not merely doubling, for the 3rd must oscillate between major and minor according to its position in the scale; and this adjustment requires an advanced harmonic system. When scholars tell us that singing in 3rds was traditional in Britain before the Roman Conquest, we must demur, especially when they tell us (in *Grove's Dictionary of Music and Musicians,* 3rd edition) that we must not expect to find written records of "so simple a process." Similarly we must not expect to find ancient Greek written records of so simple a process as steam locomotion. Still, let us not be unduly sceptical as to the extent to which popular licence and unrecorded extemporisation could advance beyond all the theoretic lore that scribes will record.

The troubadours disdained both the practice of accompaniment (which they left to their servants) and the art of scientific or written music. Not until the time and work of Adam de la Hale, surnamed the Hunchback of Arras (*c.* 1230–1288) can we trace the development of the troubadour into the learned musician. Nearly a century later, when literature is unbending from its universal Latin and becoming truly universal by becoming vernacular, we find the poet Machault, who stands with Petrarca among Chaucer's masters in the technique of verse, producing music that marks a technical advance discoverable by grim toil of expert analysis. But so far we may pardonably dismiss all such



archaic work (except *Sumer is icumen in*) with Burney's sly comment on the earliest piece of recorded music known to him: "It is not of such excellence as to make us greatly regret the loss of such music; though the disposition of those who were pleased by it may have been a great blessing to them." When music is too archaic or inaccessible to give us aesthetic data more may be learned from the disposition of those who were pleased by it than from its recorded technical data.

Before the middle of the 15th century music had passed forever out of the stage at which anything need be known about a composer other than his music. As early as 1437 an Englishman, John Dunstable, had acquired a European reputation. The golden age of the 16th century had no use for archaic music, and Morley in his *Plaine and Easie Introduction to Practickall Musicke* quotes Dunstable much as we might now quote Bach if all Bach's works were lost except for traces of contemporary hostile criticisms and awe-inspired laudations. To call Dunstable the "inventor of counterpoint" is no better than to call Cadmus the inventor of the alphabet. But he is the earliest composer whose polyphony is in direct line with that of the golden age; for Dufay, the first important master of the Netherlands, where the true polyphonic tradition was for long thought to have originated, is known to have died in 1474, 21 years after Dunstable. And when Walker, in his *History of English Music*, praises a motet by Dunstable for its distinction of style, he is describing permanently intelligible aesthetic values. By the end of the 15th century counterpoint was substantially fixed. Practice was still imperfect and aims were uncertain, but skill was increasing, and in the 16th century we leave archaic music behind.

4. THE GOLDEN AGE

From this point onward the history of music is best studied in the masterpieces of the art. Each period has its own art forms. Articles relevant to the golden age are CONTRAPUNTAL FORMS; COUNTERPOINT; HARMONY: *Modal Tonality;* INSTRUMENTATION; MADRIGAL; MASS; MOTET; with biographies on AICHINGER, GREGOR; ALLEGRI, GREGORIO; ANERIO, FELICE; ANIMUCCIA, GIOVANNI; ARCADELT, JACOB; BATESON, THOMAS; BENNET, JOHN; BULL, JOHN; BYRD, WILLIAM; DES PRÉS, JOSQUIN; ECCARD, JOHANN; FARRANT, RICHARD; FESTA, CONSTANZO; GABRIELI; GIBBONS, ORLANDO; GUERRERO, FRANCISCO; HANDL, JACOB; HASLER, HANS; ISAAC, HEINRICH; LASSO (LASSUS), ORLANDO; MARENZIO, LUCA; MORLEY, THOMAS; OBRECHT, JACOB; OKEGHEM, JOANNES; PALESTRINA, GIOVANNI PIERLUIGI DA; SWEELINCK, JAN PIETER; TALLIS, THOMAS; TAVERNER, JOHN; VICTORIA, TOMMASSO LUDOVICO DA; WEELKES, THOMAS; WILBYE, JOHN.

The external history of music is not so easily brought into true relation with the art as popular legends would have it. Everybody is familiar with the story of the drying up of polyphony in the foolish ingenuities of Flemish contrapuntists until, at the behest of the Council of Trent, Palestrina wrote the *Missa Papae Marcelli* in a pure and simple style which convinced the authorities that polyphonic music could be devout. Undoubtedly there was a great deal of barren ingenuity in the work of the lesser Flemish masters, and Obrecht himself had written masses in which the liturgical text is drowned beneath five other texts which each voice sings to other plain chants and themes of old songs. The secular tunes thus freely introduced were not always sung as *canti fermi* too slow to be recognized. Recognition sometimes even led to the singing of the original words. One old song, *L'homme armé*, became the string round which every possible ingenuity crystallized in the composition of the Mass. There is no reason to doubt that the state of church music both deserved and received the serious attention of the Council of Trent.

On the other hand, not all Flemish music was silly, and many of the quaintest "canonic" devices were really nothing but harmless cryptography applied to music that was composed on purely artistic lines. Burney discovered this when, with his usual flair for good illustrations, he quoted some dry ingenuities from Okeghem (or Okenheim) and followed them by the wonderful *Deploration de Jehan Okenheim* by that master's great pupil Josquin des Prés, who is the first unmistakably great composer and who has been well named "the Chaucer of music." No listener can fail to recognize, from anything like a competent performance, the spontaneous beauty and poetic depth of this music, throughout which, while the other voices sing an elegy in French, the tenor intones in Latin the plain chant of the Requiem beginning on a note a semitone lower than the liturgical pitch, and continuing in the wailing melodic mode thus produced. Burney had the wit to see that the "canon" *ung demiton plus bas* did not mean that some other part was to answer the tenor in canon, but was merely the "rule" for reading the cryptogram, the tenor being written at the normal pitch.

Many Flemish devices are well calculated to give coherence or climax to a large composition. One voice may wander up and down the scale with a single figure and a single motto text while the other voices tell their whole story in polyphony. For instance, declaim the words *Miserere mei Deus* in monotone rising one step just for the first syllable of *Deus*. Start on the fundamental note of the scale, and at intervals repeat the phrase a step higher each time. After reaching the fifth degree go down again. Josquin's *Miserere* is a setting of the whole 51st Psalm, woven round a tenor part entitled *Vagans* and constructed on this plan. It is one of the first mature masterpieces in the history of music. Palestrina's art is too subtle for rigid Flemish devices; but once, in one of his finest motets, *Tribularer si nescirem*, he uses Josquin's *Miserere* burden in exactly Josquin's way. Lasso is thoroughly Flemish in both sacred and secular music, and in a motet on the resurrection of Lazarus he makes a soprano *Vagans* cry *Lazare, veni foras* from the beginning of the narrative until the chorus reaches these words and joins in with them in triumphant polyphony.

One must not, then, be misled by the ecclesiastical tradition that condemns Flemish music wholesale. In any case the concern of the church authorities was liturgical rather than artistic. The bishops would have been for the most part glad enough to see church music restricted to the note-against-note style of Palestrina's litanies, *Stabat Mater, Improperia* and last book of *Lamentations*. A very sublime style it is, and Tallis's responses, in their authentic form, are a noble illustration of it. But, as Jeppesen (*The Style of Palestrina and the Dissonance*) has clearly shown, Palestrina's *Missa Papae Marcelli* shows special signs of being a deliberate demonstration that a high degree of polyphony can be reconciled with clear choral delivery of the words. Certainly the ecclesiastical authorities did not long succeed in preventing the use of secular themes in church music.

Many great musicians of today have a musical culture which ignores the golden age; and a knowledge of Palestrina is still considered, as it was in the days of Bach and of Beethoven, rather an out-of-the-way specialty. This is like a culture based on Latin and sceptical of Greek; good as far as it goes, but limited and cocksure like an 18th-century gentleman's artistic impressions of the grand tour. An illustration of the most perfect style of the golden age is appended to the article MOTET.

5. THE MONODIC REVOLUTION AND ITS RESULTS

Until Palestrina's art attained its height, the path of progress in music for the best part of two centuries was that of purity. It was not the free and bold spirits but the idlers and dullards who broke rules and disliked contrapuntal forms. The Hispano-Roman style of Victoria and Palestrina was not everything. It was not secular (though Palestrina's madrigals make him as supreme in that form as in church music), and it was not, like the glorious English polyphony, experimental or racy of the soil. But it was metropolitan, and the boldest of the Tudor composers would have been no such fool as not to hold it supreme. But even before the death of Palestrina a new music was groping toward the light; the path of progress for this music was no more that of purity than the path of omelette making is that of the conservation of eggshells.

Eve's apple was not more fatal to man's earthly paradise than the rise of instrumental music and dramatic solo declamation was to the hope of continuing the golden age of music into the 17th century. The revolution did not consist in this detail or that. To

Ex. 2. *La Déploration de Jehan Okenheim,* for soprano, male alto, two tenors and bass
(Barred according to the main rhythms.)
Phrygian mode transposed.
by Josquin des Prés

*Or "de trépas."

*The distribution of the words is uncertain. Perhaps these repeated notes are a realistic sob.

say that Monteverdi "invented" the dominant 7th, or that anyone else invented it, or that any such invention could revolutionize music, is like saying that Shakespeare revolutionized drama by inventing strange oaths. The important point is not the technical names of the details but their meaning. When Lasso was young some experiments in chromatic music had been made by Cipriano de Rore, and were eagerly imitated by Lasso. But what is Lasso's object in being the first person to write such an out-of-the-way note as A♯? Simply to express the words "*novum melos.*" Very different from such intellectual playthings is the purpose of the powerful discords of Monteverdi's madrigal *Cruda Amarilli* and of the monodic lament of Ariadne which drew tears from the spectators of his opera *Arianna.*

The article MONTEVERDI contains further remarks on his importance and on his coincidence in place and time with the creators of the violin. (*See* also OPERA.) The Palestrina style henceforth became the rightful privilege only of those composers who, either having mastered it before monody arose, or, like Orlando Gibbons (1583–1625), living in regions too remote for it to penetrate, could still compose polyphonically from impulse and not from asceticism. Orlando Gibbons did, in fact, try some monodic experiments which are poor enough.

An impulsively eclectic composer is another matter; and in uncouth, illogical Germany a giant such as Schütz could almost fill the century before the birth of Bach and Handel, with a life's work ranging from the pure polyphony of his Venetian master Gabrieli to the exploitation of all his "astute friend" (*scharfsinniger Freund*) Monteverdi's new principles in most gigantic efforts in mixed vocal and instrumental polyphony. From Schütz we can extract no such system as that which makes Monteverdi a favourite subject in musical history; but in Schütz's chaos the elements may at any moment come together in some strange work of art that fits into no historical or technical scheme but speaks clearly to us through its own coherence. Schütz's "astute friend" always knows what he is doing and whither his work is leading; but, except in a madrigal here and there, which was not his proper business, he does not produce a convincing work of art so often as Schütz who seems to have no proper business at all. It is to the astute, logical Italians that we must look for the progress and consolidation of musical art in general during the 17th century; but we must not let the enthusiasm of historians make us think that such a century of progress was a period of great music. The historians themselves are apt to neglect the intrinsic values of the 17th century compositions and to estimate them merely for their tendency towards something that was to take convincing shape later. The early 17th century was, in fact, musically not unlike what we have so far experienced of the 20th; the eyes of musicians and music-lovers were at the ends of the earth prophesying Wagner, when all that the whole century could finally achieve was the *da capo* form of aria.

Monteverdi and his fellow monodists had, in no mood of caprice, moved in the one direction that was universally important for music; yet their formless declamation soon palled, and its method survived only by becoming codified into the formulas of recitative, which are happy idealizations of Italian speech-cadence, and which survive as dramatic idioms in all music even at the present day. The "invention" of recitative has been ascribed to this or that monodist, with as little room for dispute as when we ascribe the invention of clothes to Adam and Eve. Any vocal music which, whether from inability or from disinclination, avoids organizing symmetrical melody, will be called recitative. When Wagner was still a subject of controversy, critics on both sides used to say that *Das Rheingold* was all recitative.

Two tendencies converged to make music become formal after the "first fine careless rapture" of monody was spent. First, the dramatic stage, with baroque scenery in magnificent development as early as 1667, in Cesti's *Pomo d'Oro,* greatly encouraged the ballet; so that when serious musicians cultivated the stage they also cultivated dance-music. This, however, was less important than the rise of the violin. Monteverdi had already understood its importance; and one symptom of the decadence of polyphony had been the growing habit of solo-singers to sing the top parts of madrigals with all manner of ridiculous flourishes. Persons less legendary than King Cole felt the fascination of the "tweedle-dee" of the fiddle; the great Dutch polyphonist Sweelinck (*q.v.*) used to adorn his organ works with passages of *imitatio violinistica;* and the last quarter of the 17th century saw the brilliant work of Biber with his queer abnormal violin-tunings, and the sober classical *sonate da chiesa* and *sonate da camera* of Corelli (*q.v.*). Artistically as well as morally this development of the violin was healthier than that of the voice, wherein coloratura singing tended to become an acrobatic monstrosity though it had first been regarded as a means of emotional expression. A talent for the violin was no danger to a boy; but a beautiful voice put a boy in deadly peril in an age when all the great opera-singers were *castrati.* Even Haydn had a narrow escape in his youth.

And yet there is, on the whole, more beauty than decadence in the vast mass of solo vocal music produced between 1630 and 1760. That period takes us from the advent of mature instruments and instrumentalized music to a time beyond the death of Handel. Except for the device of the ground-bass (*see* VARIATIONS) the first form that emerged from chaos organized itself on a method of balance between a solo voice and a group of instruments, together with a development of melodic form by means of a firmly-established classical key-system. The result was the classical aria, one of the most effective art-forms ever reduced to the capacity of normal musicians. It entirely destroyed the dramatic character of opera for a whole century; but this has been lamented with unnecessary vehemence. With the exception of the early monodic works and of Purcell's *Dido und Aeneas,* opera before Gluck is not an art-form at all; it is merely a name for the spectacular conditions under which the 18th century public could be induced to listen to a string of thirty arias by one composer who could either handle no other forms or find no listeners for them. The article ARIA shows the intimate connection of this form with that of the CONCERTO. Other art-forms developed in the 17th century for use in the 18th are discussed under CANTATA, OPERA, ORATORIO, SONATA, SONATA FORMS, and SUITE. Matters of style and texture are discussed in CHAMBER MUSIC, HARMONY and INSTRUMENTATION. The articles on monodic composers include CACCINI, CAVALIERI, CESTI, PERI and MONTEVERDI, besides ARTUSI and BANCHIERI who wrote against Monteverdi's earlier works with well-grounded demonstrations of their subversive effect on pure polyphony. The survival of polyphony in grimy and pompous decadence is represented by Pitoni, and later and more as a renascence by LOTTI. Early violin music is represented by BIBER and CORELLI.

The short career of PURCELL (*q.v.*) ends twenty years after the death of Schütz and ten years after the birth of Bach and Handel. Almost any random quotation from Purcell might be by a composer of the calibre of Bach or Handel. Purcell is one of the greatest contrapuntists that ever lived; one of the greatest inventors of themes; one of the greatest masters of declamation; and a completely mature master of early orchestration. And his fellows in the English music of the Restoration, Pelham Humfrey, Child and Blow were no mean spirits. Burney devotes an entire plate in his *History of Music* to examples of "Dr. Blow's crudities"; and later historians need look no farther afield for examples of intelligent prophesy. But the Restoration music lacks one thing; and that is power of composition. Purcell, in small dance-forms and short lyrics, is unsurpassable. But his only chance of getting through a sustained movement is when he writes on a ground-bass. In this fascinating forlorn hope of English music we see the fruit of nearly a century of bold endeavour ripening a generation too soon. Parry ascribes the patchiness of Purcell to the subtle humour of Charles II. in sending his best chorister to learn from Lully, the master of the French ballet-opera, how to write English church music. But Lully is not patchy, and Purcell's music is a crazy-quilt, purple with foreshadowings of the music of the future.

6. BACH, HANDEL AND THE NEAPOLITAN SCHOOL

If all music between 1685 and 1759 were annihilated except the

work of Bach and Handel, the ordinary music-lover would miss nothing but a large collection of decorative and decorous violin music and a still larger collection of arias; and to most of these favourite *gemme d'antichità* the mid-19th century editor has contributed much of their lusciousness. For us the age of Bach and Handel is the age of nobody else in music. But the contemporaries of Bach and Handel thought of Handel as a fashionable opera-writer who with advancing years developed choral music as a pious fad; while nobody thought of Bach except people within coaching-range of Saxony where Bach was known as a wonderful organist and an impracticably deep scholar. The polyphony of Bach and Handel stands almost alone in an age when polyphony was utterly unfashionable. It was inculcated as a staple subject in musical education; but to carry it into mature art was to discuss Latin grammar in the drawing-room. The opportunities and the difficulties of early symphonic orchestration alike arose from the neglect of polyphony after 1750. Apart from Bach and Handel, that neglect can be traced much further back; and it characterized musical connoisseurship much later; so that Burney could say of Philipp Emanuel Bach that wherever he got his beautiful and natural style from it was not from his father, for that eminent organist, though profoundly versed in all devices of canon and fugue, was so fond of crowding all the harmony he could into both hands that he must inevitably have lost melodic grace.

The vast and accurately-perfected aesthetic system of Bach and the improvisatorial opportunist eclecticism of Handel are discussed in the articles on those masters, and also under the headings of ARIA, CANTATA, CONCERTO, CONTRAPUNTAL FORMS, COUNTERPOINT, FUGUE, HARMONY, INSTRUMENTATION, ORATORIO, SONATA FORMS and SUITE. But, while this information covers the aesthetic values of the period, it tells us little of its historic trend. We must not look for light from the "spirit of the age" as shown in its politics or even in its religious history. Palestrina writes, from habit and preference, a devout music which neither Luther nor the Council of Trent could blame as representing the spirit of the age; and Bach achieves the ideal Lutheran music while Voltaire is at the court of Frederick the Great.

The music that pleased the contemporaries of Bach and Handel was that which continued, not too elaborately, the Neapolitan tradition founded by Alessandro Scarlatti. Lully (an Italian by birth) took this tradition to France, and transformed Italian opera by encouraging the French taste for the ballet. Rameau, greatest of classical French composers and epoch-making theorist, carried on the Lully tradition in opera, and joined forces with the exquisite school of clavecinistes, whose leader, Couperin, was admired and imitated by Bach in his suite-forms. Italian violin music and concertos in the Neapolitan style were produced by composers who were also great players. The enormous industry of Bach and Handel was nothing unusual. Arias could be written as easily as letters, and distributed by thirties in operas. Oratorios and church music, though less fashionable, were more highly organized; mainly because they kept choral music in being. And thus the Neapolitan tradition of choral music passes straight into the polyphony of Mozart, quite independently of Handel and wholly ignoring Sebastian Bach, of whom Mozart knew not a note until he was grown up. Meanwhile cultured Europe was unvexed by doubts as to who were the immortals. The Handel-Bononcini rivalry had been little more than a nine-days' wonder. Six years after Handel's death, the seven-year old Mozart in London dedicated his violin-sonatas to Queen Charlotte in the hope that under Her Majesty's protection "je deviendrai immortel comme Haendel et Hasse." Graun would probably have been the third name of European repute; and Telemann, the most voluminous composer of his voluminous day, was a great figure in his own country. As for Bach—everybody in London knew Mr. J. C. Bach, of the Bach and Abel concerts, and report said that his father had been a great musical scholar.

Behind the dignified musical history, but not (like Sebastian Bach) aloof from it, vital forces were at work in comic music-drama. This was admitted by way of *intermezzi* between the acts of serious operas. One of these intermezzi, *La Serva Padrona* by Pergolesi (known in the 19th century by his conventional *Stabat Mater* for two-part female chorus) not only broke from its moorings, like many other intermezzi, but found its way to Paris where it created a furore of popular success and precious disputation dividing musical Paris into *Buffonnistes* and *Anti-buffonnistes*. Except for the untimely blossom of English opera in the hands of Purcell in the previous century this is the only moment at which opera after Monteverdi and before Gluck (with all respect to Rameau) becomes a genuine art-form instead of a concert on the stage.

Biographical articles dealing with the following named composers who belong to this period: the violin writers CORELLI, GEMINIANI and TARTINI: the clavier writers COUPERIN and D. SCARLATTI (the Paganini of the harpsichord and a most unclassical son of the founder of classical tonality); the opera writers (which meant the all-round musicians) DURANTE (Francesco), GALUPPI (who certainly never wrote Browning's "sixths diminished, sigh on sigh"!), LEO (Leonardo), PERGOLESI and SCARLATTI (Alessandro). RAMEAU is equally important in three capacities as a master of French opera, a livelier master of instrumental music, and an epoch-making theorist. German beginnings of serious and comic music-drama were sumptuously inaugurated at Hamburg by KEISER (*q.v.*) whose influence is traceable in Handel's first opera *Almira*.

7. THE RISE OF DRAMATIC MUSIC AND THE SONATA STYLE

The fashionable distaste for polyphony was a mere negative force in the early 18th century. The positive force was, as in the monodic revolution a hundred and fifty years earlier, an impulse towards drama. Unlike the monodists who, when they rejected polyphony had no power of composition beyond the single musical sentence, the 18th century musicians could easily cover ten minutes with a well-balanced form; and the problem of making such forms dramatic was no longer confined to the monodist's problem of making them rhetorical. On the contrary, the rhetoric had to be demolished; for the action of drama is not the action of rhetoric.

The distaste for polyphony was no unfavourable condition for the rise of dramatic music; it was the inverse aspect of a growing sense of contrast in various textures cheap and valueless in themselves. The rest of the story is told in the articles, INSTRUMENTATION, HARMONY, OPERA, SONATA FORMS, and GLUCK, BEETHOVEN, HAYDN, MOZART.

It is inadequate to call Gluck a "reformer" of opera. Music itself was not dramatic before Gluck made it so. Hence it is a mistake to separate Gluck's "reform" from the whole process of the development of the sonata style. Lastly, we miss the whole meaning of that style unless we realize that as soon as it arose the purely instrumental music became more dramatic than any drama. At the same time it also became more powerfully architectural than any earlier music. The art comprised in the works of Haydn, Mozart, and Beethoven constitutes one unbroken aesthetic system, more universal in emotional range than any art since Shakespeare, and as perfectly balanced as the arts of ancient Greece. Until the end of the 19th century it would have seemed a paradox to maintain that Beethoven's work belonged to the same aesthetic system as Haydn's and Mozart's; for critics were slow to escape from the habit of estimating works of art by the face-value of their subjects and the dignity of their language. And the language of Haydn and Mozart corresponds with that of the comedy of manners, while Beethoven is the most tragic composer that ever lived. Nevertheless the huge expansion which music underwent at Beethoven's hands was no revolution, and the popular idea of Beethoven as a revolutionary artist is based on two errors; first, the commonplace habit of seeking parallels between the works of genius and the personal eccentricities of their authors; and, secondly, the inadequacy of orthodox doctrine on musical forms. This inadequacy results from the fact that the doctrines are contemporaneous with the compositions and are accordingly hostile to all but the easiest conventions. A proper grammar of a classical art requires something of the attitude of

the unjustly-despised Byzantine scholars who sacrificed aesthetic pleasures in humble devotion to the task of securing the texts. It is when the languages are dead that they live for ever and suffer no corruption.

We need not expect scholarship in the orthodoxies that were current as to musical forms used in the lifetime of the classics themselves. (*See* FUGUE for a demonstration of the irrelevance of traditional doctrine on that art-form.) Still more impertinent is our orthodoxy on sonata-forms. It ignores the differences between Haydn and Mozart which are as radical as any innovation Beethoven introduced; and, having thus cut away all ground for appreciating Beethoven, treats him as the central symphonic classic, and also as a stupendous revolutionary. This result is correct as far as it goes: central classics can be stupendous revolutionaries. But correct pious opinions are the healthier for facts that can give us a right to them; and the beginning of the 19th century was unfortunately the beginning of an age of humbug in musical education. (*See* CHERUBINI, who, however, has other claims to our respect.) One consequence is that many a musical revolt purports to revolt against the classics when its nearest contact with classical forms has been the perky generalizations of textbooks by writers who regarded the great masters as dangerous, and who deduced their rules from the uniform procedures of lesser composers. Now these procedures were often derived from one or two popular works by the greatest men: thus Beethoven himself produced one model sonata (op. 22)—if its "first subject" had only been long enough. And if Mozart's great C major quartet had not such a subversive introduction it might (and did) serve as a jelly-mould for all the quartets of Spohr. Take another jelly-mould from Spohr, and you have classical tradition.

But now comes the fundamental difficulty in all attempts to distinguish the classical from the pseudo-classical. Every individual work must be judged on its own merits. No generalizations are trustworthy. Many movements by Mozart are as alike as peas. But, being alive, they are not as alike as buttons. With Mozart and Haydn the individuality of each work is all-important for the critic, and if he neglects this all that he says about the common form is superficial. On the other hand, the materials of Beethoven's work developed so rapidly that he seems to be driven to invent a new technique for almost each composition. Hence the external differences become obvious; and unless the critic penetrates to the common form he is lost.

With the symphonic classics we enter the period when these considerations become important; for there is no gulf between that period and our own. No musical art known to Haydn has suffered, like the art of Bach, a period of total eclipse; nor, on the other hand has it had preserved a character that Haydn could have understood. Not much light is shed on Haydn and Mozart by calling them court composers, and little more on Beethoven by calling him a child of the French Revolution. In an age of court patronage Bach the theologian had been inspired to write warlike music not more by ancestral memories than by scriptural texts of war in Heaven. Mozart and Haydn were restive in the service of courts and their musical language was that of the comedy of manners when it was not racy of the soil. In Paris, where musicians might be expected to know most about the French Revolution, the modest, lovable Etienne Méhul (famous for the biblical opera *Joseph*) produced his prettiest comic operetta *Le Jeune Sage et le Vieux Fou* in the year of the Terror; and on French music the immediate effect of these tremendous days was the rise of a new type of sentimental opera concerning the hair-breadth escapes and sufferings of the political prisoner rescued by the heroic wife. Hence Cherubini's *Les Deux Journées* (*The Water-Carrier*) and Beethoven's *Fidelio*. Genius is the wind that bloweth where it listeth. In Bach's day Beethoven would have been musical interpreter of the Apocalypse; and in this 20th century Bach would be something like Dr. Schweitzer.

When we contemplate the impassable gulf that separates Bach's art not only from Haydn's and Mozart's but from the apparently more kindred spirit of Beethoven, we find it hard to realize that contemporaries were unaware of any catastrophic development. In the case of choral music a little study shows us that its forms and language remained Neapolitan. Haydn's and Mozart's masses are flamboyant Neapolitan music; and Michael Haydn, who was merely decorative as an instrumental composer, was rightly thought by his brother to be the better man at church music. Again we regard Philipp Emanuel Bach as bridging the gulf between his father's and the new art; but Philipp Emanuel was writing quite mature sonatas in the year of his father's B minor Mass and his last set of sonatas was produced in the year of Mozart's *Don Giovanni.* Clementi, born in the year after Bach's death, was an infant prodigy of eight when Handel died; he had developed an extraordinarily massive and genuine pianoforte technique (more powerful than beautiful) when he encountered Mozart in a musical tournament, and he survived Weber, Beethoven and Schubert. Nothing can be gained by a further attempt to summarize this "Viennese" period. We may call it the period of the sonata and of Mozartean comic and French romantic opera. More particular information is given in the following technical and categorical articles: HARMONY (on Key-relations); INSTRUMENTATION; MELODY; OPERA; ORATORIO; OVERTURE; RONDO; SCHERZO; SONATA FORMS; SYMPHONY; VARIATIONS, and the biographies ABEL (K. F.); BACH (K. P. E.); BEETHOVEN; BENDA; BOCCHERINI; CHERUBINI; CLEMENTI; DITTERSDORF; DUSSEK; GLUCK; HAYDN (F. J.); MOZART; PICCINNI; SCHUBERT; SPOHR; WEBER (C. M. F. E. VON).

8. THE ROMANTIC PERIOD

With the romantic period comes the development of lyric music in the forms of songs and short pianoforte pieces. Schubert, Weber, Spohr, Mendelssohn and Schumann would be the romantic composers in this sense, and many contemporaries would have added Cherubini to the list, for they thought of him not as the martinet who directed the Paris Conservatoire but as the composer of *Les Deux Journées.* Romanticism was thrilling and classicism was cold.

But this list traverses another sense of the term which opposes the romantic to the classical. The classical is in this connection identified with both formalism and mastery. Mendelssohn and Spohr chose romantic subjects to no purpose; their mastery was unromantically slick (there is no other word for it) and Spohr's forms were more thoroughly ascertained than anybody else's except those of Mozart's brilliant pupil, J. N. Hummel. Mendelssohn's forms were free; but he never got into difficulties, so how could anybody recognise his freedom? Philipp Emanuel Bach's vein of sentimental rhetoric was not only typically romantic but enabled him to write some genuinely lyrical songs. J. Schobert is another romantic writer who influenced Mozart at an impressionable time of his boyhood. Every thrilling modulation in Beethoven's music was romantic, and so were the double-bass passages at the beginning of Cherubini's overture to *Les Deux Journées.*

But the facts are more interesting than this generalization. Mastery is not the line of cleavage that ranges Spohr and Mendelssohn on the one side and Schubert, Schumann and Chopin on the other. Beethoven's later tonality and polyphony had made music ready for lyric forms which he himself adumbrated in a few of his bagatelles for pianoforte and some sporadic good things in his songs. Mendelssohn and Spohr took up song-writing and produced in that line masterpieces for the drawing-room. We ought not to despise the drawing-room. Schubert became the supreme master of song, and Schumann achieved greatness there as in his pianoforte lyrics; but you might as well think of Keats and Shelley as writers for the drawing-room.

Another line of cleavage separates Schubert from Schumann and Chopin as fundamentally as it separates him from Mendelssohn and Spohr. When Schumann and Chopin handle the large classical forms they show obvious weaknesses. Schumann makes an effective new artificial sonata form out of his stiff antithetic epigrammatic style, as a man might construct a landscape in mosaic. Chopin merely shows that he has taken the sonata forms uncritically from Hummel, though the first two movements of the B flat minor sonata are almost as happy in their classical form as the Ballades are in Chopin's unique way. But Schubert's large

forms have only the weaknesses of youth, and their positive qualities and tendencies set him above all schools and indicate that if he had lived we should not so readily have closed a historic chapter with Beethoven. The mastery that Schubert lacks is not anything that Spohr could have supplied. Younger composers with new worlds to conquer could with some truth accuse Spohr of playing with classical forms as one might play chess; but they could never have so accused the Schubert that died young or the Schubert that might have reached old age.

We do not know what Mendelssohn might have achieved if he had lived longer. His influence on the musicians he knew personally was wholly stimulating and good. But he too, seemed able to play chess with symphonies, oratorios and songs with and without words, while other composers were grappling in their music with real life, perhaps confined to one narrow art-medium like Chopin, or, like Schumann, deserting lyrics for larger forms or some artificial hypothesis, or, like young Berlioz, kicking right and left against all teaching and all criticism while dreaming new wonders of orchestral sound, and correctly dreaming the practical means to them also.

Meanwhile a greater than Berlioz was arising, a dreamer of new sense as well as of sound. Mendelssohn and Schumann saw only the beginning of Wagner's development, and could not feel very sure that this voluble and stormy reformer of music-drama was really likely to achieve anything better than the tinsel of the astute Meyerbeer who dominated the world of cosmopolitan opera. The early style of Wagner is indeed an alloy of many metals besides iron and potter's clay; but even in the 'forties his work marks the eclipse of the first romantic period and the dawn of another and greater epoch.

The art-forms peculiar to the Romantic period have no definite names, though composers began to use many literary titles, such as Ballade, Romance (already used by Mozart for slow movements in sonata-form), Nocturne and the like. Dance-rhythms, especially those of Poland, were brought into prominence in the pianoforte music of Chopin. Mendelssohn's invention of the song without words was very successful, but the notion is too facile to lead far, or always, even in Mendelssohn's hands, to justify its existence. Fantastic titles, used in the 18th century by the French clavecinistes, assumed great prominence in the pianoforte works of Schumann who created a new type of long connected cycles of epigrammatic little pieces. The articles PROGRAMME MUSIC and SONG concern this period vitally. Relevant biographical articles are CHOPIN, MENDELSSOHN, SCHUBERT, SCHUMANN, SPOHR, WEBER; while the crowd of pianoforte composers whose brilliance on that instrument obstructed all wider musical prospects, include the respectable HUMMEL, the less respectable STEIBELT and the Irish writer of beautiful pre-Chopin nocturnes, FIELD (John).

9. THE WAGNERIAN DEVELOPMENT AND THE RENASCENCE OF CLASSICAL FORM

Wagner formulated his principles of music-drama long before he matured his musical style. It is impossible to understand the musical history of the second half of the 19th century until we frankly admit that the composers of instrumental music saw in Wagner not only the subversive operatic theorist and erotic dramatist but the composer who was popular because of the salvation-army religiosity of the end of the *Tannhäuser* overture and the downright vulgarity of the entr'acte before Act III in *Lohengrin*. His theories and methods might be controversial, but these lapses never were.

Strange to say, Wagner received something like recognition from the doyen of classical champions, Spohr, whose attitude to Beethoven had been merely condescending, but who saw in *Der Fliegende Holländer* and *Tannhäuser* interesting, if faulty, works which well deserved painstaking production at his theatre at Cassel. Schumann too, after joining in the general hostility towards *Tannhäuser*, frankly recanted and praised its many noble features. Personally he and Wagner did not get on so well; he found Wagner too talkative and Wagner found that Schumann had nothing to say. Later on when Wagner was in exile, *Lohengrin* found a powerful champion in Liszt at Weimar.

Liszt presented another problem to sober musicians. Wagner himself at first saw nothing in Liszt but the virtuoso who, when asked for music, would give you a fantasia on *Robert le Diable*. On the other hand, persons who became bitterly hostile to all the musical tendencies that Liszt fostered went out of their way to declare that no such wonderful interpretations and technique as Liszt's pianoforte playing had ever before been heard on any instrument or orchestra. All Liszt's gestures were superb, from his monumental immobility at the pianoforte to his princely and often really self-sacrificing generosity to other musicians. And at the age of 37 he made the most superb of all his gestures in giving up playing in public. And so the one incontrovertible power of his art became a legend and his actual activity became the championship of unorthodox artists. He took to composing on a more ambitious scale than that of the marvellous pianoforte virtuoso; and became himself the leader of a new development of romantic music. Although he took little pleasure in counterpoint he had none of Berlioz's clumsiness in harmonic texture; and his orchestration, in which his first efforts had the secret assistance of Raff, was always brilliant and novel, though it never caught the Berliozian fire or plumbed the Wagnerian deeps. Liszt realised no more than Berlioz the true musical purport of the new ideas which his symphonic poems and Berlioz's symphonic-dramatic phantasmagorias were putting forward under all kinds of literary and pictorial names. While the new romantic composers purported to be devoting instrumental music to the illustration of literature (*see* PROGRAMME MUSIC) they were really struggling with a new musical time-scale.

As we have already seen in the present article and in the discussion of HARMONY, musical history may be traced in terms of the time-limit over which the listener's memory is brought into play. In the 16th century that limit is from accent to accent; by the end of the 17th century it ran from phrase to phrase. The great architectural forms of Bach could stretch it easily to six minutes, and, in extreme cases to ten. The rise of the dramatic sonata style did not greatly enlarge the time-scale; for there are few well-constructed sonata-movements that exceed a quarter of an hour, though on no smaller scale could Beethoven have prepared the famous harmonic collision that gave such offence in the first movement of the Eroica symphony. Now this ten-minute time-scale obviously compelled musicians to handle the action of an opera by means of conventions. (*See* OPERA.) It is less obvious that it also produced a similarly conventional artifice in the relation of sonata-forms to their emotional content. A design may complete itself in ten minutes while raising emotional issues that cannot be dealt with in less than forty. And so the sonata-forms are grouped in from two to four (rarely more) movements as artificially as the musical sections of classical operas. Wagner's enormous achievement in music-drama consisted essentially in giving music the same time-scale as that of the drama. As with all first solutions of an art-problem he achieved an extreme case, for his drama became cosmically slow. But from *Das Rheingold* onwards every Wagnerian opening instantly, and without any introductory gestures, lays down the lines of its vast time-scale, to the utter bewilderment of his contemporaries who continued to expect *Das Rheingold* to show its pattern on Beethoven's time-scale, just as Beethoven's contemporaries had heard seven *pianissimo* bars on the chord of E flat, not as that vaulted vacancy appears in the middle of the andante of the C minor symphony, but as it would have sounded if it were intruded into an andante by Mozart.

Nobody else before Richard Strauss achieved Wagner's mastery of his new time-scale; and few, if any, of his contemporaries, whether hostile or friendly to him, realized its existence. Liszt was trying, in his symphonic poems, to make a music that filled its half-hour or forty minutes continuously; but his first effort of the kind, *Ce qu'on entend sur la montagne*, spends the first twenty of its forty minutes in a series of introductions, and the remaining twenty in retracing the series backwards. And his more successful efforts, such as *Orpheus* and *Les Préludes*, are either essentially lyric or not on the new time-scale at all. He never achieved so

effective a symphonic poem as Schubert had already long ago unwittingly produced in the "Wanderer" fantasia. Musicians who might not have been repelled by new doctrines of musical form found Liszt's style even more demi-mondaine than that of the early works of Wagner; nor did Liszt show any tendency to purify it. Moreover he rivalled Meyerbeer in the efficiency of his press-bureau by which he made propaganda, often in his own fluent French, more generously for others than for himself

Meanwhile another musical development was arising, conscious of its continuity with the past, and, like Judaism as defined by Matthew Arnold. tinged with emotion in the morality of its aesthetic principles. Joachim, as great an interpreter on the violin as Liszt on the pianoforte, at first found in Liszt a congenial friend, until he saw his compositions. These horrified him, and the horror completed an estrangement already begun by his dislike of the atmosphere of Liszt's press-bureau. He and his younger friend Brahms were united not only in general musical taste but in personal devotion to the heroic widow of Schumann, who, after her husband's tragic and lingering death, was bringing up a large family on the proceeds of her concerts. These three artists soon came to regard the musical atmosphere of Weimar, where the *Lisztianer* gathered around their master, as unhealthy. In the correspondence and mutual criticism of Brahms and Joachim the word *Lisztisch* became synonymous with "devilish"; and indeed it is true that any characteristic Lisztian and many Wagnerian idioms would have a disgusting effect if intruded into Brahms's music. To-day we can be wise after the event and find matter for regret in the drastic out-spokenness of Joachim and Brahms which elevated matters of taste into questions of artistic honour. If Liszt could have been contented with *sachlich* criticism on definable issues of technique without requiring attestations of sympathy and enjoyment, and if Joachim could have resolved matters of taste into questions of artistic proportion, the neo-classical and neo-romantic musicians would have joined forces instead of condemning each other. Similar economies might be effected in nature if lions could be converted to vegetarianism.

The controversy was unequal, in two compensating ways. Wagner had a tremendous, if acrid, fluency in prose and did not care where his vitriol might alight. Moreover, Wagnerian and Lisztian music was much easier to write about, whether in attack or defence, than music which had no literary aspect. Brahms, like Wagner, needed and found friends who adored his music, but he hated the idea of a press-bureau and snubbed anybody whose compliments aroused the least suspicion of flattery. These drawbacks had their own compensation. It might be difficult to write as interestingly about Brahms as about Wagner; but Wagner, whether in exile or enthroned at Bayreuth, had Wagnerian music-drama as his whole province, while Brahms reigned over the whole of the rest of music, instrumental, choral and lyric. If criticism came to persecution, on the whole the neo-classics had the worst of it; for Brahms had no equals since Joachim gave up composition, and the position of a champion of classical forms was easily confused with that of a persecutor of the prophets of progress. As a matter of fact, Brahms was no anti-Wagnerian and was annoyed when his friends bracketed Wagner with Liszt.

But, apart from the clash of flying inkpots, the recognition of Brahms was assured by two facts; first the propaganda of his work not by words but by consummate and authoritative performance, and second, the very fact that his music required an experienced love of music for its understanding. A man might become an enthusiastic Wagnerian or even a well-equipped conductor of Wagner's music and be as the brutes that perish about symphonic orchestration, choral music, chamber-music, songs and all pianoforte music except Chopin. But it was long before any musician could venture to tackle Brahms's music on any basis except that of the most comprehensive musical culture and technique. Brahms lived long enough to become worshipped unintelligently; and after his death (in 1897) the reaction was more evident than the fashionable worship had been. There are signs that the reaction is over by now.

The Wagnerians felt deeply that their propaganda was incomplete for lack of a master of purely symphonic music. This they found in Bruckner (*q.v.*). Brahms was appalled by the clumsiness of Bruckner's forms, and the most official Wagnerians admitted the frequent lapses of their symphonic master. On the other hand Bruckner's Nibelungen-tetralogy openings to his symphonies obviously dwarfed the terse themes of Brahms. By the time Brahms and Bruckner had come into their own, the public had long lost all sense of form in its appetite for bleeding gobbets of musical butcher's-meat hacked from the living body of Wagnerian music-drama and served up in concert rooms as *Waldweben*, *Karfreitagszauber* and *Walkürenritt*. After this it was pedantry to quarrel with any symphonic composer's form so long as his openings were vast enough. Brahms was no pedant; obvious weakness of form and style did not deter him from being the first to recognize Dvořák (*q.v.*); and he was drastic in his rebuff of anybody who thought to flatter him by talking against Wagner.

The song-writer Hugo Wolf (1860–1903) became recognized too late to be made use of as a lyric-pawn in the Wagner-Bruckner party politics of music. As far as his theory of song can be summarized, it consists in the application of Wagnerian declamation to lyric poetry. If his practice were not better than this essentially prose theory of verse-rhythm (*see* RHYTHM) and the perky censorship of classical musical declamation that goes with it, Hugo Wolf's art would not have survived his short and ailing life. But it is deeper than the theories on which it is supposed to rest and its apparent revolt from lyric melody only partly conceals a powerfully organized lyric form, and does not at all conceal a great gift of characterisation.

10. NON-GERMAN MUSIC OF THE 19TH CENTURY

While these great issues were being debated in Germany, the music of other countries was awakening from long sleep or outgrowing infancy and provinciality. France had, since Rameau, been remarkably content to have its music dominated by foreigners. Before Rameau, French opera was established by the Italian Lully. After Rameau it was reformed by the German Gluck. Early 19th century French classicism was dominated by the Italian Cherubini. Another Italian, Rossini, was in the prime of his life absorbed by Paris; and the result was *Guillaume Tell*, with its rich orchestration and grandiose forms. But the crown of French opera was imposed on it by the German Jew Meyerbeer. The pretensions of the native French composers were more modest, except for the volcanic eruptions of that typical Gascon Berlioz. The popularity of Gounod (1818–1893) rested on the same misunderstanding of the meaning of art as the vogue of Doré in the capacity of an illustrator of the Bible. *Faust* was a success. Another development, more improvisatorial, uncertain of its style, but fundamentally sincere, was initiated by the Belgian, César Franck (1822–1890) (*q.v.*). From him, and not from the more prolific and facile Saint-Saëns, originated the main stream of modern French music. His style had too much affinity with Liszt to please the musicians who continued to regard Liszt as the author of all modern musical evil; but he achieved mastery in a wide range of forms all his own and he never wrote for effect.

In Italy music after Rossini was long contented to imitate the things in which Rossini was imitable. These were the mechanical cultivation of *bel canto* and the use of a full orchestra to support the voice in a thick unison of the melodic instruments, with a brassy dance-rhythm in the rest, and the big drum and cymbals to mark the rhythm. The genuine melodic inventiveness of Bellini and Donizetti did little to improve the other categories of the art; but in Verdi (1813–1901) a new genius was arising together with the Risorgimento. In *Rigoletto, Il Trovatore* and *La Traviata* Verdi's dramatic sincerity triumphs over the defects of a musical texture which still clung to traditional squalor, though strokes of genius occurred unpredictably in the orchestration of many passages. In *Aïda* the style silences all cavil; and in *Otello* (written at the age of 74) and *Falstaff* (written at the age of 80) Verdi created a new kind of opera, Wagnerian in its perfect continuity and dramatic movement, but utterly independent of Wagner's style and method.

Bold prophets in Beethoven's time had been heard to say that a great musical future was in store for Russia. The fulfilment of

this prophecy was long delayed, for when Rubinstein averred that Michael Glinka (1803–1857) was the equal or the superior of Haydn and Mozart he expressed an opinion which could have occurred only to a Russian, and then only as a patriotic paradox. Rubinstein himself achieved only a weak cosmopolitanism in his voluminous compositions, though his pianoforte playing remained, for all its waywardness, till near the end of the century, as the most monumental power of interpretation on that instrument since Liszt. The first composer to make a genuinely Russian music recognized over the whole civilized world was Tschaikovsky (1840–1893) whose symphonies were held by some critics to have eclipsed those of Brahms. This was the eclipse of drama by melodrama. The true merits of Tschaikovsky were eclipsed by the rising reputation of his less immediately successful contemporaries. Moussorgsky (1835–1881) had the posthumous fortune to have his two great operas *Boris Godunov* and *Khovantschina* revised by Rimsky-Korsakov (1844–1908) the most brilliant contemporary master of pure orchestral colour and texture. This was unquestionably good fortune in so far as it speeded these unconventional works on their way into the wide world; but something like indignation accompanied the later study of Moussorgsky's original scores, with the discovery that besides altering clumsinesses Rimsky-Korsakov constantly meddled with features in his friend's style that were far beyond his comprehension.

The 19th century was over before any musician on the continent could be persuaded that there were composers in England. Schumann had repeated St. Gregory's pun about Angles and angels when he hailed Sterndale Bennett as "ein englischer Componist"; but the trials of English musical life dried Bennett up. All who knew and loved him denied hotly that his music reflected Mendelssohn's; and perhaps, to-day, a leisurely study of it might vindicate his independence. Macfarren (1813–1887), who succeeded Bennett in his educational offices, was a widely-cultured musician whose influence for good was frustrated by his violent conservatism which co-existed with a fatal readiness to be led by faddists. (*See* HARMONY.) The renascence of English music began in the work of Parry (1848–1918) and Stanford (1852–1924). They put an end to the provincial absurdities of British oratorio tradition, and consistently set great literature in a way that revealed to contemporary poets that the antithesis between musical and general culture was false.

They also had wide and deep influence as teachers of composition.

Still, recognition of English music on the continent was rare and capricious. Englishmen wrote church music for the stage, stage music for the church, organ music for the orchestra, and, as far as they had any orchestral ideas at all, orchestral music for the organ. The one famous English composer who could be understood on the continent as saying intelligible things in fit terms, was Sullivan, with his Savoy operas. And his serious colleagues and critics urged him with owlish solemnity to produce no more light masterpieces but to go on with his serious and luscious Golden Legends and Martyrs of Antioch and generally to consummate the final merging of English music into "The Lost Chord." We may thankfully hope that that chord is now lost for ever; but the Savoy operas live, and might, without delay to their popularity, have risen to the position of great music if Sullivan had had enough steadfast love of music to finish those parts of his work to which the public did not listen; if for example, he had provided his operas with better orchestral introductions than the perfunctory pot-pourris of their favourite tunes which he calls overtures and which are quite as long as artistically-decent overtures would have been.

It is customary to explain the failure of all but the most recent British music by saying that the native art was crushed by the ponderous genius of Handel. It is a great pity that the united ponderosity of Handel and the middle-weight Mendelssohn could not avail to dam the output of oratorios by composers who might have become good song-writers or even acquired some knowledge of orchestration beyond that of choral accompaniment. The complaint of foreign domination is nonsense. No nation has had its music so long and so completely dominated by foreigners as France; and French music has always remained exclusively French and has made thoroughly French artists of the foreigners who dominated it. The traces of foreign influence on English music have always been the echoes of individual phrases or mannerisms.

While Englishmen echoed, as fashions changed, Mendelssohn, Brahms and Debussy, they learned no technical lessons from them. Such mechanical echoes show no foreign domination, but are the best proof of an inveterate provincialism and the kind of ignorant and irritable independence that goes with it. Since music ceased to be an integral part of an Englishman's culture (about the time of William and Mary) their musicians, as a rule, began its serious study far too late. The language of music cannot be begun at the age of 19 like courses in law or medicine. Their universities have played a considerable part in shaping British musical destinies; but a mighty Oxford treads on the tongue of the encyclopaedist who would pursue this topic.

(D. F. T.)

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11. MUSIC OF THE 20th CENTURY

It has often been said that the 20th century witnessed as drastic a musical revolution as that of any period in history. The attitude of the public as well as the internal evidence of the music clearly showed a definite rupture with the immediate past. At first the radical new departures aroused indignant audiences just beginning to enjoy the colourful richness of the late romantic composers like Richard Strauss and Nicolas Rimsky-Korsakov and resulted in many violent demonstrations. Critics raved; composers explained; sides were taken; and societies were formed to propagate what was then called "ultramodern" music.

But even if this were not sufficient proof, a comparison of any brief portion of Arnold Schönberg's *Pierrot Lunaire* (1912) or of Igor Stravinsky's *Le Sacre du printemps* (1913) with any previous music would reveal at once how extreme the break with the past was. Yet these and other radical new works could not be easily dismissed as the misguided experiments of a few isolated eccentrics, because their novel methods soon attracted more and more followers among musicians and the public. When the nazi and soviet states in the 1930s and 1940s began to legislate against those using the newer styles, it became clear that the modernists were to be reckoned with. By mid-century, the importance of the revolution had to be admitted by almost every musician; for not a single composer had appeared since about 1920 who could write convincingly enough in the older style to win recognition. The only important late romanticists still greatly respected during this time were those like Richard Strauss (1864–1949), Sergei Rachmaninoff (1873–1943) and Johan Julius Sibelius (1865–), who had become known earlier.

There were many attempts to summarize the distinguishing marks of the new music. Most of these efforts were made by adherents of one or the other of two main factions that began to take shape around 1930: the neoclassicists, who followed the lead indicated by the later works of Igor Stravinsky (1882–), and the atonalists, who followed Arnold Schönberg (1874–1951). Since many intelligent articles were written by the composers and their followers discussing these two points of view, both were very influential; but besides these two schools, there were a great number of independents harder to deal with in critical estimates because of their avoidance of doctrinaire attitudes. The case of Béla Bartók (1881–1945), whose music did not receive the recognition accorded his more discussed contemporaries until after his death, is a rather typical example of the fate of a composer not belonging to a pressure group who preferred to let his music alone speak for him. Five years after his death, Bartók was generally regarded as superior in many ways to almost every other composer of his time.

In spite of their doctrinaire tendencies, the neoclassicists and the atonalists represented the opposite poles between which much music of the first half of the century lay; and the undeniable mastery of Stravinsky and Schönberg lent their points of view considerable weight. Because both dwelt so much on the importance of musical technique, they had often been dismissed as "formalists" concerned only with pure form devoid of musical expression. Indeed, the neoclassicists were particularly condemned for their insistence on "objectivity," but this objectivity was really a way of achieving artistic dignity and distinction by maintaining an aesthetic distance from the emotions portrayed. It was similar to the type of representation of feelings used in the baroque era, and this attitude distinguished modern neoclassicism from that of Brahms, which was truly romantic in its direct expression of dynamic emotions. True to classical precepts, the new group adhered to the representation of centrally important human feelings seen through the restless rhythmic and harmonic tension of modern technique. This double exposure of past and present inevitably suggested a commentary of one period on the other with comic or, more often, with nostalgic overtones. This school began to decline in influence around 1945.

The atonalists, on the other hand, were concerned with intensifying and compressing direct expression to the utmost. They continued the romantic psychology of dynamic emotions but focused it on the most subjective and unusual states of mind, related to the tormented, neurotic violence of the German expressionist theatre and painting. Their weird, fantastic and personal realm found its expression in a strict musical technique that was claimed to be a summation of all the devices of previous music, combining the formal methods of preromantic styles and the psychology of romantic music with the new techniques of the 20th century.

Most of the independents reflected a concern with elaborate musical techniques and with the avoidance of large-scale, opulent, romantic rhetoric. There was also a group of followers of the "populist" composers of soviet Russia who were under official pressure to avoid these "formalist" methods. These used a kind of romantic style drastically simplified, yet with certain contrapuntal and harmonic devices similar to the neoclassicists. Their works, particularly those by Sergei Prokofiev (1891–1953) after he returned to soviet Russia in 1934 and Dmitri Shostakovich (1906–), often met with great acclaim for their very real musical values, but few of them outlasted their first flush of success.

Technically, composers of the first half of the 20th century seemed to have been mainly occupied in breaking up the relationships between the various elements of musical discourse and in reintegrating them on a level of greater freedom. The rhythmic aspect of a work often had a comparatively independent life of its own, not emphasizing the harmonic changes or the melodic flow. Harmonies were often used for their sonorous and expressive qualities and not to underline the melody. This freedom

was usually ordered by new kinds of self-imposed formal and stylistic restrictions. The neoclassicists favoured strict mechanical regularity of pulse while employing great liberty in the irregular distribution of accents and in all the other elements; the atonalists adhered to a strict system of ordering the tones of a composition, allowing the greatest licence in other directions.

Each element within its own domain was freed from previous limitations in order to bring out its particular expressive qualities. Rhythm became highly irregular, using either assymetrical groupings of rather rapid regular pulsations or sought the other extreme of expressive rubato. Two main ideas were current about melody. One, accepting the classical use of a pronounced and definite melodic line, emphasized its rhythmic aspect by reiterations or escaped into the free development of motives like that of Gregorian chant. The other idea, derived from Claude Debussy's melodies of harmonies and Schönberg's "melodies of tone-colour," renounced the clear definition of melodic outline, treating the total sound effect of any moment as a unit to be connected to other units as single tones are in a melodic line.

In harmony, any simultaneous grouping of tones was considered acceptable provided it gave the desired qualities of tension and expression. The movement from one chord to the next usually obscured or negated classical usages, dissonances not being prepared or resolved. When music had a tonal feeling, this was more a result of melodic emphasis on tonal centres than of functional harmonic activity.

Whether new music invented new "open" forms or adapted old "closed" ones to new needs, it was permeated by the principle of continual variation replacing the classical devices of literal or sequential repetition. The older symmetry of balancing sections was eliminated in favour of drastic shortenings and lengthenings to preserve the greater tension of the assymetrical rhythmic basis. Texture became predominantly contrapuntal with a freedom of relation between voices that sometimes recalled the heterophonic practices of primitive or Balinese music and more often the linear counterpoint of the middle ages. The orchestra was dissociated into sharply defined groups of colours in order to bring out the contrapuntal and linear nature of the music; the individual instruments were often treated as soloists as in chamber music.

Perhaps the most striking general aesthetic and technical feature of the period was a new attitude toward stylization. Obviously works of music had been stylized in every period, but previous composers usually drew upon the general practices of their time for the devices used to give each work its special stamp. From 1860 on, the commonly accepted methods of the immediate past began to disintegrate rapidly. Wilhelm Richard Wagner, Hugo Wolf, Modest Petrovich Mussorgsky and others added many novel features, and by the end of the century the impressionist composers Claude Debussy (1862–1918) and Maurice Ravel (1875–1937) had stretched the use of older harmonies to the point where they no longer fulfilled their former functional capacities of pushing toward cadences and employed them as separate sonorities much as blotches of colour were used in impressionist paintings. Debussy in his later works consciously strove for a more fluid style that dispensed with classical rhythmic and melodic procedures achieving a technique that resembles the "stream of consciousness" of contemporary literature. At about the same time, Alexander Scriabin (1871–1915) invented new chords to express his sensual mysticism, and Erik Satie (1866–1925) and Ferruccio Busoni (1866–1924) were demonstrating in very different ways the "objective" attitude in their works.

Around 1908 there was an outburst of musical primitivism and expressionism that paralleled the postimpressionist reaction in painting against the tenuous world of the impressionists. From this time until about 1925, each new composer strove to invent his own vocabulary of melodies, harmonies and rhythms, as well as his own grammatical rules. Each went in search of new materials and new ways of joining them, and each work provided an opportunity of carrying some technical, stylistic or aesthetic idea to its extreme limit. For a while such stylistic relativism seemed to point toward complete anarchy. It looked as if there were going to be almost as many styles as there were works written. In Stravinsky's works, for instance, the vehement barbaric ritualism of *Le Sacre du printemps* (1913) gave way to the dryly humorous pathos of *L'Histoire du soldat* (1917) with its deliberate distortions of café music. This in turn led to a whole series of works related to styles ranging from Bach to Tschaikovsky and, in 1948, to an austere setting of the Mass using bits of musical Gothic. All of these works were done with such imagination, fantasy and authority that they furnished cues for one group of followers after another.

Similar but not so drastic changes went on within the very individual styles of Bartók and Schönberg, as each passed in his own way through a period of classicism.

This desire for total stylization can be seen as shaping the background of the entire first half of the 20th century, often with sensational results as in the works of Edgar Varèse (1885–) or of Anton Webern (1883–1945), which extended stylization to the limits of unusualness, or in the later works of Erik Satie and in those of Virgil Thomson (1896–), which carried it to the opposite extreme of simplification.

Against this experimental background, however, several marked trends began to form which gave the years between 1925 and 1940 a certain unity. Around the time when Schönberg wrote his first works using the 12-tone technique in 1924, when Stravinsky had gone back to Bach in his *Piano Concerto* (1923–24) and when Bartók had finished his most experimental works, the *Piano Sonata* (1926) and the *Third String Quartet* (1927), the directions became defined. Composers felt that the previous inventions needed to be explored. At this time a number of excellent neoclassicists appeared: Sergei Prokofiev before he returned to soviet Russia, Darius Milhaud (1892–), Francis Poulenc (1899–), George Auric (1899–), who followed the new aesthetic using elements of their native French popular, folk and art music, while Arthur Honegger (1892–) combined this idea with a dramatic violence that brought him close to the romantic style. In Germany, where Busoni had prepared the way, Paul Hindemith (1895–) turned from romanticism in his clear-sounding, objective, contrapuntal style and treated chromatic elements in a new motoristic, vigorously rhythmic way derived from the neoclassic approach. His series of outstanding works revealed a growing preoccupation with the styles of the Renaissance and middle ages. In the United States, Walter Piston (1894–) and Roger Sessions (1896–) produced important and skilful works in this style. Shunning romantic attitudes, they regarded themselves as returning to the ideals of craftsmanship of earlier times. Many wrote teaching pieces and music for amateurs and other kinds of *gebrauchsmusik* (music for use) in their own idioms.

The other important rallying point, atonalism, for a time eclipsed by the success of the neoclassicists, was also related to the earlier techniques, particularly of the Renaissance. Schönberg and his followers, Alban Berg (1885–1935) and Anton Webern, developed a rigorous system usually called the 12-tone or dodecaphonic technique which they applied to their subsequent works. By this an entire composition is organized around a chosen order of the 12 tones of the chromatic scale, sometimes transposed, inverted or read in retrograde motion (backward). No tone can return unless separated by the other intermediate 11 tones, thus ensuring an equal distribution of emphasis on all 12. This was intended to obviate the classical feeling of tonality. The chosen "row" of 12 tones forms the basis of all melodies, counterpoints and harmonies in a given work, and its application immediately gives stylistic and motivic unity. Alban Berg's amazing feat of composing a full-length opera, *Lulu,* on one tone row revealed the enormous possibility of variety within the system, borne out by the numerous and varied works of Schönberg and Webern. Berg's music, surprisingly enough, is also quite clearly romantic in its feeling, while Schönberg's is more austere and Webern's fancifully aphoristic. Around 1940, many composers like the former neoclassicist, Ernst Křenek (1900–), and the young Italian, Luigi Dallapiccola (1904–), began to use this system as did many others in most important musical centres. It also had an indirect influence on Bartók and on the Americans, Sessions and Wallingford Riegger (1885–).

A mature form of nationalism that aimed at expressing the national spirit of a country in music abstracted from its folk origins emerged in almost every country during these years. The outstanding exponents of this trend were: Bartók and Zoltán Kodály (1882–) in Hungary; Manuel de Falla (1876–1946) in Spain; Ralph Vaughan Williams (1872–) and Gustav Holst (1874–1934) in England; Bohuslav Martinu (1890–) in Czechoslovakia; Gian Francesco Malipiero (1882–) in Italy; Heitor Villa-Lobos (1881–) in Brazil; Carlos Chavez (1899–) and Silvestre Revueltas (1899–1940) in Mexico; and Roy Harris (1898–), Aaron Copland (1900–), Douglas Moore (1893–) and the independent experimenter, Charles Ives (1874–), in the United States. Since all of these and many more applied in some measure the principles of stylization mentioned above, their works present a most varied character.

For sensitivity to stylistic differences had been very strongly developed as musicians came to know recordings of folk, primitive and oriental music, as well as pre-18th century music as it was occasionally performed under the supervision of musicologists intent on reviving the original music with its original style of interpretation. This expanded cultural and historical horizon, as was seen above, contributed new stylistic and aesthetic ideas to many 20th-century composers, some of whom, such as Bartók, Hindemith and Křenek, were musicologists themselves.

It is beyond the scope of this article to discuss in detail the psychological and sociological background of modern music. One characteristic feature deserves mention, however—the role of the societies which were formed in almost every occidental country to encourage and propagate the new music. Many composers took a determined stand against the banalities of the contemporary popular mass culture and relied on the understanding and support of such intelligent and progressive groups of musicians and music lovers to serve as intermediaries between them and the broad musical public. This reaction against the widespread public trend toward cultural uniformity (which in the musical world showed itself in the standardization of the repertoire) led many musicians to the cultivation of pronounced individuality of style. It also led them to uphold the integrity and dignity of modern art by assuming more meaningful attitudes toward artistic expression and toward contemporary life than were possible in popular entertainments or in the general run of concerts devoted to the repetition of familiar masterpieces. Hence modern music was often misunderstood by the general musical public, while the societies which supported modern music were able to distinguish its importance. The faith of these societies over the years was amply justified by the remarkable works which they brought to light and championed.

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MUSIC, TEACHING OF. Music is concerned with three types of individuals—composers, performers and listeners. The basic training of all three is related, since none can function fully without an understanding of musical structure. Hence the teaching of music is essentially the development of musicianship—that is, the sum of individual aptitudes, insights and skills in respect to music. Musicianship consists of both intuitive and rational responses, and the teacher's responsibility is to develop the latter through all available means according to the student's individual needs and capabilities. Musicianship is based primarily upon a grasp of how composers use their materials, and hence the greatest teacher of music, either technically or aesthetically, is music itself. But, as Franz Joseph Haydn said, "The educated ear is the sole authority," and this simple fact is the basis of the teaching of music in terms of musicianship.

Listening, as the primary type of musical activity, is transmuted into specific skills through singing, playing, analyzing, writing and creating music. These avenues of learning all have a common goal—musical insight, which is promoted by their integration. Specifically, this means that the student learns the structure of music through the simultaneous study of written and keyboard harmony, music reading, ear training, analysis and creative writing. All are of equal importance, and all contribute to "the educated ear." These, then, are the basic principles of the teaching of music: the development of musicianship through the study of music literature based upon aural perception and promoted through related and integrated skills. The teaching of these skills may be summarized thus:

Listening is a mental activity dependent only in a general sense on physical hearing. Hence "ear training" should be regarded as directed listening for all rather than as a separate skill for the select few. It may be either oral or written, and its precision will depend upon the maturity of the student and the end in view. The first aural reactions will be general in character: the recognition of register, tones of the tonic chord, consonance and dissonance. These generalities will gradually be refined to specific reactions: chord quality, inversions, form and rhythmic, melodic and harmonic complexities, paralleling the development of other skills. In general, the musical passages used should be presented as a unit, not as separate rhythmic, melodic or harmonic drills, even though each of these factors may be recognized individually. Three specialized types of dictation should be noted: (1) corrective listening—the recognition of differences between the music as printed and as performed when the instructor deliberately introduces alterations; (2) contrapuntal listening—notation of simple two-voice counterpoint; and (3) analytic listening—recognition and notation of formal design, using letters for various parts and arbitrary symbols for cadences.

Writing is one aspect of musical literacy and as such is an essential skill. In the beginning, notation is best learned directly from the analysis of familiar melodies, not as an isolated body of facts unrelated to musical experience. When the elements of notation are learned, the study of harmony is begun, and scale structure, key signatures, intervals and chords are explained as the need arises from the music examined. Four-part harmony is approached gradually through one-, two-, and three-voice writing and simple piano accompaniments. Chords are best taught in the order of their use in music literature rather than in the order of their structure; *i.e.,* triads, their inversions, seventh chords, etc. Musical usage implies the early introduction of nonchord tones and modulations. Figured bass assumes less importance, though its principles should be clearly understood. Counterpoint is studied stylistically through the vocal and instrumental idioms of Giovanni Pierluigi da Palestrina and Johann Sebastian Bach respectively. The traditional approach, strict or academic counterpoint, is less desirable, as its musical values occur unrestricted in Palestrina's style.

Keyboard Harmony makes abstract knowledge concrete. It includes melody harmonization, transposition, improvisation, modulation, score reading, harmonic reductions, keyboard dictation and playing by ear. From the beginning all students should have some keyboard experience, limited only by their technical facility. Two advanced specialized types of keyboard instruction should be noted: (1) the teaching of transposition through the use of movable clefs and (2) keyboard analysis of piano literature for interpretive purposes.

Music Reading, as the other aspect of musical literacy, is equally important. The immediate purpose of music reading or "sight singing" is dual: to read music silently and to reproduce it vocally. The training of the inner ear takes precedence, because vocal reproduction is the echo of the sound conceived mentally. Hearing precedes singing. All systems for developing a sense of pitch relationship are only means to that end and should be abandoned when it is achieved. The oldest system, solfeggio and its modification, tonic sol-fa, associated the first syllable of each line of a medieval hymn to John the Baptist with one of the six degrees of the Guidonian hexachord (*q.v.*). Its long use is due as much to tradition as to the success of the system. However, it is open to criticism on both psychological and pedagogical grounds. In America, three other systems are found: (1) the use of numbers or letters, or both, for scale pitches, (2) the development through rote singing and melodic analysis of a strong sense of tonality without the use of specific pitch names and (3) the supplementary use of a simple flutelike instrument to solve physical or psychological problems. Without evaluating these various methods, it is clear that they all are only teaching devices to aid in vocal discrimination. The whole problem of music reading is complex and includes many psychological and musical factors. The solution requires a thorough study similar to that done in the field of language. Certainly it is known that one of the essential principles is phrase-wise rather than note-wise reading, and, in general, emphasis on the musical rather than the technical elements involved.

Analysis is an understanding of the total organization of music. Its objective is the explanation of musical structure in such a way that insight results. It includes awareness of all harmonic, contrapuntal, formal and stylistic elements. In a sense, all musical activity is dependent upon either conscious or intuitive analysis, and for this reason it should permeate all levels of instruction. Even a child can understand, in his own terms, the organization of music that he performs. In harmonic analysis it is desirable to stress essential progressions rather than details; *e.g.*, chromatic embellishing chords or diatonic extensions, which can be fitted later into the general pattern. Contrapuntal analysis, especially of the baroque period, is of particular value to pianists, organists or choirmasters.

The analysis of form, or the sequence of musical ideas, is also essential for musicianship and yet is frequently neglected. The first principle of teaching form is to explain the structure in simple language understood by the student. Second, analysis must be applicable to the student's needs and relative to his experience. Third, it should be both aural and visual, though analysis by ear is a much more musical and realistic approach. Both can be combined by reading the music while listening to its performance.

Creative Writing is one of the best means for the promotion of musical insights. Creativity is universal and should be used from the outset according to individual capacity. Begin by setting short poems to music without accompaniment, or by writing free instrumental melodies, and parallel later study by composition in the small-song forms. Students, even with a meagre background, can express themselves acceptably when musical rather than technical problems are stressed. The objective is musical growth through doing, and this can be achieved on all levels.

These six skills, then, as the basis of musicianship, should be so taught as to meet the individual needs of composers, performers and listeners.

Trends.—At mid-20th century, some specific trends in music teaching were: (1) emphasis on musicianship as the goal, achieved through the study of musical literature. This implied a consideration of style as a factor of structure and consequently as a basis of judgment; *e.g.*, the different attitude toward parallel fifths in various periods. Another implication was the stress on musical rather than technical values, the recognition of general principles rather than of specific rules. Thus, if the trained ear was to be the only arbiter, a passage could not be poor musically but correct theoretically. This involved the question of taste—also an essential element of musicianship. (2) Use and integration of all avenues of learning discussed above, rather than the traditional emphasis on reading and writing. This meant that ear training, keyboard harmony, analysis and creative writing were also treated as integral and integrative factors in the development of musicianship.

General trends in the teaching of music were: (1) belief in the social and democratic values of music, and of its vital role in the well-rounded curriculum at all levels of instruction, as shown by the expanding instrumental and vocal programs in primary and secondary schools, and colleges. (2) Use of audiovisual aids enlarged and improved tremendously the techniques of both group and individual study through the use of radio, records and scores for the exploration of musical literature in accordance with the principles outlined above. (3) Growth of the adult education movement increased both the number and type of music students. Instruction of these amateur groups emphasized the cultural rather than the technical aspects of music, unless the latter were required for individual needs. (4) Remarkable development of musicology, especially in America, where outstanding European authorities had settled from 1914 onward, thereby stimulating its study.

(H. A. My.)

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UNITED STATES

Music received slight attention in the days of the American colonists. For the improvement of church music, manuals of instruction in singing were prepared early in the 18th century by two Massachusetts ministers, the Rev. John Tufts and the Rev. Thomas Walter. These books and their successors provided the text material for the "singing schools" and "musical conventions" which for years represented the chief activity in music study.

The first well-organized effort to provide a more complete musical education was the Boston Academy of Music founded by Lowell Mason in 1833. The first college recognition of music was the engagement of an instructor of music at Oberlin college, Oberlin, O., in 1838. From about 1840 a considerable number of Americans went abroad to study music, chiefly in Germany. These pioneers, home again and reinforced by many foreigners, were leaders in the marked advance of their profession, especially after the Civil War. The first comprehensive music schools were the Oberlin conservatory (1865), which in 1867 became the first college music department, and the New England conservatory (Boston, Mass., 1867). Then followed the Cincinnati conservatory (Cincinnati, O., 1867), Chicago Musical college (Chicago, Ill., 1867), Peabody conservatory (Baltimore, Md., 1868), College of Music in Cincinnati (1878), American conservatory (Chicago, Ill., 1886) and many others.

Reporting in 1908 on a study of such schools and departments of music, the bureau of education declared that their widely varying curricula in many instances were so much given to the vocational aspects of music that music was separated from general educational thought. Data in Randall Thompson's *College Music* (1935) were indicative, however, of academically well-based curricula, though varied in extent and other respects, at Oberlin by 1865, Harvard by 1870, and Smith, Vassar, Wellesley, Yale, Columbia and the Universities of Michigan and Oregon between then and the turn of the century. The Music Teachers National association (1876), comprised of teachers and, later, composers, conductors, musicologists, editors, critics, music librarians and publishers, became increasingly a disseminator of broadly educational ideas as to music teaching. Also directly effective in the improvement of many music schools and departments was the National Association of Schools of Music, founded in 1924 to develop uniform standards for granting degrees and other credentials. Efforts were made in some states to set standards for the work of private music teachers, but with only partial success.

Four music schools with large endowments became especially competent to give the highest professional training, often through

scholarships. The oldest, the Institute of Musical Art of New York, was founded in 1904 and in 1926 became affiliated with the Juilliard School of Music as its undergraduate school. The large bequest of Augustus D. Juilliard (1919) for musical education led to founding in 1924 of the above-named graduate school for students of unusual talent. The Eastman School of Music (1919), a department of the University of Rochester (N.Y.), was endowed with $12,000,000 by George Eastman, and the Curtis Institute of Music in Philadelphia (Pa., 1924) with more than $12,000,000 by Mrs. Edward W. Bok. Sharing the Boston Symphony orchestra's ideal setting at Tanglewood was the Berkshire Music centre, established by Serge Koussevitzky in 1940 in connection with the Berkshire festivals. Two classes of students were admitted to this great summer centre: those capable of profiting by the best professional training for careers as orchestra or solo players, singers, conductors or composers; and "students, teachers and others . . . seeking to enrich their capacities for life-long enjoyment." Tanglewood was given to the orchestra in 1936 by Mrs. Andrew H. Hepburn and Mary A. Tappan. A bounty of another kind was the settling in the United States of many more of the world's finest musicians and teachers shortly before and during the period of World War II.

Public school music education in the United States began with Lowell Mason's work in the Boston public schools in 1837, an example followed promptly in Buffalo, N.Y., Pittsburgh, Pa., Louisville, Ky., Cincinnati, O., San Francisco, Calif., and other communities. The Music Educators National conference was founded in 1907 by school music supervisors. Largely through that organization, with its affiliated regional, state and local associations, research council, active committees on every phase of the work, and its journal and other publications, the teaching of music in schools had by the mid-century become almost everywhere a cherished indispensable. The brief summer schools for music teachers of the early days were succeeded by special four-year curricula and graduate courses at state and other universities and some conservatories. There were still many school systems with very little or poor music instruction, some with none, but many high schools had developed excellent performing groups and music courses, while guided listening, rhythmics, class instrumental instruction and playing groups as well as singing had become common in elementary schools. Two of the greatest events for music teachers in the first half of the 20th century were the amazingly good performance of the *Eroica* symphony by a large national high school orchestra at the Music Educators National conference in Detroit, Mich., in 1926 and the superb performance of great music by a Flint (Mich.) high school *a cappella* choir at the Chicago meeting of that conference in 1928. The challenge of these revelations was felt throughout the nation.

The first music textbooks, by Lowell Mason (1841) and Charles Aiken (about 1850), were for grammar grades and high school and were derived from those of the "singing schools." The *National Music Course* (Luther W. Mason, 1870) was the first to provide distinctively for all grades. It was used widely in the U.S., and a translation published in Leipzig was used in German schools; but by 1880 its abundance of songs and the teaching of music reading mainly through them came under suspicion of not helping directly enough toward mastery of the printed page. Moreover, where accepted as a regular part of school work, music had now to prove not its appeal and human value, but that it could be taught efficiently by the grade teacher. The *Normal Music Course* (1883) gave answer in a relentlessly logical succession of exercises and songs. This won many adherents, but its use gradually revealed that mastery of details of scale and rhythm, won apart from music, was of little use in reading music. By mid-20th century 16 other complete music courses had been published and widely adopted, all using the song approach to musical learning, but many with large quantities of inane songs. The trend, however, was toward using many folk songs and other vital music and toward greater dependence, as to method, on the musicalness, judgment and skill of the teacher.

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MUSICAL-BOX. The modern musical-box is an elaboration of the elegant toy musical snuffbox in vogue during the 18th century. The notes or musical sounds are produced by the vibration of steel teeth or springs cut in a comb or flat plate of steel, reinforced by the harmonics generated in the solid steel back of the comb. The teeth are acted upon and musical vibrations produced by the revolution of a brass cylinder studded with projecting pins, which, as they move round, raise and release the proper teeth at due intervals according to the nature of the music. The revolving motion of the cylinder is effected by a spring and clockwork, and the rate is governed by a fly regulator.

MUSICAL COMEDY. Until the end of the 19th century, the term "musical comedy" was one of many used to describe any stage piece of a comic nature to which music was either integral or incidental. Within this loose usage, an *opera buffa* such as Mozart's *Le Nozze di Figaro* could be called a musical comedy; at an opposite extreme of the artistic gamut, the popular U.S. farces written and staged by Charles Hoyt in the late 19th century were sometimes referred to as musical comedies, on the strength of their interpolated songs and ballads.

A more specific application of the term, to a genre of stage piece in which popular songs, dances, and production ensembles are festooned upon or related to a comic or farcical plot, was first made in the early 1890s by George Edwardes, manager of the Gaiety theatre in London, who called his productions *In Town* and *A Gaiety Girl* musical comedies in order to distinguish them from the burlesques he had previously presented. These musical comedies were brought from the Gaiety to the United States, where, as in England, they were archetypes of a form of entertainment that persisted.

Musical comedy, as it has been known in the 20th-century U.S. and English theatres, differs from comic opera and operetta in adhering to a more vernacular style in its music, dances, lyrics and dialogue. It differs from variety, or vaudeville—to which it is indebted for many of its elements of song, dance, and humour—in its possession of a plot (however minimal), and also, as a rule, in the elaborateness (and frequently the tastefulness) of its investiture and mode of presentation. It differs from the revue not only in its employment of a plot, but also in its lack of dependence upon satire, parody and topical thrusts—though satire often is a component of musical comedy.

U.S. musical comedy, as it came into being just before the beginning of the 20th century, developed through a fusion of elements from six earlier types of musical entertainment—extravaganza, pantomime, variety, burlesque, farce-comedy (in the special sense the term acquired in the 1870s) and European comic opera. The extravaganza (in France, the *féerie*) was originally an imaginative spectacle leaning upon the devices of ballet; *The Black Crook* (1866) was a celebrated example in the United States.

After French romantic ballet dropped out of favour, almost any spectacular piece employing elaborate machinery for the production of illusions and tricks was called an extravaganza. Pantomime, still extant in England, was a short-lived importation in the United States, disappearing in the 1870s. Its most significant remnant in musical comedy is the technique of "mugging," or making humorous contortions of the face. Variety served as a proving ground for performers who later graduated into musical comedy; many songs and dance routines (including those from the blackface variety entertainments known as minstrel shows) became stock in trade of musical comedy.

Burlesque, before its decay into mere pruriency, was taken to the United States in 1868 by Lydia Thompson of London, and given a homely U.S. cast by Edward E. Rice in *Evangeline* in 1874. Among the distinguishing marks of burlesque in the 19th century were its girls in tights, playing what purported to be masculine roles, its male comedians with baggy pants and red noses and its punning humour. Farce-comedy, devised in the middle

1870s by the Vokes family of England and an American troupe called Salsbury's Troubadours, introduced the notion of hanging an array of variety specialties upon a slender thread of plot. These vernacular forms of entertainment stood in contrast to English and Viennese comic opera and French *opéra bouffe*, which at best constituted a more aristocratic genre, and elicited the contributions of the best craftsmen in the light musical field.

Borrowing from all these sources, U.S. musical comedy began a growth. In the second decade of the 20th century, ballroom dancing (as expounded by Vernon and Irene Castle) and ragtime music (particularly that of Irving Berlin) moved musical comedy largely out of the comic-opera world of imaginary Balkan principalities, princes and Cinderella heroines. In the 1920s, as the impact of Max Reinhardt's innovations in staging, Joseph Urban's rich *décors*, and the experiments of the "new theatre" began to be felt, the artistic level of musical comedy rose considerably. In the depression years of the early 1930s, political satire invaded musical comedy, and *Of Thee I Sing* became the first piece of the kind to win the Pulitzer prize. In the late 1930s and early 1940s such choreographers as George Balanchine and Agnes De Mille won for the dance a more serious participation than it had enjoyed before; and musical comedy began to be conceived of as a coherent lyric-theatre form, embodying co-operative contributions of music, dance, book, lyrics, action, costumes, stage settings and lighting. A series of "intimate" musical comedies by Jerome Kern, Guy Bolton and P. G. Wodehouse, initiated with *Very Good, Eddie* at the Princess theatre in New York in 1915, created a public demand for believable plot construction and characterization which grew consistently, and such dramatically superior works as *Lady in the Dark* and *South Pacific* were the result. U.S. musical comedy shared more and more the Broadway field with serious and even tragic "musical plays," such as Gian-Carlo Menotti's *The Consul*. These, however, were undertakings of a quasi-operatic nature, unlikely to displace the blither and less exacting genre of musical comedy. (C. M. S.)

MUSICAL INSTRUMENTS, MECHANICAL. (*See* BARREL-ORGAN; MUSICAL-BOX; GRAMOPHONE; PLAYER-PIANO.)

MUSICAL NOTATION, a graphic method of representing sounds to the ear through the medium of the eye. It is probable that the earliest attempts at notation were made by the Hindus and Chinese, from whom the principle was transferred to Greece. The exact nature of the Greek notation is a subject of dispute, different explanations assigning 1680, 1620, 990, or 138 signs to their alphabetical method of delineation. To Anicus Manlius Severinus Boethius we owe the certainty that the Greek notation was not adopted by the Latins, although it is not certain whether he was the first to apply the 15 letters of the Roman alphabet to the scale of sounds included within the two octaves, or whether he was only the first to make record of that application.

Indications of a scheme of notation based, not on the alphabet, but on the use of dashes, hooks, curves, dots and strokes are found to exist as early as the 6th century, while specimens in illustration of this different method do not appear until the 8th. The origin of these signs, known as neumes (*q.v.*) (*νεύματα*, or nods) is the full stop (*punctus*), the comma (*virga*), and the mound or undulating line (*clivus*), the first indicating a short sound, the second a long sound, and the third a group of two notes. The musical intervals were suggested by the distance of these signs from the words of the text. The variety of neumes employed at different times, and the fluctuations due to handwriting, have made them extremely difficult to decipher. In the 10th century a marked advance is shown by the use of a red line traced horizontally above the text to give the singer a fixed note (F = fa), thus helping him to approximate the intervals. To this was added a second line in yellow (for C=ut), and finally a staff arose from the further addition of two black lines over these.

A variety of experiments resulted in the assignment of the four-lined staff to sacred music and of the five-lined staff to secular music. The yellow and red colours were replaced by the use of the letters F and C (fa and ut) on the lines. This use of letters to indicate clef (*q.v.*) is forestalled in a manuscript of Guido of Arezzo's *Micrologus*, dating from the 12th century, in which is the famous hymn to St. John, printed with neumes on a staff of three lines (*see* GUIDO OF AREZZO and HEXACHORD). The use of letters for indicating clefs has survived to the present day, our clef signatures being modified forms of the letters C, F and G, which have passed through a multitude of shapes.

Before the 12th century there is no trace of a measured notation; *i.e.*, of a numerical time division separating the component parts of a piece of music. It was at the time of Franco of Cologne that measured music took its rise, together with the black notation in place of neumes, which disappeared altogether by the end of the 14th century. In the black notation, which led to the modern system, the square note with a tail (▀▌) is the long sound; the square note without a tail (■) is the breve; and the lozenge shape (♦) is the semibreve. In a later development there were added the double long ▬▌ and the minim (♦). The breve, according to Franco of Cologne, was the unit of measure.

The development of a fixed time division was further continued by Philippe de Vitry. It has been noted with well-founded astonishment that at this period double time (*i.e.*, two to the bar) was unknown, but only triple time which was regarded as "perfect"—"because it hath its name from the Blessed Trinity which is pure and true perfection." Vitry championed the rights of imperfect time and invented signs to distinguish the two. The perfect circle ○ represented the perfect or triple time; the half circle C the imperfect or double-time. This C has survived in modern notation to indicate four-time, which is twice double-time; when crossed ₵ it means double-time. The method of dividing into perfect and imperfect was described as prolation. The addition of a point to the circle or semicircle (⊙ Ͼ) indicated major prolation; its absence, minor prolation. The substitution of white for black notation began with the first year of the 14th century and was fully established in the 15th century.

It has already been shown how the earlier form of alphabetical notation was gradually superseded by one based on the attempt to represent the relative height and depth of sounds graphically. The alphabetical nomenclature, however, became inextricably associated with the graphic system. The two conceptions reinforced each other; and from the hexachordal scale, endowed with the solmization of *ut, re, mi, fa, sol, la*—which was a device for identifying notes by their names when talked of, rather than by their positions when seen on a page of music—arose the use of what are now known as accidentals (*q.v.*).

Of these it may here be said that the flat had originated from the necessity of sinking the B of the scale in order to form a hexachord on the note F in such a way as to cause the semitone to fall in the right place—which in the case of all hexachords was between the third and fourth notes. This softened B was written in a rounded form thus: ♭ (*rotundum*), while the original B remained square thus: ♮ (*quadrum*). The original conception of the sharp (*q.v.*) was to cross or lattice the square B, by which it was shown that it was neither to be softened nor to remain unchanged. The flat, which originated in the 10th century, appears to have been of far earlier date than the sharp, the invention of which has been ascribed to Josquin Des Près (1450–1521). The B-sharp was called B *cancellatum*, the cross being formed thus ※.

The use of key signatures constructed out of these signs of sharp and flat was of comparatively late introduction. The key signature states at the beginning of a piece of music the sharps and flats which it contains within the scale in which it is written. It is a device to avoid repeating the sign of sharp and flat with every fresh occasion of their occurring. The double ♭♭ and the double sharp χ are conventions of a much later date, called into existence by the demands of modern music, while the sign of the natural (♮) is the outcome of the original B quadration or square B♮. (*See* TONIC SOL-FA and CHEVÉ SYSTEM.)

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MUSIC PRINTING. Printed music originated soon after the invention of typography and the year 1465 is given as the earliest date of any record of its existence. At first the method was only used for printing the staves in red ink from a woodcut, the notes being written in by hand. Later the staves and notes were engraved separately on wood blocks and printed respectively in red and black. Then followed the practice of cutting both the staves and notes on one block for printing in black. There are no records of music being printed from separate characters before 1473 when a theological work by a German printer named Gerson was issued containing five notes of music evidently so printed. This may be regarded as the foundation of music printing.

In 1482 William Caxton, the first English printer, published a work entitled *Polychronicon,* in which there are a few notes of music, though apparently filled in to the printed stave lines by hand. Wynkyn de Worde, who succeeded Caxton, reprinted this work in 1495, introducing both the notes and stave lines by type characters, so that he must be given the credit of being the first English printer of music from movable type. The *Mainz Psalter* of 1490 contained typeprinted music. In 1500 Ottaviano Petrucci, in Venice, produced music with the staves and notes printed from type by separate operations.

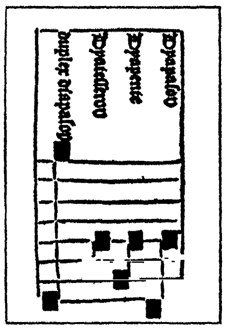
Thenceforward the system of printing the stave lines separately fell into disuse. Pierre Attaignat, in Paris (1529), was the first to print the words of songs under the notes. In 1530 music began to be printed in England with type similar to that used by Petrucci, and it was done in two printings, but in 1539 a London printer named Gough issued music from type characters with the staves and notes printed at one impression. In 1550 Richard Grafton printed in London the *Booke of Common Praier noted,* the musical part being executed in type with red stave lines. Printing from type then became general and by 1700 it had assumed the appearance of present day music.

Music printed from plates dates from 1525, when Pierre Hautin, a French engraver, cut punches for the notes and stamped them into metal plates, which were finished by engraving. This style of work became general in England and continued to hold the field until about 1710, when music printed from punched plates began to appear.

Lithographic music printing dates from 1799, being first applied by Alois Senefelder, the inventor of lithography, who drew the music direct on stone, or on transfer paper.

Typographical music printing recovered its position with the production of better music type by the English letter-founders and came largely into use for hymnals, song books, and other musical works for which large editions in a cheap form are required.

The work of setting up music type is however very tedious as the staves and notes have to be built up from a large number of small pieces. A font may contain from 400 to 500 characters. Most music printing, at least for sheet music, orchestral parts, etc., is done by lithography, the original plates being made partly by punching and partly by engraving on pewter.



FROM THE "POLYCHRONICON," PRINTED BY WYNKYN DE WORDE

SPECIMEN OF THE EARLIEST EXAMPLE OF TYPE-PRINTED MUSIC

The method of engraving starts with ruling the staves on the plate with a five-pointed rakelike tool, called a "score"; then the spacing between the notes (previously determined by marking-off the manuscript) is set out by a method called "pointing," which is done with a small compass. The character of the notes and their position on the stave are roughly indicated on the plate with a blunt steel point called a "marking pin." During the punching the plate is laid on a stone slab and the punches are held in contact with the plate while a smart blow is given with a steel mallet. A set of punches usually consists of 50 to 53 pieces as a rule. Only the heads of the notes are punched, the hooks, ties, etc., being finished by gravers and other engraving tools. All the usual signs are punched and the words of songs are filled in with letter punches. Photo-lithography has been largely used for reproducing out-of-print music, the plates of which have been destroyed. Collotype has been found very effective in reproducing old music in *facsimile.*

Bibliography.—Robt. Steele, *The Earliest English Music Printing* (1903); Andrew Deakin, *Musical Bibliography* (Birmingham, 1893); F. Kidson, *British Music Publishers, Printers and Engravers* (1900); William Gamble, *Music Engraving and Printing* (1923); John Southward, *Modern Printing,* 5th ed. (1921); article in Grove's *Dictionary of Music,* 3rd ed. (W. Gam.)

MUSK, the name originally given to a perfume obtained from the strong-smelling substance secreted in a gland by the musk deer (*q.v.*), and hence applied to other animals, and also to plants, possessing a similar odour. The variety which appears in commerce is a secretion of the musk deer; but the odour is also emitted by the musk ox and muskrat of India and Europe, by the musk duck (*Biziura lobata*) of West Australia, the musk shrew, the musk beetle (*Calichroma moschata*), the alligator of Central America, and others.

To obtain the perfume from the musk deer the animal is killed and the gland completely removed, and dried, either in the sun, on a hot stone, or by immersion in hot oil. It appears in commerce as "musk in pod," *i.e.,* the glands are entire, or as "musk in grain," in which the perfume has been extracted from its receptacle. Three kinds are recognized: (1) Tongking, Chinese or Tibetan, imported from China, the most valued; (2) Assam or Nepal, less valuable; and (3) Karbardin or Russian (Siberian), imported from central Asia by way of Russia, the least valuable and hardly admitting of adulteration. The Tongking musk is exported in small, gaudily decorated caddies with tin or lead linings, wherein the perfume is sealed down.

Good musk is of a dark purplish colour, dry, smooth and unctuous to the touch, and bitter in taste. It dissolves in boiling water to the extent of about one-half; alcohol takes up one-third of the substance, and ether and chloroform dissolve still less. A grain of musk will distinctly scent millions of cubic feet of air without any appreciable loss of weight, and its scent is not only more penetrating but more persistent than that of any other known substance. In addition to its odoriferous principle, it contains ammonia, cholesterin, fatty matter, a bitter resinous substance, and other animal principles. As a material in perfumery it is of the first importance, its powerful and enduring odour giving strength and permanency to the vegetable essences.

Artificial musk is a synthetic product, having a similar odour to natural musk. It was obtained by Baur in 1888 by condensing toluene with isobutyl bromide in the presence of aluminum chloride, and nitrating the product. It is a symtrinitro- Ψ -butyl toluene. Many preparations have been made, and the odour seems to depend upon the symmetry of the three nitro groups.

Musk in botany is *Mimulus moschatus.* (*See* Mimulus.) The musk orchis is *Herminium monorchis;* musk mallow, *Malva moschata;* muskmelon, *Cucumis melo;* musk thistle, *Carduus nutans.*

MUSK DEER (*Moschus moschiferus*), an aberrant deer, presenting many peculiar characteristics (*see* Deer). There are no antlers, but in lieu of such weapons, the upper canine teeth of the male form projecting tusks. About 20 in. high at the shoulder, the musk deer possesses long limbs, and there is a great development of the lateral pair of hoofs. The ears are large and the tail rudimentary. The grayish-brown hair is long, coarse, and brittle. This animal inhabits the forests of the Himalayas as far west as Gilgit, always at great elevations and preferring thickets of birch, juniper, and rhododendrons. It extends into Tibet, Siberia and northwestern China. In habits the musk deer is solitary, shy and nocturnal, but very active; it feeds on moss, grass and leaves. The deer takes its name from the secretion of a sac, about the size of an orange, beneath the skin of the abdomen, opening in front of the preputial aperture. This contains a dark brown substance of the consistency of "moist gingerbread." It is only present in the male (*see* Musk). A race, the southern

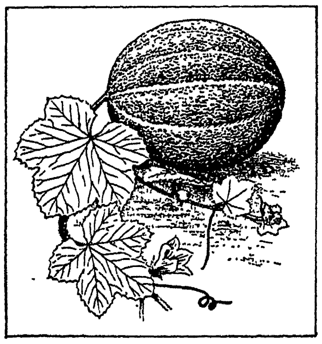
musk deer (*M. m. sifanicus*), inhabits eastern China, distinguished by its longer, black ears.

MUSKEGON, a city of western Michigan, U.S.A., on Lake Michigan, at the mouth of the Muskegon river, which expands here into a lake 5 mi. long by 1 to 5 mi. wide; a port of entry and county seat of Muskegon county. It is on federal highways 16 and 31 and is served by the Grand Trunk Western, the Pennsylvania, the Chesapeake and Ohio railways and by the Grand Trunk-Pennsylvania car ferry and boat service to Milwaukee. The population was 48,429 in 1950 and 47,697 in 1940 by federal census. Muskegon is one of four municipalities with contiguous boundaries, the others with 1950 populations, being Muskegon Heights (18,828), North Muskegon (2,424) and Roosevelt Park (1,254). Muskegon has a fine landlocked harbour, with traffic of more than 3,000,000 tons (1951). It is the centre of a summer resort region; the metropolis of a fine dairying, farming and fruit-growing district; and above all a modern industrial city, with 200 manufacturing establishments. Leading products include automobile motors and castings, aviation engines, office equipment, bowling and billiard equipment, piston rings, electric refrigerators, washers, gasoline pumps, window-shade rollers and laboratory-table equipment. The city's public parks cover 1,855 ac. and include 7 mi. of lake front. The city operates under a commission-manager form of government. A trading post was established here in 1812, and permanent settlement began in 1834. The first sawmill was built in 1837.

The town was laid out in 1849, was incorporated as a village in 1861 and chartered as a city in 1869. In 1870 the population was 6,002. The lumber industry reached its peak in 1887, with a cut of 700,000,000 bd.ft.; and the population at that time was about 24,000. With the depletion of the forests, the population dwindled. The renewed prosperity began about 1900. The name Muskegon is probably derived from a Chippewa word meaning "grassy bog."

MUSKET, the term generally applied to the firearm of the infantry soldier from about 1550 up to and even beyond the universal adoption of rifled small arms about 1850–60. The word originally signified a male sparrowhawk (Italian *moschetto,* derived perhaps ultimately from Latin *musca,* a fly) and its application to the weapon may be explained by the practice of naming firearms after birds and beasts (*cf.* falcon, basilisk). The "musket" proper, introduced into the Spanish army by the duke of Alva, was much heavier and more powerful than the arquebus. Its bullet retained sufficient striking energy to stop a horse at 500 and 600 yd. from the muzzle. A writer in 1598 (quoted *s.v.* in the *Oxford English Dictionary*) goes so far as to say that "One good musket may be accounted for two callivers." Unlike the arquebus, it was fired from a rest, which the "musketeer" stuck into the ground in front of him. But during the 17th century the musket in use was so far improved that the rest could be dispensed with. The musket was a matchlock, weapons with other forms of lock being distinguished as wheellocks, firelocks, snaphances, etc., and soldiers were similarly distinguished as musketeers and fusiliers. On the disuse, about 1690–95, of this form of firing mechanism, the term "musket" was, in France at least, for a time discontinued in favour of "fusil," or flintlock, which thenceforward reigned supreme up to the introduction of a practicable percussion lock about 1830–40. But the term "musket" survived the thing it originally represented, and was currently used for the firelock (and afterwards for the percussion weapon). Today it is generally used for military firearms anterior to the modern rifle. The original meaning of the word *musketry* has remained almost unaltered since 1600; it signifies the fire of infantry small-arms (though for this "rifle-fire" is now a far more usual term), and in particular the technique of using them (*see* INFANTRY and SMALL ARMS, THE DEVELOPMENT OF). A *musketoon* was a short, large-bore musket somewhat of the blunderbuss type, originally designed for cavalry use, but in the 18th century chiefly a domestic or coachman's weapon.

MUSKMELON, *Cucumis melo,* a polymorphic species of the family Cucurbitaceae, including numerous varieties. The muskmelon is a tender annual trailing herb with palmately-lobed leaves, and bears tendrils by means of which it is readily trained over trellises. It is monoecious, having male, female, and, in some varieties, complete flowers on the same plant; the yellow flowers have deeply five-lobed campanulate corollas and three stamens. It is a native of south Asia "from the foot of the Himalayas to Cape Comorin" (*see* Charles Naudin, *Annales des sciences naturelles,* vol. 4 [1859]), where it grows spontaneously, but is cultivated in the temperate and warm regions of the whole world. It is variable both in diversity of foliage and habit, but much more so in the fruit, which in some varieties is no larger than an olive, while in others it rivals the squash (*Cucurbita maxima*). The fruit is globular, ovoid, spindle-shaped, or serpent-like, netted or smooth-skinned, ribbed or furrowed, variously coloured externally, with white, green or orange flesh when ripe, scented or scentless, sweet or insipid, bitter or even nauseous.



J. HORACE MCFARLAND COMPANY

MUSKMELON (CUCUMIS MELO)

Like the squash and pumpkin the melon undergoes strange metamorphoses by crossing its varieties, though the varieties preserve their characters when alone. The offspring of all intervariety crosses within the species are fertile.

Naudin thought it probable that the culture of the melon in Asia is as ancient as that of all other alimentary vegetables. The Egyptians grew it, or at least inferior races of melon, which were either indigenous or introduced from Asia. The Romans and doubtless the Greeks were familiar with it, though some forms may have been described as cucumbers. The melon began to be extensively cultivated in France in 1629, according to Olivier de Serres. Gerard (*Herball,* 772) figured and described in 1697 several kinds of melons or pompions, but he included gourds under the same name. The region of origin of some modern types, such as "cantaloups," "Dudaim," "Cassaba" and probably the netted or nutmeg sorts, is believed to be Persia and the neighbouring west Asian regions. The first of these was brought to Rome from Armenia in the 16th century, and supplies the chief sorts grown for French markets; but many others are doubtless artificial productions of west Europe.

In the coolest parts of the temperate zones muskmelons, like cucumbers, can be grown to perfection only under glass. In Great Britain and northern Europe the rock and cantaloup types may be grown with a soil temperature of 70° F. and an air temperature of 75° to 80° in the sun; the Persian varieties require temperatures about 5° higher, and will tolerate 90° or more in the sun. Most varieties are subject to many diseases, control of which is aided by keeping the air humidity relatively low. Muskmelons grow well on many soil types but require high fertility and ample soil moisture and respond well to heavy applications of manure.

In the United States and in the warmer parts of the temperate zones, muskmelons are grown very extensively in the field. The plants are usually spaced about 2 ft. apart in rows 5 ft. apart or in hills 5 x 5 ft. apart. Some of the earliest plantings are protected by windbreaks of brush and paper or by individual plant covers of paper until warm weather arrives. Plants are sometimes started in pots in hotbeds or greenhouses, then set in the field when danger of frost is past. Since muskmelons are favoured by a relatively dry atmosphere they are especially adapted to growing in the irrigated valleys of western and southwestern United States. Plant breeders developed a number of varieties resistant to one or more forms of powdery mildew, a disease that nearly destroyed the muskmelon industry of the Imperial valley in California. In greenhouse culture, the flowers must be hand-pollinated, or hives of bees established inside the houses to effect pollination. The fruits must be supported in slings since the trellised vines are not strong enough to carry them. (V. R. B.)

MUSKOGEE, a city of eastern Oklahoma, U.S.A., 130 mi. E.N.E. of Oklahoma City, near the confluence of the Verdigris, the Grand and the Arkansas rivers; county seat of Muskogee county. It is on federal highways 62, 64 and 69, and is served by two commercial air lines, by the Missouri-Kansas-Texas, the Frisco, the Kansas-Oklahoma & Gulf, the Midland Valley and the Missouri Pacific railways and by motor carriers. Pop. (1950) 37,289; (1940) 32,332 (20.4% Negro).

Muskogee is the location of a U.S. Veterans' hospital (general medical and surgical) and the regional offices of the U.S. Veterans' administration. Here also are located the Oklahoma School for the Blind, the U.S. Indian Agency for the Five Civilized Tribes and the Oklahoma Free State fair. Two miles N.E., is Bacone college (Baptist, 1884), only fully accredited college for Indians in the U.S. Muskogee is the metropolis of a rich agricultural and oil-producing territory. It has large railway shops, yards and offices; wholesale and jobbing houses; cotton gins and compresses and cottonseed oil mills, and large glass-manufacturing and processing plants.

Muskogee was founded about 1870, and became the chief town of the Creek nation and the administrative centre of the former Indian territory. The first railway reached it in 1872. In 1893 the Dawes commission began to transform the tribal allotments into individual holdings.

The city was chartered in 1898, and in 1900 it had a population of 4,154. By 1910 the population was 25,278, a six-fold increase in the decade. The managerial form of government was adopted in 1920.

MUSKOGIAN INDIANS. This group constituted one of the larger speech stocks of native North America, and was typical of and dominant in the southeastern area of aboriginal culture, comprising the region from the Gulf of Mexico to Tennessee, and from the Carolinas to Louisiana. The Muskogian family comprised a series of divisions: 1, Apalachee; 2, Hitchiti, Apalachicola, etc.; 3, Alabama, Koasati, etc.; 4, Choctaw, Chickasaw, Mobile, Pensacola, etc.; 5, Tuskegee; 6, Cusabo, Yamasee and other tribes of the Georgia coast; 7, Miskogi proper. The latter formed the bulk of what was later the Creek confederacy, in which the Hitchiti and other groups were included. The Natchez and Taensa of the lower Mississippi seem to be a remote Muskogian offshoot; the Calusa and other south Floridian tribes may be. Since the middle of the 18th century the historically important tribes have been the Choctaw, Chickasaw and Creek, plus a branch of the latter, the Seminole. With the non-Muskogian Cherokee, these make up the "five civilized tribes," which for three-quarters of a century, until 1906, maintained quasi-autonomous governments in Indian territory (Oklahoma), where they had removed under the pressure of American settlement.

Ethnographically the Muskogian or Southeastern culture province included, besides the groups listed, the Chitimacha and Tunica of the lower Mississippi, the Iroquoian Cherokee, the Timucua of central Florida and, in the lower region of Georgia and Carolina, the Yuchi, the Algonkin Shawnee and various eastern Siouan tribes. All these groups were agricultural, planting maize, pumpkins, beans, cane-millet, tobacco, sometimes Jerusalem artichokes, and sunflowers. They gathered hickory nuts and wild fruits, hunted deer and, in the west, bison, and stored nut oil and bear fat. The settlements were straggling; the "town" contained a square, on which were public and religious buildings; "villages" were often outlying. The towns were autonomous and essentially constituted tribes. They united into confederacies, directed by councils; such confederacies might break up and recombine. The most successful, like those of the Creek and Choctaw, grew in population during the colonial period, largely through absorption of smaller or scattered groups. The tribes were divided into matrilineal, totemic clans; chieftainship and office were hereditary, probably in the lineage within the clan. The Natchez and some other groups had superimposed a peculiar class or caste system. Chiefs in these cases were carried in litters, enthroned on raised seats or in arbours, and accompanied in death by sacrificial followers. All the tribes were warlike and in chronic but shifting embroilment with others. They took scalps and slowly tortured prisoners to death in a frame or tied to a post in the town square. Often there was a distinction between civil and military chiefs; the towns entitled to offices of one or the other kind in a confederacy were known as peace and war, that is, white or red.

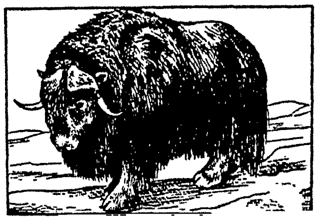
Economic life was undeveloped as compared with the fairly well organized socio-political institutions. Houses were of logs or poles, wattled, chinked or plastered with mud, the roof of thatch. Bark or thatch houses were also built. Exposed settlements were palisaded, or log forts erected. Pottery was unpainted, basketry of cane splints; simple weaving was done in bark fibres and bison hair, but the principal clothing besides mantles was breech clouts for men and apron skirts for women. Many tribes deformed their heads. There was little property, almost no treasure, and limited trade before the coming of the whites. Ritual was also simple. The most important ceremony was the busk or green-corn festival, a first-fruits and new-fire rite. Purification by emetics was a common religious observance. There was little that could be called art. Most tribes had a migration legend.

The Muskogian-Southeastern culture extended with variations north into the Ohio valley to the prehistoric moundbuilders, and northeast to the tribes of Iroquois lineage; it was represented in pallid form among many of the Algonkin groups as far as New England and the Great Lakes. The total Muskogian population was about 50,000. At the time of discovery, there may have been 7,000 Creeks (increased to 20,000 by 1832), 3,500 Chickasaw, 15,000 Choctaw, 5,000 Apalachee, perhaps 5,000 Mobile. The first three of these tribes survive in increased numbers, but much mixed with white and Negro blood.

See J. Adair, *History of the American Indians* (1775); W. Bartram, *Travels* (1791); J. Swanton, *Bur. Am. Ethn. Bull.* 43 (1911); 73 (1922); 137 (1946). (A. L. K.)

MUSK OX, an Arctic American ruminant of the family Bovidae (*q.v.*). The musk ox (*Ovibos moschatus*) is closely related to the takin of Asia and belongs in the goat-sheep subfamily. Its resemblances to the true cattle are entirely superficial. The musky odour from which the animal takes its name is not due to the secretion of a special gland, as is so often the case in mammals.

In height a bull musk ox stands about 5 ft. at the shoulder. The head is large and broad. The horns in old males have broad bases, meeting in the middle line, and covering the brow and crown of the head. They are directed at first downwards by the side of the face, and then turn upwards and forwards, ending in the same plane as the eye. In females and young males the horns are smaller, and their bases separated by a space. The ears are small, and nearly concealed in the hair. The space between the nostrils and the upper lip is covered with short hair; the rest of the animal is covered with long brown hair, thick, matted and curly on the shoulders, but elsewhere straight and hanging down, concealing the short tail. There is also a thick woolly underfur, shed in summer in blanket-like masses. The limbs are stout and short, terminating in unsymmetrical hoofs, the external being rounded, the internal pointed, and the sole in part hairy.



FROM A GROUP IN AMERICAN MUSEUM OF NATURAL HISTORY

MUSK OX (OVIBOS MOSCHATUS)

Musk oxen are confined to the northern parts of North America; they range over the "barren grounds" between lat. 64° and the shores of the Arctic sea. Northwards and eastwards they extend through the Parry Islands and Grinnell Land to north Greenland. The Greenland animal is distinguished by white hair on the forehead. Musk oxen ranged during the Pleistocene period over northern Siberia and the plains of Germany and France. They have also been found in Pleistocene gravels in England. They are gregarious, assembling in herds of 20 or 30 head, in which there are seldom more than two or three full-grown males; they run with considerable speed, but when attacked normally form a circle with the younger animals in the centre. Musk oxen feed chiefly on grass. The female brings forth one young in the end of May or beginning of June, after a gestation of nine months. The peculiar musky odour can be perceived from a distance of 100 yards. According to V. Stefansson (*The Friendly Arctic*, 1921), they are admirably suited for domestication. The flesh is excellent, the milk equal in quality to that of the domestic cow and the wool of considerable value. (J. E. HL.)

MUSKRAT or MUSQUASH, large North American ratlike

rodent, *Ondatra zibethica,* related to the voles and meadow mice and included in the subfamily Microtinae. (*See* VOLE.) It is much larger than its close relative, the European water rat, the head and body being about a foot in length and the tail but little less. It is a heavily built animal, with a broad head and short limbs; the eyes are small and the ears project little beyond the fur. The hind feet are enlarged, the five toes partly united by webs. The tail is laterally compressed, nearly naked and scaly. The hair consists of a thick soft underfur, mixed with longer stiff, glistening hairs, which overlie and partly conceal the former on the upper surface and sides. The pelage is waterproof. The colour is usually rich brown, almost black on the back, the gray of the underfur showing through on the underside. The tail and naked parts of the feet are blackish. The musky odour from which it derives its name is secreted by two large glands associated with the genital openings, present in both sexes.

U.S. DEPT. OF INTERIOR

MUSKRAT (ONDATRA ZIBETHICA)

The muskrat is found only in North America, from Alaska to Mexico. It lives in the marshes, ponds and streams, swimming and diving with great facility, feeding on roots, stems and leaves of water plants, on vegetation growing nearby, and on fresh-water mussels. Muskrats are most active at night, spending the day concealed in their burrows in the bank or in a dome-shaped house built of cat-tails, sedges and other water plants and consisting of a chamber with several passages, all opening under water. The muskrat is one of the most important fur-bearers; although individual pelts bring only a dollar or two, enormous numbers are trapped annually. Four to six young are born in the spring, in the north, but in Louisiana muskrats breed throughout the year. (*See* RODENTIA.) (J. E. HL.)

MUSK-SHREW, a name for any species of the genera *Crocidura* and *Suncus* of the family Soricidae (*see* INSECTIVORA), but generally used of the common gray musk-shrew (*S. coerulea*) of India which commonly frequents human habitations. The head and body, blue-gray in colour, measure about 6 in., and the tail is rather more than half that length.

MUSLIM: *see* ISLAM.

MUSLIN, a light cotton cloth said to have been first made at Mosul, a city of Mesopotamia. Muslins have been largely made in various parts of India, whence they were imported to England towards the end of the 17th century. Some of these Indian muslins were very fine and costly. Among the specialties are *Arni muslin,* made in the Madras presidency, and *Dacca muslin,* made at Dacca in Bengal. Muslins of many kinds are now made in Europe and America, and the name is applied to both plain and fancy cloths, and to printed calicoes of light texture. *Swiss muslin* is a light variety, woven in stripes or figures, originally made in Switzerland. *Book muslin* is made in Scotland from very fine yarns. Mulls, jaconets, lenos and other cloths exported to the east and elsewhere are sometimes described as muslins.

MUSQUASH: *see* MUSKRAT.

MUSSEL, the name given to certain aquatic bivalve molluscs of the class Lamellibranchia. In its most regular usage, it is applied to the marine Mytilidae, of which the edible mussel, *Mytilus edulis,* is the most familiar example, and to the fresh-water genus *Anodonta.* The members of the large fresh-water genus *Unio* are sometimes called mussels.

The marine mussels (*Mytilus, Modiolaria, Modiolus*) belong to the suborder Mytilacea of the order Filibranchia. The edible mussel, *Mytilus edulis,* has a wide distribution. It is found on both sides of the Atlantic and in the Mediterranean, and on the eastern Atlantic seaboard its range extends as far south as Rio de Oro in Morocco. Its habitat is towards low-tide mark, where it lives attached to rocks or on consolidated shingle or sandbanks. It is usually found in large numbers, such mussel-beds sometimes covering several acres and containing millions of individuals.

The Mytilidae have an inequilateral shell, the apex or umbo appearing to be displaced to one end when compared with that of a cockle, for example. This is due to the imperfect development of the anterior end of the shell. The foot is provided with a byssus, a bunch of hairs secreted in a glandular cavity of the foot. From this cavity the hairs are extruded and harden on contact with the sea water, forming a means of attaching the mussel to a rock or stone. This fixation is not, however, permanent; the animal can discard the byssus and anchor itself afresh in a new situation. Such a means of anchorage and the faculty of occasionally changing position are highly important in animals which live, as the Mytilidae do, in the tidal zone where gales tend to shift the sand or shingle on which they live, and where the animal is liable to be swept away from its feeding ground or buried beneath the debris of the shore.

The edible mussel, *Mytilus edulis,* is of considerable economic importance as human food and as bait for edible fishes.

M. edulis, however, is not eaten to any great extent in the United States.

It is considered of fair size for eating when it is 2 in. long, a size attained three years after the young mussel settles down. Under favourable conditions it will attain a much greater size. The degree of salinity of the water has a considerable effect on the size of the shell. For example, those mussels which live in the comparatively fresh water of the Baltic sea are often a quarter or one-fifth the size of the North sea forms. Nevertheless, it seems to thrive best in water having a salinity lower than that of normal sea water. In Great Britain the chief mussel beds are in Morecambe bay (Lancs.) and in the Wash.

There are many genera in the family Mytilidae, which has a wide distribution. They include *Modiolaria, Lithophaga* (the date mussel), which bores into rock, *Modiolus* and *Crenella.*

The fresh-water mussels are members of the family Unionidae (order Eulamellibranchia) and include the genera *Anodonta, Unio, Quadrula,* etc. They are mainly found in rivers and lakes. They burrow in the soft mud of the bottom and, living thus in more tranquil conditions than the sea-mussels, have a byssus only in the juvenile stage. The developmental history of these mussels is unique among molluscs, as the young larva (*glochidium*) undergoes part of its development as a parasite on fish. The members of the genus *Unio* and its near allies are of considerable economic importance in the United States, where they are cultivated for their pearly shell, which is used in button-making. At one time the pearls obtained from these animals were widely sought in Europe; but this industry has decayed owing to the introduction of the Orient pearls of Ceylon, etc.

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MUSSELBURGH, a small burgh of Midlothian, Scotland, 5½ mi. E. of Edinburgh by the L.N.E.R. Pop. (1951), 17,012. The burgh, which lies on the south shore of the Firth of Forth, is intersected by the Esk and embraces the village of Fisherrow on the left bank of the river. While preserving most of the ancient features of its High street, the town, with its fine beach and golf course, has tended to become a suburb of the capital. Loretto school, one of the foremost public schools in Scotland, occupies the site of the chapel of Our Lady of Loretto, which was founded in 1534 by Thomas Duthie, a hermit from Mt. Sinai, and was the favourite shrine of Mary of Guise. The 1st earl of Hertford destroyed it in 1544, and after it was rebuilt the Reformers demolished it again, some of its stones being used in erecting the tolbooth. In the west end of the town is Pinkie house, a Jacobean mansion, with a fine fountain, formerly a seat of the abbot of Dunfermline, but transformed in 1613 by Lord Seton. The painted gallery, with an elaborate ceiling, was utilized as a hospital after the battle of Pinkie in 1547, and Prince Charles Edward slept in it after the fight at Prestonpans (1745). Near the tolbooth stands the market cross. At the west end of High street is a statue of David Macbeth Moir ("Delta," 1798–1851), born in Mussel-

burgh. A 16th-century stone bridge crosses the Esk, and Roman remains have been found near it. The chief bridge, which carries the high road from Edinburgh to Berwick, was built by John Rennie in 1807. The principal industries include papermaking, brewing, the making of nets and wire, confectionery, mats, boatbuilding, pottery, besides saltworks and seed-crushing works. The fishery is confined to Fisherrow, where there is a good harbour. Race meetings and archery contests are held on the links. About 1 mi. S.E. is the site of the battle of Pinkie, and 1½ mi. further is Carberry Hill, where Mary surrendered to the lords of the Congregation in 1567, the spot being still known as Queen Mary's Mount. Musselburgh is in the eastern parliamentary division of Edinburgh, which returns one member.

MUSSET, ALFRED DE [Louis Charles Alfred] (1810–1857), French poet, play-writer and novelist, was born on Dec. 11, 1810 in a house in the middle of old Paris, near the Hôtel Cluny. In the summer of 1827 he won the second prize (at the Collège Henri IV.) by an essay on "The Origin of our Feelings." He took up law and medicine but could endure no profession. He was taken by Paul Foucher to Victor Hugo's house, where he met Alfred de Vigny, Prosper Mérimée, Charles Nodier, Sainte-Beuve, and others. His first original volume, *Contes d'Espagne et d'Italie* (1829), had an immediate success, provoked bitter opposition, and produced many unworthy imitations. This volume contained a fantastic parody in verse on certain productions of the romantic school. This was the famous "Ballade à la lune" with its recurring comparison of the moon shining above a steeple to the dot over an *i*. It was, to Musset's delight, taken seriously.

In December 1830 Musset was just twenty years old, and was already conscious of that curious double existence within him so frequently symbolized in his plays—in Octave and Célio for instance (in *Les Caprices de Marianne*), who also stand for the two camps, the men of matter and the men of feeling—which he has elsewhere described as characteristic of his generation. At this date his *Nuit vénitienne* was produced by Harel, manager of the Odéon. It failed and Musset was disgusted with the theatre.

Musset now belonged, in a not very whole-hearted fashion, to the "Cénacle," but the connection came to an end in 1832. In 1833 he published the volume called *Un Spectacle dans un fauteuil*, and was asked to contribute to the *Revue des deux mondes*. In this he published, in April 1833, *André del Sarto*, and he followed this six weeks later with *Les Caprices de Marianne*. The latter play has perhaps more of the Shakespearian quality—the quality of artfully mingling the terrible, the grotesque, and the high comedy tones—which exists more or less in all Musset's long and more serious plays, than is found in any other of these. Its brilliant dialogue and swiftness of action give it superficially the character of comedy, but throughout there runs the sense of fate.

In 1833 the *Revue* published *Rolla*, a symptom of the *maladie du siècle*. Rolla, for all the strain which is not to be denied of Wertherism, has yet a decided individuality. The poem was written at the beginning of Musset's *liaison* with George Sand, and in December 1833 Musset started on the unfortunate journey to Italy. It is well known that the rupture of what was for a time a most passionate attachment had a disastrous effect upon Musset, who was absolutely and completely struck down by the blow. But it was not so well known until Paul de Musset pointed it out that the passion expressed in the *Nuit de décembre*, written about twelve months after the journey to Italy, referred not to George Sand but to another and quite a different woman. As fiction, the story is told in the two volumes called respectively *Elle et lui* by George Sand, and *Lui et elle* by Paul de Musset.

During Musset's absence in Italy *Fantasio* was published in the *Revue*, *Lorenzaccio* is said to have been written at Venice, and not long after his return *On ne badine pas avec l'amour* was written and published in the *Revue*. In 1835 he produced *Lucie*, *La Nuit de mai*, *La Quenouille de Barberine*, *Le Chandelier*, *La Loi sur la presse*, *La Nuit de décembre*, and *La Confession d'un enfant du siècle*, wherein is contained what is probably a true account of Musset's relations with George Sand. To 1836 belong the *Nuit d'août*, the *Lettre à Lamartine*, the *Stances à la Malibran*, the comedy *Il ne faut jurer de rien*, and the beginning of the brilliant letters of Dupuis and Cotonet on romanticism. *Il ne faut jurer de rien* is as typical of Musset's comedy work as is *Les Caprices de Marianne* of the work in which a terrible fatality underlies the brilliant dialogue and keen polished characterization. In 1837 was published *Un Caprice*, which afterwards found its way to the Paris stage by a curious road. Mme. Allan-Despréaux, the actress, heard of it in St. Petersburg as a Russian piece. On asking for a French translation of the play she received the volume *Comédies et proverbes* reprinted from the *Revue des deux mondes*. In 1837 appeared also some of the *Nouvelles*. In 1839 Musset began a romance called *Le Poète déchu*, of which the existing fragments are full of passion and insight.

In 1840 Musset passed through a period of feeling that the public did not recognize his genius—as, indeed, they did not—and wrote a very short but very striking series of reflections headed with the words "À trente ans," which Paul de Musset published in his *Life*. In 1841 there came out in the *Revue de Paris* Musset's "Le Rhin allemand," an answer to Becker's poem which appeared in the *Revue des deux mondes*. This fine war-song made a great deal of noise, and brought to the poet quantities of challenges from German officers. Between this date and 1845 he wrote comparatively little. In the last named year the charming "proverbe" *Il faut q'une porte soit ouverte ou fermée* appeared. In 1847 *Un Caprice* was produced at the *Théâtre Français*. The word "rebonsoir" shocked some of the old school. But the success of the piece was immediate. In 1848 *Il ne faut jurer de rien* was played at the Théâtre Français and the *Chandelier* at the Théâtre Historique. Between this date and 1851 *Bettine* was produced and *Carmosine* written. The poet died on May 2, 1857

Alfred de Musset now holds the place which Sainte-Beuve first accorded, then denied, and then again accorded to him—as a poet of the first rank. He had genius, though not genius of that strongest kind which its possessor can always keep in check. His own character worked both for and against his success as a writer. He inspired a strong personal affection in his contemporaries. His very weakness and his own consciousness of it produced such beautiful work as, to take one instance, the *Nuit d'octobre*. His *Nouvelles* are extraordinarily brilliant; his poems are charged with passion, fancy and fine satiric power; in his plays he hit upon a method of his own, in which no one has dared or availed to follow him with any closeness. He was one of the first, most original, and in the end most successful of the first-rate writers included in the phrase "the 1830 period." The wilder side of his life has probably been exaggerated; and his brother Paul de Musset has given in his *Biographie* a striking testimony to the finer side of his character. In the later years of his life Musset was elected, not without opposition, a member of the French Academy. Besides the works above referred to, the *Nouvelles et contes* and the *Oeuvres posthumes*, in which there is much of interest concerning the great tragic actress Rachel, should be specially mentioned. (W. H. Po.; X.)

The biography of Alfred de Musset by his brother Paul, partial as it naturally is, is of great value. Alfred de Musset has afforded matter for many appreciations, and among these in English may be mentioned the sketch (1890) of C. F. Oliphant and the essay (1855) of F. T. Palgrave. *See* also the monograph by Arvède Barine (Madame Vincens) in the "Grands écrivains francais" series. Musset's correspondence with George Sand was published intact for the first time in 1904.

See M. Donnay, *Alfred de Musset* (1914); C. Maurras, *Les Amants de Venise: George Sand et Musset* (1916), pp. 316; E. Moroncini, *A. de Musset e l'Italia* (Milan, 1921), pp. 228.

MUSSOLINI, BENITO (1883–1945), Italian politician and journalist, was born July 29, 1883, at Dovia, in the commune of Predappio (province of Forli). His father, Alessandro Mussolini, was a blacksmith of antireligious and vaguely socialist opinions. His mother, Rosa Maltoni, was a school teacher of strong character. Young Mussolini was named Benito after Benito Juarez, the Mexican revolutionary leader. Benito Mussolini was sent by his mother to the Salesian school of Faenza. The boy showed there a vivid intelligence and an insubordinate temper. Later he went to the normal school at Forlimpopoli and qualified as a school teacher at 18, obtaining an appointment at Gualtieri (province of Reggio Emilia).

The Leftist Period.—As a youth Mussolini was interested

Italian-German military alliance was concluded. At the beginning of World War II Mussolini proclaimed a policy of nonbelligerency but on June 10, 1940, declared war on France and Great Britain at the moment he thought Germany had certainly won the war. Italy's subsequent military debacles are described in WORLD WAR II; they led finally to his downfall on July 25, 1943, after the Fascist Grand council, led by Count Dino Grandi, had repudiated his leadership by a vote of 19 to 7. The king "accepted" Mussolini's resignation and appointed Marshal Pietro Badoglio to succeed him. Il duce was placed in protective custody, but on Sept. 12, 1943, the Germans announced he had been rescued by nazi paratroopers at a place later identified as a hotel on Gran Sasso mountain in the Abruzzi. The Germans then set up a "republican fascist party" with Mussolini as its titular head. In April 1945, when the war in Europe was nearing an end, he and his party were apprehended by Italian Partisans outside the Italian village of Dongo, near Como, where, after "trial" they were executed on the 28th.

Mussolini's official biography was published in English by Margherita Sarfatti (Butterworth, 1925). *See* S. Jones, *Benito Mussolini* (1927); Prezzolini, *Benito Mussolini* (1924); P. Orano, *Mussolini da Vicino* (1932); G. Salvemini, *Mussolini diplomatico* (1930); G. A. Borgese, *Goliath: The March of Fascism* (1937). *See* also his own account of his life (Eng. trans. *My Autobiography,* 1928). (M. W. S.; X.)

MUSSOORIE or MASURI, a town and sanitarium of India, in the Dehra Dun district of Uttar Pradesh, about 6,600 ft. above the sea. Population (1941) 5,966, rising to 17,000 in the hot season. It stands on a ridge of one of the lower Himalayan ranges, amid beautiful mountain scenery, and is one of the chief summer resorts for European residents in the plains of the Uttar Pradesh.

Mussoorie practically forms one station with Landaur, 7,362 ft. above the sea. Some distance off, on the road to Simla, is the cantonment of Chakrata, 6,890 ft. The climate makes it suitable for numerous schools for Europeans, including St. George's College, the Oak Grove School of the East Indian railway, and several Church of England and Roman Catholic institutions, together with a cathedral of the latter faith. The first brewery in India was established there in 1850. The town has botanical gardens, and is the summer headquarters of the Trigonometrical survey.

MUSSORGSKY, MODEST PETROVICH (1839–1881), Russian composer, was born at Karevo, Pskov government, March 21, 1839. The son of a landowner, he was sent to the army cadet school in St. Petersburg at 13, and at 17 entered the Preobrazhensky regiment. He became seriously interested in music in 1857, when he met Alexander Dargomijsky, César Cui and Mily Balakirev (*qq.v.*). The following year he began to study systematically under Balakirev, who was only three years older. From the age of 19 Mussorgsky suffered intermittently from a nervous disorder, and before entering the civil service in 1863 led the life of a dilettante, playing the piano in society and beginning various compositions, an opera based on Gustave Flaubert's *Salammbô* and others remaining unfinished. What drove him to earn his living was the liberation of the serfs in 1861, with which he was politically in sympathy, but which impoverished him as a member of a landed family. His first mature songs date from 1864. He was artistically influenced by Michael Glinka, who had died in 1857, but whose sister he met in 1866, and Nicolas Rimsky-Korsakov (*q.v.*), whom he had first known in 1861. Although Rimsky-Korsakov was five years younger and at first as amateurish as any of the circle, he acquired a more solid technical equipment than Mussorgsky ever achieved and, far less of a spontaneous and natural genius though he was, gained a kind of artistic ascendancy over him. The two shared lodgings from 1871 until Rimsky-Korsakov's marriage. This association was to bear questionable fruit after Mussorgsky's death, when his friend undertook to edit the finished and unfinished works left by the composer who, though faultily trained, was by far the most important figure among the five who formed the group known as *moguchaya kuchka* (the mighty handful) including these two, Balakirev, Alexander Borodin and Cui.

In 1868 Mussorgsky, who by that time had written more than half of his many songs, began an opera based on Nikolai Gogol's *The Marriage,* but abandoned it in favour of another, *Boris Godunov,* based on Alexander Pushkin's drama and N. M. Karamzin's Russian history. The first version was finished in 1869, but was at least twice revised by the composer, the second time at the behest of the Imperial opera, which refused to produce the work without a love episode, but at last performed it on Feb. 8, 1874. Yet another version appeared after Mussorgsky's death, drastically altered and "corrected" by Rimsky-Korsakov, and this held the stage until the earlier versions were tried during the 20th century and judged superior by many authorities. They certainly far better represent Mussorgsky's art, which includes some characteristic crudities more interesting and attractive than any editorial polish. The next two operas, *Khovanshchina* (1872–80) and *Sorochintsy Fair* (1874–80), both remained unfinished. Drunkenness laid hold of Mussorgsky more and more disastrously and made him incapable of sustained work. He still wrote many remarkable songs, however, including the cycles *Sunless* (1874) and *Songs and Dances of Death* (1875–77), as well as the vivid piano suite *Pictures From an Exhibition* (1874). He died in misery at a military hospital in St. Petersburg, March 28, 1881.

Mussorgsky survives as a great composer on few works. *Boris Godunov* is recognized as an opera nonetheless great for being in some ways defective, and many of the songs, which show his great gift of outlining human character are among the most striking and memorable ever written. Mussorgsky had neither the copiousness nor the assured craftsmanship of Tschaikovsky, but ranks with him as a great composer, representing at its best the national side of music in Russia as Tschaikovsky stands for its cosmopolitan aspect.

See M. D. Calvocoressi, "Mussorgsky," *Master Musicians Series* (New York, London, 1946). (E. W. BM.)

MUSTAFA KEMAL ATATÜRK (1881–1938), Turkish soldier and statesman, was born in Salonika, Gr.; his father, a customs officer who afterward entered the timber trade, died when Mustafa was a small child. At the military preparatory school he proved to be an exceptional student, especially in mathematics. His teacher in mathematics, who was also named Mustafa, gave him the distinctive surname of Kemal (Arabic, perfection), as a tribute to his ability. He did not receive the name Atatürk till Dec. 1934, when family names were introduced into Turkey by law.

In 1904 he was gazetted lieutenant, but arrested on the same day and, after examination, banished to Damascus, Syr. There, after observing the deplorable condition into which the civil and military organization of the empire had fallen, he founded in 1905 the secret political society Vatan (Fatherland). From Damascus he was transferred to Jaffa, whence he made his way secretly to Salonika to organize a similar political movement in the European provinces. The association which he founded at Salonika was afterward affiliated with the Union and Progress society. The Constantinople government again ordered his arrest; but he escaped and the government presently forgot him. In 1907 he was promoted and sent to Salonika, where he resumed his revolutionary activities.

When the revolution of 1908 re-established the constitution of 1876, Mustafa Kemal found himself in serious disagreement with the leaders of the victorious Union and Progress party. In consequence he abandoned politics for the time and turned his whole energy into his military career, in which he advanced rapidly. In 1911 he went to Tripoli incognito to take part in the war against Italy. There he was promoted to major. The first Balkan War was over before he could return; but in July 1913, during the second Balkan War, he was appointed chief of staff to the newly organized army corps on the Gallipoli peninsula, where he made a detailed first-hand study of the problem of defending the Dardanelles. After the restoration of peace he was appointed military attaché at Sofia with the rank of colonel and held this post until the autumn of 1914.

Mustafa Kemal believed that Turkey had entered the war prematurely and that Germany was doomed to eventual defeat. Possibly for this reason his desire to return to active service was not encouraged; but on his insistence he was appointed commander of the forces at Rodosto, Turk., and afterward (in 1915) at the Dardanelles. He inspired the defense of the straits against the British attack—this, when the Turkish high command had lost hope. Mustafa Kemal was then sent to the Caucasus, where he was promoted to the rank of pasha and recovered Bitlis and Mush from the Russians. In 1917 he was posted to the Hejaz.

At this time Germany's intervention in the internal affairs of Turkey had reached its height, and Mustafa Kemal Pasha put himself at the head of the opposition to it. He sent in a succession of reports adverse to the Baghdad expedition, which he thought would end in another disaster, and when his advice was ignored he resigned. In 1918 he yielded to the insistence of Sultan Mehmed and accepted command of the 7th army corps in Palestine but all chance of taking the offensive, or even averting disaster, had then disappeared.

When the Turkish government negotiated the armistice of Mudros (Oct. 30, 1918), Mustafa Kemal was opposed to the policy of complete surrender and, after the signature of the armistice, retired to Constantinople. The Greek landing at Smyrna on May 16, 1919, which re-awakened the Turkish nation, and his appointment by the Ottoman government in Constantinople as inspector of the 9th army corps in northeastern Anatolia gave him his chance. Mustafa Kemal meant to create a nucleus of national resistance against the partition of the country and therefore accepted with alacrity the position offered him

by the unsuspecting government. As soon as he landed at Samsun he began to organize his new movement locally at Amasia, Tokat and Sivas and to correspond secretly with other parts of the country. The sultan's government, too late, recalled him to Constantinople, but he went on instead to Erzerum and sent in his resignation. He next convened two congresses, one at Erzerum in July, the other at Sivas in Sept. 1919. Both congresses endorsed his program of fighting for national existence to the bitter end, and relations between the capital and the interior of Anatolia were broken. All the efforts of the Constantinople government and the Allied powers to frustrate Mustafa Kemal's activities simply strengthened his conviction. On April 23, 1920, he gathered at Angora the nationalist members of the late parliament who had escaped from Constantinople and was unanimously elected president of this new national assembly.

During the two and one-half years which followed Mustafa Kemal's military ability, intellect and oratory carried his countrymen through their ordeal. During the summer campaign of 1921, which was the supreme crisis of the Graeco-Turkish War, the Angora assembly appointed him generalissimo of the Turkish forces, with unlimited power; and he took personal charge at the front during the 22 days' and nights' fighting of the battle of the Sakaria, which brought him the rank of field marshal and the traditional title of Ghazi (the victorious). The destruction of the Greek army, the peace settlement at Lausanne, Switz., the abolition of the sultanate, the declaration of the republic and the abolition of the caliphate were the direct work of Mustafa Kemal. On Oct. 29, 1923, when the republic was proclaimed, the national assembly unanimously elected him president, an office to which he was re-elected on Nov. 1, 1927, on May 4, 1931 and finally on March 2, 1935. He died on Nov. 10, 1938, and was succeeded as president by Ismet Inönü (*q.v.*).

Atatürk was the builder of a modern Turkish nation, the reformer of all Turkish life. Under his strong guidance the legacy of the mediaeval and oriental Ottoman empire was discarded and the country turned into a modern progressive secularized republic which could keep abreast of all human progress and take a constructive place at the side of other nations. Though Atatürk, in view of the general backwardness of the country, could accomplish his aim only by dictatorial methods, he remained faithful to the progressive and liberal ideas of his youth. He emancipated the Turkish women, established complete equality of all citizens, introduced universal education and became an educator to democratic forms of life. The democratic constitution of the republic was jealously guarded; Atatürk regarded his dictatorship as a temporary institution for strengthening the foundations of liberal democracy in a population not prepared for it.

In foreign affairs Atatürk resolutely abandoned all dreams of expansion or of military glory, so dear to other nationalist dictatorships. He taught the Turks the virtue of moderation in their aspirations and even succeeded in making a lasting peace with the Greeks, with whom the Turks had fought bitterly for many centuries and whom he had defeated shortly before. The firm friendship with Greece allowed Turkey to become the leader in an effort to secure a lasting peace by collective agreements with its neighbours: the Balkan pact which united Turkey with Greece, Yugoslavia and Rumania; and the Near Eastern pact which united it with Iran, Afghanistan and Iraq. Atatürk also maintained close and friendly relations with the U.S.S.R., which had helped Turkey throw off the conditions of the peace of Sèvres. He also led Turkey to join the League of Nations and to make peace with the former enemy nations, Great Britain and France.

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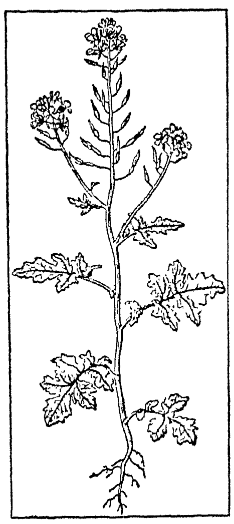
(A. J. T.; H. Ko.; X.)

MUSTANG, the wild or semiwild horse of the prairies of North America, the descendant of the horses imported by the Spaniards after the conquest in the 16th century (*see* Horse).

MUSTARD. The varieties of mustard seed of commerce are produced from several species of the genus *Brassica* (family Cruciferae). Of these the principal are the black mustard, *Brassica nigra* (*Sinapis nigra*), the white mustard, *Brassica alba*, and the Sarepta mustard, *B. juncea*. Both the white and black mustards are cultivated to some extent in various parts of England, Europe and North America. The white is grown as a salad plant and has come into increasing favour in England as a forage crop or as a green manure. The black mustard is grown solely for its seeds, which yield the condiment. When white mustard is cultivated in England for its herbage it is sown usually in July or August, after some early crop has been removed. In about six weeks it is ready either for feeding off by sheep or for plowing down as a preparative for wheat or barley.

Brassica nigra occurs as a weed in waste and cultivated ground throughout England and the south of Scotland, and widely in the United States and Canada. It is a large branching annual 2 to 3 ft. high with stiff, rather rough, stem and branches, dark green leaves ranging from lyrate below to lanceolate above, short racemes of small bright yellow flowers one-third of an inch in diameter and narrow smooth pods. *B. alba* is more restricted to cultivated ground in Great Britain and has only sparingly escaped from cultivation in the United States; it is distinguished from black mustard by its smaller size, larger flowers and seeds, and spreading rough hairy pods with a long curved beak.



BY COURTESY OF THE NATURAL HISTORY MUSEUM

WHITE MUSTARD (SINAPIS ALBA), SHOWING FLOWERS AND FRUITS (SILIQUAE)

The pungency and odour to which mustard owes much of its value are due to an essential oil developed by the action of myrosin, an enzyme, upon the glucoside (*see* Glucosides, Natural) sinigrin, $C_{10}H_{18}KNS_2O_{10}$. In presence of water myrosin acts on sinigrin, splitting it up into the essential oil of mustard, a potassium salt and glucose. The enzyme is destroyed by boiling water, and therefore it is not proper to use very hot water (above 120° F.) in the preparation of mustard. Essential oil of mustard is an isothiocyanate of allyl, C_3H_5NCS. The seed of white mustard contains in place of sinigrin a peculiar glucoside called sinalbin, $C_{30}H_{44}N_2S_2O_{16}$, in several aspects analogous to sinigrin. In presence of water myrosin splits sinalbin up into acrinyl isothiocyanate, sulphate of sinapin and glucose. The first of these is a powerful rubefacient, whence white mustard, although yielding no volatile oil, forms a valuable material for plasters.

Both as a table condiment and as a medicinal substance, mustard has been known from a very remote period. Under the name of νᾶπυ it was used by Hippocrates in medicine. The dry form in which table mustard is sold in the United Kingdom dates from 1720, about which time Mrs. Clements of Durham hit on the idea of grinding the seed in a mill and sifting the flour. In the United States a thin paste of mustard prepared with vinegar and spices is commonly sold in glass for table use.

The volatile oil distilled from black mustard seeds after maceration with water is official in the *British Pharmacopoeia* under the title *Oleum sinapis volatile*. In the United States *Pharmacopoeia* it is called *Sinapis nigra*. It is a yellowish or colourless pungent liquid, soluble only in about 50 parts of water, but readily so in ether and in alcohol. From it is prepared, with camphor, castor oil and alcohol, the *linimentum sinapis*. The mustard plaster or *Emplastrum sinapis* of the U.S. contains mustard mixed with flour from one to four parts. Used internally as a condiment, mustard stimulates the salivary but not the gastric secretions. It increases the peristaltic movements of the stomach. One drachm to half an ounce of mustard in a tumblerful of warm water is an efficient emetic, acting directly on the gastric sensory nerves. It should be used only for emergency treatment of poisoning.

Brassica juncea, leaf mustard, is grown extensively in the orient and to an increasing extent in the United States as a salad plant or potherb. There are numerous forms and horticultural varieties that produce large, rather upright rosettes of attractive leaves, varying from broad and flat through spatulate to very much curled. These forms shoot to seed much later than common white or black mustard and produce a much greater yield of leaves. The species is adapted to cool seasons, and grows well in any good garden soil. It is usually sown thinly in rows 1½ to 2 ft. apart and the plants thinned to stand 2 to 3 in. apart in the row. (V. R. B.)

MUSTARD GAS, the name given to β, β'-dichlorodiethyl sulphide, one of the most effective toxic agents used during World War I. This substance is not easily destroyed by weathering; at ordinary temperatures, it is a liquid which evaporates only slowly. It therefore tends to persist for days or weeks in any area where it has been released. This property largely governs its tactical use. Inhalation of a sufficient quantity of mustard-gas vapour causes pulmonary inflammation. When the vapour or (more particularly) droplets of the liquid come in contact with the skin, severe blisters

and burns are produced (vesicant effect). Of these two modes of action, the second is by far the more important for military purposes. In World War I mustard gas caused many temporary casualties but few permanent injuries and still fewer deaths. (*See* CHEMICAL WARFARE.)

MUSTARD OILS, a general term applied to the esters (*q.v.*) of isothiocyanic acid. The name arises from the fact that allyl isothiocyanate occurs in, and forms the principal component of, the oil obtained by distilling black mustard seeds (*Sinapis nigra*). These seeds contain a glucoside (*q.v.*) termed potassium myronate which undergoes a fermentative change due to an enzyme (*q.v.*) myrosin also present in the seeds. *Allyl mustard oil* (allyl isothiocyanate), $C_3H_5{\cdot}N{:}C{:}S$, is a colourless liquid sparingly soluble in water and boiling at 151° C.; it has a sharp pungent odour and produces blisters on the skin, whence the efficacy of the mustard poultice as a counterirritant. It can be prepared synthetically by heating allyl bromide, $CH_2{:}CH.CH_2Br$, with potassium thiocyanate. The odour and taste of mustard (*q.v.*) are due to this substance.

The analogues of allyl isothiocyanate are readily prepared by the action of carbon bisulphide on primary amines, when alkyl dithiocarbamates are formed which on distillation with mercuric chloride yield the corresponding mustard oils. These compounds are colourless liquids with pungent irritating odours. This general reaction proceeds so smoothly that it is employed as a distinctive test for primary amines. (*See* AMINES.) Methyl and ethyl mustard oils are thus obtained from methylamine and ethylamine, respectively; the former, a solid, melts at 35° C. and boils at 119°C.; the latter is liquid and boils at 134° C. Phenyl mustard oil from aniline is a colourless liquid boiling at 222° C.

MUSURUS, MARCUS (*c.* 1470–1517), Greek scholar, was born at Rhithymna (*Retimo*) in Crete, and was a pupil of John Lascaris at Venice. He was professor of Greek at Padua and Venice, and died in 1517. Since 1493 Musurus had been associated with Aldus Manutius, and belonged to the "Neacademia," a society founded by Manutius and other learned men for the promotion of Greek studies. Many of the Aldine classics were brought out under Musurus's supervision, and he is credited with the first editions of the scholia of Aristophanes (1498), Athenaeus (1514), Hesychius (1514), Pausanias (1516).

See R. Menge, *De M. Musuri vita studiis ingenio,* in vol. 5 of M. Schmidt's edition of Hesychius (1868).

MUTATION: *see* VARIATION: *Experimental;* HEREDITY; EVOLUTION, ORGANIC.

MUTIAN, KONRAD (1471–1526), German humanist, was born in Homberg on Oct. 15, 1471 of well-to-do parents named Mut, and was subsequently known as Konrad Mutianus Rufus, from his red hair. At Deventer under Alexander Hegius he had Erasmus as schoolfellow; he took the master's degree at Erfurt in 1492. From 1495 he travelled in Italy, taking the doctor's degree in canon law at Bologna. Returning in 1502, the landgraf of Hesse promoted him to high office. The post was not congenial; he resigned it (1503) for a small salary as canonicus in Gotha. The circle which gathered round Mutian at Erfurt, known as the *Mutianischer Bund,* included Eoban Hess, Crotus Rubeanus, Justus Jonas and other leaders of independent thought. He wrote little himself, but inspired others. He desired the reform of the Church, but not schism. Like Erasmus, he was with Luther in his early stage, but deserted him in his later development. Though he had personally no hand in it, the *Epistolae obscurorum virorum* (due especially to Crotus Rubeanus) was the work of the Reuchlinists in his *Bund.* He died at Gotha on March 30, 1526.

See F. W. Kampschulte, *Die Universität Erfurt* (1858–1860); C. Krause, *Eobanus Hessus* (1879), and *Der Briefwechsel des Mutianus Rufus* (1885).

MUTILATIONS AND DEFORMATIONS. In every part of the world to-day, both in civilised as well as uncivilised communities some form of mutilation of the human body is found; but the widest variety of mutilations as well as the most severe occur among the more primitive peoples.

Early historians and writers, long before the Christian era, show that in those days such mutilations as tattooing and circumcision, as well as skull deformation, were well known. Some form of mutilation was probably practised from earliest prehistoric times. On the cave walls of France and Spain, where Aurignacian and Magdalenian man painted the mammoth, elephant and woolly rhinoceros during the closing phases of the last Ice Age (*see* ARCHAEOLOGY: *Stone Age*), are painted hands which indicate the removal of one or more finger joints, a practice common today in South Africa, India and elsewhere. The reason for this mutilation on the part of prehistoric man can only be conjectured by analogy with these modern primitive peoples. In the Wellcome Historical Medical Museum in London, there is exhibited a skeleton of an early man from a prehistoric grave at Gebel Moya in the Sudan. Found close to the jaw is a stone stud exactly similar to the lip studs worn by Nilotic peoples today. Other evidence may be found in folk tales; early paintings and carvings, and by a careful interpretation of objects found in the graves. The motives behind mutilation may be classified as: Tribal Convention; Adornment; Initiation Ceremonial; Religion; Punishment and Health.

Skin.—Tattooing consists of puncturing the skin in the pattern desired and rubbing in colouring material so that the pattern is indelibly fixed. In New Zealand the Maoris brought tattooing to a very high art, and the intricate patterns with which they adorned their faces were executed with exquisite workmanship and taste. In China, Borneo, India and other parts of the Far East tattooing is prevalent, and thence has been introduced into Europe, chiefly by sailors. Arms, legs, body and face are all considered suitable surfaces for decoration. To-day tattooing saloons exist in London and in many of the bigger sea-ports. True tattooing, but of a less lasting nature, is occasionally found in parts of Africa, and must not be confused with scarification.

Scarification.—This consists of cutting deep marks into the skin and rubbing in charcoal and other irritant material to keep open the wound which eventually is allowed to heal but which leaves a deep scar. Sometimes the wound is so treated that a shiny "keloid" instead of a flat scar results. Scarification occurs all over Africa for reasons as numerous as they are different. Very frequently small scars are made on the face which serve as tribal and clan marks. Often elaborate patterns are worked out on the chest for purely personal adornment; these are especially good on the West Coast. Sometimes the object of the operation is semi-magical, women of many African tribes being scarified on the abdomen during pregnancy. At other times, scarification is merely the result of surgical treatment and is the consequence of rather crude cupping methods followed by the application of an irritant powder. In Australia the aborigines scarify their arms and chests, which often show great black keloids representing many years of patient work, the wound being opened up from time to time and fresh irritants applied.

Hair.—Depilation by some means or other, has been practised by primitive peoples for hundreds of years, while all modern civilised peoples still continue to remove unwanted hair by various methods. One of the widely accepted modern methods employs electrolysis as a means for removal of adventitious growth of hair. One of the commonest primitive methods of hair removal is by plucking out each individual hair by its root, every time it grows. By starting at an early age the time comes when the hair on the parts so treated could be grown only sparsely even if desired. Depilation by plucking is common all over Africa and in many parts of the east and Oceania. The areas so treated are more especially the face and pubic regions, and chest and under the arms. Some individuals even go to the length of removing all body hair.

Shaving of the face, as well as of the scalp, is a common practice among primitive people, and may be carried out with such instruments as a piece of broken glass, or a special iron blade. It is usually done dry, without the use of water or lather. Depilation by singeing, as well as by the use of ointments occasionally occurs. Removal of the hair is usually due to tribal custom, as hairy people are despised and often unable to find a mate.

Head.—There are few if any parts of the world where some portions of the head and face entirely escape mutilation, but the

most commonly maltreated are the ears, nose, lips and teeth. Skull deformation may be the result of deliberate intention, or of chance. In some tribes, especially in America every individual was intentionally treated as a child with the direct view of reducing the skull to a certain shape. In other cases, as in parts of Africa, deformation is the unintentional result of the local methods of carrying water pots or loads on the head. Young children, especially girls, start such work long before the skull is properly developed and the result is a definite and fairly uniform deformation. Skull deformation occurs in nearly every part of the world, though commonest in the Americas and least common, if at all existent, in Australia. Intentional deformation is carried out from various motives, sometimes a long pointed head, sometimes a flat depressed head being the shape required. Various methods are employed, commonest of which are by bandaging, and by tying the child's head to a flat board fixed to the occipital region.

Ears.—These are pierced to carry earrings all the world over, indeed very few, primitive or civilised peoples, leave the ears totally unmutilated, though the Andamanese, Bushmen and true Baganda are reported as doing so. Both the ear lobes, as well as the cartilage round the top of the ear, are commonly pierced. This is usually done during childhood and a small piece of wood is inserted into the wound which is then left to heal. Later this plug is removed and a larger one inserted, the process being continued until the required size of hole is obtained by reason of this continual stretching. In many countries both sexes treat their ears in this way, while in others it is confined to one or other sex. The greatest distensions are to be found in Borneo and East Africa. In both these places lobes are often seen so stretched that they hang down to the shoulder, with holes so large that it would be possible to pass a closed fist through them. In all these ear mutilations adornment is the end in view. Large carved wooden plugs, carved stone ornaments, metal rings and fibre and paper rolls, all are used as earrings, while to-day even earthenware jam pots and circular cigarette tins are popular in some parts of Africa.

In some tribes such as the Kikuyu, a husband if displeased with his wife breaks the lobe of her ear with his hands.

Nose.—The nose is often mutilated for purposes of personal adornment especially in India, and the East, as well as in New Guinea and Polynesia, S. America, Australia and in parts of Africa. Nose ornaments also signify social rank. Sometimes it is the alae, and sometimes the septum which is perforated. Often only a small hole is made through the septum from which a gold ring or other jewel is suspended; at other times the hole in the septum is big enough for a finger to be passed through. Elsewhere one, and occasionally both, nostrils are pierced and distended to carry coloured studs, sometimes of unbelievable size, as among the Makonde of Portuguese East Africa. Nose ornaments are more common with women than men, but in New Guinea and especially among the Tugeri and the Solomon Islanders, the men wear great pointed sticks, or sometimes the tusks of wild pig through holes in the nose.

Lips.—In several parts of Africa, especially in the Congo, the south east Tanganyika Territory, and the upper reaches of the Nile, and among the Botocudo of S. America enormous plates and plugs are inserted in hugely distended holes, cut in the upper and lower lips. The lip studs and pins of the Nilotic peoples of Uganda, Kenya Colony and the Sudan are usually small and made of ivory, rock crystal or stone, and are inserted through the upper and lower lips or both. Other lip mutilations include pricking and rubbing with irritant to cause them to swell. This is done in parts of West Africa.

Teeth.—Over the greater part of Africa, as well as in Australia, New Guinea and elsewhere, it is a common practice to remove one or more front teeth in the upper or lower or both jaws. Sometimes the ceremonial knocking out of the teeth accompanies initiation and is a test of ability to bear excruciating pain unflinching; sometimes it is simply a matter of custom; sometimes it serves as a tribal mark, while yet another reason given is the fear of lock-jaw. The removal of the teeth is in this case a precaution which would enable the patient to be fed if the disease were contracted.

Another common practice in Africa, found also in Southern India, is the filing or chipping of teeth to serve either as a tribal mark or as an initiation step, or for both purposes. The Akamba and certain Congo peoples file their incisors to sharp points, and for some unknown reason this was considered by early travellers as a sign of cannibalism—a most erroneous view. The Eskimo file the teeth to make them shorter and less like those of dogs and in south and central Africa the incisors are filed to all sorts of shapes and patterns as described by Dr. G. Turner in the *Transvaal Medical Journal* for 1911

The Dyaks of Borneo and other people in the East, occasionally drilled holes in the teeth, into which plugs of gold were driven to serve as ornament. This method of adornment was also used in ancient Mexico, precious stones being inlaid in the teeth.

Tongue, Cheeks and Neck.—Among the Bateso of East Africa a hole is sometimes bored through the tongue and a brass ring bearing one or two beads is inserted. The cutting out of the tongue was once a legal penalty in Europe, and has only recently been forbidden in some parts of Africa.

The Aleutian Islanders bored a hole through each cheek through which seal's whiskers were stuck. Feathers are put through holes in the cheek in parts of S. America.

The *Padang* of the South Shan States deform the necks of their womenfolk by making them wear—from early childhood onwards—high metal collars whose length is gradually increased; this eventually produces such elongation and dislocation of the neck that if the collars were removed the wearers would not be able to hold up their heads.

Eyes and Body.—Putting out eyes as a punishment for various crimes has existed at different times all over the world—Europe included. Priests and worshippers of certain eastern cults still gash and cut themselves with knives as did the priests of Baal in olden times. In parts of Africa it was once a practice to cut off the breasts of an unfaithful wife.

Limbs.—In former times both in England, and Europe generally, amputation of one or more limbs was a common punishment for crime (*see* Pike's *History of Crime in England,* 1893), and this method has only been suppressed in parts of Africa, as in the Congo and Uganda, by the European governments.

For purposes other than punishment and medical necessity, amputation consists chiefly of cutting off the finger joints, especially the little finger. In South Africa this is either done as mourning, or as a magical preventative measure in the case of a child born to a mother whose last baby was still-born. In Southern India grandmothers used (in some castes) to have to cut off one joint for each grandson born to them. In the Tonga Islands the practice is also considered as of magical importance against disease. There is too the bandaging of girl children's feet to prevent their development. This Chinese practice is now prohibited.

MUTINY: *see* MILITARY LAW and COURT-MARTIAL.

MUTIS, JOSÉ CELESTINO (1732–1808), Spanish naturalist, was born at Cadiz on April 6, 1732. He received his bachelor's degree at the University of Seville and afterwards studied medicine at Madrid where in the general hospital he became for a time a lecturer in anatomy. His preference, however, was for the study of mathematics and natural science, especially botany. He became one of the first disciples of the Swedish botanist, Linnaeus (*q.v.*), in Spain. Attracted by the wide and fruitful fields of study which South America then afforded he sailed in 1760 for New Granada (Colombia), accompanying the Spanish viceroy as physician. In New Granada he occupied himself collecting and describing plants both from the lowlands and from the higher Andean regions, but he did not neglect medicine as is shown by his appointment as king's physician in the viceroyship. He spent much time on sanitary problems such as the establishment of proper cemeteries, the prevention of small-pox and the reduction of malaria. He put into general use many American herbs, the properties of which he had studied, among them ipecacuanda, guaco and Peruvian balsam. Some of these, such as the cinnamon laurel of the Andes, he made known in Europe. His

favourite study, however, was quinine, which he studied from every angle from the distribution of the different species of cinchona down to experiments in the curative properties of the drug. His *El Arcano de la quina* was published in 1793. Later studies were published in the *Papel periodico* and after his death by his nephew Sinforoso Mutis, who completed and arranged his notes on the subject (1828). His work probably had much to do with making possible the colonization of malaria-infested regions. It attracted the attention of the king, who created the Royal Botanical expedition of New Granada and placed Mutis at its head. With 18 of his best students, Mutis carried out a systematic survey in which material was collected for the monumental *Flora de Bogotá ó de Nueva Granada* which he planned in 13 folio volumes.

Because of his immense activity in other lines only the first volumes of this intended work were arranged at his death. For the remaining volumes he left manuscripts, notes, illustrations and sketches in such profusion that only some one knowing his schemes of arrangement could have finished the work. Among these botanical riches were 6,480 illustrations, admirable in precision and colour, which were intended for an atlas volume. This material, amounting to more than 4,000 folios of loose manuscripts, and his collection of more than 20,000 plants were sent after his death to the botanical garden at Madrid, where they are preserved.

For 18 years Mutis carried on a correspondence with Linnaeus, much of which was published in *A Selection of the Correspondence of Linnaeus* (1821). He furnished many specimens of plants which the Swedish naturalist described. Linnaeus named in his honor the beautiful genus *Mutisia*, of the family Compositae, comprising about 50 species of plants found in South America.

He died at Bogotá on Sept. 11, 1808.

MUTRACHA: *see* CASTE (INDIAN).

MUTSU HITO: *see* MEIJI TENNO.

MUTTON. Mutton is the flesh of mature sheep; that of the younger animals is called lamb. Because sheep are widely available except in the moist tropics, are easily butchered and cooked and are small enough to permit prompt consumption when refrigeration is not available, meat from sheep in moderate amounts is consumed widely by human beings. Moreover, religious objections to the eating of sheep's meat are not nearly so widespread as are those relating to some other domestic livestock. The great demand for lambs occurs at the Easter season, when lamb is sought not only by Christians, including the Greek Orthodox, but also by Orthodox Jews for the Feast of the Passover. Some producers specialize in hothouse or Easter lambs which are ready for the market out of the normal season.

The preferred cuts, including ribs, loins and legs, are excellent but comparatively expensive meat items. The less desirable cuts, particularly from the older animals, provide one of the most economical sources of high-grade protein. On the basis of 100 g., raw edible portion, leg roast of lamb compares very favourably in food energy, phosphorus and vitamins with beef (round steak). (*See* table.) Nevertheless, in some parts of the world, particularly the

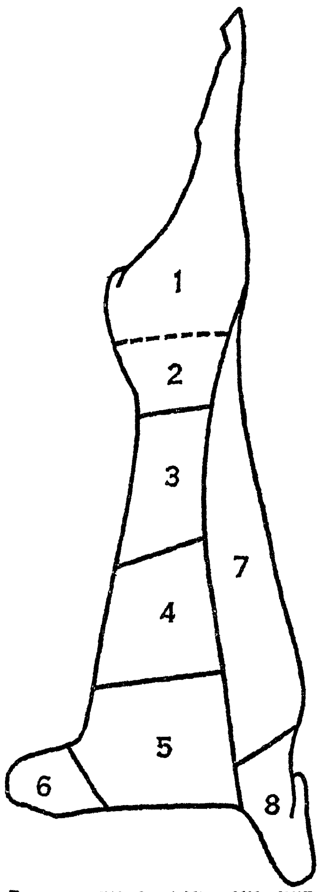
Leg Roast of Lamb and Beef (*Round Steak*)
(100 g.; raw edible portion)

Properties	Lamb	Beef	Properties	Lamb	Beef
Water	63.7%	69.0%	Phosphorus	213.0 mg.	180.0 mg.
Food Energy	235 cal.	182 cal.	Iron	2.7 mg.	2.9 mg.
Protein	18.0 g.	19.5 g.	Thiamine	.16 mg.	.08 mg.
Fat	17.5 g.	11.0 g.	Riboflavin	.22 mg.	.17 mg.
Calcium	10.0 mg.	11.0 mg.	Niacin	5.2 mg.	4.7 mg.

United States, consumption of lamb and mutton has declined, largely because of decreasing availability. In the U.S. it dropped from a 6.7-lb. average per person per year before World War II to about 4 lb. in the postwar period.

Production.—Most sheep are slaughtered for consumption directly from pasture or the range. This applies to those entering overseas commercial channels, as from New Zealand and Argentina, as well as to those consumed locally. However, several million head (chiefly lambs) are "fattened" each year, particularly in the U.S. and the United Kingdom. A variety of feedstuffs—hay, grain, sugar beet pulp, silage, etc.—is utilized to produce additional weight and to improve condition. This conditioning may be done in or near the pasture area or, after transport, in an area of surplus feedstuffs nearer the ultimate consumption market.

Slaughter to serve the major urban and export markets occurs largely in the best-equipped, most modern packing houses. The animals are "round dressed"; *i.e.*, the pelt, head and viscera are removed. The hind shanks are disjointed at the hoof head and the front shanks at the bottom of the cannon bone. Studies involving about 15 breeds and crossbreeds of sheep indicate that dressing percentage varies widely from breed to breed. Carcass weight in relation to live weight will approximate 50% for the better mutton breeds but considerably less for those of Merino derivation, developed especially for their wool.



RETAIL CUTS OF LAMB AND MUTTON (*see* TEXT OF ARTICLE FOR EXPLANATION)

Though mutton and lamb in 1952 were estimated to account for only 8% of the 77,200,000,000 lb. of total meat output in principal countries exclusive of the far east, it may be estimated that for the world as a whole approximately 400,000,000 head or more of sheep and lambs are consumed yearly, or roughly 10,000,000 tons of meat. They are the main meat of many nomadic tribes of the steppe and desert edge, a fact which contributes to the difficulty of obtaining an estimate.

Trade.—Though all sheep are potentially producers of a joint crop of wool and meat, New Zealand, Argentina, the United Kingdom and western continental Europe, the United States to a considerable extent and even some parts of Australia of late years have emphasized meat production.

International trade in mutton and lamb, mostly in chilled or frozen form, prior to World War II averaged about 350,000 metric tons per year. In the postwar period the average rose to about 440,000 tons. Exports from particular countries vary widely from year to year but come largely from the following countries in approximate amounts: New Zealand (260,000 tons); Argentina (100,000 tons); Australia (60,000 tons); Uruguay (less than 10,000 tons). The major importer has been the United Kingdom, receiving about 400,000 tons per year, much of it from New Zealand under a long-term purchasing agreement.

Classes and Grades of Carcasses.—Age of the animal is a primary determinant of class. "Milk lambs" may be marketed at three to five months of age, prior to or at weaning time, for special luxury or religious festival trade. The usual "lamb" is 6 to 12 months old and may be marketed directly from pasture or after special fattening. The "yearling" is 12 to 20 months old, the "mature mutton" older. There is no sex differentiation except as to the older animals, which are predominantly ewes (discarded breeding females), bucks (uncastrated mature males) and, more rarely, wethers (males castrated when young but retained probably for wool production).

Conformation, finish and quality also enter into government and packer grades. Conformation relates to "meatiness," a high proportion of meat in relation to bone, but especially a high percentage of weight in the higher-priced cuts; *i.e.*, ribs, loins and legs. Conformation is much affected by improved breeding. Finish, some-

what related to the breed of sheep, is also dependent on the quality of pasturage or feeding. For good flavour and tenderness there should be a covering of at least ¼ in. of fat and good marbling (fat in the connective tissue). Quality relates to texture, the colour of the lean and the fat and the colour and porosity of the bone in relation to the age of the animal. Government grades are prime, choice, good, commercial, utility and cull. Only a small percentage of mature mutton carcasses grade as high as "good."

Cuts and Cookery.—Lamb and mutton give the skilled cook wide latitude for his art, ranging from the simplest broiling to the use of complicated sauces and herbs. The leg (*see* diagram, sections 1 and 2) is used as a roast or for steaks, retaining the tibia bone if a long French leg is desired. The sirloin (2) from a heavy leg may be used separately for roasting or chops. The loin (3) and the ribs (4) are prime chops. The English chop is a double loin chop, with which the kidney may be retained. Rib chops become French chops by clearing the bone end for an inch or more and covering it with a "chop holder." The shoulder (5) provides chuck rib or shoulder chops or may be roasted. The neck (6) and the shank (8) are braised or stewed, and the breast (7) is normally stewed.

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MUTTONBIRD: *see* Shearwater.

MUTTRA (officially, and anciently, Mathura), a city and district in the Agra division of Uttar Pradesh, India. The city is on the right bank of the Jumna, 30 mi. above Agra; pop. (1951) 105,773 (municipality 98,552, cantonment 7,221). In the 6th century B.C. it was the capital of the Saurasenas. Fa Hien (*c.* A.D. 400) refers to it as a centre of Buddhism; but his successor Hsuan Tsang (*c.* 650) is forced to record a Brahmanical revival. It was sacked by Mahmud of Ghazni in 1017–18; about 1500 Sultan Sikandar Lodi destroyed all the Hindu shrines, temples and images; and in 1636 Shah Jahan appointed a governor expressly to "stamp out idolatry." In 1669–70 Aurangzeb visited the city and continued the work of destruction. Muttra was again captured and plundered by Ahmad Shah with 25,000 Afghan cavalry in 1757. The town is still a great centre of Hindu devotion, and temples and bathing stairs line the river bank. The majority are modern, but the mosque of Aurangzeb, on a lofty site, dates from 1669. Most of the public buildings are of white stone, handsomely carved. The city is the seat of two colleges of Agra university and of the Curzon museum of antiquities. Cotton, paper and pilgrims' charms are the chief manufactures.

Muttra District (area 1,467 sq.mi.; pop., 1951, 912,264) consists of an irregular strip of territory on both sides of the Jumna. The eastern half consists of a rich upland plain, abundantly irrigated by wells, rivers and canals, while the western part, though rich in mythological association and antiquarian remains, is comparatively unfavoured by nature. The principal crops are millet, pulse, cotton, wheat, barley and sugar cane. The eastern half is watered by the navigable Agra canal and the western half by branches of the Ganges canal. The central part of Muttra district is one of the most sacred spots in Hindu mythology. The district within a circuit measuring about 170 mi. around Gokul and Brindaban was called Braj-Mandal and had many associations of earliest Aryan times. There Krishna and his brother Balarama fed their cattle; and numerous relics of antiquity in the towns of Muttra, Gobardhan, Gokul, Mahaban and Brindaban attest the sanctity of this holy tract. After the invasion of Mahmud of Ghazni the city fell into insignificance till the reign of Akbar; thenceforward its history merges in that of the Jats of Bharatpur, until it again acquired separate identity under Suraj Mal in the mid-18th century. The whole of Muttra passed under British rule in 1804.

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MUTULE, in architecture, a rectangular block, beneath the soffit or underside of the projecting portion of the cornice of the Doric order. (*See* Order.) It is usually decorated on the underside with guttae (*q.v.*) or little cylindrical projecting blocks. In Greek work its lower side is inclined, following approximately the roof slope; in Roman and Renaissance work it is generally level and is crowned with a cap moulding. In origin it is probably a stone representation of an original projecting wooden rafter end.

MUYBRIDGE, EADWEARD (Edward James Muggeridge) (1830–1904), British photographer and pioneer in motion photography, was born at Kingston-on-Thames April 9, 1830. He emigrated to the U.S. in 1852 and was engaged in business until 1860, when he joined the U.S. coast and geodetic survey as a photographer. In 1872 he made a series of photographs which proved that at one point in its stride a galloping horse has all four feet off the ground. His major work, published in 1887, was *Animal Locomotion: An Electro-photographic Investigation of Consecutive Phases of Animal Movements, 1872–1885,* 11 vol., containing 781 photoengravings.

Muybridge also developed the zoopraxiscope, a forerunner of the modern motion-picture projector. Photographs were mounted on a disk which when rapidly rotated recaptured the original motion of the subjects and cast the enlarged images upon a screen.

Muybridge returned to Kingston-on-Thames in 1900 and died there May 8, 1904.

MUZAFFAR-ED-DIN, shah of Persia (1853–1907), the second son of Shah Nasr-ed-Din, was born on March 25, 1853. He was in due course declared *vali ahd,* or heir apparent, and invested with the governorship of Azerbaijan, but on the assassination of his father in 1896 it was feared that his elder brother Zill-es-Sultan, the governor of Isfahan, might prove a dangerous rival, especially when it was remembered that Muzaffar-ed-Din had been recalled to Tehran by his father upon his failure to suppress a Kurd uprising in his province. Muzaffar-ed-Din was duly enthroned, with the support of the British and Russian governments, on June 8, 1896, the Russian general Kosakowsky, commander of the Persian Cossacks, presiding with drawn sword.

In the summer of 1906 popular discontent culminated in extraordinary demonstrations at Tehran, which practically amounted to a general strike. The shah proclaimed a liberal constitution, the first parliament being opened by him on Oct. 12, 1906. Muzaffar-ed-Din died on Jan. 8, 1907, being succeeded by his son Mohammed Ali Mirza.

MUZAFFARGARH, a municipality, *tehsil* (subdivision) and district of the Multan division of Punjab province, Pakistan. The town (pop., 1951, 11,271) is near the right bank of the Chenab, 20 mi. S.W. of Multan. Its fort and mosque were built by Nawab Muzaffar Khan in 1794–96.

Muzaffargarh Tehsil had a population in 1951 of 234,856.

Muzaffargarh District (area 5,605 sq.mi.; pop., 1951, 751,249) occupies the dagger-shaped southern end of the Sind-Sagar *doab* between the Indus and Chenab rivers. The northern half of the district is an arid plateau, the *thal,* in the cold months the grazing ground of the camel herds belonging to Afghan *povindah* merchants. Elsewhere in the district wheat, pulse, rice and indigo are cultivated. Irrigation is effected from the two rivers.

MUZAFFARPUR, a town and district in the Tirhut division of Bihar, India. The town, which is the divisional headquarters, is on the right bank of the Little Gandak river, about 36 mi. N.N.E. of Patna. Pop. (1941) 54,009. The town is well laid out along two lakes and is an important trade centre, being on the Patna-Nepal route. Four colleges in the town are connected with Patna and Bihar universities. Muzaffarpur is the headquarters of the Behar Light Horse.

Muzaffarpur District (area 3,025 sq.mi.; pop., 1951, 3,520,739) is a plain watered by the Great Gandak, Baghmati and Little Gandak rivers and their tributaries; it is dotted with mango groves and clumps of bamboo. It is closely cultivated, rice being the main crop. The indigo industry, almost extinguished by the coming of the synthetic dye, was largely replaced by sugar.

Excavations revealed the remains of buildings of *c.* A.D. 300; hundreds of seals of the 4th or 5th century A.D. also have been found. At Kolhua, 3 mi. N.W. of Muzaffarpur, is a pillar crowned by a lion, set up by the emperor Asoka to mark a stage of his journey to Nepal in 249 B.C.

MUZIANO, GIROLAMO (1528–1592), Italian painter, was born at Acquafredda, near Brescia, in 1528. He died in Rome, and was buried in the church of Santa Maria Maggiore. He came to Rome about 1550, where his pictures gained him the name of *Il Giovane de' paesi* (the young man of the landscapes). His great picture of the "Resurrection of Lazarus" established his fame. As superintendent at the Vatican, he developed mosaic as a perfect imitation of painting. He helped to found the Academy of St. Luke in Rome.

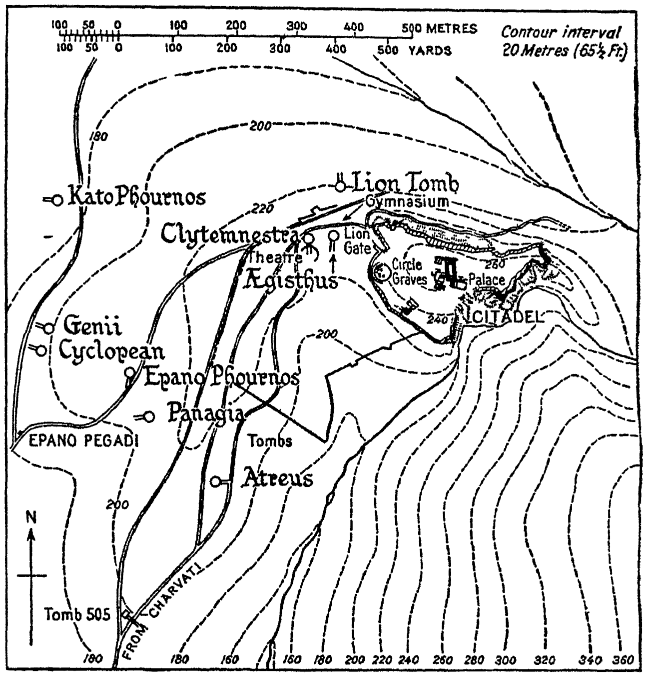
Many of Muziano's works are in the churches and palaces of Rome; he also worked in Orvieto and Loreto. In Santa Maria degli Angeli, Rome, is one of his chief works, "St. Jerome preaching to Monks in the Desert"; his "Circumcision" is in the church of the Gesu, his "Ascension" in the Araceli, and his "St. Francis receiving the Stigmata" in the church of the Conception. A picture by him representing Christ washing the feet of His disciples, is in the cathedral of Reims.

MWERU (or MOERU), a large lake of eastern central Africa. It lies 3,000 ft. above the sea, in a western branch of the great Tanganyika rift-valley. The lake is about 68 m. long by some 25 in breadth, and is roughly rectangular. It is cut a little south of its centre by 9° S. Mweru, first visited in 1798 by Dr. Lacerda, was reached by Livingstone in 1867, but its western shore was first explored in 1890 by Sir Alfred Sharpe, who two years later circumnavigated the lake. The eastern shores belong to Northern Rhodesia, the western to the Belgian Congo. The district is a game preserve and shooting is prohibited.

MYCENAE, one of the most ancient cities of Greece. The citadel on the summit is triangular with sides facing north, south-east and south-west. Part of the south-eastern wall and the palace within have been undermined by the torrent which bounds the lower town on the east. For the artistic significance of the various graves and building remains scattered among the groups of houses forming the lower town, *see* AEGEAN CIVILIZATION. Mycenae is a natural rock citadel standing in the north corner of the Argive plain flanked to north and south by deep ravines. It watched the hills, controlled the plain, and was the key to the road from the Gulf of Argos to the Gulf of Corinth which afforded the shortest route from Crete to central Greece.

The hill is roughly triangular with the apex pointing south and is defended by massive cyclopean walls. At the northwest angle is the Lion Gate surmounted by the famous limestone relief of two confronted lions ten feet high. The gate itself is about ten feet square and with its approaches is built of ashlar masonry in hard conglomerate. In the north wall is a smaller but similar gate and near it lies a secret underground cistern fed by the Perseian spring and approached by a subterranean passage from inside the walls. The extreme northeast angle is a later addition to strengthen this important point and to provide a sally port. Within the Lion Gate lies the Grave Circle enclosing the Royal Graves found by Schliemann and by it are ruined houses and storehouses. From the gate an inclined roadway leads to the summit crowned by the palace. This was built at different periods, but the ruins now visible belong in the main to the last great age of Mycenae. At the northwest angle was a columned entrance porch, and a throne room, a shrine, a bathroom, and a room with store jars have been found. On the south a wide staircase with two flights ascends to a spacious court. To the east a porch and vestibule open into the great hall (*megaron*) in the centre of which is a large circular hearth covered with painted stucco and surrounded by four column bases. The walls and floors of the *megaron*, court and vestibule were covered with painted stucco and there are plentiful remains of frescoes which adorned other rooms at different periods. West of the court a staircase led to the upper stories and to its north ran two parallel corridors giving access to other rooms at higher levels.

From the citadel a narrow ridge runs westwards so that its backbone forms the natural approach to the Lion Gate. Here are three of the beehive tombs (the Tomb of Aegisthus, the Lion Tomb, and the Tomb of Clytaemestra) and also the north wall of the Hellenistic lower town and the ruins of its gymnasium and theatre. At its west end a wider and longer ridge runs due south. Its northern end was included in the Hellenistic lower town and somewhere along it must have run the prehistoric road. On its east side stands the Treasury of Atreus, the largest beehive tomb, and on its west another, and all about are rock cut chamber tombs. Below its southern extremity the ravine which runs from the south side of the citadel was spanned by a prehistoric bridge on the road leading southeast towards the Argive Heraeum and Tiryns. Sub-



PLAN OF THE CITADEL OF MYCENAE

sidiary ridges running westwards to the plain are also honeycombed with tombs among which are four more beehive tombs. On one ridge, Kalkani, traces of early Bronze Age occupation have come to light, and in the hollows are two ancient wells. On the peak of Hagios Elias which overlooks Mycenae to the north stands a small fort of the later part of the Third Bronze Age which clearly served as a signal station, for thence the whole plain can be surveyed from Asine to Argos with the passes towards Arcadia, Nemea and Cleonae and the Acrocorinthus itself can be seen. A system of built roads radiates through the hills from Mycenae and they and the signal station emphasize its strategic and political importance.

Argolis was inhabited in the Neolithic age by a branch of the race that occupied central and northern Greece. No settlement of this period has yet been found at Mycenae, whose history begins with the Bronze Age. Then the citadel was occupied by the bronze using folk of the Early Aegean period who seem to have come into Greece from the islands and southwest Asia Minor. There is no clue to the language of the neolithic race, but the Bronze Age people probably spoke a non-Hellenic tongue and brought into Greece the place names which end in -nthos, -assos, or -ene. Among these is Mykene, a heroine mentioned by Homer whose name is to Mykenai as Athene is to Athenai. It is hard to estimate either the date of the Bronze Age settlement, which probably existed before the third millennium B.C., or its size, for ceramic remains, though frequent, are much disturbed by later buildings. With the beginning of the Middle Aegean period soon after 2200 B.C. a new racial element of unknown origin entered Greece. Its presence is marked by a class of pottery called Minyan Ware which has several varieties. The plentifulness of this and of a matt painted fabric, developed from the Early Bronze Age pottery at Mycenae, shows that the city prospered under this new impulse. As Minyan ware is practically unknown in Crete, though common in the islands, relations between Crete and Mycenae cannot have been intimate, and so the latter's expansion would have been mainly independent of Crete. Through-

out the Middle Bronze Age, on the hillside where the Grave Circle and Lion Gate were afterwards built, a cemetery had been in use, as this was the nearest spot where the rock was soft enough for simple cist graves of the type usual at the period. Among them in one special area larger and deeper graves were hewn out to contain the remains of the princes, the famous Shaft Graves, the treasures of which, excavated by Schliemann, first revealed the great prehistoric civilisation of Greece. The earliest, the Sixth, contains some objects from Crete, but the bulk of its pottery is unmistakably indigenous.

This Shaft Grave Dynasty rose to power about 1600 B.C. almost coinciding with the establishment of the 18th Dynasty in Egypt and the renaissance of Knossos after its destruction towards the end of the Middle Bronze Age. Slight signs of Cretan influence appear shortly before, but now at the beginning of the Late Bronze Age Cretan fashions and art were largely adopted at Mycenae. Three explanations are possible: (1) that Cretans now conquered the mainland and displacing the native population colonized a large portion; (2) that Mycenaean kings, strong on land and sea, successfully raided Crete, bringing home rich treasures and craftsmen as slaves; (3) that the kings of Mycenae grew powerful and rich, entered into relations with Crete and absorbed its culture. The first view seems least probable because for one reason Cretan pottery of the date of the alleged conquest is extremely rare at Mycenae where local fabrics still continued. Which of the other two is more correct time alone can show. The "Crétoiserie" of the Shaft Grave kings can be compared to the European *Chinoiserie* of the early 18th century, which was not the result of a Chinese conquest of Europe. These kings undoubtedly resided on the summit of the citadel where there are traces of a "palace" underlying the later palace. No signs of a circuit wall have yet been found and in any case it would not have had the area of the later enceinte. Still the richness of the royal graves and of private tombs of the period shows that a high standard of civilisation had been reached. This was not due entirely to the adoption of the Cretan culture, but to the fact that the newcomers of the Middle Bronze Age, who may well have spoken Greek, were themselves keen, energetic, and well advanced in things material, and needed only the contact with Crete to develop artistically as well.

Towards the close of the 16th century B.C. a change in royal burials indicates a new dynasty, which laid its princes in stone built beehive tombs from 25 to 50 feet in height and diameter. Nine such tombs exist at Mycenae. Their architecture displays gradual advance in technical matters, the use and cutting of materials and the handling of the problems of stresses and weights, so that they fall by progressive development into three groups of three tombs each. The first group belongs to the later 16th and to the early 15th century B.C. and the second group to the later 15th century. The earlier tombs were smaller, the construction primitive, the material inferior, the stone unshaped, and stresses not understood. The second group is larger and better built, the stone was hewn but not sawn, and a relieving triangle over the lintel was employed. In the two first groups the finest are the Tomb of Aegisthus and the Lion Tomb which last was closed with a door and threshold instead of rude stone walling. The first Beehive Tomb kings must have lived in the citadel but, apart from signs of their activity in the palace area, no other building can be definitely assigned to this date. The standard of culture was the same and there was intercourse with the islands, Crete and Egypt. The private tombs show that comfort was extending and the rather simple rock cut tombs of the 16th century now developed into spacious chambers with wide entrances.

After 1400 B.C. when Knossos fell and Egypt decayed under the last Amenhoteps, Mycenae, which had been rapidly developing since the end of the Middle Bronze Age, now took first place. Greek traditions, Homer's picture of Agamemnon as suzerain of the princes who sailed against Troy, and its mighty ruins, all bear witness to its greatness. Under the aegis of Mycenae ruled by the later kings of the Beehive Tomb Dynasty the Minoan-Mycenaean culture spread throughout the Eastern Mediterranean, and echoes of this are found in Homer. To this great age the majority of the amazing buildings at Mycenae belong. The palace was reconstructed on a large and sumptuous scale, the cyclopean walls of the citadel were built with the Lion Gate. Within the walls rose storehouses and residences for the civil and military officers of the court, and for their guards and servants. The royal Shaft Graves with part of the old cemetery were enclosed within the enceinte and the space round them was levelled, ringed with standing slabs, and made into a sacred area for the worship of the dead princes.

These later kings of the Beehive Tomb Dynasty to whose energy and ability the greatness of Mycenae seems so largely due, were buried in the last group of Beehive Tombs, the Treasury of Atreus, the Tomb of Clytaemestra, and the Tomb of Genii. These are naturally the best in construction, plan and size, and are built throughout of hard stone, mainly sawn. Each had a door, and a threshold constructed on a wedge principle. The understanding of stresses and of the means to counteract them shows that their architects profiting by earlier experiments perfected their methods and materials, so that two of these tombs still stand almost intact. The Treasury of Atreus is structurally so like the Lion Gate and the palace that it is possible that the royal builder of the two latter prepared the former as his tomb. The same style occurs in the walls and palace at Tiryns which are contemporary. The civilian population of Mycenae must have lived in undefended settlements on the neighbouring hills and the many cemeteries of this date divide into local groups suggesting separate communities. The tombs are carefully hewn in the rock with long narrow entrance passages and were furnished with objects in pottery, bronze, glass, ivory and gold, which show that the culture of Mycenae at its zenith even if less artistic displays wonderful technical ability. During the 14th and 13th centuries B.C. at Mycenae not only were crafts such as the potter's intensively and skilfully practised, but also professions such as those of engineers and architects, for the cyclopean walls and great domes like the Treasury of Atreus imply structural genius.

Troy according to tradition was taken early in the 12th century. Then, as the use of iron spread, the Iron Age began and as the contemporary Egyptian records say "the Isles were restless." This was the age of the Dorian Migration. Then Mycenae fell and the palace and houses were burnt. The walls, however, were not destroyed and as such a stronghold could not be left untenanted Mycenae was inhabited during the early Iron Age, but was of small importance as Dorian Argos usurped her place. As a small city state it preserved its independence and a Doric temple of Athena who ousted the local heroine Mykene arose early in the sixth century upon the ruins of the palace of the Bronze Age kings. Some sculptures from this temple survive. The débris among the ruins proves Mycenae's continuous existence, through the geometric, orientalising and archaic periods of Greek art down to the Persian Wars. Then Mycenae sent her small contingent to join in resisting Xerxes' invasion. Her men fought at Plataea in 479 B.C. and the name Μυκανῆς can still be read on the serpent column from Delphi now in the Hippodrome at Constantinople. Argive jealousy, however, could not forgive and in 470 B.C. when Sparta was in difficulties an Argive army besieged Mycenae. The citadel was starved out, its walls and buildings were overthrown and the site laid waste.

In 235 B.C. the Argive tyrant Aristippos was murdered at Mycenae which like other small towns dependent on Argos was probably reoccupied by the Argive tyrants of the third century B.C. during their struggles with the Achaean League. The walls of the citadel were repaired and part of the hillside on the south was walled in to make a lower town. In this lay a small theatre directly above the Tomb of Clytaemestra and by it was a gymnasium. The Doric temple, which the Argives had perhaps spared in 470 B.C., still stood on the summit of the citadel. Inscriptions dating probably from 194 B.C. and referring to Mycenae's relations with Argos and Nabis of Sparta give some details of its government. After Argos was freed from Nabis Mycenae vanishes from history and Pausanias in the second century A.D. makes no mention of inhabitation. A few remains of the Roman period have been

found so it cannot have been entirely deserted, but the depopulation of Greece must have affected Mycenae and a few inhabitants among ruins so famous would give every impression of desolation. Soon after it must have been completely deserted, for there are no traces of Byzantine or later occupation.

The site of Mycenae was never forgotten as Pausanias who saw the Lion gate shows and when Greece began to be revisited by travellers from western Europe it became a place of pilgrimage. Excavations were begun by Schliemann who made soundings in 1873, but conducted his epoch-making campaign in 1876 when he found the royal Shaft graves. Stamatakes followed from 1877 to 1879 when he found the sixth Shaft grave and cleared the Treasury of Atreus. From 1886 to 1902 Tsountas in a fruitful series of excavations cleared several houses, and found the palace, three beehive tombs and a large number of private tombs. Rodenwaldt did valuable work on the frescoes in the palace between 1912 and 1914. From 1920 to 1923 Wace excavated here for the British school at Athens, when many tombs were found and new and important results were obtained from the Grave circle, the Beehive tombs and the palace.

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MYCETOZOA or **MYXOMYCETES.** The lower members of the plant and animal kingdoms approach each other so closely that it is often difficult to decide to which they belong. Among such organisms are the remarkable Mycetozoa. Literally the term means "fungus-animals," and the synonym preferred by botanists is Myxomycetes or "slime moulds," the latter being a common designation for the assemblage. While students have disagreed as to the types embraced by the name Mycetozoa, all are agreed that the rather homogenous assemblage known as the Myxogastres must be included. Indeed, since the beginning of the 20th century the tendency has been to limit the definition of the Mycetozoa to the point where it is customary to use, as does this article, either Mycetozoa, Myxomycetes, or slime moulds as synonyms for the stricter designation, Myxogastres.

The Plasmodium.—The stage in the life cycle of the Mycetozoa which has commanded most attention begins by the sexual fusion of microscopic gametes. Nuclear division commences in the amoebalike zygote, but unlike true amoebae the zygote does not split following nuclear division. Thus, with repeated nuclear divisions there is formed a creeping, jellylike plasmodium of no fixed shape, containing many nuclei. As the plasmodium grows, the amoeboid creeping is no longer feasible by the extension of a pseudopod into which the mass of protoplasm flows or which pulls the rest after it; the diffusion of oxygen to the interior, the excretion of waste and the intake of nutrients impose conditions which a rather compact amoeba can no longer meet.

Therefore, the plasmodium becomes thin and sheetlike, broken into interconnecting strands of protoplasm, and assumes a fanlike shape. The plasmodium, by the time it is easily visible to the unaided eye, has already achieved the characteristic fanlike appearance; and the fan both grossly and microscopically has distinguishable regions. The front comprises a broadly curved sheet of protoplasm, usually with a raised anterior border. Just posterior the sheet is thinner, and microscopic examination shows that it is formed of gelled protoplasm crossed by anastomosing strands of liquid protoplasm in active streaming motion. Toward the rear the sheet begins to break up into strands until the trailing end of the plasmodium is formed of a few strands, or frequently a single strand, of protoplasm.

The vivid protoplasmic streaming shown by the Mycetozoa has excited the curiosity of naturalists since it was first observed. In the strands of the plasmodium it is somewhat rhythmic, the flow being first in the general direction of the front, then slowing, coming to a full stop and reversing. The forward creeping of the plasmodium is at least in part because of the accumulation of protoplasm at the front by forward streaming. The reverse streaming does not last for so long a period as the forward flow and presumably has the function of depositing waste to the rear.

While because of its mass a large plasmodium may not change shape as rapidly as an amoeba, the shape is by no means constant. A plasmodium may reverse its direction of creeping either by turning around or by simple reversal of the main protoplasmic flow, in which case the former rear now becomes a broadly fan-shaped front. At times small secondary fans are formed which may be later resorbed, or not infrequently may finally separate from the parent. The fan shape is typical only of plasmodia on a smooth substrate in the laboratory or on the surfaces of logs, leaves and other vegetable debris. For these plasmodia which live within decaying wood the fan shape is obviously impossible, and the plasmodium is a loosely flung network through fissures, within vessels and along the tunnels of boring insects.

If a strand of a vigorous plasmodium is severed, there is an immediate welling out of the fluid endoplasm which may continue until a drop the size of a pea or larger is formed. Almost immediately there is gelation of the endoplasm at the surface which continues toward the interior, and in a few minutes the entire drop becomes a soft but firm mass. If placed on a new substrate, it forms a small plasmodium; if left in place, it is resorbed in a matter of hours.

Simultaneously with the injury, the strand usually gels for some distance on either side of the cut, so that further flow does not occur until the interior reverts to its former fluid state. The fluid-gel reversal also occurs naturally. The flowing protoplasm of a channel may come to rest and gel, while adjacent protoplasm will become fluid and begin to flow, thus creating a new channel.

Although mycetozoan plasmodia, because of their often great size, have been used frequently for studies on the physiology of undifferentiated and primitive protoplasm, the protoplasm is neither particularly primitive, undifferentiated nor more resistant to abuse than the protoplasm of more conventional cells. Rough mechanical treatment may kill part or all of the plasmodium; it may be overwhelmed by bacterial contamination; and the protoplasm of some forms is sensitive to lack of oxygen and to excessive wetting.

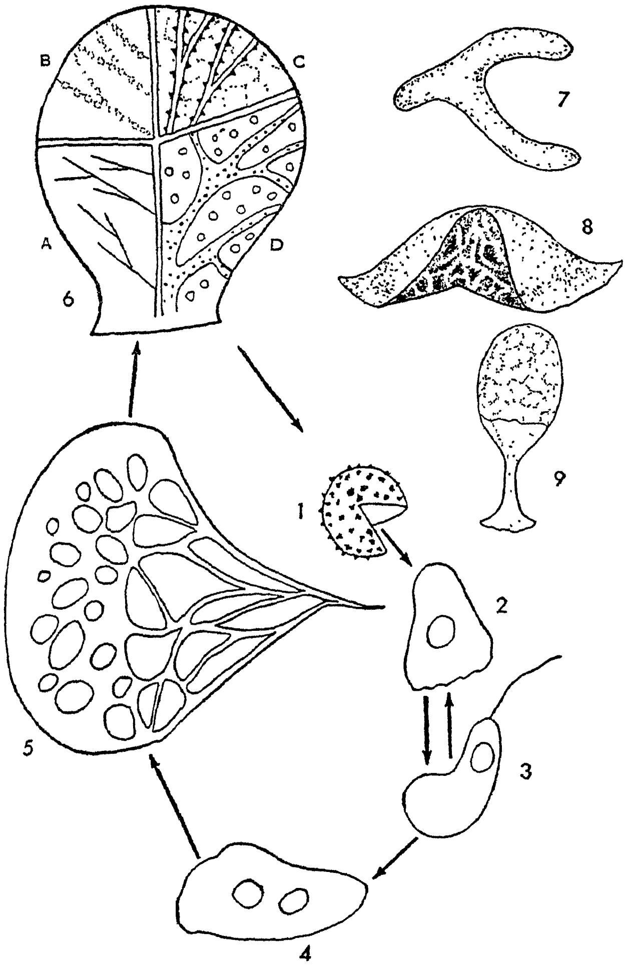
Most of the Mycetozoa are terrestrial forms which spend their vegetative existence creeping in and among damp, decaying leaves, twigs and logs. Nutrition and safety are aided by tactic behaviour—the oriented response to external conditions, such as light, moisture and food.

Negative chemotaxis is exhibited in the laboratory by movement away from stale to fresh substrates and by the avoidance of certain bacterial colonies. Positive chemotaxis is often dramatically shown toward other bacteria or fungi, as when the plasmodium of *Physarum polycephalum* envelops and digests a large mushroom down to an unrecognizable slimy mass within a day after first contact has been established.

Plasmodia from the field are often seen to be crowded with fungus spores, woody particles and other debris indicating an animal-like ingestion of particles, some of which might have nutritive value. But other data indicated that the chief mode of nutrition was saprophytic, the absorption of the dissolved products of decaying organic matter.

In 1939 it was shown that plasmodia could partially digest vegetable substrates but could not grow indefinitely upon them alone. Micro-organisms were also necessary, and indeed plasmodia could grow indefinitely solely by ingesting various killed or living bacteria or yeasts, thus making it probable that the chief mode of nutrition is animal-like.

Life History.—The plasmodium does not always remain in a fluid state of differentiation, but under ill-defined conditions it generally seeks an elevated place for fruit formation. The details of fruiting body formation differ from group to group, but usually the plasmodium breaks up into small globules which become invested with pellicles which dry into the peridium. The globules may remain sessile on the substrate or be elevated on stalks while within the sporangium the protoplasm forms tubular vacuoles, the walls of which become lined with secreted material forming a branched or network system which hardens into the capillitium. Further successive division of the protoplasm results in separa-



FIGS. 1—9.—LIFE CYCLE AND TYPES OF FRUITING BODIES IN MYCETOZOA

All figures highly diagrammatic; figs. 1–4, magnified approximately 1,000 ×; 6, 7 and 9, approximately 12 ×; 5 and 8, approximately life size. Fig. 1. —Emptied spore case from which myxameba (fig. 2) has escaped. Fig. 3.—Swimming stage (gamete) which may revert back to myxameba or fuse in pairs. Fig. 4.—Fused gametes, flagellae retracted, nuclei unfused. Fusion of nuclei and growth of zygote produces plasmodium, fig. 5. Fig. 6.—Sessile fruiting body showing stages of development: A, formation of strain lines in protoplasm which develop into chains of vacuoles; B, C, coalescence of vacuoles to form system of hollow tubes; protoplasm is cleaving into blocks from which spores are formed; D, mature fruit, granule-filled capillitium with a few spores in the meshes. Fig. 7.—Plasmodiocarp. Fig. 8.—Aethalium as in *Fuligo septica*, cut open to show black spore masses and interlacing walls of the separate, imperfect sporangia. Fig. 9.—Stiped fruiting body of *Arcyria*, showing the expanded capillitial network

tion of each nucleus with its surrounding protoplasm as a spore. Investment of the spore with a firm wall and drying of the sporangium releases the dry, microscopic spore for dissemination by wind. In some genera such as *Arcyria* and *Trichia* the capillitium plays an active role in spore dispersal. With the drying of the fructification, the peridium is burst by the elastic capillitium, spores being scattered by the sudden expansion of the capillitium and by the constant twisting of its threads with changes in the moisture content of the surrounding air.

On attaining a suitable wet environment, the spore absorbs water, nuclear division occurs and the spore wall is either ruptured or partly dissolved to release two or more swarm cells or, more frequently, an amoeboid mass which soon divides into uninucleate swarm-cells. The swarm cell of the Mycetozoa has two interchangeable phases, an amoeboid, creeping stage, in which it crawls over the substrate ingesting bacteria and other particles, and a swimming stage, in which it is comma-shaped with a flagellum projecting from the anterior, tapering end.

Since 1911 there is agreement that the swarm cells are sexual cells or gametes; prior to that time it was thought that the plasmodium was formed either by nonsexual fusion of swarmers or that nuclear fusion took place before germination of the spore. It is probable that such early concepts and some later disagreements may be because of the difference in nuclear behaviour dependent either on species or condition of plasmodial formation. The coalescence of groups of swarm cells probably results in nuclear pairing and fusion within the young plasmodium at a later period, while pairing of gametes may result either in immediate or delayed nuclear fusion. With fusion of the gametes, retraction of flagella and nuclear fusion, the plasmodium is initiated as previously described.

There are alternative resting conditions which, unlike spore formation, do not result in propagation. The swarm cell—on fouling of the medium, starvation or desiccation—may surround itself with a smooth cyst wall to await the return of favourable circumstances. Under similar circumstances the plasmodium may form a sclerotium. Microscopic examination shows that the plasmodium has divided into numerous cells, which may contain from 1 to more than 20 nuclei each. These sclerotia retain their viability when dry, viability having been recorded up to 20 years, though 3 years is the usual limit. On being moistened, the cyst walls are dissolved, the contents of the cysts coalesce and the plasmodium resumes vegetative activity.

Extent of the Group.—Approximately 500 species of Mycetozoa are known. Identification of genus and species is based on the fruit, for the plasmodia are usually very similar in appearance and of inconstant colour, the prevailing colours being yellow, orange and buff to watery white. In all genera except *Ceratiomyxa* the spores are obviously borne within fruiting bodies. In *Ceratiomyxa* the fructifications are apparently composed of pillars or ridges, with the spores borne individually on minute stalks. The researches of H. C. Gilbert, however, indicate that the so-called spores are sporangia reduced to the extreme degree where each contains one spore.

Diagnosis of family, genus and species is made, in order of importance, on the colour of the spores, the existence of a capillitium, the presence or absence of calcium carbonate granules in the sporangium wall and in the capillitium, the type of fruit and the often beautiful sculpturing of the capillitium and of the spore walls. The fruits are of several types. The individual sporangia may be sessile on the substrate or on a thin horny sheet, the hypothallus, or raised on a stalk. Some species fruit without breaking up into individual sporangia, the fructifications, called plasmodiocarps, resembling more or less completely the strands of the plasmodium. The aethalium is a type of fructification consisting of fused individual sporangia or of plasmodiocarps. In some cases the walls of the separate sporangia comprising the aethalium may be reduced to threadlike remnants resembling the capillitium and known as a pseudocapillitium.

Field observations and laboratory cultivation indicate that fructifications derived from a single plasmodium may vary greatly in type, depending on external conditions at the time of sporangium formation. Thus, the author has found the well-known *Physarum polycephalum* fruiting as plasmodiocarps and as sessile sporangia as well as the typically stalked forms with convoluted sporangia.

Other Groups Sometimes Included with the Mycetozoa.—The Acrasieae (or Sorophoreae) constitute a remarkable group of organisms which engage in communal encystment. The vegetative stage is passed as small individual amoebae indistinguishable from the many other small amoebae which inhabit the soil and decaying vegetable matter. The vegetative period is also the period of reproduction by fission, a sexual cycle not being established for the group. At the completion of the vegetative period the amoebae creep toward a common centre, the converging streams of their closely packed cells recalling the strands of a plasmodium; and therefore this stage is known as a pseudoplasmodium. The pseudoplasmodium becomes more compact, and in the lower forms all the individual amoebae encyst, to be scattered by wind or rain as a prelude to excystment and commencement of the vegetative stage. In the higher forms, such as *Polysphondylium* and *Dictyostelium*, the cells comprising the pseudoplasmodium become differentiated, some of them being sacrificed to form the vacuolated, polygonal cells of the stalk and branches

(sorophores), on which are borne the heads of cysts (sori). In the highly developed *Dictyostelium discoideum* the entire pseudoplasmodium migrates as a unit before fructification. For an account of this remarkable group the reader is referred to the papers of Kenneth Raper.

The Labyrinthulae is a group very imperfectly known and with certainty containing only the type genus, *Labyrinthula,* whose species are all parasites of aquatic plants, one being the cause of an economically important disease of eel grass (*Zostera marina*). The characteristic structure of *Labyrinthula* is the net-plasmodium, which unlike the true plasmodium of the Myxomycetes, shows only partial fusion of the individual cells. The spindle-shaped bodies are connected to each other by a network of slender extensions along which they move with relation to each other. Prior to 1929 it was generally believed that these strands were pseudopodial extensions, but work since that date indicates that they may be nonliving tubes or threads along which the spindles glide. The life cycle is still very obscure, only vegetative division and cyst-formation having been observed.

The Plasmodiophoreae in some respects approach most closely the Mycetozoa in life cycle and in morphology. The vegetative state is a plasmodium, parasitic in higher plants, which eventually breaks up into spores. On being freed from the host, and on germination, these spores produce anteriorly flagellate swarm cells which gain access to the host through the root hairs. There is little agreement on the details of the life cycle, but there is reasonable agreement that these swarm cells are gametes, and on fusion initiate the plasmodium either immediately or after an intermediate stage.

Relationships.—Forming, as they do, small fruiting bodies resembling those of the higher fungi, it is understandable that for a very long time the Mycetozoa were supposed to be a division of the Gasteromycetes, hence the name Myxogastres. Not until the classical work of Heinrich Anton de Bary was it made clear that these forms were not to be grouped with the highly specialized puff balls, but instead were related to very primitive forms resembling both plants and animals.

In some respects the Mycetozoa resemble the lowest fungi—the chytrids, some of which may spend a large part of the life cycle without a firm cell wall. In other respects, they recall strongly the amoeboid-flagellate line with its borderline members such as the flagellate amoeba, *Mastigamoeba.* A. Pascher has described the chlorophyll-bearing counterparts of the Mycetozoa, Labyrinthulae and of *Mastigamoeba,* and it is well recognized that any line drawn across the flagellates to separate plants from animals is an arbitrary one. While close relationship with the amoeboid-flagellate line is very likely, the Mycetozoa probably form an evolutionary blind alley of their own.

As to the relationships between the Mycetozoa as defined here, and the Plasmodiophorae, Acrasieae, Labyrinthulae and other curious forms such as *Vampyrella* and Proteomyxa, too little is known of the life history to group these forms together with any certainty, or else increased knowledge has widened the gulf between the Mycetozoa and some divisions formerly included with them, such as the Acrasieae.

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MYCOLOGY is the science of fungi (Greek μύκης, a mushroom, λόγος, discourse), and is dealt with in the article Fungi.

MYCORRHIZA. The roots of land plants live in soil, competing therein for water and nutrients with a crowded population of microorganisms. They are surrounded by a rich and varied fungus flora many members of which are potential parasites, but the majority of roots are relatively immune to such parasitic attack and continue to flourish side by side with their fungus competitors. To the interaction of these three phenomena—the competitive struggle for food, the capacity of many fungi to penetrate living tissues and the properties of resistance to such invasion possessed by roots in common with organisms in general—is probably due the evolution of *mycorrhiza,* that curious and interesting partnership between the roots of vascular plants and fungus mycelium now known to affect a vast number of the higher plants and to be of great importance in their lives.

Mycorrhizae or fungus roots (μύκης, a mushroom) (ῥίζα, a root) are formed alike by wild and cultivated plants, by species from the high mountains and by those from salt marshes at sea level, in the vegetation of tropical forests and in that within the arctic circle. The phenomenon was comparatively well-known, especially to foresters when, in 1885, the German botanist, Albert B. Frank, coined the name, 'mycorrhiza,' to register his view that the root with its associated mycelium constituted an independent organ of great importance in plant nutrition. He reported an invariable and intimate association of fungus mycelium with the roots of forest trees, especially oak, beech, hornbeam and other members of Cupuliferae, and certain conifers, such infection being, in his opinion, not parasitic but of definite service to the trees in relation to the absorption of water and nutrient salts. On a contemporary view associated especially with the name of Robert Hartig, the root fungi of trees were mischievous parasites hindering root action and conferring no benefit upon the hosts.

By the end of the 19th century it was realized by botanists that the mycorrhizal habit was widespread, affecting not only trees but an immense number of herbaceous species belonging to different families.

Distribution and Structure.—Mycorrhiza is formed by ferns, club mosses, conifers and an ever growing list of flowering plants belonging to many different families. It is constant and conspicuous in certain groups, *e.g.,* Orchidaceae, Ericales, Empetraceae and forest trees generally, and is invariably well developed in species lacking chlorophyll, e.g., *Neottia Nidus-avis, Corallorhiza* spp. and a number of tropical orchids belonging to this class, members of the Monotropoideae, and certain species belonging to the families Gentianaceae and Burmanniaceae. Structures closely resembling the mycorrhizal tissues of living species have been described in fossils of Coal Measure age. It is specially characteristic of the vegetation of humus soils, viz., those of moorlands, woodlands and heaths, but may be well developed in garden soil and in the most diverse situations elsewhere. It may be regarded as an annual phenomenon affecting all or a proportion only of the young absorbing roots of the current year.

It is assumed that the fungi concerned are widely distributed in soil, and with few exceptions invasion of the roots takes place from this source. The effect of infection is strikingly different from that in ordinary parasitism, there being no indication that the tissues suffer any permanent injury from the more or less extensive infestation by mycelium to which they are subjected. The external appearance of the root may be altered, as in trees, where arrest of growth accompanied by profuse branching results in the production of dense clusters of rootlets, brown or variously coloured according to the kind of mycelium present. Sometimes the appearance of the roots is not altered in any way. There is great variation in different plants and at different seasons in

respect to the relative abundance of mycelium, its distribution upon and within roots and the details of structure of individual mycorrhizas.

It is still convenient to recognize two main types of structure and use the descriptive names given to them by Frank in 1885; the *ectotrophic* type, specially characteristic of trees, in which mycelium completely invests the tip and younger portion of the root as with a sheath of varying thickness, branches from which penetrate between the cortical cells to form a continuous network, while individual cells remain relatively immune from infection; and the *endotrophic* type, showing a variable amount of mycelium externally without formation of a sheath, combined with a more or less profuse distribution of hyphae within the cells, sometimes irregularly distributed in the cortical tissues, sometimes localized in definite zones. The individual cells that suffer invasion become filled with coiled or branched hyphae continuous with those which form an irregular mesh upon the external surface of the root and permeate the soil around it. In a majority of fungus roots these intracellular hyphal complexes disintegrate, dwindle and disappear, the soluble by-products presumably passing to the host cells.

These two types of mycorrhiza are not sharply distinguished from one another as Frank believed. It is known now that those of the ectotrophic type often exhibit relatively heavy infection of individual cells, and it seems probable that the structural differences are related to the character of the mycelium and to soil conditions rather than to any fundamental distinction in the association as a whole.

The Mycorrhiza of Orchids.—The mycorrhiza of orchids is of the endotrophic type and mycelium may be widely distributed throughout the root cortex or confined to certain regions. Two contrasting types of cell are observable: *Pilzwirthzellen* or "host cells," containing active hyphae, and *Verdauungzellen* or "digestion cells," enclosing only their disintegrated remains subsequent to digestion. In the former the mycelium fills the cells with skeins or "pelotons" of characteristic appearance and probably abstracts nutrient materials from the host; in the latter these substances and possibly others brought in from the soil are placed at the disposal of the root.

The researches of a French botanist, Bernard, initiated a new method of experimental inquiry and demonstrated the far-reaching character of the relationship in orchids. The difficulties experienced by growers in germinating seeds of orchids had long been known. Bernard isolated the root fungi from a number of species and showed, by "pure culture" methods, that germination of seed and development of the seedling are bound up with infection by the appropriate root fungus at a critical stage of development. In nature, this symbiotic type of germination is ensured by the presence of mycelium of the root fungus in the soil about the roots of the parent plant; in horticultural practice, artificial cultures have been successfully utilized by L. Knudson for the same purpose. It has been discovered that the stimulus normally provided by the appropriate fungus can be replaced artificially by carefully adjusting the chemical constitution and reaction of the seedbed, and such asymbiotic methods of securing germination have been successfully applied by horticulturalists in the case of certain orchid species.

There remains much that is obscure in the relation of fungus and host in this group of plants. The nature of the problems awaiting solution is sufficiently indicated by the invariable association of particular fungus strains with individual orchid species, and by the fact that orchid growing is concerned not only with the cultivation of natural species but with the raising of new hybrids.

Mycorrhiza in Ericaceae.—In northern Europe certain members of the family Ericaceae, *e.g.*, various kinds of heath (*Erica* spp.), and heather or ling (*Calluna vulgaris*) are a constant feature of the vegetation of humus soils—moorland and woodland—on which they often monopolize large areas to the almost complete exclusion of other plants.

Described by Frank as obligate mycorrhiza plants, it was early recognized that members of this group might exhibit specialized relations with their root fungi. The mycorrhiza is of the endotrophic type with certain characteristic features, in some respects showing points of resemblance with that of trees. The young roots are excessively fine, the outermost layer of cells in each forming a definite mycorrhizal zone. In favourable soil conditions practically every cell in this layer is filled with a densely branched complex of fungal hyphae from which strands of mycelium extend outwards into the soil. The growth of mycelium on the outside of the roots is rather more profuse than in orchids and, in certain species, may resemble the sheathlike condition found in ectotrophic mycorrhizas. As in orchids, the complexes of mycelium within the root cells are subject to rapid and complete digestion followed by disappearance of the resulting products.

In ling (*Calluna vulgaris*) and certain allied species an obligate relation unique of its kind has been revealed by experimental research. In these plants the mycelium which infests the root spreads throughout the tissues of the vegetative shoots, flowers and fruits reaching eventually the seed coats of the developing seeds. These are shed bearing with them the mycelium of the fungus partner and at germination the emerging seedling is immediately subject to invasion.

The distribution of mycelium throughout the plant thus compares sharply with that found in orchids where it is limited to the roots of the adult and the embryonic tissues of the seedling. In *Calluna* and kindred ericaceous species it is practically coextensive with the plant tissues. Only the embryo and endosperm of the resting seed are free from contamination; at all other stages of development and throughout its vegetative existence every plant of ling yet examined is a dual organism. In the genus *Vaccinium* the intimacy of the relation has been carried a stage farther and mycelium is present, not only externally upon the seed coats, but internally throughout the tissues of the seed. The mode of infection observed in Ericaceae is unique, for, in all other known cases, the mycelium responsible for forming mycorrhiza enters the root from the soil.

In ling and probably in allied species the formation of functional mycorrhiza is closely related to soil conditions. It is at a maximum in peaty soils and in cultivated soils with abundant humus, much less conspicuous in sandy soils deficient in organic matter, and may appear to be absent under certain conditions, although roots are never free from fungus infection.

Since seedling development follows and depends upon invasion by fungus mycelium at germination, it is impossible to provide experimental evidence bearing on the behaviour of individuals with and without fungus infection.

The Mycorrhiza of Trees.—The mycorrhiza of trees is characteristic and easily recognized. Structurally, it belongs to the ectotrophic type; each rootlet is enveloped in a sheath of mycelium formed by the close interweaving of hyphae continuous internally with a branch system penetrating between the cells of the roots, externally with the network of mycelium in the soil.

Woodland soils possess an unusually rich and varied fungus flora among which members of the great group known as Hymenomycetes are conspicuous, as evidenced by the profusion of their spore bodies—toadstools—produced during suitable seasons. So constant is the association of some of these with certain trees that it has been said that they follow the latter "as the dolphin follows the ship."

In order to prove a direct relation between these common woodland fungi and the mycorrhiza of the trees beneath which they grow, it was necessary to isolate the endophytes, learn something of their behaviour and compare the growth of young trees with and without mycorrhiza. By such means a number of Hymenomycetes have been identified as the specific root fungi of pine, spruce, larch, birch and other trees.

There is no evidence that seedling development is bound up with fungus infection or that anything in the nature of an obligate relation exists. As regards the effect of tree mycorrhiza on nutrition, it must be noted that woodland soils possess certain definite characteristics. There is severe competition for water and salts and they show a notable deficiency of certain plant nutrients, in particular nitrates. On the other hand, they possess

large reserves of nitrogen in the form of organic compounds. It has been proved experimentally that the possession of mycorrhiza is beneficial to trees, especially in relation to the supply of nitrogenous nutrients. Hence, the supply of nitrates being deficient it may be concluded that it possesses a vital significance for trees and other plants growing in woodland soils. The application of these conclusions to natural conditions raises problems of great importance to practical foresters.

Identity of Mycorrhizal Fungi.—It may be assumed that the fungi responsible for forming mycorrhiza are widely distributed in soil. Their systematic position is known only in those forms which have been isolated and grown in "pure culture" outside the root.

The root fungi of orchids are generally recognized as belonging to a common group, sometimes included in the well-known genus *Rhizoctonia,* sometimes placed in a new genus *Orcheomyces.* The mycelium must be locally present about the roots of wild orchids but nothing is known as to its wider distribution.

The mycorrhizal fungi of *Calluna* and other ericaceous species have been isolated and included in a single species of the genus *Phoma, P. radicis.* The specialized strains associated with different ericaceous species are distinct and must be locally distributed in heath and moorland soils but there is no certain knowledge of their wider occurrence.

The fungi definitely identified with the mycorrhiza of trees belong to the genera *Boletus, Amanita, Cortinarius, Lactarius, Russula* and *Tricholoma.* It is probable that many others will prove to belong to the same category.

Outside these specialized groups, the fungi responsible for mycorrhiza formation still await identification. The mycelium present in a large number of herbaceous flowering plants, certain ferns and club mosses, is uniform in type and produces characteristic structures: round or pear-shaped swellings or *vesicles,* variously regarded as organs relating to spore formation or to the storage of reserves, and intracellular branch systems first described by Gallaud in 1905 under the name of *arbuscules.* Following upon digestive activity in the host cells the latter disintegrate to structureless masses named *sporangioles* before their true nature is recognized. The fungus responsible for this widespread type of mycorrhiza has hitherto resisted all attempts at isolation and nothing is known with certainty as to its systematic position.

It has been reported that the mycorrhiza of many herbaceous plants is of dual character, involving primary infection by a fungus with the characters just described followed by secondary infection by one of the type associated with orchid roots. Whether this reported "double infection" is of biological significance is at present unknown.

Role of Mycorrhiza in Plant Growth.—There can be little doubt that the mycorrhizal habit had its origin in parasitic attack on the part of certain soil fungi, or that existing mycorrhiza plants are the survivors of a long and perilous evolutionary history. Many must be regarded as cases of compromise fluctuating between an almost complete resistance to fungus invasion and a remarkable toleration of the same. That there is an exchange of nutrient material in practically all cases can hardly be doubted but, in the absence of information based on the behaviour of individuals with and without mycorrhiza, attempts to express the shifting relationships in terms of mutual advantage or the reverse are premature and often misleading.

In certain groups of plants mycorrhiza has become a regular feature in the life history, a condition of delicately balanced equilibrium between fungus and host has been established and critical experimental study has placed certain facts beyond doubt. In both orchids and heaths the normal development of the seedling is bound up with the presence and activities of mycorrhizal fungi showing marked adaptation to individual species, accompanied in members of Ericaceae by a distribution of mycelium throughout the tissues so extensive that it is difficult to conceive of the individual plant as other than a single entity of double constitution. In orchids, the traditional view attributes a beneficial role to the root fungi based on their utilization of organic soil constituents and the wholesale digestion of mycelium that takes place subsequently in the root cells. A claim has been advanced for fixation of atmospheric nitrogen by the root fungi of several orchid species.

It may safely be concluded that mycorrhiza possesses a vital significance for trees and other plants growing in woodland soils, and there is reason to believe that the reaction and constitution of the soil are important factors in promoting its healthy development and functioning. In the Ericaceae, *Calluna* and many of its allies are characteristic and abundant members of the vegetation of humus soils thus pointing to similar conclusions, while in this group there is likewise evidence that the capacity to draw indirectly upon the organic compounds in the soil humus is supplemented by the ability of the root fungi to utilize atmospheric nitrogen. In both orchids and heaths the obligate character of the association is probably confined to the seedling phase and does not extend to the adult, although in heaths infection of the roots follows directly upon that of the seedling tissues.

The older theories of beneficial symbioses in mycorrhiza were deduced from distribution and structure untested by experiment. Modern research has been marked by the application of new and more precise methods and has revealed unsuspected relationships. On the whole, it supports the view that the possession of mycorrhiza is frequently of service to vascular plants, the nature and degree of benefit depending upon the physical conditions of the environment and the character of the association in individual cases. (M. C. R.)

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MYDDELTON or MIDDLETON, **SIR HUGH,** 1st Bart., cr. 1622 (*c.* 1560–1631), was a younger son of Sir Richard Myddelton, governor of Denbigh castle, Wales.

Hugh was a successful London goldsmith, occupying a shop in Bassihaw or Basinghall street. He made money by commercial ventures on the Spanish main, being associated in these with Sir Walter Raleigh; he was also interested in clothmaking. He was an alderman, and then recorder of Denbigh, and was a member of parliament for that borough for a number of years.

In 1609 Myddelton took over from the corporation of London the projected scheme for supplying the city with water obtained from springs near Ware, in Hertfordshire. For that purpose he made a canal about 10 ft. wide and 4 ft. deep and more than 38 mi. in length, which discharged its waters into a reservoir at Islington called the New River Head. The work was completed in 1613. Myddelton also worked lead and silver mines in Cardiganshire and reclaimed a piece of the Isle of Wight from the sea.

He died on Dec. 10, 1631, and was buried at St. Matthew's, Friday street, London.

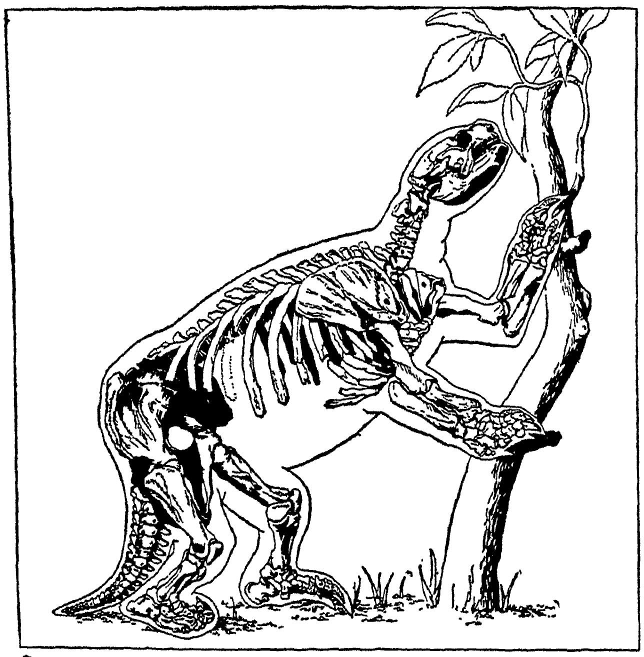
MYELITIS, from the Greek word meaning marrow, is used in medicine in accordance with the significance of the root and ending to mean an inflammation of the marrow of the bone as osteomyelitis or of the spinal cord as in poliomyelitis. A large number of descriptive adjectives are used to describe more accurately the various types of disorders involving the spinal cord. (*See* BONE, DISEASES AND INJURIES OF; NERVOUS SYSTEM; SPINAL CORD, etc.) (F. L. A.)

MYERS, FREDERIC WILLIAM HENRY (1843–1901), English poet and essayist, son of Frederic Myers, was born at Keswick, Cumberland, on Feb. 6, 1843, and educated at Cheltenham and Trinity college, Cambridge, where he was appointed classical lecturer in 1865. He had no love for teaching, which he soon discontinued, but he took up his permanent abode at Cambridge in 1872, when he became a school inspector under the education department. He published poems, for instance *St. Paul,* but is more likely to be remembered by his *Essays, Classical and Modern* (2 vol., 1883). The essay on Virgil, by far the best

thing he ever wrote, represents the matured enthusiasm of a student and a disciple to whom the exquisite artificiality and refined culture of Virgil's method were profoundly congenial. In 1882 Myers led a small band of explorers (including Henry Sidgwick and Richard Hodgson, Edmund Gurney and F. Podmore), who founded the Society for Psychical Research. He was the mouthpiece of the society, and steered a middle couse between extremes. He helped to revise the cumbrous mass of *Proceedings,* the chief concrete results being the two volumes of *Phantasms of the Living* (1886). His *Human Personality and its Survival of Bodily Death* (2 vols. 1903) was described by William James as "the first attempt to consider the phenomena of hallucination, hypnotism, automatism, double personality and mediumship, as connected parts of one whole subject." Also there was *Science and a Future Life* (1893). He died at Rome on Jan. 17, 1901, but was buried in his native soil at Keswick.

MYLIUS-ERICHSEN, LUDWIG (1872–1907), Danish explorer, was born at Viborg, Jutland, on Jan. 15, 1872. He made two notable expeditions to Greenland in 1902–04 and in 1906. The first of these yielded much valuable ethnographical information; the second provided increased geographical knowledge of the eastern coast. The explorer died as a result of the hardships he had suffered, on Nov. 25, 1907.

MYLODON, type of family of large ground sloths characteristic of the Pleistocene of the new world. *Paramylodon* was of the size of a rhinoceros, with short stout limbs, very large digging claws, five digits on each foot, but the outer ones had no claws, a broad body and massive tail. It walked on the outer edge of the sole, both fore and hind foot (compare fore foot of modern anteater). The head was rather long, with wide blunt muzzle, no front teeth, and moderately large prismatic cheek teeth, five above and four below on each side. In cross section the more anterior teeth were rounded oval, while the posterior ones were progressively larger and more elaborate, the last molar always two- or three-lobed. The skin was probably like that of the genus Mylodon itself, in which, as shown by specimens from a cave off



SKELETON OF GLOSSOTHERIUM ROBUSTUM (PLEISTOCENE, SOUTH AMERICA)

the Straits of Magellan, the skin was studded with bony ossicles and covered with heavy coarse brown hair.

Paramylodon and its ally *Glossotherium* ranged from Canada to Patagonia, and many complete skeletons have been found in Argentina, California and the central United States. A number of related genera are also found in the Pleistocene of South America. *Lestodon* has the front pair of teeth enlarged as tusks and a flaring, bell-shaped muzzle. *Scelidotherium* has a much more elongate skull, narrower body and more reduction and specialization in the toes. These with some other less known genera form the family Mylodontidae, whose ancestry can be traced back to the Miocene in Patagonia although not so well known as the related Megatheriidae. These small Miocene ground sloths come near to being ancestors of the modern tree sloths as well; they likewise approach the anteaters in various particulars and suggest a more remote affinity to the armadillos. (W. D. M.; X.)

MYLONITE, in petrology, a rock which has been crushed and ground down by earth movement and at the same time rendered compact by pressure. Mylonites are fine-grained, sometimes even flinty, in appearance, and often banded in parallel fashion with stripes of varying composition. The great majority are quartzose rocks, such as quartzite and quartz-schist; but in almost any type of rock mylonitic structure may be developed. Gneisses of various kinds, hornblende-schists, chlorite-schists and limestones are not infrequently found in belts of mylonitic rock. The process of crushing by which mylonites are formed is known also as "granulitization" and "cataclasis," and mylonites are often described as granulites, though the two terms are not strictly equivalent in all their applications. Mylonites occur in regions where there have been intense earth movements. Thrust planes and great reversed faults are often bounded by rocks which have all been crushed to fine slabby mylonites, that split readily along planes parallel to the direction in which movement has taken place. These "crush belts" may be only a few feet or several hundred yards broad. The movements have probably taken place slowly without great rise of temperature, and hence the rocks have not recrystallized to any extent.

MYMENSINGH, a town and district of British India, in the Dacca division of Bengal. The town (formerly known as Nasirabad) is situated on an old channel of the Brahmaputra, and has a station of the Eastern Bengal State railway. Pop. (1941) 52,950. The District of Mymensingh, with an area of 6,156 sq mi. and a population (1941) of 6,023,758, is the largest district in India, and its administration is an onerous charge. It occupies a portion of the alluvial valley of the Brahmaputra east of the main channel (called the Jamuna) and north of Dacca, for the most part level and open, covered with well-cultivated fields, and intersected by numerous rivers. The Madhupur jungle is a slightly elevated tract, extending from the north of Dacca district into the heart of Mymensingh; its average height is about 60 ft. above the level of the surrounding country, and it nowhere exceeds 100 ft. This tract divides Mymensingh into two distinct parts. On the west is an alluvial plain watered by the Jamuna; the eastern area is fertilized by the Surma or Meghna, the old Brahmaputra and other streams, and contains extensive marshes, which are under water for eight months in the year and are grazing grounds for cattle for the other four months. The only other elevated tract in the district is on the southern border, where the Susang hills rise. The Jamuna forms the western boundary for a course of 94 mi.; during the rainy season it expands in many places to 5 or 6 mi. in breadth. The Brahmaputra formerly flowed through Mymensingh till it joined the Meghna a little below Bhairab Bazar, but over a century ago the formation of bars of sand in the upper part of its course diverted the main volume of water into the present channel of the Jamuna. The staple crop is rice. A branch line of the Eastern Bengal State railway runs north from Dacca through Mymensingh, which is also connected with Jagannathganj and Bhairab Bazar.

MYNAH, the name given to several birds of the starling family (*sturnidae*). The Indian house mynah (*Acridotheres tristis*) is a well-known bird in the east and has been introduced into Australia and New Zealand. Somewhat larger than a thrush, with brown plumage, except for a black head and white on the wings and tail, the house mynah is easily domesticated and will learn to talk. The true talking mynah (*Gracula religiosa*) is, however, a very different bird. (*See* GRACKLE.)

MYRA (mod. *Dembre*), an ancient town of Lycia situated a short distance inland between the rivers Myrus and Andracus. Its early history is obscure. St. Paul touched Myra on his last journey westward, and changed into "a ship of Alexandria sailing

into Italy." In the 3rd century St. Nicholas, of Patara, was its bishop. Theodosius II made Myra the Byzantine capital of Lycia, and as such it was besieged and taken by Harun al-Rashid in 808. The town seems shortly afterwards to have decayed. A small Turkish village occupied the plain at the foot of the acropolis, and a little Greek monastery lay about a mile westward by the church of St. Nicholas. The latter has formed the nucleus of modern Dembre. The western scarp of the acropolis has been sculptured into a number of sepulchres imitating wooden houses with pillared façades, some of which have pediment reliefs and inscriptions in Lycian. The theatre lies at the foot of this cliff and is partly excavated out of it, partly built. The church of St. Nicholas lies out in the plain, at the western end of Dembre. Its floor is far below the present level of the plain, and until recently the church was half filled with earth. There are also extensive ruins of Andriaca, the port of Myra, about 3 mi. west, containing churches, baths and a great grain store, inscribed with Hadrian's name. They lie along the course of the Andraki river, whose navigable estuary is still fringed with ruined quays.

MYRIAPODA. A group of terrestrial Arthropoda, comprising the Chilopoda (centipedes, *q.v.*), Diplopoda (millipedes, *q.v.*), Pauropoda (*q.v.*) and Symphyla (*q.v.*). The name was originally used by Pierre Latreille (1796) to embrace the centipedes and millipedes, which, with certain Crustacea, he ranked as an order under the Insecta. Subsequently William Leach (1814) restricted the term to the centipedes and millipedes, raising the group to the rank of a class, of equal status with insects and Crustacea, the Pauropoda and Symphyla being incorporated much later.

Since 1893 a classification of Myriapoda into Progoneata and Opisthogoneata has been widely adopted among zoologists, the Progoneata (comprising Diplopoda, Pauropoda and Symphyla) having the reproductive opening near the anterior end of the trunk, while in the Opisthogoneata (comprising the Chilopoda) it is located at its hinder end. The classification is held to imply the independent descent of the two groups from a common ancestor with multiple reproductive openings, any resemblance being therefore of a fortuitous and superficial character. The remarkable anatomical characters of the Symphyla seem, however, altogether to invalidate this classification, for, as shown by A. D. Imms (1936) and O. W. Tiegs (1940), they are surely closely related to the Insecta, even though the latter are opisthogoneate.

The Myriapoda are, indeed, by no means an unnatural assemblage of animals. A. Sedgwick, who shared this view, defined them as follows: "Tracheates with numerous and similar pedigerous segments, with one pair of antennae followed by a pair of palpless mandibles, with regularly and segmentally arranged tracheal stigmata, and with malpighian tubules. The young are, with a few exceptions, not provided with the full complement of segments at hatching." (From A. Sedgwick, *Student's Text-Book of Zoology*, by permission of The Macmillan Company, publishers.) Many of these characters, he points out, are also found in Onychophora (*q.v.*) and insects, and he is led to conclude that "the classes Insecta, Onychophora and Myriapoda are the survival of a once great and continuous group of land Arthropods, a large number of which have become extinct, leaving two groups, Insecta and Onychophora, each fairly compact and showing little variety of organization, and one, the Myriapoda, loose and heterogeneous, and with considerable gaps between the orders."

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(O. W. T.)

MYRICA, the only genus of the family Myricaceae, perhaps most nearly allied to the willows and birches. There are about 45 species widely distributed throughout the world. Well known representatives are the sweet-gale and wax myrtle (*qq.v.*).

MYRISTICACEAE, the nutmeg (*q.v.*) family, comprising 18 genera and 300 species, all tropical and especially numerous in Asia. They are trees or shrubs with evergreen leaves.

MYRMIDONES, in Homer, the inhabitants of Phthiotis in Thessaly. According to posthomeric legends their original home was Aegina, whence they crossed over to Thessaly with Peleus, but the converse view is now more generally accepted. Their name is derived from a supposed ancestor, son of Zeus and Eurymedusa, who was wooed by the god in the form of an ant (Gr. μύρμηξ); or from the repeopling of Aegina (when all its inhabitants had died of the plague) with ants changed into men by Zeus at the prayer of Aeacus, king of the island. As the fierce and devoted followers of Achilles, their name came to be used in modern times to mean subordinates who carry out orders implacably.

MYROBALANS, the name given to the astringent fruits of several species of *Terminalia,* largely used in India for dyeing and tanning and exported for the same purpose. They are large deciduous trees of the family Combretaceae. The chief kinds are the chebulic or black myrobalan, from *Terminalia chebula,* which are smooth, and the belleric, from *T. bellerica,* which are five-angled and covered with grayish down. There is also *Prunus cerasifera,* known as myrobalan and widely employed as stock for cherries.

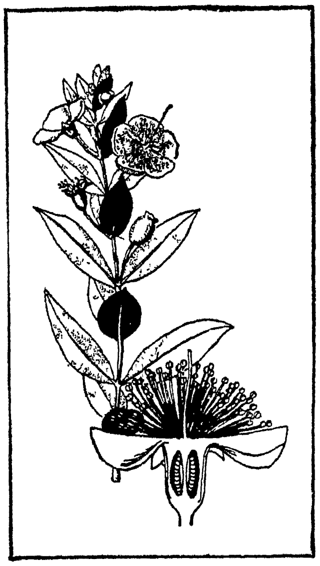
MYRRH, a gum resin (*see* RESINS), highly esteemed by the ancients as an unguent and perfume, used for incense in temples and also in embalming; it was one of the gifts offered by the Magi. True myrrh is the product of *Commiphora myrrha,* a small tree of the family Burseraceae that grows in eastern Africa and Arabia, but the name is also applied to gum resins obtained from other species of *Commiphora. Baisa bol, bhesa bol* or *bissa bol,* from *Commiphora kataf,* resembles true myrrh in appearance, but has a disagreeable taste and is scarcely bitter. It is used in China, mixed with food, to give to cows to improve the quality and increase the quantity of milk, and when mixed with lime as a size to impart a gloss to walls. Opaque bdellium produced by *C. playfairii,* when shaken with water forms a slight but permanent lather. It is known as *meena hărma* in Bombay, and was formerly used there for the expulsion of the guinea worm. African bdellium is from *C. africanum,* and like opaque bdellium lacks the white streaks which are characteristic of myrrh and bissa bol; both are acrid, but have scarcely any bitterness or aroma. Indian bdellium, probably identical with the Indian drug googul obtained in Sind and Baluchistan from *C. mukul* and *C. pubescens,* Hook, is of a dark reddish colour, has an acrid taste and an odour like cedarwood, and softens in the hand.

As met in commerce true myrrh occurs in pieces of irregular size and shape, from ½ in. to 2 or 3 in. in diameter, and of a reddish-brown colour. The transverse fracture has a resinous appearance with white streaks; the flavour is bitter and aromatic, and the odour characteristic. It consists of a mixture of resin, gum and essential oil, the resin being present to the extent of 25 to 40%, with 2½ to 8% of the oil, myrrhol, to which the odour is due.

MYRTACEAE, the myrtle or eucalyptus family, dicotyledonous trees and shrubs found in all the warmer parts of the world, especially in Australia and tropical America. There are about 90 genera and some 2,800 species, all with oil glands in the evergreen leaves. Several species yield useful timber, and *Eucalyptus* also gives oil; *Eugenia,* cloves, etc. Some have edible fruits, as *Pisidium* (guava), *Rhodomyrtus* (hill-gooseberry), various species of *Syzygium* and *Eugenia,* and *Feijoa* (pineapple guava). *Pimenta officinalis* yields allspice (*q.v.*) and *P. acris,* bay oil. (*See* EUCALYPTUS; FEIJOA; GUAVA.)

MYRTLE, the *Myrtus communis* of botanists, as now found growing wild in many parts of the Mediterranean region. It is a low-growing, evergreen shrub, with opposite leaves, varying in size, but always small, simple, dark-green, thick in texture, and studded with numerous receptacles for oil. When the leaf is held up to the light it appears as if perforated with pinholes owing to the translucency of these oil cysts. The fragrance of the plant depends upon the presence of this oil. Another peculiarity of the myrtle is the existence of a prominent vein running round the leaf within the margin. The flowers are borne on short stalks in the axils of the leaves. The fruit is a purplish berry, enclosing very numerous minute seeds. Many varieties are in cultivation. The typical species is quite hardy in the south of England. The Chilean guava (*M. ugni*), a shrub with ovate, dark-green leaves and white flowers succeeded by globular red or black glossy fruit

with a pleasant smell and taste, is a greenhouse shrub, hardy in southwest Britain. The common myrtle is the sole representative in Europe of a large genus (100 species) which has its headquarters in extra-tropical South America, while other members are found in Australia and New Zealand. The genus *Myrtus* also gives its name to a very large family, Myrtaceae (*q.v.*). Myrtle is also used for the bog myrtle (*see* SWEET-GALE), the crape myrtle (*Lagerstroemia indica*), the sand myrtle (*Leiophyllum buxifolium*), the creeping myrtle (*Vinca minor*) and many others.



MYRTLE (MYRTUS COMMUNIS), SHOWING FLOWERING BRANCH AND VERTICAL SECTION OF FLOWER

MYSIA, a district of northwest Asia Minor, bounded by Lydia and Phrygia on the south, by Bithynia on the northeast, and by the Propontis and Aegean sea on the north and west. Its precise limits are difficult to assign, the Phrygian frontier being vague and fluctuating, while in the northwest the Troad was sometimes included in Mysia, sometimes not.

The most important cities were Pergamum (*q.v.*) in the valley of the Caicus and Cyzicus (*q.v.*) on the Propontis. But the whole seacoast was studded with Greek towns, several of which were places of considerable importance; thus the northern portion included Parium, Lampsacus and Abydos, and the southern Assus, Adramyttium, and farther south, on the Elaitic Gulf, Elaea, Myrina and Cyme.

Ancient writers agree in describing the Mysians as a distinct people, like the Lydians and Phrygians, though they never appear in history as an independent nation. That they were kindred with the Lydians and Carians, is attested by their common participation in the sacred rites at the great temple of Zeus at Labranda, as well as by the statement of the historian Xanthus of Lydia that their language was a mixture of Lydian and Phrygian. Strabo was of opinion that they came originally from Thrace (*see* BITHYNIA), and were a branch of the same people as the Mysians or Moesians (*see* MOESIA) who dwelt on the Danube. The Mysians appear in the list of the Trojan allies in Homer; the first historical fact we learn is their subjugation, together with all the surrounding nations, by Croesus of Lydia. After the fall of the Lydian monarchy they remained under the Persian empire until its overthrow by Alexander; they continued to form a part of the Syrian monarchy until the defeat of Antiochus the Great (190 B.C.), after which they were transferred by the Romans to the dominion of Eumenes of Pergamum. After the extinction of the Pergamenian dynasty (130 B.C.) Mysia became a part of the Roman province of Asia.

See J. A. R. Munro in *Geogr. Journal* (1897, Hellespontica); W. von Diest, *Petermanns Mitth.* (Erganzungsheft 94, Gotha, 1889; Pergamene). *Cambridge Ancient History*, vol. iii (with bibliography).

MYSLOWICE (Ger. *Myslowitz*), a town of Poland on the river Przemsa. It is 120 mi. S.E. of Breslau by rail and an important railway junction. Pop. (1931) 22,943. It became a town in 1857 and is in an industrial area with coal mines, flax spinning and brick making. Germany took it in 1939.

MYSORE, a native state of southern India, almost surrounded by the Madras presidency, but in political relations with the governor-general. It is naturally divided into two regions of distinct character—the hill country called the Malnad, on the west, and the more open country known as the Maidan, comprising the greater part of the state, where the wide-spreading valleys and plains are covered with villages and populous towns. The drainage of the country, with a slight exception, finds its way into the Bay of Bengal, and is divisible into three great river systems—that of the Kistna on the north, the Cauvery on the south, and the Northern and Southern Penner and Palar on the east. Owing to either rocky or shallow beds none of the Mysore rivers is navigable. The main streams, especially the Cauvery and its tributaries, support an extensive system of irrigation by means of channels drawn from immense dams (*anicuts*), which retain the water at a high level and permit only the overflow to pass down stream. The streams are embanked to form reservoirs or tanks.

Mysore is a very prosperous state. Situated on a healthy plateau, it receives the benefit of both the southwest and northeast monsoons, which, in conjunction with its irrigation system, has brought it a large degree of immunity from famine. The silk industry and gold mining are very profitable, and two sandalwood-oil factories have recently been opened. Manganese, mica and steatite are worked. The famous Kolar gold fields are worked by electric power, which is conveyed for a distance of 92 mi. from the Cauvery falls. A long period of administration by British officers led to the introduction of a system based on British models, and the state has developed rapidly in recent years. Departments of industry and commerce and of agriculture have been organized, welfare work for the agricultural population undertaken, a public health institution started, and a university opened at Mysore. There is an agricultural college, and several experimental farms.

The total area of the state, including the civil and military station of Bangalore, is 29,458 sq.mi., subdivided into 8 districts, namely: Bangalore, Kolar, Tumkur, Mysore, Hassan, Kadur, Shimoga and Chitaldrug. Pop. (1941), 7,329,140. The influenza epidemic of 1918 was very serious in the state. Kanada is spoken by the majority of the people, $\frac{3}{4}$ of whom are engaged in agriculture. The proportion of Hindus, who are 16 times as numerous as the Mohammedans, shows how ineffectual was the persecution of Hyder and Tippoo. Of 87,538 Christians, over 55,000 are Roman Catholics. The finances of the state have been successfully managed under native rule, assisted by large profits from railways and gold-mines. The revenue amounts to about £2,278,000, largely derived from land, and a subsidy and peshkash of £233,333 is paid to the British government. The state maintains a military force, which numbered 2,780 in 1925. A representative assembly has been in existence since 1881. In 1923 it was placed on a statutory basis, its powers extended, and the franchise widened. There is also a legislative council of 50 members, 30 nonofficial and 20 official.

History.—In the earliest historical times the north of Mysore was held by the Kadamba dynasty, whose capital, Banawasi, is mentioned by Ptolemy; they reigned during 14 centuries, though later they became feudatories of the Chalukyas (*q.v.*). The Cheras were contemporary with the Kadambas, and governed the southern part of Mysore till they were subverted by the Cholas in the 8th century. Another ancient race, the Pallavas, held a small portion of the eastern side of Mysore, but were overcome by the Chalukyas in the 7th century. These were overthrown in the 12th century by the Ballalas (Hoysalas), an enterprising and warlike race professing the Jain faith. They ruled over the greater part of Mysore, and portions of the modern districts of Coimbatore, Salem and Dharwar, with their capital at Dwarasamudra (the modern Halebid); but in 1310 the Ballala king was captured by Malik Kafur, the general of Ala-ud-din; and 17 years later the town was entirely destroyed by another force sent by Mohammed Tughlak. After the subversion of the Ballala dynasty, a new and powerful Hindu sovereignty arose at Vijayanagar. In 1565 a confederation of the Mohammedan kingdoms defeated the Vijayanagar sovereign at the battle of Talikota. The most important of the petty local chiefs was the *wodeyar* of Mysore, who in 1610 seized the fort of Seringapatam, and so laid the foundation of the present state. His fourth successor, Chikka Deva Raja, during a reign of 34 years, made his kingdom one of the most powerful in southern India. In the middle of the 18th century the famous Mohammedan adventurer Hyder Ali (*q.v.*), usurped the throne. His dynasty, however, was as brief as it was brilliant, and ended with the defeat and death of his son Tippoo at Seringapatam in 1799. Krishnarajah Wodeyar, only five years old, was placed on the throne, and until he came of age in 1811 the state was under the administration of Purnaiya, the

Brahman minister of Hyder and Tippoo. When Krishnarajah took over the management of his state he received an orderly and contented principality with a surplus of two crores of rupees. Within twenty years he had driven his subjects into rebellion and involved himself and his state in heavy debt. The British government therefore assumed the administration in 1831, and placed it in the hands of commissioners. In 1867 it was determined to secure the continuance of native rule in Mysore and on March 25, 1881, Chamarajendra, Krishnarajah's successor, having attained the age of 18 years, was publicly entrusted with the administration of the state. He made over to the British a small tract at Bangalore, forming the "civil and military station," and received in return the island of Seringapatam. By the signing of the "instrument of transfer," the young maharajah, for himself and his successors, undertook to perform the conditions imposed upon him. The maharajah died at Calcutta on Dec. 28, 1894. His eldest son, Krishnarajah Wadiyar (1884–1940), succeeded him, and his widow, Maharani Vanivilas, was appointed regent, until in 1902 the maharajah was formally invested with full powers by the viceroy in person. In 1913 the "instrument of transfer" was replaced by a treaty. Sri Jaya Chamarajah Wadiyar (1919–) succeeded his uncle as ruler Sept. 8, 1940.

See B. L. Rice, *Mysore* (2nd ed., Bangalore, 1897); *Mysore and Coorg Gazetteer* (Calcutta, 1908); the annual *Administration Report* (Bangalore).

MYSORE, the capital of the state of Mysore, India, 10 mi. S.W. of Seringapatam on the Mysore State railway. Pop. (1941), 150,540. The city, which is spread over a large area, has its nucleus at the foot of the Chamundi hill, in a valley formed by two parallel ridges running north and south. The fort stands in the south of the town, forming a quarter by itself; the ground plan is quadrangular, each of the sides being about 450 yd. long. The palace of the maharaja within the fort contains the throne said to have been presented to Chikka Deva Raj by the emperor Aurangzeb. The houses of the European residents are for the most part east of the town. The residency or government house was built in 1805. The building afterwards used for the district offices was originally built by Colonel Wellesley (duke of Wellington) for his own occupation. The domed building for the public offices in Gordon park, the Maharajah and Maharani's training colleges, the Mary Holdsworth hospital, the fine new Palace offices and the law courts are conspicuous. A teaching and residential university was established in 1916, and the Mysore bank in 1913. There is also a chamber of commerce. Mysore, though the dynastic capital of the state, was superseded by Seringapatam as the seat of the court from 1610 to 1799, and in 1831, on the British occupation, the seat of administration was removed to Bangalore.

MYSTERY. It is necessary to differentiate *mystery*, Gr. *μυστήριον*, from its homophone, properly written *mistery*, late Lat. *ministerium*, a trade or craft; hence *mystery plays* (*see* DRAMA), those performed by trade-gilds. We must also set aside the Hellenistic meaning, common in modern languages, of "secret," "puzzling occurrence."

Properly, then, a mystery is a Greek rite which is kept secret (*μύειν*, to shut the mouth or eyes) from all save the initiated (*οἱ μύσται, οἱ μεμυημένοι*). These are specially prepared to have the secret revealed to them, under the guidance of a hierophant (*ἱεροφάντης*, "revealer of holy things"). According to Theon Smyrnaeus (*de util. math.*, p. 15, Hercher) there were four stages: (1) preliminary purification (*καθαρμός*); (2) communication of mystic knowledge, *τελετῆς παράδοσις*, presumably including a sort of sermon of instruction or exhortation; (3) *ἐποπτεία*, or revelation of the holy things, the central point of the rite; (4) the crowning or garlanding of the mystic, who was thus, as it were, badged as a privileged person. We know that the central revelation was something done (*δρώμενον*), not spoken, or not merely spoken; Lucian says (*de saltat.*, 15) that all mysteries included dancing. Hence it is usually, and reasonably, concluded that some sort of pageant or rudimentary sacred drama was shown.

We may now ask why the rites should be secret at all. A plausible but mistaken explanation has recently been revived by O. Kern (*Die Religion der Griechen*, i. 1926): the invading Hellenes oppressed, perhaps actually used religious persecution against, the earlier inhabitants of Greece, hence driving their cults into secrecy.

It might be urged in favour of this view that in Crete, according to Diodorus Siculus (v. 77, 3), rites similar to the Greek mysteries lay open to all and had nothing "mysterious" about them, and also that the *telesterion* or hall of initiation at Eleusis originates in Minoan-Mycenaean constructions, and Eleusis itself has a name probably pre-Greek (*cp.* A. W. Persson in *Archiv f. Religionswissenschaft*, xxi., p. 291 ff.; M. P. Nilsson, *Minoan-Mycenaean Religion*, 1927, p. 402, ff.); furthermore, that several survivals of things pre-Hellenic have been more or less certainly traced in the ritual of the mysteries, Eleusinian and other. But these considerations can hardly avail against the facts that the mystic deities include many undoubtedly Greek, as *Demeter, Kore, Ge, Aglauros*, the *Charites, Hecate*, and others; that the ritual is in the hands of noble and distinguished families, not of slaves or other remnants of a conquered population; and that a good magico-religious reason for secrecy can be given. The deities of these cults are one and all chthonian; these, however benevolent, are in their nature dangerous to approach; therefore, to avoid all possibility of disturbance at a critical time, it is but prudent to shroud the whole performance in secrecy, and keep the impure and unprepared at a safe distance.

For the student of Hellenism, the Eleusinian and Orphic ceremonies are of paramount importance; the Samothracian, which vied with these in attractiveness for the later Hellenic world, were not Hellenic in origin; nor wholly hellenized in character, and cannot be considered in an article of this compass.

As regards the Eleusinia, we are in a better position for the investigation of them than our predecessors were; for the modern methods of comparative religion and anthropology have at least taught us to ask the right questions and to apply relevant hypotheses; archaeology, the study of vases, excavations on the site, yielding an ever-increasing hoard of inscriptions, have taught us much concerning the external organization of the mysteries, and have shown us the beautiful figures of the deities as they appeared to the eye or to the mental vision of the initiated.

In seeking to guess what the secret of the mysteries was, we must first rid ourselves of the notion that it was any esoteric philosophy, or elaborate theology kept hidden from the world at large. Negatively, we have no jot of evidence that the initiates were more intelligent than the rest of Greece, or that their belief or practice differed from those of their fellow-countrymen to any marked degree, although there need be no doubt that a certain amount of verbal instruction was given by the hierophant (*see* below). Positively, we have the repeated insistence, from the Homeric hymn down (*hymn. Homer*, ii., 480) that the initiates saw something which greatly comforted their souls, not that they learned anything of great importance. What they saw was doubtless the sacred *dromenon*. We can realize what effect this might have on excited and believing minds, if we consider the importance, for a pious Catholic, of such impressive ceremonies as the elevation of the Host at mass.[1]

Our evidence is of two kinds. Firstly, a number of works of art show us scenes probably or certainly taken from the ritual of the Eleusinian or other mysteries. But here we may be certain that the artists, even if they themselves had no scruples, would not risk violating the deepest religious sentiments of thousands of their fellow-countrymen. Secondly, we have literary evidence. But this, if pagan, is restrained by the same reasons as the artists' from saying too much; if Christian, the writers seldom, if ever, can be shown to have been initiates themselves; some indeed cannot have been, for they were never pagans. Their

[1]This is well and sympathetically discussed by O. Kern, *Die griechischen Mysterien der klassischen Zeit* [1927], especially p. 23 ff. Aristotle [frag. 45, Rose] declares that the *mystae* learned nothing, but underwent "an experience and an influence" [*παθεῖν καὶ διατεθῆναι*;] an important testimony.

statements are generally uncritical and do not clearly differentiate between the Eleusinian mysteries and others, such as the Orphic, Sabazian, and those of Cybele and Attis.

The questions that the critical analysis of all the evidence may hope to solve are mainly these: (*a*) What do we know or what can we infer concerning the personality of the deities to whom the Eleusinian mysteries were originally consecrated, and were new figures admitted at a later period? (*b*) When was the mystery taken over by Athens and opened to all Hellas, and what was the state-organization provided? (*c*) What was the inner significance, essential content or purport of the Eleusinia, and what was the source of their great influence on Hellas? (*d*) Can we attribute any ethical value to them, and did they strongly impress the popular belief in immortality? Limits of space allow us only to adumbrate the results that research on the lines of these questions has hitherto yielded.

The paramount divine personalities of the mystery were, in the earliest period of which we have literary record, the mother and the daughter, Demeter and Kore, the latter being never styled Persephone in the official language of Eleusis; while the third figure, the god of the lower world known by the euphemistic names of Pluto (Plouton) and at one time Eubouleus, the ravisher and the husband, is an accessory personage, comparatively in the background. This is the conclusion naturally drawn from the Homeric hymn to Demeter, a composition of great ritualistic value, probably of the 7th century B.C., which describes the abduction of the daughter, the sorrow and search of the mother, her sitting by the sacred well, the drinking of the *κυκεών* or sacred cup, and the legend of the pomegranate. An ancient hymn of Pamphos, from which Pausanias freely quotes and which he regards as genuine[1], appears to have told much the same story in much the same way. As far as we can say, then, the mother and daughter were there in possession at the very beginning. The other pair of divinities known as ὁ θεός, ἡ θεά that appear in a 5th century inscription and on two dedicatory reliefs found at Eleusis, have been supposed to descend from an aboriginal period of Eleusinian religion when deities were nameless[2]. But for various reasons the contrary view is more probable, that ὁ θεός and ἡ θεά are later cult-titles of the married pair Pluto-Cora (Plouton-Kore), the personal names being omitted from that feeling of reverential shyness which was specially timid in regard to the sacred names of the deities of the underworld. And it is a fairly familiar phenomenon in Greek religion that two separate titles of the same divinity engender two distinct cults.

The question as to the part played by Dionysus in the Eleusinia is important. Some scholars, like M. Foucart, have supposed that he belonged from the beginning to the inner circle of the mystery; others that he forced his way in at a somewhat later period owing to the great influence of the Orphic sects who captured the stronghold of Attic religion and engrafted the Orphic-Sabazian *ἱερὸς λόγος*, the story of the incestuous union of Dionysus-Sabazius with Demeter-Kore, and of the death and rending of Zagreus, upon the primitive Eleusinian faith. A saner and more careful criticism rejects this view. There is no genuine trace discovered as yet in the inner circle of the mysteries of any characteristically Orphic doctrine; the names of Zagreus and Phanes are nowhere heard, the legend of Zagreus and the death of Dionysus are not known to have been mentioned there. Nor is there any print within or in the precincts of the *τελεστήριον*, the hall of the *Μύσται*, of the footsteps of the Phrygian deities, Cybele, Attis, Sabazius.

The exact relation of Dionysus to the mysteries involves the question as to the divine personage called Iacchus; who and what was Iacchus? Strabo (p. 468), who is a poor authority on such matters, describes him as "the daemon of Demeter, the founder of the leader of the mysteries." More important is it to note that "Iacchus" is unknown to the author of the Homeric hymn, and that the first literary notice of him occurs in the well-known passage of Herodotus (viii. 65), who describes the procession of the mystae as moving along the sacred way from Athens to Eleusis and as raising the cry Ἴακχε. We find Iacchus the theme of a glowing invocation in an Aristophanic Ode (*Frogs*, 324–398), and described as a beautiful "young god"; but he is first explicitly identified with Dionysus in the beautiful ode of Sophocles' *Antigone* (1119); and that this was in accord with the popular ritualistic lore is proved by the statement of the scholiast on Aristophanes (*Frogs*, 482) that the people at the Lenaea, the winter-festival of Dionysus, responded to the command of "Invoke the god!" with the invocation "Hail, Iacchus, son of Semele, thou giver of wealth!" We are sure, then, that in the high tide of the Attic religious history Iacchus was the youthful Dionysus, a name of the great god peculiar to Attic cult, and this is all that here concerns us to know.

We thus see that Iacchus was an Athenian, not an Eleusinian, god; his abiding-place was Athens, and he merely visited Eleusis for the mysteries. We may indeed conjecture that his votaries read Dionysiac interpretations into Eleusinian *dromena*. But all this is conjecture. The interpretation of what was shown would naturally change somewhat with the changing sentiment of the ages; but Demeter and Kore, *τὼ θεώ*, and no one else, are the paramount figures at Eleusis from the "Homeric" hymn to Alaric's invasion. Triptolemus the apostle of corn-culture, Eubouleus—originally a euphemistic name of the god of the under-world, "the giver of good counsel," conveying a hint of his oracular functions—these are accessory figures of Eleusinian cult and mythology that may have played some part in the great mystic drama that was enacted in the hall.

As to the history of the Eleusinian mysteries[1], the legends concerning the initiation of Heracles and the Dioscuri imply that originally they were closed to strangers, which, as they probably were in origin local rites in honour of local deities, is exactly what we should expect. But the "Homeric" hymn implies that they are open to all; with this we may connect the sagas of the conquest of Eleusis by Athens (*see* EUMOLPUS) and the early unification of Attica under Theseus (*see* CONSTITUTION OF ATHENS). By what steps the mysteries grew in importance and fame we do not know, but certainly Peisistratus paid attention to them, while Pericles found them highly important and made them more so. Decrees of his time[2] proclaim a holy truce for pilgrims to the festival and invite the subject-allies of Athens to send first-fruits of corn, a part of his imperial policy. The *μυστικὸς σηκός* at Eleusis is of his date.

At least from the 5th century onwards, Athens was in charge of the organization and external control of the mysteries, the management being in the hands of the archon basileus and a committee of four *epimeletai* (overseers) and a *paredros* (assessor). The State, as elsewhere in Greece, controlled the Church. But the priesthood was Eleusinian. Two ancient clans, the *Eumolpidai* (*see* EUMOLPUS) and the *Kerukes* (*see* HERALD) performed the whole ceremony between them; it appears that in the 4th century the *Kerukes* died out and the *Lukomidai* of Phlye took their place, perhaps bringing with them a tendency to Orphism. From the Eumolpidae was chosen the hierophant, who was so holy that his personal name was no longer used when once he was appointed, and he alone might enter the innermost shrine,—or perhaps, for the details are obscure, he and a priestess. Demeter and Kore had also each a *hierophantis* or female hierophant; considering that the Thesmophoria (*q.v.*) was entirely in the hands of women, it is not surprising that they took part in the mysteries also. The *Kerukes*, afterwards the *Lukomidai*, chose the δᾳδοῦχος or torch-bearer, who ranked next after the hierophant, from their number.

Turning now to the celebration itself, we can only sketch the more salient features here. On the 13th of Boedromion, the Attic month corresponding roughly to our September, the Ephebi (*q.v.*) marched out to Eleusis, and returned to Athens the next

[1] i. 38, 3; i. 39, 1.

[2] *See* Dittenberger, *Syll.* 83, 39; 200, 21; *C.I.G.* ii. Add. 1620c; *Ephem. archaiol.* (1886), πιν. 3; Heberdey in *Festschrift für Benndorf*, p. 3, Taf. 4; Von Prott in *Athen. Mittheil.* (1899), p. 262.

[1] To be distinguished from the Eleusinia, an important festival, but not connected with the mysteries, see *Revue des études grecques*, xxxii., p. 462.

[2] Dittenberger, *Sylloge*, 3rd. ed. 21 (=*I.G.* i. 1); 83, 30 ff.

day, bringing with them the "holy things" (ἱερά) to the "Eleusinion" in the city; these ἱερά probably included small images of the goddesses. The 16th was the day of the ἀγυρμός, the gathering of the catechumens, when they met to hear the address of the hierophant, called the πρόρρησις. This was no sermon, but a proclamation bidding those who were disqualified or for some reason unworthy of initiation to depart. The legally qualified were all Hellenes and subsequently all Romans above a certain—very youthful—limit of age, women, and as it appears even slaves; barbarians, and those uncleansed of some notorious guilt, such as homicide, were disqualified. We are sure that there was no dogmatic test, nor would time allow of any searching moral scrutiny, and only the Samothracian rites, in this respect unique in the world of classical religion, possessed a system of confessional. The hierophant appealed to the conscience of the multitude; but we are not altogether sure of the terms of his proclamation, which can only be approximately restored from late pagan and early Christian writers. We know that he demanded of each candidate that he should be "of intelligible speech (*i.e.*, Hellene) and pure of hand"; and he catechized him as to his condition of ritualistic purity— the food he had eaten or abstained from. It appears also from Libanius that in the later period at least he solemnly proclaimed that the catechumen should be "pure of soul" (*Or. Corinth,* iv. 356), and this spiritual conception of holiness had arisen already in the earlier periods of Greek religious thought. On the other hand we must bear in mind the criticism that Diogenes is said to have passed upon the Eleusinia, that many bad characters were admitted to communion, thereby securing a promise of higher happiness than an uninitiated Epameinondas could aspire to.

An essential preliminary was purification and lustration, and after the assembly the "mystae" went to the sea-shore (ἅλαδε μύσται) and purified themselves with sea-water, and probably with sprinkling of pigs' blood, a common cathartic medium. After their return from the sea, a sacrifice of some kind was offered as an essential condition of μύησις, but whether as a sacrament or gift-offering to the goddesses it is impossible to determine. On the 19th of Boedromion the great procession started along the sacred way bearing the "fair young god" Iacchus; and as they visited many shrines by the way the march must have continued long after sunset, so that the 20th is sometimes spoken of as the day of the exodus of Iacchus. On the way each wore a saffron band as an amulet; and the ceremonious reviling to which the μύσται were subjected as they crossed the bridge of the Cephissus answered the same purpose of averting the evil eye. Upon the arrival at Eleusis, on the same night or on the following, they celebrated a midnight revel under the stars with Iacchus, which Aristophanes glowingly describes.

The question of supreme interest now arises: What was the mystic ceremony in the hall; what was said and what was done? We can distinguish two grades in the celebration; the greater was the τέλεα and ἐποπτικά, the full and satisfying celebration, to which only those were admitted who had passed the lesser stage at least a year before. As regards the actual ritual in the hall of the mystae, much is still uncertain. That there was some kind of holy pageant or play, the accusations against Aeschylus and Alcibiades would suffice to prove, and Porphyry speaks of the hierophant and the δᾳδοῦχος acting divine parts. What the subject of this drama was may be gathered partly from the words of Clement—"Deo (Demeter) and Kore became the personages of a mystic drama, and Eleusis with its δᾳδοῦχος celebrates the wandering, the abduction and the sorrow" (*Protrept.*, p. 12, Potter), supported by Apuleius (*Met,* vi., 2). We may believe then that the great myth of the mother's sorrow, the loss and the partial recovery of her beloved was part of the Eleusinian passion-play. Did it also include a ἱερὸς γάμος? We should naturally expect that the sacred story acted in the mystic pageant would close with the scene of reconciliation, such as a holy marriage of the god and the goddess. But the evidence that this was so is mainly indirect, apart from a doubtful passage in Asterius, a writer of questionable authority in the 4th century A.D. (*Econom. martyr.* p. 194, Combe). At any rate, if a holy marriage formed part of the passion-play, it may well have been acted with solemnity and delicacy. We have no reason to believe that even to a modern taste any part of the ritual would appear coarse or obscene; even Clement, who brings a vague charge of obscenity against all mysteries in general, does not try to substantiate it in regard to the Eleusinia, and we hear from another Christian writer of the scrupulous purity of the hierophant.

It would be interesting to know if the birth of a holy child, a babe Iacchus, for example, was a motive of the mystic drama. The question seems at first sight to be decided by a definite statement of Hippolytus (*Philosoph.* 5, 8), that at a certain moment in the mysteries the hierophant cried aloud: "The lady-goddess Brimo has borne Brimos the holy child." But a careful consideration of the context almost destroys the value of his authority. For he does not pretend to be a first-hand witness, but admits that he is drawing from Gnostic sources, and he goes on at once to speak of Attis and his self-mutilation. The formula may then refer to the Sabazian-Phrygian mystery, which the Gnostics with their usual spirit of religious syncretism would have no scruple in identifying with the Eleusinian. And the archaeological evidence that has been supposed to support the statement of Hippolytus is deceptive.

The simple structure of the building and the absence of any reference, in the many inscriptions, to expenses for scenery or the like forbid us to suppose that there was any elaborate staging. The pageant-play produced its effect by means of gorgeous raiment, torches and stately figures.

But the mystic action included more than the pageant-play. The hierophant revealed certain holy objects to the eyes of the assembly. There is reason to suppose that these included certain primitive idols of the goddesses of immemorial sanctity; and, if we accept a statement of Hippolytus (*loc. cit.*) we must believe that the *epoptai* were also shown "that great and marvellous mystery of perfect revelation, a cut corn-stalk." The value of this definite assertion, which appears to be an explicit revelation of the secret, would be very great, if we could trust it; but unfortunately it occurs in the same suspicious context as the Brimo-Brimos formula, and we again suspect the same uncritical confusion of Eleusinian with Phrygian ritual, for we know that Attis himself was identified in his mysteries with the "reaped corn," the στάχυς ἀμητος, almost the very phrase used by Hippolytus. Only, it is in the highest degree probable, whether Hippolytus knew anything or not, that a corn-token was shown among the sacred things of a mystery which possessed an original agrarian significance and was intended partly to consecrate and to foster the agricultural life. But to say this is by no means the same as to admit the view of Lenormant[1] and Dr. Jevons[2] that the Eleusinians worshipped the actual corn, or revered it as a clan-totem. For of direct corn-worship or of totemism there is no trace either at Eleusis or elsewhere in Greece.

Among the δρώμενα or "things done" may we also include a solemn sacrament, the celebration of a holy communion, in which the votary was united to the divinity by partaking of some holy food or drink? We owe to Clement of Alexandria (*Protrept.* p. 18, Potter) an exact transcription of the pass-word of the Eleusinian mystae; it ran as follows (if we accept Lobeck's emendation of ἐγγευσάμενος for ἐργασάμενος) "I have fasted, I have drunk the barley-drink, I have taken (the things) from the sacred chest, having tasted therof I have placed them into the basket and again from the basket into the chest." We gather from this that some kind of sacrament was at least a preliminary condition of initiation; the mystae drank of the same cup as the goddess drank in her sorrow, partly—as we say—"in memory of her," partly to unite themselves more closely with her. We know also from an inscription that the priest of the Samothracian mysteries broke sacred bread and poured out drink for the mystae (*Arch. epigr. Mitth.*, 1882, p. 8, No. 14). But neither in these nor in the Eleusinian is there any trace of the more mystic sacramental conception, any indication that the votaries believed themselves to be partaking of the actual body of their

[1]Daremberg et Saglio, *Dictionnaire,* i., p. 1066.
[2]*Introduction to the Study of Religion.*

divinity[1], for there is no evidence that Demeter was identified with the corn, still less with the barley-meal of which the κυκεὼν was compounded. Nor is it likely that the sacrament was the pivot of the whole mystery or was part of the essential act of the μύησις itself. In the first place we have an almost certain representation of the Eleusinian sacrament on an archaic vase in Naples[2], probably of Attic *provenance*, and the artistic reproduction of a holy act would have been impious and dangerous, if this had belonged to the inner circle of the mystery. Again, there is no mention of sacrament or sacrifice among the five essential parts of μύησις given by Theo Smyrnaeus, nor in the imaginary narrative of the late rhetorician Sopatros (*Rhet. Graec.* viii, 121) who supposes the strange case of a man being initiated by the goddesses in a dream: they admit him to their full communion merely by telling him something and showing him something.

Besides the δρώμενα, then, there were also certain things said in the hall, or in the earlier stages of initiation, which we would gladly discover. Part of these were mystic formulae, one of which has been discussed already, the pass-word of the votaries. We gather also from Proclus and Hippolytus (*in Tim.* 293[c]; *Ref. Omn. Haer.* 5, 7, p. 146) that in the Eleusinian rites they gazed up to heaven and cried aloud "rain"—ὕε—and gazed down upon the earth and cried "conceive"—κύε. This ritual charm—we cannot call it prayer—descends from the old agrarian magic which underlay the primitive mystery. What else the votaries may have uttered, whether by way of thanksgiving or solemn litany, we do not know[3]. But there was also a certain ἱερὸς λόγος some exposition accompanying the unfolding of the mysteries; for it was part of the prestige of the hierophant that he was chief spokesman, "who poured forth winning utterance and whose voice the catechumen ardently desired to hear" (*Anth. Pal.*, app. 246); and Galen speaks of the rapt attention paid by the initiated "to the things done and said in the Eleusinian and Samothracian mysteries" (*De usu part.* 7. 14). But we have no trustworthy evidence as to the real content of the λόγος of the hierophant. We need not believe that the whole of his discourse was taken up with corn-symbolism, as Varro seems to imply (Aug. *de civit. Dei.* 20), or that he taught natural philosophy rather than theology, or again, the special doctrine of Euhemerus, as two passages in Cicero (*De natur. deor.* i. 42; *Tusc.* i. 13) might prompt us to suppose. His chief theme was probably an exposition of the meaning and value of the ἱερά as in an Australian initiation rite it is the privilege of the elders to explain the nature of the "churinga" to the youths. And his discourse on these may have been coloured to some extent by the theories current in the philosophic speculation of the day. But though in the time of Julian he appears to have been a philosopher of Neo-platonic tendencies, we ought not to suppose that the hierophant as a rule would be able or inclined to rise above the anthropomorphic religion of the times. Whatever symbolism attached to the ἱερά, the sacred objects shown, was probably simple and natural; for instance, in the Eleusinian, as in Egyptian eschatology, the token of the growing corn may have served as an emblem—though not a proof—of man's resurrection. The doctrine of the continuance of the soul after death was already accepted by the popular belief, and the hierophant had no need to preach it as a dogma; the votaries came to Eleusis to ensure themselves a happy immortality. And in our earliest record, the Homeric hymn, we find that the mysteries already hold out this higher promise. How, we may ask, were the votaries assured? The Egyptianizing theory of Foucart, that they were given directions and spells to take them past the terrors of the underworld, after the manner of the *Book of the Dead,* is wholly improbable. The terror of hell is not normal Greek, although something of the kind existed in Orphism; nor have we any evidence that spells of any kind were taught or that the λόγος was regarded as particularly important. If we could be sure that the Minoans had a developed eschatology (*see* Evans in *Journ. Hell. Stud.,* xlv. p. 43 ff., but *cf.* Nilsson, *Minoan-Myc. Rel.,* p. 549 ff.), we might suppose some of it to survive; but the matter is very doubtful.

The assurance of the hope of the Eleusinian votary was obtained by the feeling of friendship and mystic sympathy, established by mystic contact, with the mother and the daughter, the powers of life after death. Those who won their friendship by initiation in this life would by the simple logic of faith regard themselves as certain to win blessing at their hands in the next.

That the mysteries preached a higher morality than that of the current standard is not proved. That they exercised a direct and elevating influence on the individual character is nowhere explicitly maintained, as Diodorus (v. 49) maintains concerning the Samothracian. But on general grounds it is reasonable to believe that such powerful religious experience as they afforded would produce moral fruit in many minds. The genial Aristophanes (*Frogs,* 455) intimates as much, and Andocides (*De myster.* p. 36, § 31; p. 44, § 125) assumes that those who had been initiated would take a juster and sterner view of moral innocence and guilt.

Besides the greater mysteries at Eleusis, we hear of the lesser mysteries of Agrae on the banks of the Ilissus. Established, perhaps, originally by Athens herself at a time when Eleusis was independent and closed her rites to strangers, they became wholly subordinated to the greater, and were put under the same management and served merely as a necessary preliminary to the higher initiation into them. Sacrifice was offered to the same great goddesses at both; but we have the authority of Duris (*Athenae, 253d*), the Samian historian, and the evidence of an Attic painting, called the *pinax* of Nannion[1], that the predominant goddess in the mysteries at Agrae was Kore. And this agrees with the time of their celebration, in the middle of Anthesterion, when Kore was supposed to return in the young corn. Stephanus (*s.v.* Ἄγρα), drawing from an unknown source, declares that the Dionysiac story was the theme of their mystic drama; an isolated statement with nothing to confirm or interpret it.

The influence of Eleusis in early times must have been great, for we find offshoots of its cult, whether mystic or not, in other parts of Greece. In Boeotia, Laconia, Arcadia, Crete and Thera, Demeter was called Eleusinia, meaning in all probability "goddess of Eleusis." The initiation rites of Demeter at Celeae near Phlius, at Lerna in Argolis, and at Naples, were organized after the pattern of the Eleusinian. But of these and the other Demeter mysteries in the Greek world, there is little to record that is certain and at the same time of primary importance for the history of religion. The Arcadian city of Pheneus possessed a mystery that boasted an Eleusinian character and origin, yet in the record of it there is no mention of Kore, and we may suspect that, like other Demeter-worships in the Peloponnese, it belonged to a period when the goddess was revered as a single personality and Kore had not yet emanated from her. We know much more of the details of the great Andanian mysteries in Messenia, owing to the discovery of the important and much-discussed Andanian inscription of 91 B.C.[2]. But what we know are facts of secondary importance only. We gather from Pausanias (4. 33. 4; *cf.* 4. I. 5. and 4. 26. 8; 4. 27. 6) that the rites, which he regards as second in solemnity and prestige to the Eleusinian alone, were consecrated to the Μεγάλαι θεαί (the great goddesses) and that Kore enjoyed the mystic title of Hagnē, "the holy one." The inscription has been supposed to correct and to refute Pausanias, but it does not really controvert his statements, which are attested by other evidence; it proves only that other divinities came at

[1]This is Dr. Jevons's supposition—*op. cit.*—on which he bases an important theory of the whole Eleusinian mysteries and their intrinsic attraction.

[2](Farnell, *Cults,* vol. iii. pl. xv.[b]).

[3]The other formula which the scholiast on Plato (*Gorg.* 407 *c.*) assigns to the Eleusinian rite: "I have eaten from the timbrel, I have drunk from the cymbal, I have carried the sacred vessel, I have crept under the bridal-chamber," belongs, not to Eleusis, but, as Clement and Firmicus Maternus themselves attest, to Phrygia and to Attis.

[1]Farnell, *Cults of the Greek States,* vol. iii. p. 242, Pl. xvi.

[2]*See* Sauppe, *Mysterieninschrift von Andania; cf.* Foucart's commentary in Le Bas, *Voyage archéol.* 2, No. 326[a]; H. Collitz, *Dialect-inschriften,* 4689.

a later time to have a share in the mysteries, such as the Μεγάλοι θεοί who were probably the Cabeiri (*q.v.*). It is clear that the Andanian mysteries included a sacred drama, in which women personated the goddesses. The priestesses were married women, and were required to take an oath that they had lived "in relation to their husbands a just and holy life." We hear also of grades of initiation, purification-ceremonies, but of no sacrament or eschatologic promise; yet it is probable that these mysteries, like the Eleusinian, maintained and secured the hope of future happiness.

The Eleusinian faith is not wholly unattested by the grave-inscriptions of Hellas, though it speaks but rarely on these. The most interesting example is the epitaph of a hierophant who proclaims that he has found that "death was not an evil, but a blessing[1]."

Of equal importance for the private religion of Greece were the Orphic mystic societies, bearing a Thraco-Phrygian tradition into Greece, and associated originally with the name of Dionysus, and afterwards with Sabazius also and the later cult-ideas of Phrygia[2]. The full account of the Dionysiac mysteries would demand a critical study of the Dionysiac religion as a whole, as well as of the private sects that sprang up under its shadow. It is only possible here to indicate the salient characteristics of those which are of primary value for the history of religion.

Originally a great nature-god of the Thraco-Phrygian stock, powerful over all vegetation and especially revealing his power in the vine, Dionysus was forcing his way into Greece at least as early as the Homeric period, and by the 6th century was received into the public cults of most of the Greek communities. We can gather with some certainty or probability his aboriginal characteristics and the form of his worship. Being a god of the life of the earth, he was also a nether divinity, the lord of the world of souls, with whom the dead votary entered into privileged communion; his rites were mystic, and nightly celebrations were frequent, marked by wild ecstasy and orgiastic self-abandonment, in which the votary became at one with the divinity and temporarily possessed his powers; women played a prominent part in the ritual; a savage form of sacramental communion was in vogue, and the animal victim of whose flesh and blood the votaries partook was at times regarded as the incarnation of the divinity, so that the god himself might be supposed to die and to rise again; finally we may regard certain cathartic ideas as part of the primeval tradition of this religion. Admitted among the soberer cults of the Greek communities, it lost most of its wildness and savagery, while still retaining a more emotional ecstatic character than the rest. But this cooling process was arrested by a new wave of Dionysiac fervour that spread over Greece from the 7th century onwards, bringing with it the name of Orpheus, and engendering at some later date the Orphic brotherhoods (*thiasoi*). This religious movement may have started like the earlier one from the lands north of Greece; but Crete and even Egypt are supposed to have contributed much to the Orphic doctrine and ritual. Plato's contemptuous mention (*Rep.* 364A) of wandering Orphic initiators brings to our notice a phenomenon unknown elsewhere in Greek religion; the missionary spirit, the impulse to preach to all who would hear, which foreshadows the breaking down of the gentile religious barriers of the ancient world. And it is probable that some kind of "Orphic" propagandism, whether through books or itinerant mystery-priests, or both, had been in vogue some time before Plato. Orphism was known to Pindar (*Olym.* ii. and frags. 129-133 v. Christ) and Euripides, see *Hipp.* 952–4 and, yet more important, frag. 472 (*Nauck*) which attests the antiquity of these mystic Dionysiac associations in Crete. The initiated votary proclaims himself as sanctified to Zeus of Ida, to Zagreus and to the mountain-goddess Rhea-Cybele; he has fulfilled "the solemn rite of the banquet of raw flesh," and henceforth he "robes himself in pure white and avoids the taint of childbirth and funerals and abstains from meat." And—what is most significant—he calls himself by the very name of his god—he is himself Βάκχος. In spirit and in most of its details the passage accords well with the *Bacchae* of Euripides, which reflects not so much the public worship of Greece, but rather the mystic Dionysiac brotherhoods. Throughout this inspired drama the votary rejoices to be one with his divinity and to call himself by his name, and this mystic union is brought about partly, though Euripides may not have known it, through "the meal of raw flesh" or the drinking of the blood of the goat or the kid or the bull. The sacramental intention of this is confirmed by abundant proof; even in the state-cult of Tenedos they dressed up a bull-calf as Dionysus and reverentially sacrificed it (Ael. *Nat. an.* 12. 34); those who partook of the flesh were partaking of what was temporarily the body of their god. The Christian fathers at once express their abhorrence of this savage ὠμοφαγία and reveal its true significance (Arnob. *Adv. nat.* 5. 119); and Firmicus Maternus (*De error.*, p. 84) attests that the Cretans of his own day celebrated a funeral festival in honour of Dionysus in which they enacted the life and the death of the god in a passion-play and "rent a living bull with their teeth."

But the most speaking record of the aspirations and ideas of the Orphic mystic is preserved in the famous gold tablets found in tombs near Sybaris, one near Rome, and one in Crete. These have been frequently published and discussed; and here it is only possible to allude to the salient features that concern the general history of religion. They contain fragments of a sacred hymn that must have been in vogue at least as early as the 3rd century B.C., and which was inscribed in order to be buried with the defunct, as an amulet that might protect him from the dangers of his journey through the under-world and open to him the gates of Paradise. The verses have the power of an incantation. The initiated soul proclaims its divine descent: "I am the son of Earth and Heaven." "I am perishing with thirst, give me to drink of the waters of memory." "I come from the pure": "I have paid the penalty of unrighteousness": "I have flown out of the weary, sorrowful circle of life." His reward is assured him: "O blessed and happy one, thou hast put off thy mortality and shalt become divine." The strange formula ἔριφος ἐς γάλ' ἔπετον "I a kid fell into the milk," has been interpreted by Dieterich (*Eine Mithras-Liturgie*, p. 174) with great probability as alluding to a conception of Dionysus himself as ἔριφος, the divine kid, and to a ritual of milk-baptism in which the initiated was born again[1].

We discern, then, in these mystic brotherhoods, the germs of a high religion and the prevalence of conceptions that have played a great part in the religious history of Europe. And as late as the days of Plutarch they retained their power of consoling the afflicted (*Consol. ad. uxor.*, *c.* 10).

The Oriental mysteries, associated with Attis, Cybele, Isis and Sabazius, which invaded later Greece and early imperial Rome, were originally akin to these and contained many concepts in common with them. But their orgiastic ecstasy was more violent, and the psychical aberrations to which the votaries were prone through their passionate desire for divine communion were more dangerous. Emasculation was practised by the devotees of Attis, whatever the reason may have been[2], and the high priest himself bore the god's name. Or communion with the deity might be attained by the priest through the bath of blood in the taurobolium (*q.v.*), or by the gashing of the arm over the altar. A more questionable method which lent itself to obvious abuses, or at least to the imputation of indecency, was the simulation of a sacred marriage, in which the catechumen was corporeally united with the great goddess in her bridal chamber (Dieterich, *op. cit.* pp. 121–134). Prominent also in these Phrygian mysteries were the conception of rebirth and the belief, vividly impressed by solemn pageant and religious drama, in the death and resurrec-

[1] *Eph. arch.* (1883) p. 81.

[2] The best account of the origin and development of the Dionysiac religion is in Rohde's *Psyche*, vol. i.; for Orphic ritual and doctrine *see* Roscher's *Lexikon*, art. *Orpheus;* J. E. Harrison, *Prolegomena to the Study of Greek Religion*, pp. 455–659, with critical appendix by G. Murray on the Orphic tablets; and *cf.* ORPHEUS.

[1] *See* also C. W. Vollgraff, ἔριφος ἐς γάλ' ἔπετον (over den oorsprong der dionysische mysteriën), Amsterdam, 1924.

[2] *See* H. J. Rose in *Class. Quart.*, xviii. p. 11, ff.; A. D. Nock. in *Archiv f. Relig.*, xxiii., p. 25, ff.

tion of the beloved Attis. The Hilaria in which these were represented fell about the time of our Easter; and Firmicus Maternus reluctantly confesses its resemblance to the Christian celebration (Farnell, *Cults*, iii, 299).

The Eleusinian mysteries are far more characteristic of the older Hellenic mind. These later rites breathe an oriental spirit, and though their forms appear strange and distorted they have more in common with the subsequent religious phenomena of Christendom. And the Orphic doctrine may have even contributed something to the later European ideals of private and personal morality.*

BIBLIOGRAPHY.—C. A. Lobeck, *Aglaophamus* (1829) is still very useful for material. General discussion of the subject in M. P. Foucart, *Les grands mystères d'Eleusis* (1900); Goblet d'Alviella, *Eleusinia* (1903); L. R. Farnell, *Cults of the Greek States*, vol. iii (1906), with collection of relevant passages. Anthropological parallels, etc., A. Lang, *Myth, Ritual and Religion* (1887); Sir J. G. Frazer, *Golden Bough*, 3rd ed., especially vols. ii (1911) and vii (1912) (bibl.). *See* also DIONYSUS; DEMETER; GREAT MOTHER OF THE GODS; MITHRAS; ORPHEUS, and literature cited in text. (L. R. F.; H. J. R.)

MYSTERY STORIES. Although the "mystery story" as a minor literary genre, a convenient category for book reviewers, is not old, its origins are lost in the blackout of antiquity. Its seeds are found in the folklore of the oldest nations: little tales, hints, anecdotes, superstitions, that are as old as recorded time. They are part of ethnology, philosophy, religion; and their long growth into a department of literary art or artifice parallels the history of man's mind.

In that history the emotion of fear always has bulked large, and the oldest and strongest of man's fears is fear of the unknown. Mystery, by definition, is that which is unknown. But tied in with fear of the unknown is the emotion of curiosity concerning it; and out of that fear and curiosity perhaps was born the mystery story, at first a tale of wonder and terror concerned largely with supernatural matters. Later it became a subsidiary of romance; and in still later times, notably our own, it came to be a sort of game invented and played for intellectual relaxation and artificial excitement.

"The art of self-tormenting is an ancient one, with long and honorable literary traditions," in the words of Dorothy L. Sayers[1]; and, commenting on the present scene, she adds: "Man, not satisfied with the mental confusion and unhappiness to be derived from contemplating the cruelties of life and the riddle of the universe, delights to occupy his leisure moments with puzzles and bugaboos." More pungently, Carolyn Wells[2] has observed that "in safe surroundings people like to be frightened."

Early examples of the mystery story are to be found in the folklore of all times and races, notably in that of Egypt, China, India and the Semitic nations. Cosmic terror appears as an ingredient of this mythology in all literatures; it is probable that great tracts of it vanished in prehistoric times for lack of a written medium. Certain supernatural themes appear, with little variation, in the traditions of all nations, pointing to yet earlier stories unknown to historians. The earliest known specimens are concerned with witchcraft, fairies, vampires, werewolves, ghosts (friendly and unfriendly), wraiths of the living and similar occult phenomena, much of it still in use by contemporary practitioners.

It will not do to identify the mystery story too completely with the horror story or the tale of terror; but in its origins it was probably no more than that—before the creative impulse added riddles and puzzles ingeniously devised for their own sake. Today a mystery story is, loosely, any story containing a mystery. It may be, and frequently is, a tale of horror and terror; but it may also be a pseudoscientific fantasy, a tale of diplomatic intrigue, an affair of codes and ciphers and secret societies, a crime story or a dozen other things involving an enigma. In the beginning, however, it was a tale of spectres and the supernatural.

It will be noted that the detective story *per se* is omitted from the above list. By recent arbitrary definition, the detective story, lustiest offspring of the mystery story, is a separate and distinct division of literature, a "pure" form that demands individual consideration. However, it is obviously a mystery story; the separation is largely one of convenience.

While mystery stories cannot always be classified with exactness—since mystery is everywhere present—they may be divided, for easy understanding, into three groups: ghost stories, riddle stories and detective stories. The literature of ghosts, as already stated, is time old. The middle ages took over the dark heritage of antiquity and amplified it with academically formulated magic and cabbalism. In Germany and England particularly, the tale took on a terrible intensity and a macabre atmosphere, with its Witches' Sabbaths, Daemon Lovers, and similar paraphernalia that doubled the force of its horrors. Perhaps the ghostly angle—complicated by devils, ghouls, ruined castles, subterranean passages, and suchlike mediaeval claptrap—began to emerge most clearly as a department of romance in the 18th century, with what is called the Gothic tale.

It was invented by a worldly Englishman, Horace Walpole, whose *Castle of Otranto* (1764) may be said to have founded the horror story as a permanent form. Among his outstanding successors were Anne Radcliffe (*The Mysteries of Udolpho*, 1794), Matthew Gregory Lewis (*The Monk*, 1795), Charles Robert Maturin (*Melmoth the Wanderer*, 1820) and the early American novelist, Charles Brockden Brown. Mary Godwin Shelley, the wife of the poet, took a hand in the game, in 1817, with her famous novel *Frankenstein*, still a classic horror story, and with it introduced the pseudoscientific note—the creation out of charnel fragments of a monster that ultimately destroyed its creator.

The influence of the Gothic tale persisted well into the 19th century in the work of such writers as J. Sheridan Le Fanu and Wilkie Collins; indeed, it is obvious in Bram Stoker's gruesome vampire tale *Dracula*, published as late as the year 1891. And pseudoscientific nightmares have not ended with H. G. Wells. Greatest of all names in the field, however, is that of Edgar Allan Poe (1809–1849), who first forced the tale of mystery and horror into the artistic regions of pure literature, and invented the modern short story form. He is the classic of the genre, and his influence has been enormous in nearly all lands. His masterly stories of bizarre incident, his tales of ratiocination, his psychological studies, tales of conscience and romances of death, have made him a major prophet of literature. His most relevant successors perhaps have been Le Fanu, a strangely neglected Irish genius, Robert Louis Stevenson, Arthur Conan Doyle, Ambrose Bierce, Arthur Machen, Algernon Blackwood, Lord Dunsany and the American *fantaisiste*, H. P. Lovecraft. But any such list of masters is inevitably and unfairly incomplete—such isolated masterpieces as W. W. Jacobs' "The Monkey's Paw," have not infrequently lifted writers of a more miscellaneous genius into the front rank of mystery masters.

Riddle stories too began in time out of mind, for the enjoyment of puzzles—Miss Sayers' "art of self-tormenting"—is as old as humanity itself. But there is a practical utility in puzzle-solving, also, that no doubt was recognized by the ancients; regular exercise is as necessary for the brain as for the body. The riddle of Samson, propounded in the Bible (*Judges*, 14: 12–18), is the most famous early example; but, although Samson has been called the Father of Riddles, it may be that older and better ones were even then buried in antiquity. "Out of the eater," *etc.*, propounded about 1200 B.C., at least contains the true principle of the riddle and the riddle story: the asker already knew the solution, and that was the reason the guessers strove to attain a re-solution. In those days riddles were commonly proposed at wedding feasts and other social events, and obviously they were very popular.

Among the Egyptians puzzling was a religious rite and the Sphinx was their goddess. We are told that such was the esoteric religion of the Egyptians that all the priests were riddlers and their religion one vast enigma. The classic "riddle of the Sphinx," however, belongs to Grecian mythology. Its date is not authenticated but it wears the halo of antiquity, for Sophocles wrote about it in the 4th century B.C.

So much for antiquity: the riddle story came down the years as did the ghost story, and not infrequently the two overlapped. Its distinguishing feature, at the moment, is that the reader shall be confronted with a number of mysterious facts and situations, explanation of which is reserved until the end of the story. Unlike the pure detective story—which also, of course, is a riddle story—there may be no clues, either leading or misleading, to assist or to trick the reader. The whole operation of reading may be one of sustained wonder and abiding curiosity. Equally, however, there may be numerous clues to solution: the tale will not turn into a detective story unless there is crime and detection—*i.e.*, crime *plus* detection.

A good example of the riddle story may be one describing a search for lost treasure, in which mysterious conditions are encountered. In many such, a cipher or cryptogram is added to the business of the tale, to complicate the over-all mystery with an interior riddle that most readers find irresistibly attractive. Poe's great short story, "The Gold Bug," is a classic example of this ingenious and popular story-plot. Of another kind is Kipling's short mystery, "The Sending of Dana Da," a tale involving a plethora of cats visited upon a hater of cats. In the more sinister field of murder are innumerable tales of roguery involving mystery and crime, but without the familiar detective interludes. Two notable—almost notorious—riddle stories of modern times offered no solution to the riddle posed and gained wide attention by their novelty—"The Lady or the Tiger" by Frank R. Stockton, and "The Mysterious Card" by Cleveland Moffett.

More nearly kin to the detective story than any of these are the spy stories, the secret service stories, the tales of international intrigue and adventure that, in our own day, have been entertainingly

*See *Archiv für Religionswiss.* (1906), article by Salomon Reinach.

written and prolifically produced by such men as E. Phillips Oppenheim, John Buchan, "Francis Beeding," Valentine Williams, H. C. McNeile and William Le Queux, to name only half a dozen out of many who are typical. These stories are on the borderline between adventure and bona fide detection; in certain instances—*Bulldog Drummond, Clubfoot, et al.*—they overlap the pure detective story and almost force an entrance into the more select field. But they have been relegated to the broader acres of general mystery by detective story students and specialists who prefer their detection straight.

BIBLIOGRAPHY.—[1]Dorothy L. Sayers (ed.), *Great Short Stories of Detection, Mystery and Horror* (1928); [2]Carolyn Wells, *The Technique of the Mystery Story* (1929); H. P. Lovecraft, "The Supernatural in Fiction," *The Outsider and Others.*

Detective Stories.—The detective story, as a literary form, celebrated its 100th anniversary in April 1941. Pedantry asserts that its seeds are to be found in the earliest folklores, and it is true that the antecedents of the various motifs combined in the genre are as old as man's mental habits, of which they are in part the history. The puzzle motif is as old as the Prophets, and the Erinyes theme—revenge relentlessly tracking down the wicked—is anterior to literature. Alleged examples of the "detective story," in this prenatal sense, have been dug from the pages of Aesop, Herodotus, Cicero, Vergil and the authors of the Apocryphal Scriptures: specimens have been found in all the literatures of the East. Best of these, perhaps, is the Apocryphal account of Daniel's superb sleuthing in the story of "Bel and the Dragon," in which the prophet is shown to have anticipated Sherlock Holmes by many centuries.

Mediaeval literature also yields relevant tales and legends from the writings of Boccaccio, Chaucer and others, revealing detectival habits of thinking in certain fictive characters; and more pertinent examples are outstanding in the *Arabian Nights.* Most striking of modern prototypes is a famous chapter in Voltaire's *Zadig,* an 18th century romance in which the philosopher-hero accurately describes a lost horse and dog, although he has seen neither, by pure Holmesian deduction.

Nevertheless, the detective story as we know it was born in the pages of *Graham's Magazine,* a Philadelphia journal, in April 1841, with the publication of a short story, "The Murders in the Rue Morgue," by Edgar Allan Poe. Of this story, Dorothy L. Sayers[3] has observed that "it constitutes in itself almost a complete manual of detective theory and practice." A sequel, "The Mystery of Marie Rogêt," appeared in *Snowden's Ladies' Companion,* of New York, in the issues of November and December 1842, and February 1843. Poe's third and last pure detective story, "The Purloined Letter," was published in a Philadelphia annual, *The Gift,* for the year 1845, in which year all three stories, with others, were brought together in a book called simply, *Tales,* the most important volume in the history of the detective story. Each of the three tales celebrated an exploit of the Chevalier C. Auguste Dupin, who must be called the first fictional detective, and this for a good reason: the profession of detective had only recently been invented, and until there were detectives in the world to write about, no stories about them were possible.

If anybody preceded the American, it was Eugène François Vidocq, the reformed French thief, who established the world's first official detective bureau, at Paris in 1817, and published his *Mémoires* in 1828–29. There is no doubt that Poe read this book and was influenced by it; but presumably—and ostensibly—Vidocq's volume was a factual record of his own experience, not a fictional detective story. And if Poe drew somewhat of his inspiration from the French book—the background of his tales was the Paris of Vidocq's *Brigade de Sureté*—Dupin was no Vidocq: he was Poe, himself, in a new rôle invented for the occasion, that of the perfect reasoner, the divine amateur, later to find world popularity in the epic figure of Sherlock Holmes. It may be noted, however, that Poe did not use the word *detective* in any of his stories: that was to come later.

With Poe's three tales of ratiocination, almost miraculously the detective story sprang into flower full blown. "The extraordinary thing," says H. Douglas Thomson, in *Masters of Mystery,* "is that at its very inception the principles and canons of detective fiction writing were brilliantly conceived, even with a touch of finality." It is not known why Poe stopped at the third story: he may have tired of his creation or, as is more likely, the public response may have been lukewarm. Two other mysteries by this author, "The Gold Bug" and "Thou Art the Man," are sometimes called detective stories, but strictly speaking they are outside the canon.

Poe was ahead of his public. Twenty years were to elapse before the infant he had laboured and then deserted was adopted; and then it was by a parent from another land. The year was 1866 when Emile Gaboriau, who had been contributing stories of military and fashionable life to the Parisian newspapers, began to publish his *L'Affaire Lerouge* in *Le Pays,* and woke up one morning to find himself famous. Thereafter until his death in 1873 he was a busy man, for he had invented the *long* detective story and it was a spectacular success. Other detective novels flowed from his pen—*Le Dossier 113, Le Crime d'Orcival, Monsieur Lecoq*—and his detective creations, Père Tabaret and Lecoq, now stand with Dupin on the shelf of illustrious practitioners. Less clever than Dupin, they were more humorously alive—more recognizably human, indeed: Tabaret, the bibliomaniac amateur, Lecoq, the brilliant professional. With Dupin they are the forerunners, the immediate ancestry, of Sherlock Holmes. It is possible that Gaboriau was familiar with Poe's *Tales,* in the translation of Baudelaire (1856–57), but more likely that he was directly influenced by Vidocq, whose *Mémoires* were looted by scores of French writers of the period, among them Balzac, Hugo and Dumas. These masters, however, never wrote a detective story. Gaboriau's only relevant contemporary was his successor and imitator, Fortuné du Boisgobey, author of a line of sensational police romances, of which the first, *Le Forçat Colonel,* was published in 1872.

But before Gaboriau had ceased to write, the movement had crossed the Channel; the next landmark in detective fiction was English. In 1868, within a year of the appearance of *L'Affaire Lerouge,* a famous book was published in London—*The Moonstone,* by Wilkie Collins. An earlier masterpiece by Collins, *The Woman in White,* had appeared in 1860, but, although an excellent mystery, it was not a detective story. In *The Moonstone,* Collins wrote what many critics have called the greatest detective story of them all. However that may be—and the detection in the book is not exhibitional, but a device to catalyze the elaborate ingredients—it was the first full-length detective novel in English, and is properly a classic. With Sergeant Cuff, the professional detective who raised roses in his unprofessional moments, says Mr. Thomson,[4] "the paradox was born, the detective with a sensibility greater than his sense." With Sergeant Cuff also, it has been said, "character began to raise its head."

Throughout all these years, Charles Dickens had been writing voluminously in England, without producing a detective novel. He was, however, interested in police work and had watched the growth of England's protective system with alert appreciation of its possibilities for literature. In 1829, Sir Robert Peel had established the London metropolitan police force, with a back door opening on a spot called Scotland Yard; and in 1842 a detective branch had been added, with headquarters in the Yard itself. Thus the scene was set; and it may be said that Dickens in a sense inaugurated the long literature that followed those momentous events when, in 1853, he made his friend Inspector Field a character in *Bleak House.* However, *Bleak House* is not a detective novel. Suddenly, in the last year of his life, and probably under the influence of Collins, he began to write *The Mystery of Edwin Drood* but died with the novel half finished on his desk. The fragment was published in 1870 and remains to this day the most exasperating detective story in the world. Hundreds of literary detectives have tried to penetrate its mystery and none has succeeded. There can be little doubt, though, that the book is another landmark in this history.

In America, meanwhile, a young woman named Anna Katharine Green was getting ready to write *The Leavenworth Case,* first of a long line of melodramatic novels of crime and detection from the same hand. The book appeared in 1878 and is still its author's most famous story, although possibly not her best. It is an American classic, however, the first detective *novel* by an American and the first by a woman in any language. Stilted and old-fashioned as Miss Green's books now seem, her plots, says Howard Haycraft, in *Murder for Pleasure,* are "models of careful construction that can still hold their own against today's competition."

Two remarkable events occurred in 1887 to make that year memorable in the history of the detective story. Out of Australia came a sensational thriller, *The Mystery of a Hansom Cab,* by Fergus Hume, to become the greatest commercial success in the annals of literary crime. Issued in paper wrappers at a small figure, it is said that its first London edition of 25,000 copies was exhausted in three days. When Hume died, in 1932, more than half a million copies had gone over the counter, and all without profit to the author, who had sold the book outright for £50. This famous tale is scarcely readable today, but historically it is important; and with it survives the name of its author. Although Hume wrote more than a hundred other books after his first great triumph, he was never able to repeat his success.

That was the first event. The second was the appearance of Sherlock Holmes, still the greatest name in detective literature. His creator, Arthur Conan Doyle, was a young Scotch-Irish physician, who had been inspired by an insufficiency of patients to try his hand at writing: *A Study in Scarlet,* first of the Holmes stories, was a potboiler that brought him only £25. It appeared just before Christmas, 1887, and there was no sequel until 1890, when *The Sign of Four* was written for an American magazine. Neither story set England on fire, but both were widely pirated in America, in the absence of an international copyright act. The widespread popularity of the detective dates from July 1891, when "A Scandal in Bohemia," first of the shorter *Adventures of Sherlock Holmes,* was published in the *Strand Magazine,* to be followed by 23 others over the next two years. The last 12 became the *Memoirs of Sherlock Holmes,* and in the final story Holmes was killed off by his creator, a deed of violence that shocked the world. By that time, however, the doctor's future had been assured; he had given up medicine, and was—as he confessed—heartily tired of his famous puppet, who was obscuring his more important work in the historical field.

But public indignation harassed him until he was forced to bring Holmes back to life. In 1902 he yielded to supplication and published *The Hound of the Baskervilles,* a "reminiscence" of Sherlock Holmes; in 1905 he surrendered unconditionally, in *The Return of Sherlock Holmes,* in which he resurrected the detective with great ingenuity.

Three other volumes followed, *The Valley of Fear* in 1915, *His Last Bow* in 1917, and *The Case-Book of Sherlock Holmes* in 1927. Sir Arthur Conan Doyle died in 1930, leaving behind him the greatest reputation in the history of detective fiction, and a detective whose name bids fair to remain a permanent part of the English language.

For the inspiration that led Conan Doyle to write the tales of Sherlock Holmes we have to thank, first, his unemployment; second, his admiration for the work of Poe and Gaboriau; and last, his happy recollection of the methods and mannerisms of his old teacher, Dr. Joseph Bell of Edinburgh, who was the living prototype of the detective. Most of the stories are told by the amiable and obtuse Doctor Watson, a fictional character almost as famous and well-loved as Holmes himself. In Watson, it is fair to assume, we have a self-portrait of Dr. Conan Doyle, the impecunious Portsmouth physician who contributed them both to the gallery of immortals.

Thus, says Dorothy L. Sayers,[3] "the ball—the original nucleus deposited by Edgar Allan Poe nearly 40 years earlier—was at last set rolling. As it went, it swelled into a vast mass—it set off others—it became a spate—a torrent—an avalanche of mystery fiction." In England and America writers were quick to try their talents at the popular game, and for the most part the Sherlock model prevailed. Best of immediate imitations was *Martin Hewitt, Investigator* (1894), by Arthur Morrison, and its several sequels. Simultaneously, pseudo-scientific detection made its appearance in the tales of Mrs. L. T. Meade and her collaborators, Clifford Halifax and Robert Eustace, a series that began with *Stories from the Diary of a Doctor,* in 1894. The aestheticism of the 1890s was reflected in the genre, to some extent, in M. P. Shiel's *Prince Zaleski* (1895); and Grant Allen closed the decade with three excellent volumes, of which the best was *Hilda Wade,* published in 1900.

The 20th century opened with the Baroness Orczy's anonymous detective, *The Old Man in the Corner,* functioning brilliantly in the magazines (book publication was delayed), and between the years 1907 and 1911 three detectives of the first water appeared in covers: Dr. John Thorndyke, in R. Austin Freeman's *The Red Thumb Mark* (1907), A. E. W. Mason's Hanaud, in *At the Villa Rose* (1910) and G. K. Chesterton's Father Brown, in *The Innocence of Father Brown* (1911). Father Brown, the little English Catholic priest, has been called one of the immortals, and Thorndyke is indubitably great, a scientific investigator whose science is as sound as it is fascinating. In 1913 *Trent's Last Case,* by E. C. Bentley, was hailed by critics as one of the great masterpieces of the genre. The Sherlock Holmes period may be said to have ended, in England, with Ernest Bramah's *Max Carrados* (1914), a volume of notable short stories introducing the first *blind* detective.

The American scene, in the early years of the century, produced detective stories in number, but only a few that were important. Still remembered is the work of Jacques Futrelle, best viewed in *The Thinking Machine* (1907), and Arthur B. Reeve, whose stories in *The Silent Bullet* (1912) introduced the long series about Craig Kennedy. More important are Mary Roberts Rinehart and, perhaps, Carolyn Wells. Mrs. Rinehart's *The Circular Staircase* (1908) was the first of several books—on the borderline between detection and mystery—that helped to make her for a time the most popular of American storytellers. Miss Wells, with less talent, wrote more than 70 detective novels, most of them starring her Sherlockian creation, Fleming Stone. "High spots" of the period were *In the Fog* (1901) by Richard Harding Davis, Cleveland Moffett's *Through the Wall* (1909), *The Mystery of the Boule Cabinet* (1912) by Burton E. Stevenson and *The Achievements of Luther Trant* (1910) by William MacHarg and Edwin Balmer. In the latter book the methods of the psychological laboratory were used for the first time in fictional crime detection.

America's outstanding contribution to detective fiction, after Poe's Dupin stories, was *Uncle Abner, Master of Mysteries,* by Melville Davisson Post, which was not published until 1918; but as early as 1896 Post had begun his career in crime literature. His first attempts were stories of legal chicanery, but by 1909 his tricksy lawyers had gone over to the side of law and order and this superlative technician was moving into the field of pure detection. In the Uncle Abner stories, tales of early Virginia, he produced an American classic and added the first great American investigator to the gallery of illustrious detectives. Post's only comparable contemporary was Frederick Irving Anderson, who published just three books between 1914 and 1930, and was in consequence forgotten between volumes: his best-known work is *The Book of Murder* (1930).

Of the years between the first and second world conflicts it is difficult to write briefly. For a time, the most popular writer of detective fiction in the world probably was J. S. Fletcher, whose excellent novels were given a tremendous impetus by President Wilson's publicized pleasure in *The Middle Temple Murder* (1918). Then, in 1920, another great landmark made its appearance in England: this was *The Cask,* by Freeman Wills Crofts, a book of remarkable quality that has influenced profoundly the modern detective story as a whole. "Mr. Crofts," says John Carter,[5] "combined the elaboration of Gaboriau with an integrity of method which set an altogether new standard for the many police detectives who have followed [his] Inspector French." And the years from 1920 onward introduce, one after another, names that today are household words among readers of detective fiction: Poirot, in Agatha Christie's *Mysterious Affair at Styles* (1920); Reggie Fortune, in H. C. Bailey's *Call Mr. Fortune* (1920); Lord Peter Wimsey, in Dorothy L. Sayers' *Whose Body?* (1923); Anthony Gethryn, in Philip MacDonald's *The Rasp* (1924); Dr. Priestley, in "John Rhode's" *Paddington Mystery* (1925); Roger Sheringham, in Anthony Berkeley's *Layton Court Mystery* (1925); J. G. Reeder, in Edgar Wallace's *The Mind of Mr. J. G. Reeder* (1926).

Others who contributed notable volumes of detection in this period were Eden Phillpotts and A. A. Milne, authors more widely known in other fields. In *Enter Sir John* (1928), Clemence Dane and Helen Simpson created a popular actor-detective. Albert Campion, languid hero of a dozen distinguished books by Margery Allingham, although he made his first appearance in 1928, did not reach his peak until 1934. All in all, the third decade of the century was memorable—a golden age of the detective story.

In America also, in this decade, important deeds were accomplished: at least four fictional detectives of stature were added to the records. Chronologically, Charlie Chan was first: a new and appealing figure in the world of fantasy, he made his bow in *The House Without a Key* (1925), by Earl Derr Biggers. Five other novels now celebrate his exploits and, aided by the motion pictures, the aphoristic little Chinese-American lives in the affection of readers more surely than many better detectives.

Philo Vance, his immediate successor, is still the best American detective in the English tradition. With Vance, according to Howard Haycraft,[6] "overnight, American crime fiction came of age." Introduced in *The Benson Murder Case* (1926), by S. S. Van Dine, his later appearances broke records for detective fiction and made him for some years the most famous fictional sleuth in the world. Van Dine, his reputed creator, was in reality Willard Huntington Wright, a well-known critic of the arts—and, like his hero, a dilettante—who brought all his imposing erudition in several fields to the task of making Vance one of the immortals of detective fiction. In spite of considerable pretentiousness, and some lack of humour, it may be admitted that he succeeded.

Ellery Queen, as writer and detective, entered the field in 1929: the name is a pseudonym concealing the identities of Frederic Dannay and Manfred B. Lee; but Queen also is the central figure in the stories written under that name. Since his appearance in *The Roman Hat Mystery,* his adventures have been increasingly popular: his name is the trademark of a reliable brand of entertainment.

Last and most important of the four leading American writers of the period is Dashiell Hammett, ex-Pinkertonian and graduate of the pulp magazines, whose unsentimental narratives have established new standards of realism in the detective story field. In five novels of startling originality, backgrounded largely by the underworld of American gangsterdom, Hammett invented what has been called the hard-boiled school of crime fiction; but he did more than that—he created a definitely American *style,* separate and distinct from the English pattern which had been slavishly followed by American writers for generations. As character studies alone, it is claimed, his stories approximate capitalized Literature. His influence, however, while enormous, has not been altogether good: it has been the more meretricious of Hammett's spectacular bag of tricks that have been exploited by his less talented imitators, in particular his not infrequent salaciousness. First of the Hammett novels was *Red Harvest* (1929). His masterpiece is generally believed to be *The Maltese Falcon* (1930), one of the all-time high points in its field. His most sensationally successful story, *The Thin Man* (1932), was the last of an extraordinary quintette. As summing up his short and brilliant career critical opinion today finds that no other writer of modern times has so basically changed and influenced the detective story form.

Most popular of American writers since Hammett have been Erle Stanley Gardner, author of the persistent Perry Mason novels; Rex Stout, whose fat, orchid-raising Nero Wolfe seems to have become a permanent part of the new mythology; and Raymond Chandler, Hammett's most relevant successor. In England, the best traditions of Holmes, Thorndyke, *et al.,* have been carried on in the literate entertainments of such writers as Nicholas Blake, Michael Innes, Ngaio Marsh and Cyril Hare. A top-flight practitioner hailed on both sides of the Atlantic is the Anglo-American writer John Dickson Carr ("Carter Dickson").

On the continent of Europe, except in France, few detective stories of distinction were published at any time. Germany's efforts along the years have been abortive and ponderous; and examples of Scandinavian detective literature, although readable, are unexceptional and not strictly canonical. In France, two writers of high importance must be noted in Gaston Leroux and Maurice Leblanc. Leroux's *Le Mystère de la Chambre Jaune* (1908) has been called the masterpiece of French detective fiction. In Arsène Lupin, in the same period, Leblanc created a romantic rogue, half detective, who ranks with E. W. Hornung's Raffles in popular esteem. It was not until 1930 that a writer came to stand with Gaboriau, Leroux and Leblanc: then there appeared a figure of international interest, Georges Simenon. His masterful and masterly Inspector Maigret is now popular in 17 languages and recently has taken England and America by storm. Introduced to the English-speaking world in *The Patience of Maigret* (1940), he is the newest of the "immortals"; in the opinion of a critic, "the greatest character in detective fiction since Sherlock Holmes."

Thus the detective story's climb to the world popularity it now

enjoys is seen to have been slow until recent times. Figures indicate that from its beginnings with Poe, in 1841, up to and including the year 1920, approximately only 1300 new titles were published in English-speaking countries; whereas, from 1921 to the end of 1940 more than 8,000 new titles were published. In this summary, "dime novel" figures are included; *i.e.,* the statistics of such series as the Nick Carter and Sexton Blake libraries. The greater activity began in 1929, in which year, and the next, as many books were published as in the preceding 8 years. The most extraordinary gain was in the years 1931–40 inclusive, when some 6,000 titles were published. The peak year was 1938, a year that produced 2 volumes a day throughout its course. In the years 1931–40 about 1,100 new writers of detective stories appeared, as against an approximate 600 in the previous decade, and as against about 300 in all the preceding 80 years.

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MYSTICISM, a phase of thought, or rather perhaps of feeling, which from its very nature is hardly susceptible of exact definition. It appears in connection with the endeavour of the human mind to grasp the divine essence or the ultimate reality of things, and to enjoy the blessedness of actual communion with the Highest. The first is the philosophic side of mysticism; the second, its religious side. The first effort is theoretical or speculative; the second, practical. The thought that is most intensely present with the mystic is that of a supreme, all-pervading, and indwelling power, in whom all things are one. Hence the speculative utterances of mysticism are always more or less pantheistic in character. On the practical side, mysticism maintains the possibility of direct intercourse with this Being of beings—intercourse, not through any external media such as an historical revelation, oracles, answers to prayer, and the like, but by a species of transfusion or identification, in which the individual becomes in very truth "partaker of the divine nature." God ceases to be an object to him, and becomes an experience.

Universality.—In the writings of the mystics, ingenuity exhausts itself in the invention of phrases to express the closeness of this union. Mysticism differs, therefore, from ordinary pantheism in that its inmost motive is religious; but, whereas religion is ordinarily occupied by a practical problem and develops its theory in an ethical reference, mysticism displays a predominatingly speculative bent, starting from the divine nature rather than from man and his surroundings, taking the symbolism of religious feeling as literally or metaphysically true, and straining after the present realization of an ineffable union. The union which sound religious teaching represents as realized in the submission of the will and the ethical harmony of the whole life is then reduced to a passive experience, to something which comes and goes in time, and which may be of only momentary duration. Mysticism, it will be seen, is not a name applicable to any particular system. It may be the outgrowth of many differing modes of thought and feeling. Most frequently it appears historically, in relation to some definite system of belief, as a reaction of the spirit against the letter. When a religion begins to ossify into a system of formulas and observances, those who protest in the name of heart-religion are not unfrequently known by the name of mystics. At times they merely bring into prominence again the ever-fresh fact of personal religious experience; at other times mysticism develops itself as a powerful solvent of definite dogmas. Mysticism appears in various phases in all the higher religions known to history. Its distinctive characteristics emerge in the religions of India and Persia as well as in the faith of Islam. These subjects are dealt with elsewhere; but its relation to Judaism and the religions of Greece requires special mention here. For opposite reasons, neither the Greek nor the Jewish mind lent itself readily to mysticism: the Greek, because of its clear and sunny naturalism; the Jewish, because of its rigid monotheism and its turn towards worldly realism and statutory observance. It is only with the exhaustion of Greek and Jewish civilization that mysticism becomes a prominent factor in Western thought. It appears, therefore, contemporaneously with Christianity, and is a sign of the world-weariness and deep religious need that mark the decay of the old world. Whereas Plato's main problem had been the organization of the perfect state, and Aristotle's intellect had ranged with fresh interest over all departments of the knowable, political speculation had become a mockery with the extinction of free political life, and knowledge as such had lost its freshness for the Greeks of the Roman Empire. Knowledge is nothing to these men if it does not show them the infinite reality which is able to fill the aching void within. Accordingly, the last age of Greek philosophy is theosophical in character, and its ultimate end is a practical satisfaction. Neoplatonism seeks this in the ecstatic intuition of the ineffable One. The systematic theosophy of Plotinus and his successors does not belong to the present article, except so far as it is the presupposition of their mysticism; but, inasmuch as the mysticism of the mediaeval Church is directly derived from Neoplatonism through the speculations of the pseudo-Dionysius, Neoplatonic mysticism fills an important section in any historical review of the subject.

Neoplatonism.—Neoplatonism appears in the first half of the 3rd century, and has its greatest representative in Plotinus. He develops the Platonic philosophy into an elaborate system by means of the doctrine of emanation. The One, the Good, and the Idea of the Good were identical in Plato's mind, and the Good was therefore not deprived of intelligible essence. It was not separated from the world of ideas, of which it was represented as either the crown or the sum. By Plotinus, on the contrary, the One is explicitly exalted above the *νοῦς* and the "ideas"; it transcends existence altogether (*ἐπέκεινα τῆς οὐσίας*), and is not cognizable by reason. Remaining itself in repose, it rays out, as it were, from its own fullness an image of itself, which is called *νοῦς*, and which constitutes the system of ideas of the intelligible world. The soul is in turn the image or product of the *νοῦς*, and the soul by its motion begets corporeal matter. The soul thus faces two ways—towards the *νοῦς*, from which it springs, and towards the material life, which is its own product. Ethical endeavour consists in the repudiation of the sensible; material existence is itself estrangement from God. (Porphyry tells us that Plotinus was unwilling to name his parents or his birthplace, and seemed ashamed of being in the body.) Beyond the *καθάρσεις*, or virtues which purify from sin, lies the further stage of complete identification with God (*οὐκ ἔξω ἁμαρτίας εἶναι, ἀλλὰ θεὸν εἶναι*). To reach the ultimate goal, thought itself must be left behind; for thought is a form of motion, and the desire of the soul is for the motionless rest which belongs to the One. The union with transcendent deity is not so much knowledge or vision as ecstasy, coalescence, *contact* (*ἔκστασις, ἅπλωσις, ἀφή, Ennead.,* vi. 9. 8–9). But in our present state of existence the moments of this ecstatic union must be few and short.

It will be seen from the above that Neoplatonism is not mystical as regards the faculty by which it claims to apprehend philosophic truth. It is first of all a system of complete rationalism; it is assumed, in other words, that reason is capable of mapping out the whole system of things. But, inasmuch as a God is affirmed beyond reason, the mysticism becomes in a sense the necessary complement of the would-be all-embracing rationalism. The system culminates in a mystical act, and in the sequel, especially with Iamblichus and the Syrian Neoplatonists, mystical practice tended more and more to overshadow the theoretical groundwork.

Dionysius Areopagiticus.—It was probably about the end of the 5th century, just as ancient philosophy was dying out in the schools of Athens, that the speculative mysticism of Neoplatonism made a definite lodgment in Christian thought through the literary forgeries of the pseudo-Dionysius (*see* DIONYSIUS AREOPAGITICUS). The doctrines of Christianity were by that time so firmly established that the Church could look upon a symbolical or mystical interpretation of them without anxiety. The author of the *Theologia mystica* and the other works ascribed to the Areopagite proceeds, therefore, to develop the doctrines of Proclus with very little modification into a system of esoteric Christianity. God is the nameless and supra-essential One, elevated above goodness itself. Hence "negative theology," which ascends from the creature to God by dropping one after another

every determinate predicate, leads us nearest to the truth. The return to God (ἕνωσις, θέωσις) is the consummation of all things and the goal indicated by Christian teaching. The same doctrines were preached with more of churchly fervour by Maximus the Confessor (580–622).

The West.—St. Maximus represents almost the last speculative activity of the Greek Church, but the influence of the pseudo-Dionysian writings were transmitted to the West in the 9th century by Erigena, in whose speculative spirit both the scholasticism and the mysticism of the middle ages have their rise. Erigena translated Dionysius into Latin along with the commentaries of Maximus, and his system is essentially based upon theirs. In Erigena mysticism has not yet separated itself in any way from the dogma of the Church. There is no revulsion, as later, from dogma as such, nor is more stress laid upon one dogma than upon another; all are treated upon the same footing, and the whole dogmatic system is held, as it were, in solution by the philosophic medium in which it is presented. No distinction is drawn, indeed, between what is reached by reason and what is given by authority; the two are immediately identical for Erigena. In this he agrees with the speculative mystics everywhere, and differentiates himself from the scholastics who followed him. The chief representatives of scholasticism aim at demonstrating that the content of revelation and the teaching of reason are identical, but this is only an equation of two things which have been dealt with on the supposition that they are separate. Mysticism, on the other hand, is marked on its speculative side by even an overweening confidence in human reason; and this is pre-eminently visible in the work of Erigena. Nor need this be wondered at if we consider that the unity of the human mind with the divine is its underlying presupposition. Hence where reason is discarded by the mystic it is merely reason overleaping itself; it occurs at the end and not at the beginning of his speculations. Even then there is no appeal to authority; nothing is accepted from without. The appeal is still to the individual, who, if not by reason then by some higher faculty, claims to realize absolute truth and to taste absolute blessedness.

Anti-dialectical.—Mysticism first appears in the mediaeval Church as the protest of practical religion against the predominance of the dialectical spirit. It is so with Bernard of Clairvaux (1090–1153), who condemns Abelard's distinctions and reasonings as externalizing and degrading the faith. St. Bernard's mysticism is of a practical cast, dealing mainly with the means by which man may attain to the knowledge and enjoyment of God. Reason has three stages, in the highest of which the mind is able, by abstraction from earthly things, to rise to *contemplatio* or the vision of the divine. More exalted still, however, is the sudden *ecstatic* vision, such as was granted, for example, to Paul. This is the reward of those who are dead to the body and the world. Asceticism is thus the counterpart of medieval mysticism; and, by his example as well as by his teaching in such passages, St. Bernard unhappily encouraged practices which necessarily resulted in self-delusion. Love grows with the knowledge of its object, he proceeds, and at the highest stage self-love is so merged in love to God that we love ourselves only for God's sake or because God has loved us. "As the little water-drop poured into a large measure of wine seems to lose its own nature entirely and to take on both the taste and the colour of the wine; or as iron heated red-hot loses its own appearance and glows like fire; or as air filled with sunlight is transformed into the same brightness so that it does not so much appear to be illuminated as to be itself light—so must all human feeling towards the Holy One be self-dissolved in unspeakable wise, and wholly transfused into the will of God. For how shall God be all in all if anything of man remains in man? The substance will indeed remain, but in another form, another glory, another power" (*De diligendo Deo*, c. 10).

Mysticism was more systematically developed by Bernard's contemporary Hugh of St. Victor (1096–1141). The Augustinian monastery of St. Victor near Paris became the headquarters of mysticism during the 12th century. It had a wide influence in awakening popular piety, and the works that issued from it formed the textbooks of mystical and pietistic minds in the centuries that followed. Hugh's pupil, Richard of St. Victor, declares, in opposition to dialectic scholasticism, that the objects of mystic contemplation are partly above reason, and partly, as in the intuition of the Trinity, contrary to reason. He enters at length into the conditions of ecstasy and the yearnings that precede it. Bonaventura (1221–1274) was a diligent student of the Victorines, and in his *Itinerarium mentis ad Deum* maps out the human faculties in a similar fashion. He introduces the terms "apex mentis" and "scintilla" (also "synderesis" or συντήρησις) to describe the faculty of mystic intuition. Bonaventura runs riot in phrases to describe the union with God, and his devotional works were much drawn upon by mystical preachers.

Theology of the Heart.—From the 12th and 13th centuries onward there is observable in the different countries of Europe a widespread reaction against the growing formalism and worldliness of the Church and the scandalous lives of many of the clergy. Men began to feel a desire for a theology of the heart and an unworldly simplicity of life. In the beginning of the 13th century the foundation of the Dominican and Franciscan orders furnished an ecclesiastical and regular means of supplying the same wants, and numerous convents sprang up at once throughout Germany. The German mind was a peculiarly fruitful soil for mysticism, and a number of women appear about this time, combining a spirit of mystical piety and asceticism with sturdy reformatory zeal directed against the abuses of the time. Even before this we hear of the prophetic visions of Hildegard of Bingen (a contemporary of St. Bernard) and Elizabeth of Schönau. In the 13th century Elizabeth of Hungary, the pious landgravine of Thuringia, assisted in the foundation of many convents in the north of Germany. (For an account of the chief of these female saints *see* the first volume of W. Preger's *Geschichte der deutschen Mystik.*) Mechthild of Magdeburg appears to have been the most influential, and her book *Das fliessende Licht der Gottheit* is important as the oldest work of its kind in German. It proves that much of the terminology of German mysticism was current before Eckhart's time. Mechthild's clerico-political utterances show that she was acquainted with the "eternal gospel" of Joachim of Floris. Joachim had proclaimed the doctrine of three world-ages—the kingdom of the Father, of the Son, and of the Spirit. The reign of the Spirit was to begin with the year 1260, when the abuses of the world and the Church were to be effectually cured by the general adoption of the monastic life of contemplation.

Very similar to this in appearance is the teaching of Amalric of Bena (d. 1207); but, while the movements just mentioned were reformatory without being heretical, this is very far from being the case with the mystical pantheism derived by Amalric from the writings of Erigena. His followers held a progressive revelation of God in the ages of the Father, Son and Holy Spirit. Just as the Mosaic dispensation came to an end with the appearance of Christ, so the sacraments of the new dispensation have lost their meaning and efficacy since the incarnation of God as Holy Spirit in the Amalricans. With this opposition to the Church they combine a complete antinomianism, through the identification of all their desires with the impulses of the divine Spirit. Amalric's teaching was condemned by the Church, and his heresies led to the public burning of Erigena's *De divisione naturae* in 1225.

Eckhart.—In Meister Eckhart (? 1260–1327) the German mind definitively asserts its pre-eminence in the sphere of speculative mysticism. Eckhart was a distinguished son of the Church; but in reading his works we feel at once that we have passed into quite a different sphere of thought from that of the churchly mystics; we seem to leave the cloister behind and to breathe a freer atmosphere. The scholastic mysticism was, for the most part, practical and psychological in character. It was largely a devotional aid to the realization of present union with God; and, so far as it was theoretical, it was a theory of the faculties by which such a union is attainable. But in Eckhart the attitude of the churchman and traditionalist is entirely abandoned. His system enables him to give a profound significance to the doctrines

of the Church; but, instead of the system being accommodated to the doctrines, the doctrines—and especially the historical facts—acquire a new sense in the system, and often become only a mythical representation of speculative truth.

The political circumstances of Germany in the first half of the 14th century were in the last degree disastrous. The war between the rival emperors, Frederick of Austria and Louis of Bavaria, and the interdict under which the latter was placed in 1324 inflicted extreme misery upon the unhappy people. From some places the interdict was not removed for twenty-six years. Men's minds were pained and disquieted by the conflict of duties and the absence of spiritual consolation. The country was also visited by a succession of famines and floods, and in 1348 the Black Death swept over Europe like a terrible scourge. In the midst of these unhappy surroundings religion became more inward in men of real piety and the desire grew among them to draw closer the bonds that united them to one another. Thus arose the society of the Friends of God (*Gottesfreunde*) in the south and west of Germany, spreading as far as Switzerland on the one side and the Netherlands on the other. They formed no exclusive sect. They often took opposite sides in politics and they also differed in the type of their religious life; but they uniformly desired to strengthen one another in living intercourse with God. Among them chiefly the followers of Eckhart were to be found. Such were Heinrich Suso of Constance (1295–1366) and Johann Tauler of Strasbourg (1300–1361), the two most celebrated of his immediate disciples. It was doubtless one of the Friends who sent forth anonymously from the house of the Teutonic Order in Frankfort the famous handbook of mystical devotion called *Eine deutsche Theologie,* first published in 1516 by Luther..

Jan van Ruysbroeck (1294–1381), the father of mysticism in the Netherlands, stood in connection with the Friends of God, and Tauler is said to have visited him in his seclusion at Groenendal near Brussels. He was decisively influenced by Eckhart, though there is noticeable occasionally a shrinking back from some of Eckhart's phraseology. Ruysbroeck's mysticism is more of a practical than a speculative cast. He is chiefly occupied with the means whereby the *unio mystica* is to be attained, whereas Eckhart dwells on the union as an ever-present fact, and dilates on its metaphysical implications. Towards the end of Ruysbroeck's life, in 1378, he was visited by the fervid lay-preacher Gerhard Groot (1340–1384), who was so impressed by the life of the community at Groenendal that he conceived the idea of founding a Christian brotherhood, bound by no monastic vows, but living together in simplicity and piety with all things in common, after the apostolic pattern. This was the origin of the Brethren of the Common Lot (or Common Life). The first house of the Brethren was founded at Deventer by Gerhard Groot and his youthful friend Florentius Radewyn; and here Thomas à Kempis (*q.v.*) received his training. Similar brother-houses soon sprang up in different places throughout the Low Countries and Westphalia, and even Saxony.

Mystics and the Reformation.—It has been customary for Protestant writers to represent the mystics of Germany and Holland as precursors of the Reformation. In a sense this is true. But it would be false to say that these men protested against the doctrines of the Church in the way the Reformers felt themselves called upon to do. There is no sign that Tauler, for example, or Ruysbroeck, or Thomas à Kempis had felt the dogmatic teaching of the Church jar in any single point upon their religious consciousness. Nevertheless, mysticism did prepare men in a very real way for a break with the traditional system. Mysticism instinctively recedes from formulas that have become stereotyped and mechanical. On the other hand its claim for spiritual freedom was soon to be found in opposition also to the Reformers. The wild doctrines of Thomas Münzer and the Zwickau prophets, merging eventually into the excesses of the Peasants' War and the doings of the Anabaptists in Münster, first roused Luther to the dangerous possibilities of mysticism as a disintegrating force. He was also called upon to do battle for his principle against men like Caspar Schwenkfeld (1490–1561) and Sebastian Franck (*c.* 1499–*c.* 1543), the latter of whom developed a system of pantheistic mysticism, and went so far in his opposition to the letter as to declare the whole of the historical element in Scripture to be but a mythical representation of eternal truth. Valentin Weigel (1533–1588), who stands under manifold obligations to Franck, represents also the influence of the semi-mystical speculation that marked the transition from scholasticism to modern times. The final breakdown of scholasticism as a rationalized system of dogma may be seen in Nicolas (or Nicolaus) of Cusa (1401–1464), who insists that all real apprehension of God is by way of a "knowledge above knowledge." The influence of later mediaeval mysticism is seen in Jacob Boehme (1575–1624).

Other Forms of Mysticism.—Mysticism did not cease within the Catholic Church at the Reformation. In St. Theresa (1515–1582) and John of the Cross the counter-reformation can boast of saints second to none in the calendar for the austerity of their mortifications and the rapture of the visions to which they were admitted. But, as was to be expected, their mysticism moves in that comparatively narrow round, and consists simply in the heaping up of these sensuous experiences. The speculative character has entirely faded out of it, or rather has been crushed out by the tightness with which the directors of the Roman Church now held the reins of discipline. The gloom and harshness of these Spanish mystics are absent from the tender, contemplative spirit of François de Sales (1567–1622); and in the quietism of Mme. Guyon (1648–1717) and Miguel de Molinos (1627–1696) there is again a sufficient implication of mystical doctrine to rouse the suspicion of the ecclesiastical authorities.

In the 17th century mysticism is represented in the philosophical field by the so-called Cambridge Platonists, and especially by Henry More (1614–1687), in whom the influence of the Kabbalah is combined with a species of Christianized Neoplatonism. Pierre Poiret (1646–1719), an ardent student of Tauler and Thomas à Kempis, exhibits a violent reaction against the mechanical philosophy of Descartes, and especially against its consequences in Spinoza. The first influence of Boehme was in the direction of an obscure religious mysticism. J. G. Gichtel (1638–1710), the first editor of his complete works, became the founder of a sect called the Angel-Brethren. All Boehme's works were translated into English in the time of the Commonwealth, and regular societies of Boehmenists were formed in England and Holland. Later in the century he was much studied by the members of the Philadelphian Society, John Pordage, Thomas Bromley, Jane Lead, and others. The mysticism of William Law (1686–1761) and of Louis Claude de Saint Martin in France (1743–1803), who were also students of Boehme, is of a much more elevated and spiritual type. The "Cherubic Wanderer," and other poems, of Johann Scheffler (1624–1677), known as Angelus Silesius, are more closely related in style and thought to Eckhart than to Boehme.

The religiosity of the Quakers, with their doctrines of the "inner light" and the influence of the Spirit, has decided affinities with mysticism; and the autobiography of George Fox (1624–1691), the founder of the sect, proceeds throughout on the assumption of supernatural guidance. Stripped of its definitely miraculous character, the doctrine of the inner light may be regarded as the familiar mystical protest against formalism, liberalism, and scripture-worship. Swedenborg, though selected by Emerson in his *Representative Men* as the typical mystic, belongs rather to the history of spiritualism than to that of mysticism as understood in this article. He possesses the cool temperament of the man of science rather than the fervid Godward aspiration of the mystic proper; and the speculative impulse which lies at the root of this form of thought is almost entirely absent from his writings. Accordingly, his supernatural revelations resemble a course of lessons in celestial geography more than a description of the beatific vision.

Analysis.—The term mysticism is often extended by popular usage and philosophical partisanship to the whole activity of the German idealistic thinkers who followed Kant; but this looseness of phraseology only serves to blur important distinctions. However absolute a philosopher's idealism may be, he is erroneously styled a mystic if he moves towards his conclusions only by the

patient labour of the reason. Hegel therefore, to take an instance, can no more fitly be classed as a mystic than Spinoza can. It would be much nearer the truth to take both as types of a thoroughgoing rationalism. In either case it is of course open to anyone to maintain that the apparent completeness of synthesis really rests on the subtle intrusion of elements of feeling into the rational process. But in that case it might be difficult to find a systematic philosopher who would escape the charge of mysticism; and it is better to remain by long-established and serviceable distinctions.

So, again, when Récéjac defines mysticism as "the tendency to draw near to the Absolute in moral union by symbolic means," the definition, as developed by him, is one which would apply to the philosophy of Kant. Récéjac's interesting work, *Les Fondements de la connaissance mystique* (Eng. trans. 1899), though it touches mysticism at various points, and quotes from mystic writers, is in fact a protest against the limitations of experience to the data of the senses and the pure reason to the exclusion of the moral consciousness and the deliverances of "the heart." But such a position is not describable as mysticism in any recognized sense. On the other hand, the term is in place where the movement of revulsion from a mechanical philosophy takes the form rather of immediate assertion than of reasoned demonstration, and where the writers, after insisting generally on the spiritual basis of phenomena, either leave the position without further definition or expressly declare that the ultimate problems of philosophy cannot be reduced to articulate formulas. Examples of this are men like Novalis, Carlyle and Emerson, in whom philosophy may be said to be impatient of its own task.

Modern Studies.—Study of the subject may be said to begin with Dean Inge's Bampton Lectures on Christian Mysticism (1899). It has since been pursued along the parallel routes of psychology, history and philosophy of religion, with the result that the claim of mysticism to be regarded as a genuine form of human experience is justified. These aspects of mysticism cannot rigidly be separated, or indeed understood in isolation, each being of vital importance to the rest.

William James, in his epoch-making Gifford Lectures on *The Varieties of Religious Experience* (1902), originated the serious study of mysticism, especially from the psychological point of view, and attempted to discover its relation to other forms of consciousness. Although based on material chosen from too restricted a field, the publication of this book revolutionised the attitude of students towards religious psychology. The conception of the subconscious was now first used to provide an explanation and sanction for the ecstatic and other abnormal phenomena found in connection with mysticism, and an attempt was made to distinguish the accompaniments of genuine religious apprehension from their pathological imitations.

These researches have continued vigorously, especially in America and France. Pratt's *Religious Consciousness* (1921) represents the matured result of the movement started by James. Considerable advance has been made towards the correlation and better understanding of such types as the prophet, visionary and religious revivalist, in all of whom a strong mystical impulse is commonly at work. The hostile study of mysticism from the psychological standpoint has its chief exponent in J. H. Leuba, and to some extent in the work of experimental psychologists such as P. Janet, whilst an approach midway between the philosophical and psychological is provided by Bucke's *Cosmic Consciousness*, a curious work which has exercised considerable influence. Delacroix's sympathetic but penetrating analyses of the evolution of the great mystics have shed much light on the psychological characteristics of religious genius. Valuable studies of the nature of mystical contemplation, and restatement in modern terms of its processes, have been produced by Roman Catholic scholars, the best being those of Père Poulain, S.J.

Influence of Psychology.—The psychological study of mystical phenomena has illuminated many historical problems, especially those connected with prophecy and the origins of religious movements. The treatment of the subject in such works as Heiler's *Das Gebet* and *Der Katholizismus* or Brémond's monumental *Histoire du Sentiment religieux en France,* is symptomatic of the changed outlook. Material available for students of historical mysticism has been much enriched. Good texts and translations of many masterpieces of European mysticism have appeared, with valuable studies such as those of Abbot Butler and Rufus Jones, based on the historical method.

The changed outlook of physical science, the new understanding of its limitations and the marked revolt from 19th-century materialism, have brought about a *rapprochement* between mysticism and philosophy. Inge's *Philosophy of Plotinus* (1918) and Otto's widely discussed essay *Das Heilige* (The Idea of the Holy, 1924) show different aspects of the reaction of philosophy to mysticism. But this is also felt in the pure metaphysics of Wittgenstein, and in the inimical attitude of Croce and his school. The greatest and ultimately most influential expositions of the place of mysticism in theistic philosophy, and its limitations and rightful relation with other aspects of knowledge, are Von Hügel's *Mystical Element of Religion* and *Eternal Life.* These books have affected all modern religious thinkers, and may provide the starting-point of a critical realism harmonising the mystical, moral and intellectual approaches to reality. In America, Hocking's *Meaning of God in Human Experience* is probably the most important philosophic contribution to this subject.

Modern Practical Mysticism.—The first quarter of the 20th century saw, especially in France, a revival of genuine Christian mysticism; possibly the beginning of what later historians may recognise as a "mystical epoch." Its most impressive document is the *Spiritual Journal* of the lady known as Lucie-Christine (1844–1908), a record which bears comparison with the historical classics of mysticism. Its most striking product is the career of the hermit saint of the Sahara, Charles de Foucauld (1858–1916). These stand out among a number of more obscure personalities, such as Elizabeth de la Trinité (1880–1906) and Madeleine Sémer (1874–1921), all of whom claim and describe with a conviction and sobriety compelling respect the characteristic mystical experience and certitude. From India, the autobiography of the saintly Hindu theist Maharshi Devendranath Tagore (1817–1905), and the experiences of the Christian convert Sadhu Sundar Singh (born 1889), whose career and personality have made a widespread impression, provide unspoilt examples of first-hand mysticism, and deepen the sense of unity in the spiritual intuitions.

The revived interest in mysticism has had popular results in several directions. It has seemed to endorse the shallow eclecticism in which many escape the difficulties of belief. Its superficial peculiarities have been exploited by theosophists and other apostles of eccentric religiosity. It has produced numerous bastard cults, mostly hailing from America though often wearing Oriental disguise; cults mainly compounded of pantheism, quietism and crude autosuggestion, and offering a "mystical religion" to those seeking a spiritual home full of modern conveniences and devoid of discipline. On the other hand, its spirit has affected for good the literature and activity of the organised Churches; shifting the emphasis from tradition to experience, and bringing back into focus those mysterious realities which religious symbols and institutions seek to express.

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schichte der Deutschen Mystik (1874–93). *See* also articles on the greater mystical writers named. (A. S. P.-P.; E. Un.; X.)

MYTH AND RITUAL. The fundamental association of myth with ritual emerges clearly in the view of Robertson Smith, that in all antique religions mythology takes the place of dogma. He thought that mythology was no essential part of ancient religion for it had no sacred sanction and no binding force on the worshippers. Belief in myths was not obligatory as a part of true religion. He argued that, from the outset, ritual and practical usage were strictly speaking, the sum total of ancient religions. Political institutions are older than political theories and in like manner religious institutions are older than religious theories. Dr. Cook (*Religion of the Semites,* 3rd Edn. 1927) points out that myth and ritual often act upon each other. Some, he thinks, are based upon misunderstandings, are explanations of explanations, are the product of the more intelligent and sophisticated individuals, or have been purified of earlier crudities, while fancy and imagination have transformed them. While myths are specifically of personal interest, in general they appeal to the different types of mind in mixed communities. The views of Robertson Smith have assumed a more precise shape in the argument of Professor Radcliffe-Brown that "it is necessary to take into account the explanations given by the natives themselves. Although these explanations are not of the same kind as the scientific explanations that are the objects of research, yet they are of great importance as data. Like the civilized man of Western Europe, the savage of the Andamans seeks to rationalise his behaviour; being impelled to certain actions by mental dispositions of whose origin and real nature he is unaware, he seeks to formulate reasons for his conduct, or even if he does not when left to himself, he is compelled to when the enquiring ethnologist attacks him with questions. Such a reason as is produced by this process of rationalisation is rarely, if ever, identical with the psychological cause of the action that it justifies, yet it will nearly always help us in our search for the cause. At any rate, the reason given as explaining the action is so intimately connected with the action itself that we cannot regard any hypothesis as to the meaning of a custom as being satisfactory unless it explains, not only the custom, but also the reasons that the natives give for following it. . . . Tales that might seem merely the products of a somewhat childish fancy are very far indeed from being merely fanciful and are the means by which the Andamanese express and systematise their fundamental notions of life and nature and the sentiments attaching to these notions." (A. Radcliffe-Brown, *The Andaman Islanders,* pp. 234 and 330, 1922.)

The process of symbolic thought is of important reference to and criticism of the interpretation of "the beliefs of savages as being the result of attempts to *understand* natural facts such as dreams, death, birth, etc. Such writers assume that the savage is impelled by the same motive that so strongly dominates themselves, the desire to understand—scientific curiosity, and that such beliefs as animism or totemism are in the nature of scientific hypothesis, invented to explain the facts of dreaming and of death on the one hand, and of conception and birth on the other. If this view of the nature of primitive thought were correct it would be impossible to conceive how such inconsistencies as those that were met with among the Andamanese could be permitted. On the view that the myths of primitive society are merely the result of an endeavour to express certain ways of thinking and feeling about the facts of life which are brought into existence by the manner in which life is regulated in society, the presence of such inconsistencies need not in the least surprise us, for the myths satisfactorily fulfil their function, not by any appeal to the reasoning powers but by appealing, through the imagination, to the mind's affective dispositions." (A. Radcliffe-Brown, *The Andaman Islanders,* 1922, p. 397.)

Malinowski insists that "the function of myth, briefly, is to strengthen tradition and endow it with a greater value and prestige by tracing it back to a higher, better, more supernatural reality of ancient events." From myth spring the epic romance and tragedy. Myth, therefore, touches the deepest desires of man—his fears, his hopes, his passions, his sentiments as it validates the social order, justifies the existing social scheme and ranges from expressions of sheer artistry to legalism. (*Myth in Primitive Psychology,* 1927.)

Bibliography.—*See* the bibliographies to Egypt: *Religion* and Babylonian and Assyrian Religion; also A. B. Keith, *Indian Mythology* (1917). For China *see* J. J. M. de Groot, *Religious Systems of China* (Leyden, 1892, etc.). *See* also A. Radcliffe-Brown, *The Andaman Islanders* (1922); Baldwin Spencer, *The Arunta* (1927); R. H. Codrington, *The Melanesians* (1891); J. H. Hutton, *The Angami Nagas* (1921), *The Sema Nagas* (1921); J. P. Mills, *The Ao Nagas* (1916), *The Lhota Nagas* (1922); J. Shakespeare, *The Lushai-Kuki Clans* (1912); R. E. Enthoven, *The Folklore of Bombay* (1924); W. Crooke, *Folklore and Popular Religion of Northern India* (edit. R. E. Enthoven, 1926); E. Thurston, *Omens and Superstitions of Southern India* (1912); G. Lindblom, *The Akamba* (2nd enlarged ed., 1920); J. Roscoe, *The Baganda* (1911); E. W. Smith and A. M. Dale, *The Ila-speaking Peoples of Northern Nigeria* (1920); C. K. Meek, *The Northern Tribes of Nigeria* (2 vols., 1925); L. Tauxier, *Le Noir de Giunée* (1908), *Le Noir du Soudan* (1912), *Le Noir de Yatenga* (1917), *Le Noir de Bondoukou* (1921); W. C. Willoughby, *The Soul of the Bantu* (1928); James Frazer, *The Golden Bough* (3rd ed., 12 vols., 1907–15).

MYTHOLOGY, the science which examines μῦθοι, myths or legends of cosmogony and of gods and heroes. Mythology is also used as a term for these legends themselves. Thus when we speak of "the mythology of Greece" we mean the whole body of Greek divine and heroic and cosmogonic legends. When we speak of the "science of mythology" we refer to the various attempts which have been made to explain these ancient narratives. Very early indeed in the history of human thought men awoke to the consciousness that their religious stories were much in want of explanation. The myths of civilized peoples, as of the Aryans of India and the Greeks, contain two elements, the rational and what to modern minds seems the irrational. The rational myths are those which represent the gods as beautiful and wise. The real difficulties of mythology spring from the irrational element, which to modern minds appears senseless or repellent.

Classical mythology is discussed under Greek Religion; Roman Religion and Odysseus; Theseus; Orpheus. For other mythology consult Animism; Totemism; Lycanthropy; Metempsychosis, etc.; *see* Religion and Theology, Articles on.

MYXINE, a genus of cyclostome fishes known as slime eels. They are closely related to the hagfishes, differing in having a single external gill-opening. They have similar parasitic habits. (*See* Hagfish; Cyclostomata.)

MYXOEDEMA, the medical term for a constitutional disease (*see* Metabolic Diseases) caused by a deficiency or hypofunction of the thyroid gland, and occurring in adults; cretinism is essentially the same condition appearing in early childhood. There are two forms, myxoedema proper and operative myxoedema (*cachexia strumipriva*). (1) Myxoedema was termed "Gull's Disease" from Sir William Gull's observations in 1873. Women are more often the victims than men, in a ratio of six to one. It frequently affects members of the same family and may be transmitted through the mother; it has been observed sometimes to follow exophthalmic goitre. The symptoms are a marked increase in bulk and weight of the body, puffy appearance of skin which does not pit on pressure, the line of the features becoming obliterated and getting coarse and broad, the lips thick and nostrils enlarged, with loss of hair, subnormal temperature and marked mental changes. There is striking slowness of thought and action, the memory becomes defective, and the patient becomes irritable and suspicious. In some instances the condition progresses to that of dementia. The basal metabolic rate is very low. The thyroid gland itself is diminished in size, and may become completely atrophied and converted into a fibrous mass. The untreated disease is progressive, but the course is slow and the symptoms may extend over 12 to 15 years, death from asthenia or tuberculosis being the most frequent ending. (2) Symptoms similar to the above may follow complete removal of the thyroid gland. Kocher of Berne found that, in the total removal of the gland by operation, out of 408 cases operative myxoedema occurred in 69, but it is thought that if a small portion of the gland is left, or if accessory glands are present, these symptoms will not develop. The treatment of myxoedema, like that of cretinism, is by administration of thyroid extract.

N

IN all known alphabets the letter N has stood in close connection with M, the particular form of one being generally reflected in the other. Semitic (*nun*) and Greek (*nu*) are its predecessors. In the inscriptions from Thera the form was consistently . Other forms were from Corinth and N in the Ionic alphabet of Abu-Simbel. In the Lydian alphabet the form was , Etruscan has sometimes the curious form corresponding to its five-stroked (M). In the Italic alphabets the form of the letter followed that of M, being found in Umbrian as , in Oscan as and in Faliscan as . The Latin forms were N and .

The minuscule cursive form of the 6th century was , probably accounted for by the writing of the letter without taking the pen from the paper commencing at the top of the left-hand vertical stroke. This would cause the oblique stroke to rise from left to right instead of being downward in direction. The Carolingian hand developed the rounded minuscule form . From this derives the modern minuscule. The sound that the letter has represented throughout its history is the dental nasal, the nasals being of all sounds the least liable to change. (B. F. C. A.)

NAME OF FORM	APPROXIMATE DATE	FORM OF LETTER
PHOENICIAN	B.C. 1,200	
CRETAN	1,100-900	
THERAEAN	700-600	
ARCHAIC LATIN	700-500	
ATTIC	600	
CORINTHIAN	600	
CHALCIDIAN	600	
IONIC	403	
ROMAN COLONIAL	PRE-CLASSICAL AND CLASSICAL TIMES	
URBAN ROMAN		N
FALISCAN		
OSCAN		N
UMBRIAN		
CLASSICAL LATIN AND ONWARDS		N

DEVELOPMENT OF THE LETTER "N" FROM THE EARLIEST TIMES TO THE PRESENT DAY

NABATAEANS, a people of ancient Arabia, whose settlements gave the name of Nabatene to the border-land between Syria and Arabia from the Euphrates to the Red sea. The history of the Nabataeans cannot be carried back beyond 312 B.C., at which date they were attacked without success by Antigonus I. (*Cyclops*) in their mountain fortress of Petra.

The Nabataeans were Arabs—as their proper names show—who came under Aramaic influence. They wrote a letter to Antigonus "in Syriac letters," and Aramaic continued to be the language of their coins and inscriptions when the tribe grew into a kingdom, and profited by the decay of the Seleucids to extend its borders northward over the more fertile country east of the Jordan. They occupied Haurān, and about 85 B.C. their king Aretas (Ḥārīthath) became lord of Damascus and Coele-Syria. Allies of the first Hasmonaeans in their struggles against the Greeks (i. Macc. v. 25, ix. 35; 2 Macc. v. 8), they became the rivals of the Judaean dynasty in the period of its splendour, and a chief element in the disorders which invited Pompey's intervention in Palestine. The Roman arms were not very successful, and King Aretas retained his whole possessions, including Damascus, as a Roman vassal. (*cf.* 2 Cor. xi. 32). As "allies" of the Romans the Nabataeans continued to flourish throughout the first Christian century. Their power extended far into Arabia, particularly along the Red sea; and Petra was a meeting-place of many nations, though its commerce was diminished by the rise of the Eastern trade-route from Myoshormus to Coptos on the Nile. A sober, acquisitive, orderly people, wholly intent on trade and agriculture (Strabo, xvi. 4), they might have long been a bulwark between Rome and the wild hordes of the desert but for the short-sighted cupidity of Trajan, who reduced Petra and broke up the Nabataean nationality (A.D. 105). (*See* SEMITIC LANGUAGES.) (W. R. S.; S. A. C.)

NABBES, THOMAS (b. 1605), English dramatist, was born in humble circumstances in Worcestershire. He entered Exeter College, Oxford, in 1621, but left the university without taking a degree, and about 1630 began a career in London as a dramatist.

Nabbes's plays were collected in 1639; and *Microcosmus* was printed in Dodsley's *Old Plays* (1744). All his works, with the exception of his continuation of Knolles's history, were reprinted by A. H. Bullen in his *Old English Plays* (second series, 1887). *See* also F. G. Fleay, *Biog. Chron. of the English Drama* (1891).

NABHA, an Indian state, within the Punjab. Area 947 sq.mi. Pop. (1941) 340,044. Its territories are scattered; one section with twelve separate tracts, lies among the territories of Patiala and Jind, in the east and south of the Punjab; the other section is in the extreme southeast. Nabha is one of the Sikh states, founded by a member of the Phulkian family, which established its independence about 1763. In 1807–1808, the raja obtained British protection against threatened encroachments of Ranjit Singh. During the Mutiny in 1857 the raja showed distinguished loyalty, and was rewarded by grants of territory to the value of over £10,000. The state also did good service during World War I. The ruler in 1944 was Maharaja Pratap Singh Malvendra Bahadur (born 1919), who succeeded in 1928. He has a salute of 13 guns. The average revenue is £212,000.

The town of Nabha, founded in 1755, has a station on the North-Western railway. Population (1941) 12,704.

NÁBIGHA DHUBYÁNÍ [Ziyād ibn Muʻawīyya] (6th and 7th centuries), Arabian poet, was one of the last pre-Islamic poets.

He lived at the courts of Hira and Ghassān. In Hira he remained under Mondhir (Mundhir) III and his successor. After a sojourn at the court of Ghassān, he returned to Hira under Nu'mān. He was compelled to flee to Ghassān, but returned again about 600. About 605 he withdrew to his own tribe. The date of his death is uncertain. He wrote mainly eulogies and satires concerned with the strife of Hira and Ghassān, and of the Bani Abs and the Bani Dhubyān. He is one of the six pre-Islamic poets whose poems were collected before the middle of the 2nd century of Islam.

His poems have been edited by W. Ahlwardt in the *Diwans of the Six Ancient Arabic Poets* (London, 1870), and separately by H. Derenbourg (Paris, 1869, a reprint from the *Journal asiatique* for 1868). (G. W. T.)

NABIS, tyrant of Sparta, seized the throne after Sparta's heavy defeat by the Achaean League in 207 B.C. He seems to have put into practice the "four points" of the revolutionary programme of the day, abolition of debt, division of land, confiscation of personal property and liberation of slaves, though he does not appear to have tackled the Helot problem very completely. Whether he was the monster of cruelty represented by Polybius it is difficult to say. No revolutionary leader gets fair play from contemporary historians as a rule, and few revolutionary leaders can afford very gentle measures. In any case, he carried out more thoroughly the aims of Agis and Cleomenes, and extended his system to Argos, which was put into his hands by Philip V in 198. The Achaeans under Philopoemen first attacked him in 201, and defeated him at Scotitas. Later in 195 B.C. after the conclusion of the war with Philip the Romans under Flamininus turned their attention to the affairs of Greece. The League was unanimous for war against Nabis, and Flamininus duly undertook it. Nabis organized a vigorous defense, and raised an army of 10,000 from Sparta with the help of the enfranchised Helots. After some desultory fighting and a good deal of negotiation, Nabis obtained peace at the price of losing Argos and some harbours, and the internal affairs of Sparta were left undisturbed. As soon as the Romans had gone Nabis was embroiled with the Achaeans again. He was eventually murdered by some Aetolian auxiliaries, and Philopoemen ruthlessly suppressed one of the few whole-hearted attempts at social revolution in Greek history.

See Plutarch, *Philopoemen;* Polyb. xiii–xx; Paus. iv–viii; Liv. 31–35; W. W. Tarn, in *The Hellenistic Age* (Cambridge, 1923), and *Hellenistic Civilization* (1927).

NABOB, a corruption of the word *nawab,* a native Indian ruler. In the 18th century it was sarcastically applied to Englishmen who returned with fortunes from the east.

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NABUA, a municipality (with administrative centre and 17 *barrios* or districts) in the extreme south of the province of Camarines Sur, Luzon, Philippine Islands, on the Bikol river, a short distance north of Lake Bato. Pop. (1939) 29,433; one was white. The surrounding country produces palay (rice), maize (corn), sugar and pepper.

NACHTIGAL, GUSTAV (1834–1885), German explorer in Central Africa, son of a Lutheran pastor, was born at Eichstedt in the Mark of Brandenburg, on Feb. 23, 1834. After studying medicine at the universities of Halle, Würzburg and Greifswald he practised for some years as a military surgeon. He went to Algiers and Tunis in search of health, and took part, as a surgeon, in several expeditions into the interior. The king of Prussia sent him on a mission to the sultan of Bornu in 1869. He visited Tibesti and Borku, regions of the central Sahara then unknown to Europeans. From Bornu he went to Bagirmi, and, proceeding by way of Wadai and Kordofan, arrived at Khartum in the winter of 1874. His journey, graphically described in his *Sahara und Sudan* (3 vols., 1879–89), placed the intrepid explorer in the front rank of discoverers. Nachtigal was consul-general for the German empire at Tunis until 1884, when he was sent by Bismarck to West Africa as special commissioner, ostensibly to enquire into the condition of German commerce, but really to annex territories to the German flag. As the result of his mission Togoland and Cameroon were added to the German empire. On his return voyage he died at sea off Cape Palmas on April 20, 1885.

NADEN, CONSTANCE CAROLINE WOODHILL (1858–1889), English author, was born at Edgbaston, Birmingham, on Jan. 24, 1858, her father being an architect. In 1881 she published *Songs and Sonnets of Springtime;* in 1887, *A Modern Apostle, and other Poems.* W. E. Gladstone included her, in an article in the *Speaker,* among the foremost English poetesses of the day. She died on Dec. 23, 1889. After 1876 she had paid increasing attention to philosophy, with her friend Dr. Robert Lewins, and the two had formulated a system of their own, which they called "Hylo-Idealism." Her main ideas on the subject are contained in a posthumous volume of her essays (*Induction and Deduction,* 1890), edited by Dr. Lewins.

NADIA, a district of India, in the Presidency division of Bengal. Area, 2,879 sq.mi.; pop. (1941) 1,759,846. Standing at the head of the Gangetic delta, Nadia is an alluvial plain, the level of which has been raised by deposits of silt, so that it is subject to inundation only in years of high flood. Along the north-eastern boundary flows the main stream of the Ganges or Padma, of which the remaining rivers of the district are offshoots. The Bhagirathi on the eastern border, and the Jalangi and the Matabhanga meandering through the centre of the district, are the chief of those offshoots, called distinctively the "Nadia rivers." In former times the Nadia rivers afforded a regular means of communication between the Ganges and the seaboard; but the levels of the river beds have risen and, except in the rains, the rivers have diminished into shallow streams. The land no longer receiving a fertilizing deposit of silt, the productiveness of the soil has been reduced; this, with obstructed drainage and consequent epidemics of fever, has caused a gradual loss of population. Rice is the staple crop; but the district is not as a whole fertile, the soil being sandy. The manufacture of molasses from the juice of date palms is the principal industry.

The headquarters of the district are at Krishnagar (pop. [1941] 32,016), which contains the residence of the Maharajah of Nadia.

Nabadwip or Nadia was formerly situated on the east bank of the Bhagirathi, which has since changed its course. Population (1941) 30,583. It is celebrated for its capture by the Mohammedans in the 12th century, for the sanctity and learning of its pundits, and as the birthplace of Chaitanya, the Vaishnava reformer.

NADIR, a term used in astronomy for the point in the heavens exactly opposite to the zenith, the zenith and nadir being the two poles of the horizon; that is, the zenith is directly overhead, the nadir directly under foot. It is also used figuratively of the lowest point in a career.

NADIR SHAH GHAZI, MOHAMMED (1880–1933), King of Afghanistan, born April 10, 1880. After abdication of Amanullah (*q.v.*) in 1929, Nadir Shah defeated Habibullah, who had seized the throne, and became king. In 1933 he was assassinated. His son, Mohammed Zahir Shah, succeeded him.

NAEGELI, KARL WILHELM VON (1817–1891), Swiss botanist, was born on March 26, 1817, near Zürich. He studied botany under A. P. de Candolle at Geneva, graduated at Zürich in 1840, then devoted himself to the microscopical study of plants. Soon after graduation he became *Privatdozent* and subsequently professor extraordinary, in the University of Zürich. He was later called to fill the chair of botany in the universities of Freiburg (1852), and Munich (1858), where he died on May 10, 1891.

Naegeli made many important and varied discoveries. He extended Robert Brown's discovery of the nucleus to the principal families of Cryptogams and asserted that it is present in all plants. He investigated the "mucous layer" (*Schleimschicht*) in cells and showed this to be the living matter of the cell. This discovery was made independently and at the same time by Hugo von Mohl, who called the living substance "protoplasm." Naegeli also investigated the mode of growth in a large number of plants belonging to the algae, mosses, liverworts and angiosperms. He discovered the spermatozoids and antheridia of ferns. He also wrote papers on the anatomy of vascular plants and on the structure,

development and various forms of starch grains. In his last book he introduced the idea of a substance which he called "idioplasm" as the definite material basis of heredity.

Among his more important contributions to science were a series of papers in the *Zeitschrift für wissenschaftliche Botanik* (1844–46); *Die neuern Algensysteme* (1847); *Gattungen einzelliger Algen* (1849); *Pflanzenphysiologische Untersuchungen* (1855–58), with C. E. Cramer; *Beiträge zur wissenschaftlichen Botanik* (1858–68); a number of papers contributed to the Royal Bavarian academy of sciences, forming three volumes of *Botanische Mitteilungen* (1861–81); and, finally, his volume, *Mechanisch-physiologische Theorie der Abstammungslehre*, published in 1884.

Biographies of Naegeli are to be found in *Nature*, Oct. 16, 1891, and in *Proc. Roy. Soc.*, vol. li; see also C.-Ed. Cramer, *Leben und Wirken von Carl von Naegeli* (1896).

NAEVIUS, GNAEUS (*c.* 264–? 194 B.C.), Latin epic poet and dramatist. From a phrase in Gellius (i. 24. 1.) it has been inferred that he was born in a colony in Campania, but it seems just as probable that he was a Roman citizen. He served in the First Punic War. His career as a dramatic author began with the exhibition of a drama in or about the year 235, and continued for 30 years. Towards the close he incurred the hostility of some of the nobility, especially, it is said, of the Metelli, by the attacks which he made upon them on the stage, and at their instance he was imprisoned (Plautus, *Mil. Glor.* 211). After writing two plays during his imprisonment, in which he is said to have apologized for his former rudeness (Gellius iii. 3. 15), he was liberated through the interference of the tribunes of the commons; but he had shortly afterwards to retire from Rome (in or about 204) to Utica. His epic may have been written during his exile. Probably his latest composition was the epitaph already referred to, written like the epic in Saturnian verse:—

"Immortales mortales si foret fas flere,
Flerent divae Camenae Naevium poetam;
Itaque postquam est Orci traditus thesauro
Obliti sunt Romai loquier lingua Latina"[1]

Like Livius, Naevius professed to adapt Greek tragedies and comedies to the Roman stage. Among the titles of his tragedies are *Aegisthus, Lycurgus, Andromache* or *Hector Proficiscens, Equus Trojanus,* the last named being performed at the opening of Pompey's theatre (55). But he also produced at least two specimens of the *fabula praetexta* (national drama) one founded on the childhood of Romulus and Remus (*Lupus* or *Alimonium Romuli et Remi*), the other called *Clastidium,* which celebrated the victory of M. Claudius Marcellus over the Celts (222). But it was as a writer of comedy that he was most famous. He is placed in the canon of the grammarian Volcacius Sedigitus third (immediately after Caecilius and Plautus) in the rank of Roman comic authors. He is there characterized as ardent and impetuous in character and style. He is also appealed to as a master of his art in one of the prologues of Terence. His comedy, like that of Plautus, seems to have been rather a free adaptation of his originals than a rude copy of them, as those of Livius probably were, while the titles of most of them, like those of Plautus, are Latin. He used the stage, as it had been used at Athens, as a political arena, and his sympathies are strongly popular and anti-Senatorial. Among the few lines still remaining from his lost comedies, we seem to recognize the idiomatic force and rapidity of movement characteristic of the style of Plautus. There is also found that love of alliteration which is a marked feature in all the older Latin poets. In one considerable comic fragment attributed to him—the description of a coquette—there is great truth and shrewdness of observation. But we find no trace of the exuberant comic power and geniality of his great contemporary.

He was not only the oldest native dramatist, but the first author of an epic poem (*Bellum Punicum*)—which, by combining the representation of actual contemporary history with a mythical background, may be said to have created the Roman type of epic poetry. The earlier part of it treated of the mythical adventures of Aeneas, and the later part of the events of the First Punic War in the style of a metrical chronicle. This poem is the first appearance in Roman literature of the belief in the foundation of Rome by Aeneas. The few remaining fragments produce the impression of vivid and rapid narrative, to which the flow of the native Saturnian verse, in contradistinction to the weighty and complex structure of the hexameter, was naturally adapted.

[1]"If it were permitted that immortals should weep for mortals, the divine Camenae would weep for Naevius the poet; for since he hath passed into the treasure-house of death men have forgotten at Rome how to speak in the Latin tongue."

Fragments (dramas) in L. Müller, *Livi Andronici et Cn. Naevi Fabularum Reliquiae* (1885), and (*Bellum Punicum*) in his edition of Ennius (1884); monographs by E. Klussmann (1843); M. J. Berchem (1861); D. de Moor (1877); F. Marx, *Naevius* (Leipzig, 1911); Mommsen, *History of Rome*, bk. iii., ch. 14. On Virgil's indebtedness to Naevius and Ennius, *see* V. Crivellari, *Quae praecipue hausit Vergilius ex Naevio et Ennio* (1889).

NAEVUS, in medicine, a non-malignant tumour composed of newly-formed blood channels. Three varieties, capillary, venous, and arterial, are described, but the walls of the blood channels differ widely in their microscopic appearances from the corresponding normal vessels. The capillary naevus consists of tortuous small channels, often with relatively thick walls; it may be slightly raised above the surface of the skin (and then bleeds readily on slight injury) or flat and purple in colour, when it constitutes the "port-wine stain" or "mother's mark." The venous naevus consists of large irregular channels with very thin walls and is usually found in the subcutaneous tissue or the liver. Capillary and venous naevi are common on the face and may extend in size rapidly. The arterial naevus is rare; it pulsates and the channels may be emptied by pressure. Most naevi are so small as to call for no special treatment; if they take on growth or are initially so large as to cause disfigurement they may be treated by electro-puncture or by application of radium or carbonic-acid snow. The object desired is coagulation of the contained blood and replacement of the tumour by scar tissue. In the case of a large naevus, especially if venous, treatment may take weeks but great cosmetic improvement is usually possible.

NAGA, a municipality (with administrative centre and 11 *barrios* or districts), capital of the province of Camarines Sur, Luzon, Philippine Islands, a short distance south of San Miguel bay, on the Bikol river. Pop. (1939) 22,505; 74 were white. As early as 1573 Juan de Salcedo reached the vicinity and shortly afterward, by order of Gov. Francisco de Sande, the town of Nueva Cáceres was founded on or near the site of the native settlement which had existed there long before. The new town became the capital of Camarines province which, in 1919 was divided into Camarines Norte and Camarines Sur, Naga becoming the latter's capital. It is on the railway from Manila to the southeast and is reached on the river by small steamers from Manila and elsewhere. The surrounding region is fertile, and there are various household industries.

Bikol is the vernacular. Of the inhabitants aged 6 to 19 inclusive, 46·5% in 1939 attended school, while 63·8% of the population 10 years old and over was literate.

NAGA HILLS, a district of British India in the Surma Valley and Hill Districts division of Assam. It forms part of the mountainous borderland lying between the Brahmaputra valley and Upper Burma. Area, 4,289 sq.mi.; pop. (1941) 189,641. The whole country forms a wild expanse of forest, mountain and stream: Japvo (9,890 ft.), south of Kohima, is the highest mountain in Assam. Coal is known to exist in many localities, as well as iron ore and petroleum; a coal mine is worked by the Nazira Coal Company. The administrative headquarters of the district are at Kohima, at which is stationed a battalion of the Assam Rifles. When the British first came into contact with them, the Nagas were blood thirsty savages with a passion for head-hunting. The necessity of protecting British subjects from their ferocious raids led to punitive expeditions and the gradual occupation of the hills. A frontier district was first formed in 1866; the twelfth and last expedition came to a successful issue in 1880, after which it was decided that the Naga Hills should be administered as British territory. In 1904 some territory of the eastern Angamis, the most warlike tribe, was annexed, and during the operations of 1917–19 against the Kukis of Manipur a further tract was occupied, bringing the boundary up to Burma, north of Manipur. Since 1880 the Nagas have given no serious trouble and have been pacified and to some extent civilized. (X.)

The Nagas.—This name is used for a group of tribes inhabiting the northern part of the hills dividing Assam from Burma. Within the group are tribes of mixed origin, varying cultures, and very different physique and appearance, but having enough in common to make it generally possible to say, within the area indicated, whether a given tribe is Naga (as distinct from Kachin, Kuki, Kachari, etc.) or not.

Every sort of political organization is found from the autocracy of tabued chiefs (Konyak tribes) though gerontocracy (Ao tribe) to purest democracy (Angami tribe). Socially patrilineal exogamy is everywhere the rule, but there are indications of the pre-existence of matrilineal and perhaps totemistic systems and of leviritical polyandry. Dual organization (*q.v.*) is found and communal houses for the unmarried. Some tribes (*e.g.*, Sema, Chang) practice polygyny; monogamy is more common, divorce being easy and frequent. Inheritance of land always passes in the male line.

Agriculture is practised by all tribes, some growing rice on elaborately built up and irrigated terraces (Angami, Tangkhul), others growing it dry, and others using millet, *Coix lachryma* or taro as the staple crop, with maize, sorghum, yams and sago as subsidiary. Millet is often grown on dry terraces among pollarded alders; cotton is grown, cattle are kept and numbers of mithun (*bos frontalis*), which has generally but not everywhere displaced the buffalo. Dogs are reared for food (*see* CYNOTHERAPY) as well as hunting. Fishing is practised, particularly with the use of intoxicants which kill or incapacitate the fish. Manufactures and the arts include weaving (on simple tension looms), dyeing, potmaking, blacksmith's work and rough wood-carving. Material culture shows many links with Indonesia and Melanesia, and the northern tribes make huge wooden xylophones, membraneless "drums" often suggestive of dug-out canoes with carved figureheads, which are beaten to raise an alarm or celebrate important events. The prevailing weapon is the throwing-spear, but crossbows are used by some tribes, also guns. Music and dancing are most highly developed in the southern tribes, but are everywhere popular. The languages, which belong to the Tibeto-Burmese family, are diverse and excessively numerous, nearly every village having its own dialect. All dialects are tonal and agglutinative.

See Mills, *The Ao Nagas* (1926, bibl.). (J. H. H.)

NAGASAKI, a town on the south-west of the island of Kyushu, Japan, in 32° 44′ N., 129° 51′ E., with 252,630 (1940) inhabitants. The first port of entry for ships coming from the south or the west to Japan, it lies at the head of a beautiful inlet some 3 mi. long, which forms a splendid anchorage, and is largely used by ships coming to coal and by warships. The most important industries of the town are represented by the engine works of Aka-no-ura, three large docks and a patent slip, the property of the Mitsubishi Company.

Nagasaki is a noted shipbuilding port and coaling station. The coal is obtained chiefly from Takashima, an islet 8 mi. S.E. of the entrance to the harbour, and in lesser quantities from two other islets, Naka-no-shima and Ha-shima, which lie about 1 mi. farther out.

Nagasaki owed its earliest importance to foreign intercourse. Originally called Fukae-no-ura (Fukae Bay), it was included in the fief of Nagasaki Kotaro in the 12th century, and from him it took its name. But it remained an insignificant village until the 16th century, when, becoming the headquarters of Japanese Christianity, and subsequently the sole emporium of foreign trade in the hands of the Dutch and the Chinese, it developed considerable prosperity. The opening of the port of Moji (*q.v.*) deprived Nagasaki of its monopoly as a coaling station and in general diminished its importance in foreign trade, since the industrial portions of Kyushu are nearer to Moji and Shimonoseki.

NAGAUR, a town in India, in Jodhpur state of Rajputana. Pop. (1941) 14,714. Nagaur is surrounded by a wall more than 4 mi. in circuit. It has given its name to a famous breed of cattle.

NAGINA, a town of British India, in Bijnor district of the United Provinces, 48 mi. N.W. of Moradabad. Pop. (1941) 26,077. There is considerable trade in sugar, besides manufactures of guns, glassware (especially bottles for the use of pilgrims carrying the sacred water of the Ganges from Hardwar) and ebony wares.

NAGOYA, the capital of the province of Owari, Japan, on the great trunk railway of Japan, 235 mi. from Tokyo and 94 mi. from Kioto. Pop. (1940) 1,328,084. It is the third of the chief cities in Japan. It lies near the head of the shallow Isenumi bay, about 30 mi. from the port of Yokkaichi, with which it communicates by light-draught steamers and by rail. The castle of Nagoya, erected in 1610, never suffered in war, but in modern times became a military depôt; the interior contains much splendid decoration. The religious buildings of Nagoya include a very fine Buddhist temple, Higashi Hongwanji. Nagoya is one of the great seats of the pottery trade; 13½ mi. distant are the potteries of Seto, where the first glazed pottery made in Japan was produced by Kato Shirozaemon, after a visit to China in 1229.

Nagoya is an important weaving and spinning centre, but in recent years the relative importance of its textiles has declined, and by 1940 it ranked only below Tokyo and Osaka as an industrial centre, manufacturing light and heavy machinery, including aircraft engines.

NAGPUR, a city, district and division of British India in the Central Provinces, of which it is the capital. The old capital of the Bhonsla dynasty has expanded out of all recognition between 1852, when it came under British rule, and the present day. Its population, 84,000 in 1872, had expanded to 301,957 at the census of 1941. From being the terminus of a branch line it has become an important railway centre, nearly half way between Bombay and Calcutta and on the new north and south railway route between Madras and Delhi. It is also connected by a 2 ft. 6 in. gauge railway with Chindwara and Chanda. It is the commercial, as well as the administrative capital of the Province and the centre of education, being the seat of the university and the headquarters of both the Anglican and Roman Catholic dioceses and of important Protestant missions.

The whole area is dominated by the hill and fort of Sitabaldi, overlooking the civil station on the west, the city proper on the east and north, and the suburbs of Sitabaldi and Craddock Town to the south. This hill is the scene of the famous battle of Nov. 1817 where a small British force of less than 1,500 strong repulsed the Mahratta army of 20,000. The only regular troops in Nagpur now are those stationed in this fort, but it is the headquarters of the auxiliary force. Besides the mills, there is an important hand-weaving industry carried on by Koshtis, producing fine fabrics and silk-bordered cloths. There is also a large community of Momins or Mohammedan weavers.

The DISTRICT OF NAGPUR has an area of 3,836 square miles and a population of (1941) 1,059,989 as compared with 630,346 in 1872. It contains in all 12 towns and is situated on an extension of the Berar plain eastwards of the Wardha river. In the western portion Deccan trap overlies sandstone formation. In the eastern portion the sandstone is broken up by granite and the juxtaposition of these formations, which meet at Sitabaldi, makes the geology of the district interesting. In the north and north-east there are valuable deposits of manganese ore which are worked by three large companies and several individual concessionaires. The sacred hill of Ramtek in the north-east, with its gleaming white temples, is a landmark for miles around. The drainage of the east is to the Wainganga in Bhandara, and of the west to the Wunna and Wardha rivers. The plain is broken up in the west by ranges of flat-topped hills, but there are many plains, fertile valleys and pockets of rich land.

Agriculture is varied, Kunbis being the great cultivating Mahratta caste, but Raghvis and Kirars, immigrants from Upper India, are also excellent cultivators. To the west the cropping is mainly cotton and *juar*, in the centre and south wheat, linseed, and pulses are the chief staples. On the north-east and south-east there is a considerable area of rice. There are fine betel leaf plantations and the district is famous for its orange gardens. Government forests cover 500 square miles, mostly concentrated in the reserves along the Pench river on the north, but isolated blocks of not much value are scattered over the rest of the district.

NAGYKANIZSA (nŏd'ĭ-kăn-ĭts'ah), a town of west Hungary, county Zala, a railway junction and agricultural market town. It has large flour-mills, distilleries, breweries and vegetable-preserving works, manufactures bricks and trades in cereals and cattle. It was once a powerful fortress, important during the attacks of the Turks who held it 1600–90. Pop. (1930) 34,217.

NAGYSZOMBAT: *see* TRNAVA.

NAHUATL. The Nahua or Nahuatl language was that spoken in and about Anahuac—the high valley of Mexico. It forms, with Shoshonean and Piman, the Uto-Aztecan speech family. The centre of the Nahuan peoples was on the south-east end of the great central mesa of Mexico, where the Toltecs were the most important prehistoric and the Aztecs the best known historic representatives. Nahuan groups also extended southward into Morelos and Guerrero, eastward along the coast to Colima, and northward again into Jalisco, where they abutted on Piman-Sonoran peoples. Except at this point, the related Piman and Nahuan groups were not in contact, but were separated by the alien Tarasca and Otomi. South-east of Mexico and Puebla, the Atlantic lowlands from Vera Cruz to Tabasco were Nahuan; here were the Olmecs and others, north of the Zapotec and Mixe-Zoque, and bordering in the east on Mayan peoples. The Nahua territory is continuous thus far. Beyond, there were detached areas in Chiapas, Guatemala, El Salvador, Nicaragua, and even Panama. These represented dispersal migrations, some early, some later. Nahuan speech seems to have been fairly uniform, but was further standardized to the dominant Aztec by Spanish influence. It is still the mother tongue of over half a million Mexican Indians, while probably as many more, and many whites, are partially acquainted with it. Through the Toltecs and Aztecs, the Nahuan peoples share with the Maya the distinction of having been the bearers of highest culture in aboriginal America.

NAHUM (Hebrew for "rich in comfort [is God]"), an Old Testament Prophet. Of the Prophet himself, all that is known is the statement of the title that he was an Elkoshite. But the locality denoted by the designation is quite uncertain. The original heading of Nahum's prophecy is contained in the second part of the superscription: "(the book of) the vision of Nahum the Elkoshite." The first part ("Oracle concerning Nineveh") is a late editorial insertion, but correctly describes the main contents of the little book.

Contents.—Chapters i. and ii. The prophecy against Nineveh in its present form really begins with chapter ii. 1, followed immediately by v. 3, and readily falls into three parts, viz. (*a*) ii. 1, 3–10; (*b*) ii. 11–13; and (*c*) iii. Here (*a*) describes the assault on Nineveh. The city is mentioned by name in ii. 8 (9 Heb. text), its capture and sack; (*b*) contains an oracle of Yahweh directed against the king of Assyria; (*c*) again gives a vivid picture of war and desolation which are to overtake and humiliate Nineveh, as they have already overtaken No-Amon (*i.e.*, Egyptian Thebes, vv. 8–10). The absence of distinctly religious motive is remarkable.

Chapter i. forms the exordium of the prophecy of doom against Nineveh. Its tone is exalted, and a fine picture is given of Yahweh appearing in judgment: The effects of the divine anger on the physical universe are forcibly described (vv. 3–6); on the other hand, God cares for those "that put their trust in Him" (v. 7), but overwhelms His enemies (vv. 8–12*a*). In the following verses (12*b*–15) the joyful news is conveyed to Judah of the fall of the oppressor.

Regarding Chapter i. and ii. 2 (=i. and ii. 1, 3, Heb. Text) there has been much discussion in recent years. It was long ago noticed that traces of an alphabetic acrostic survive in this section of the book. In vv. 12*b*, 13 and (certainly) v. 15 (=ii. 1 Heb.) Judah appears to be addressed. The text of i. 1–15, ii. 1–2 has been reconstructed by H. Gunkel and G. Bickell so as to form a complete alphabetic psalm with contents of an eschatological character, and is regarded by them as a later addition to the book. It is generally held by scholars that i. 1–8, 13, 15, and ii. 2 certainly do not proceed from Nahum (i. 9–12 may, however, belong to the prophet). No satisfactory solution has been reached.

Date.—The date of the composition of Nahum's prophecy must lie between 612, when Nineveh was captured and destroyed by the Babylonians and Medes, and the capture of Thebes (No-Amon), which is alluded to in iii. 8–10, in 663 B.C. On the whole a date somewhat near 612 is more probable. The poetry of the book is of a high order.

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NAIADS, in Greek mythology the nymphs of wells, mountains and the sea, taking their name from the sphere of nature they represented. (*See* NYMPHS.)

NAIDU, SAROJINI (1879–1949), Indian poetess, orator in languages and nationalist, eldest child of Aghorenath Chattopadhyaya, principal of the Nizam's college, Hyderabad, Deccan, was born in that city on Feb. 13, 1879. She matriculated at the Madras university when only 12, and began soon after to write English verse. Sent to Britain in 1895, she studied at King's college, London, and Girton college, Cambridge. Her volumes of verse were sponsored by such discerning critics as Arthur Symons and Edmund Gosse, and included *The Golden Threshold, The Bird of Time* and *The Broken Wing.* They were translated into the chief Indian vernaculars and European languages, and her verse was frequently set to music. Her marriage to M. G. Naidu, a rajput who became head of the medical service in Hyderabad state, was resented in orthodox Hindu circles on grounds of caste. Mme. Naidu soon deserted the poetic muse to promote social and political reform and the feminist movement—fields which gave scope for fiery oratory and telling wit—and increasingly identified herself with the advanced wing of the Indian National Congress party. At Cawnpore in 1925 she was the first Indian woman to preside at an annual session. She threw herself into Mohandas Gandhi's civil disobedience movement in 1930, and underwent the first of several imprisonments. She accompanied the mahatma to London when he was the sole representative of the Congress party at the second session of the Indian round table conference. Though inclined to realism, she supported the attitude of aloofness from, and then of avowed hindrance of, India's great part in the war effort of the United Nations. Following on the decision in Aug. 1942 to embark on mass civil disobedience, she was arrested with other members of the working committee of the Congress party, being released in March 1943 on grounds of health. In 1947 she became governor of the United Provinces. She died in Lucknow, India, on March 2, 1949. (F. H. BR.; X.)

NAIK or NAYAK, from a Sanskrit word meaning a leader, a title used in India in various senses. In the army it denotes a rank corresponding to that of corporal, and Hyder Ali of Mysore was proud of being called Haidar Naik, analogous to "le petit caporal" for Napoleon.

It was also the title of the petty dynasties that arose in southern India on the downfall of the Hindu empire of Vijayanagar in the 16th century.

NAIL MANUFACTURE. Iron nails were commonly in use during the Roman occupation of Britain, large numbers having been found in places where they were wrought by the Romans. There is a striking similarity between the forged Roman nail (fig. 1) and the type of nail which is manufactured at the present time.

The forging of nails was an industry of some importance in Great Britain up to the end of the 17th century, and gave way only before the advent of machinery and the cut and machine-headed nail.

Wire Nails.—The use of wire for nail making has completely revolutionized the method of manufacture; nails made from drawn wire are produced so cheaply that they can be purchased at almost the same price as the wire from which they are made. Cut nails, sheared from plates or flat stock, are produced, but the quantities in which these nails are used are so small, compared to the production of round wire nails, that cut nails are now negligible items.

Catalogues of prominent nail manufacturers show nearly 100 different types of nails or fasteners made of round wire, but the

number of items, by gauges and sizes, run over 400. Figure 1 shows many common types of wire nails, (*a*) common nail, (*b*) barbed car nail, (*c*) finishing nail, (*d*) clinch nail, (*e*) slating nail, (*f*) countersunk head, (*g*) double-head form nail, (*h*) flooring brad, (*i*) broom nail, (*j*) roofing nail, (*k*) fine nail.

Screw type (*m*) nails have been developed and are used to some extent, principally as roofing nails. This type of nail tends to drive more easily, rotates as it enters the wood and retains greater holding power than does a similar nail of round wire. One method in common use for the manufacture of this type of nail is to produce it as a round wire nail and then pass the nail between two rolls and roll into the shank four or five spiral flutes. Another type of nail, developed to increase holding power, has annular serrations or saw-tooth ridges around the shank that are designed to bite into the grain of the wood when forces tend to withdraw the nail. This particular type of nail is used to some extent for fastening composition type shingles and siding.

Forming wire nails is a typical cold heading operation. Stresses and pressures in various parts of the nail machine are great and nail machines are relatively massive. There are principally four component parts in a nail machine; a hammer mounted in a cross-head to which is imparted reciprocating motion through a connecting-rod and a crankshaft, a set of cam-actuated slides which hold case-hardened tools that form the point and cut the nail after it is headed, another set of cam-actuated slides which hold the dies that grip the round wire and act as an anvil for the hammer forming the head, and a reciprocating feed table which straightens the wire as it unwinds from the coil and feeds through the heading dies the proper amount of wire stock for the nail. In operation, the feed table straightens and forces wire through the header dies in sufficient amount to provide stock for the head, the header

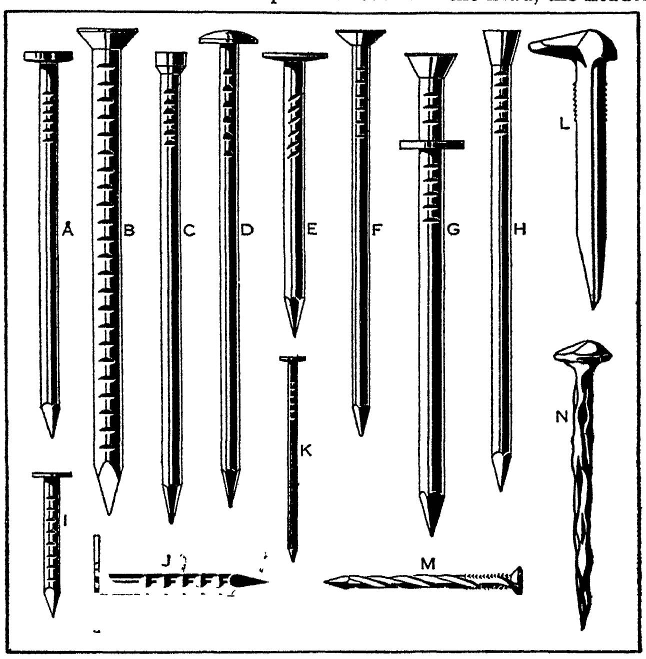

FIG. 1.—VARIOUS KINDS OF NAILS
(A) Common, (B) barbed car, (C) finishing, (D) clinch, (E) slating, (F) countersunk, (G) double-head form, (H) flooring brad, (I) broom, (J) roofing, (K) fine nail, (L) dog spike, (M) screw nail, (N) Roman

dies then grip the wire and the hammer moves forward to form the head. During the forward travel of the hammer, the feed table is retracted, ready to feed material into the machine for the next nail. After the head is formed, the hammer is withdrawn and the feed table moves forward with wire for another nail. After the feed table has completed its forward travel and the header dies have gripped the wire, the cutting and pointing tools move together, form the point and cut off the nail and the cycle is repeated, for each nail, at every revolution of the crankshaft.

Nail machines operate at speeds varying from 150 12″ spikes to over 600 cigar-box nails per minute. After nails are "cut," they are placed in rumblers, with a small amount of sawdust, and rumbled 15 or 20 minutes to remove "whiskers" and be polished and are then dumped into kegs for shipment.

Staples.—As staples are a form of nail, their manufacture is usually carried on with that of nails. They are made both from bright and galvanized wire, and in all kinds of sizes. The three different forms of points on staples are illustrated (fig. 2), the names themselves indicating the difference in the style of point. The term "presser point" simply means that the point is so sharp and fine that the staple can be stuck into the wood by simple pressure previous to being hammered down.

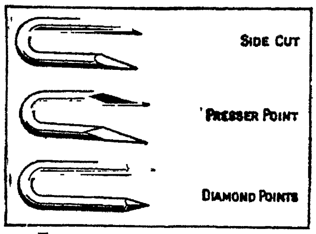

FIG. 2.—FENCING STAPLES
The points are selected according to the kinds of wood used

The several types of machines used in the making of staples follow the same principle as in the making of the straight nail, the wire being automatically fed forward from the swift, and the operation of cutting and pointing being immediately followed by the bending of the wire into its required shape to form the staple.

(R. M. HU.)

NAIL VIOLIN, a musical curiosity invented by Johann Wilde, a musician in the imperial orchestra at St. Petersburg. It consisted of a wooden soundboard about 1½ft. long and 1ft. wide, bent into a semicircle. In this soundboard were fixed a number of iron or brass nails of different lengths, tuned to give a chromatic scale, and the sound was produced by friction with a strong bow, strung with black horsehair.

NAINI TAL, a town and district in the Kumaon division of Uttar Pradesh, republic of India. The town (which is the divisional headquarters) is 6,400 ft. above sea level. Pop. (1951) 12,350. Naini Tal is a popular sanatorium for the residents in the plains. It is situated on a lake, surrounded by high mountains, and is subject to landslides; a serious catastrophe of this kind occurred in Sept. 1880. There are several European schools and a college of Agra university, besides military barracks.

NAINI TAL DISTRICT comprises the lower hills of Kumaon and the adjoining Tarai or submontane strip. Area, 2,632 sq.mi. Pop. (1951) 335,414. The district includes the Gagar and other foothills of the Himalayas, which reach an extreme height of nearly 9,000 ft. The Bhabar tract at their base consists of boulders from the mountains, among which the hill streams are swallowed up. Forests cover vast areas of the hill country and the Bhabar. Beyond this is the Tarai, moist and extremely unhealthy. There the principal crops are rice and wheat. In the hills a small amount of tea is grown, and a considerable quantity of fruit.

NAINSOOK, a light and fine cotton fabric of the plain calico weave, and of texture similar to that of lawn and cambric. It is usually bleached and sometimes striped and checked and finished with a very soft feel for use as lingerie and underwear.

NAIRN, a royal and small burgh and the county town of Nairnshire, Scot., on the Moray Firth, at the mouth of the Nairn, 16 mi. E.N.E. of Inverness by road. Pop. (1951) 4,700. The town attracts many summer visitors by its mild and dry climate, good sea bathing and golf courses. Salmon, herring and white fishing are carried on. There is a good harbour, constructed by Thomas Telford in 1820 and enlarged by the building of a dock in 1932. Nairn (originally Invernairn) was made a royal burgh by Alexander I (d. 1124); but his charter, having been lost, was confirmed by James VI in 1589.

NAIRNE, CAROLINA, BARONESS (1766–1845), Scottish song writer, was born in the "auld hoose" of Gask, Perthshire, on Aug. 16, 1766. She was descended from an old family settled in Perthshire in the 13th century, and could boast of kinship with the royal race of Scotland. Her father, Laurence Oliphant, was one of the foremost supporters of the Jacobite cause, and she was named Carolina in memory of Prince Charles Edward. In 1806 she married W. M. Nairne, who became Baron Nairne in the year 1824. She brought out a collection of national airs set to appropriate words. To this collection, *The Scottish Minstrel* (1821–24), she contributed a large number of original

songs, adopting the signature "B. B."—"Mrs. Bogan of Bogan." The music was edited by R. A. Smith. She died at Gask on Oct. 26, 1845. Among her most famous songs are: "The Laird o' Cockpen," "The Fife Laird," "John Tod," "Charlie is my darling," "Caller Herrin'" and the "Land o' the Leal." For vivacity, genuine pathos and bright wit her songs are surpassed only by those of Burns.

For Lady Nairne's songs, see *Lays from Strathearn, arranged with Symphonies and Accompaniments for the Pianoforte by Finlay Dun* (1846); vol. i of the *Modern Scottish Minstrel* (1857); *Life and Songs of the Baroness Nairne, with a Memoir and Poems of Caroline Oliphant the Younger*, edited by Charles Rogers (1869, new ed. 1886). *See* also T. L. Kington-Oliphant, *Jacobite Lairds of Gask* (1870).

NAIRNSHIRE, a northeastern county of Scotland, bounded west and south by Inverness-shire, east by Elginshire and north by the Moray firth. Land area 104,252 ac. or 162.9 sq.mi. There are 9 mi. of coast. It is the fourth smallest county in Scotland. The seaboard, skirted by sandbanks dangerous to navigation, is lined by low dunes extending into Elginshire. Traces of old marine terraces are seen at elevations of 100, 50 and 25 ft. above present sea level. Parallel with the coast there is a deposit of blown sand and gravel about 90 ft. high stretching inland for 4 or 5 mi. This and the undulating plain behind are a continuation westward of the fertile Laigh of Moray. The lowland rocks are Old Red Sandstone, widely covered with glacial deposits consisting of lower and upper boulder clays, with later gravels forming ridges on the moorland between the rivers Findhorn and Nairn. From this region southward the land rises rapidly to the confines of Inverness-shire, where the chief heights occur. This higher land consists of the eastern, Dalradian, or younger Highland schists, with associated granite masses. Several border hills exceed 2,000 ft. in elevation. The only rivers of importance are the Findhorn and the Nairn, both rising in Inverness-shire. The Findhorn after it leaves that county takes a northeasterly direction down Strathdearn for 17 mi. and enters the sea to the north of Forres in Elginshire after a total course of 72 mi. The Nairn, shortly after issuing from Strathnairn, flows to the northeast for 12 mi. out of its complete course of 38 mi. and falls into the Moray firth at the county town. There are eight lochs, all small: that of Clans contains crannogs, or ancient lake dwellings.

History.—The country was originally peopled by the Gaelic or northern Picts. Stone circles believed to have been raised by them are found at several places, particularly in the valley of the Nairn. To the north of Dulsie Bridge is a monolith called the Princess stone. Mote hills and stones with cup markings are also common. Beyond the occasional finding of Roman coins, there is little evidence of effective Roman occupation. Columba and his successors made valiant efforts to Christianize the Picts, but it was long before their labours began to tell, although the saint's name was preserved late in the 19th century in the annual fair at Auldearn called "St. Colm's Market," while to his biographer Adamnan—corrupted into Evan or Wean—was dedicated the church at Cawdor, where an old Celtic bell also bears this name. By the 10th century the Picts had been subdued with the help of the Norsemen, and Nairn, which was one of the districts colonized by the Scandinavians as part of the ancient province of Moray, soon became an integral portion of the kingdom of Scotland. Hardmuir, between Brodie and Nairn, is the heath where Macbeth is reputed to have met the witches. Territorially Moray was greatly contracted in the reign of David I, and thenceforward the history of Nairn merges in the main in that of the bishopric and earldom of Moray. (*See* ELGIN.) The thane of Cawdor was constable of the king's castle at Nairn, and when the heritable sheriffdom was established toward the close of the 14th century this office was also filled by the thane of the time.

Industries.—The soil of the alluvial plain, or Laigh, is light and porous and careful cultivation has rendered it very fertile, and there is some rich land on the Findhorn. Although advanced methods of agriculture are in use, only a small proportion of the surface is capable of tillage, with oats, turnips and swedes usually predominating. The hills are mostly covered with heath and pasture, suitable for sheep, and cattle are kept on the lower-lying ground. A little sandstone quarrying and the sea and salmon fisheries of the Nairn are the only industries of the shire. The London Midland Region railway from Forres to Inverness crosses the north of the shire.

Population and Government.—The population was 8,719 in 1951. In 1931 Gaelic and English were spoken by 410 persons. Nairn (1951 pop. 4,700), the county town, is the only royal burgh and only small burgh. Nairn and Moray shires combine to return one member to parliament. There are no county districts.

The shire forms a sheriffdom with Moray and a sheriff-substitute from Elgin sits also at Nairn.

NAIROBI, the capital of Kenya colony, British East Africa, 330 mi. by railway from Mombasa; railway headquarters for Kenya and Uganda and the most important urban centre in East Africa. It is built on the Athi plains, at the foot of the Kikuyu hills, and is 5,452 ft. above sea level. It commands magnificent views of Kilimanjaro and Mt. Kenya. Pop. (1948) 54,579 non-natives, of whom 10,830 were Europeans. Nairobi is the seat of the Kenya legislature and the headquarters of most of the European organizations in the colony. Nearly all the whites are British, and the town has most of the amenities of a European city. Both the standard and the cost of living are high. Laid out on a large scale, Nairobi has many fine private and public buildings.

The main thoroughfares are Government road, where numbers of shops and offices are owned by Indians, and Delamere avenue. The churches include an Anglican cathedral, mosques and a synagogue. In Sixth avenue are a cenotaph to the European soldiers who died in World War I and opposite it a striking memorial, three figures on a single base, to the African troops and carriers who died in the war The African memorial was erected in 1928 Parklands, the Hill, Muthiaga, Kilimani and Westlands are residential suburbs for Europeans. The Coryndon Memorial museum, a natural history museum, in Kirk road, was opened in 1922. The McMillan Memorial library was opened in 1931. The Indian bazaar covers nine acres. The natives occupy separate locations on the outskirts at Pumwani Village and Pangani. A memorial hall was erected at Pumwani in memory of the 46,618 natives who gave their lives during World War I. A branch railway runs to the foot of Mt. Kenya, and from Nairobi there is a motor road to the navigable Nile at Nimule or Rejaf. This is part of a motor road from Rhodesia to the Sudan (practicable in dry weather). Nairobi is governed by an elected municipality, with separate franchise rolls for Europeans and Indians. The climate is generally good.

The site of Nairobi was selected as the headquarters of the Uganda railway, and the first buildings were erected in 1899. For some time nearly all its inhabitants were railway officials and Indian coolies engaged in the construction of the line. In 1902 the surrounding highlands were found to be suitable for European settlement and Nairobi speedily grew in importance; in 1907 the headquarters of the administration were transferred to it from Mombasa. Nairobi had then 350 white inhabitants; in 20 years their number increased tenfold. An ambitious town-planning scheme was adopted in 1927.

Nairobi has a good bus system for local transportation, several well-appointed hotels, a number of social clubs, playing fields for cricket, football, soccer and polo and tennis courts and golf links. There are several schools for European children of both sexes. There are local radio broadcasts and daily and weekly newspapers. There is an airport. (R. J. BE.)

NAIVASHA, a lake, town and province, in Kenya colony. The lake, which is roughly circular with a diameter of about 13 mi., lies 6,135 ft. high on the crest of the highest ridge in the eastern rift-valley between the Kikuyu escarpment (east) and the Mau escarpment (west). It is fed by the rivers Gilgal and Morendat, which run in deep gullies, but has no known outlet. The water of the lake is fresh; the shore in many places is lined with papyrus. North and northwest the lake is closed in by the volcanic Buru hills; to the south towers the extinct volcano of Longonot. Hippopotami and otters frequent the lake, and on an island about 1 mi. from the shore are large numbers of antelopes and other game. Naivasha was discovered in 1883 by Gustav Adolf Fischer (1848–86), and visited in the same year by Joseph

Thomson, the Scottish explorer. The railway from Mombasa to Victoria Nyanza skirts the eastern side of the lake, and on the railway close to the lake is built the town of Naivasha, 6,230 ft. above the sea, 395 mi. N. by rail from Mombasa. Naivasha province contains much land suitable for colonization by white men, and large areas have been leased to Europeans. The land is especially suitable for cattle and sheep rearing.

NAJARA, ISRAEL BEN MOSES, Hebrew poet, was born in Damascus and wrote in the latter part of the 16th century (1587–1599). He was inspired by the mystical school, and his poems are marked by their bold, sensuous images, as well as by a depth of feeling unequalled among the Jewish writers of his age. He often adapted his verses to Arabic and Turkish melodies. To tunes which had been associated with light and even ribald themes, Najara wedded words which reveal an intensity of religious emotion which often takes a form indistinguishable from love poetry. Some pietist contemporaries condemned his work for this reason; but this did not prevent many of his poems from attaining wide popularity and from winning their way into the prayer-book.

He published during his lifetime a collection of his poems, *Songs of Israel* (*Zemiroth Israel*), in Safed in 1587; an enlarged edition appeared in Venice (1599–1600). Others of his poems were published at various times, and W. Bacher has described some previously unknown poems of Najara (*Revue des études juives,* no. 116 *et seq.*).

NAJIBABAD, a town of India, in the Bijnor district of Uttar Pradesh. Pop. (1941) 26,898. It was founded in the middle of the 18th century by a Rohilla chief, and still contains several architectural monuments of Rohilla magnificence. There is considerable trade in timber, sugar and grain, and manufactures of metalware, shoes, blankets and cotton cloth.

NAKHICHEVAN, an autonomous republic of Russian Transcaucasia created in 1921, and linked administratively with the Azerbaijan S.S.R., from which it is, however, separated by a strip of Armenian territory. It is bordered on the south and southwest by Iran and on the north and east by the Armenian S.S.R.

Area 2,085 sq.mi. Pop. 117,000 (1933). Though the republic is small, its relief is varied. In the southwest it consists of the valley on the left bank of the Araxes river, which there forms the boundary between Russia and Iran, and along the left bank of which goes the railway loop from Tiflis on the Black sea–Caspian line, which links Armenia and the south of Azerbaijan with Baku, and from which a branch line goes to Tabriz from Dzhulpha in the Nakhichevan republic. The republic thus forms a centre for trade between Russia and Iran. From the valley of the Araxes the Armenian or Transcaucasian plateau rises to a height of about 10,000 ft.

The industries of the region are mainly silk weaving, cotton cleaning and wine production. The numerous small cotton-cleaning enterprises were reorganized after the revolution into two large government factories.

Of the mineral wealth in the republic, salt, lead, sulphur, arsenic, copper, sulphur pyrites and coal, only salt is exploited. Curative arsenical and sulphur springs have been known to the native shepherds for centuries.

The population consists chiefly of Armenians and Azerbaijan Turks, with some Russians in the towns of Nakhichevan (pop. 11,700) and Ordubat (pop. 3,665). The number of schools and teachers has markedly increased, and there are Turkish, Armenian and Russian schools, but many children still receive no education.

Grants from the central government of the U.S.S.R. provided for the building of a school, hospital and electric station in the town of Nakhichevan, and a grant was also made for the repair and rebuilding of the small factories, and the irrigation canals, and the development of cotton, silk and salt production. The region was important at an early date because it lay on the route from Teheran and Tabriz to Caucasia. It was laid waste by the Persians in the 4th century, by the Seljuk Turks in the 11th century and by the Mongols in the 13th century. From that time until 1828, when by the peace of Turkman-chai it passed under Russian rule, it was a khanate vassal to Persia and was frequently devastated during the wars between Persia, Armenia, Turkey and Russia. Its importance for trade and its great fertility helped it to recover after each of these disasters and after the more recent 1917–20 period of disorder and struggle.

NAKHICHEVAN, a Russian town, the administrative centre of the Nakhichevan S.S.R. in 39° 14′ N., 45° 24′ E., on the Kish-chai river and at the terminus of a short line linking it with the railway that runs north of the Araxes river and which is connected with Baku. The town is on a spur of the Karabagh mountains at an altitude of 2,940 ft. Pop. 11,700 (1933), mainly Tatars and Armenians. It has an electric plant, motor-driven flour mills and a leather factory. A little to the southeast of it, a branch railway goes to Tabriz.

An ancient site on the Tiflis to Tabriz and Teheran road, the town had much transit trade, especially in salt, between Persia and the north in prerailway days. Armenian tradition claims Noah as its founder, and a mound of earth as his grave. Ptolemy mentions it as Naxuana.

The Persians sacked the town in the 4th century and it did not revive until the 10th century. Alp Arslan, Sultan of the Seljuk Turks, captured it in 1064 and the Mongols raided it in the 13th century. From this period onward it was a bone of contention between Persians, Armenians and Turks. By the peace of Turkman-chai in 1828 it became Russian. The present houses have for the most part been quarried from ancient ruins. A gateway with a Persian inscription and the 12th-century Tower of the Khans remain.

NAKHICHEVAN-ON-THE-DON, a town of the Russian S.F.S.R. in the North Caucasian area on the right bank of the Don, in 47° 18′ N., 39° 45′ E., 6 mi. N.E. of Rostov-on-Don. Pop. 71,321. It shares in the trading prosperity of the latter town, and has smelting, rope and cloth works. It was founded in 1780 by Armenian immigrants, and their descendants still form a large percentage of the population along the banks of the Don.

NAKSKOV, a seaport of Denmark, in the *amt* (county) of Maribo, on a wide bay of the Laalands belt at the west end of the island of Laaland, 31 mi. W. of Nykjøbing by rail. Pop. (1950) 16,074.

A great dike, extending southeast to Rødby (20 mi.), protects the coast against inundation. Nakskov possesses a fine harbour and shipyards, and one of the largest sugar factories in Europe.

NAMAQUALAND, a region of southwestern Africa, extending along the west coast more than 600 mi. from Damaraland (22° 43′ S.) on the north to 31° S., and stretching inland 80 to 350 mi. It is divided by the lower course of the Orange river into two portions—Little Namaqualand to the south and Great Namaqualand to the north.

Little Namaqualand forms part of Cape Colony (*see* CAPE PROVINCE), and Great Namaqualand is the southern portion of German South-West Africa (*q.v.*). The people of Namaqualand are the purest surviving type of Hottentots, and number about 20,000 to 30,000.

NAMASUDRA, "low Shudra," the largest caste in Eastern Bengal, Pakistan; the older Chandal now divided into several subcastes. *En masse* it ranks low, but its agricultural subcastes stand higher. Numbering 2,172,823 in 1921, it shows no tendency to decline.

NAME. The distinguishing appellation by which a person, place, thing or class of persons or things is known. (O. Eng. *nama;* the word is common to all Indo-European languages.)

(*a*). **Savage and Barbarian.**—To the savage, and in a lessening but still considerable degree, to the barbarian and the civilized man in his earlier stages, the name shares the essence of the personality. Therefore a savage has a personal name which is seldom or never pronounced, he being referred to in common parlance by some nickname or by a term of relationship. Not infrequently, to avoid calling the attention of evil spirits to him a savage child is not named at all, being referred to simply as "the child," or he may be given some derogatory name, as "grub," "filth," to deceive hostile powers. Apart from this, we may often distinguish, firstly a birth-name. This is given by the

parents or by some relation, as a rule, and its choice is governed by various considerations. Thus, he may be named from some trifling incident at the time of birth, or from the state of affairs in the country at the time ("Famine" and "War" are known Basuto names); or he may be given a name signifying "child of such a one" (patronymic or matronymic); or frequently among peoples who believe in reincarnation, he may be named after some dead relative supposed to be reborn in him. Very often, at puberty, or on undergoing some ceremony of initiation, he is given a new name, which may be kept secret. Various ceremonies often attend the giving even of the childhood name.

(*b*). **Civilized.**—Modern surnames include: those derived from a place-name, as Johnston (the *ton* or steading of John); these often occur among noble families, as Dumaresque (*de Mariscis,* "of the marshes"; a plebeian equivalent is Marsh); from an occupation, as Smith, Miller; nicknames, as Longfellow, Campbell ("crooked-lip"); and patronymics, as Dickenson (son of Dicken). The familiar Celtic names of the types Ap Rhys, Bowen (Ap Owain), O'Brian, MacFarlane, are of this kind, the surname proper being of later development among Celts than among Teutonic peoples.

Roman Names.—The earliest Italian and Roman names, consisted of a personal name (*praenomen*), as Marcus, followed by an adjective signifying the clan to which the person belonged (*nomen*), as Caecilius, "of the *gens Caecilia.*" All the *praenomina* had originally a meaning, as Gaius, "joyful" It is stated by the author of the little work *De praenominibus* that boys were never given a *praenomen* till they came of age, girls until they married. The latter statement is certainly wrong, since a woman never officially had a *praenomen* at all; the former is contradicted by most of the available evidence. It is possible, however, that a boy's name was not officially given him until he took the *toga virilis* or garb of manhood. Later, a third name was added, originally a personal name or nickname, as *Pulcher,* "handsome." This was called a *cognomen,* and often became a family name; *i.e.,* one common to all the direct descendants of its original bearer, who formed a section of the clan or *gens.* A man might have any number of these *cognomina,* as Publius Cornelius Scipio Aemilianus Africanus, where Scipio is the *cognomen* of the family into which the bearer had been adopted, Aemilianus an adjective formed from the name of his original clan, the *gens Aemilia*—this was a common, although not invariable, method of indicating adoption—and Africanus an officially bestowed title. (*See* also PLACE-NAMES.)

Law.—The Christian name, *i.e.,* the name given to a person on admission to baptism into the Christian Church, dates back to the early history of the church. In England individuals were for long distinguished by Christian names only, and the surname (*see* below) or family name is still totally ignored by the church. In process of time the use of surnames became universal, the only exceptions in England being the members of the royal family, who sign by their baptismal names only.

A clergyman of the Church of England is compelled to perform the ceremony of baptism when required by a parishioner, and to give whatever name or names the godparents select, but although the rubrics do not expressly say so he can object to any name on religious or moral grounds.

The freedom enjoyed in England and the United States as to the kind of Christian name which may be given to a child is somewhat limited in France and Germany. In France, by a decree of the 11 Germinal, an XI., the only names permitted to be recorded in the civil register as Christian names (*prénoms*) of children were those of saints in the calendar and the names of personages known in ancient history. Even at the present day an official list is issued (revised from time to time) containing a selection of forenames, and no name of a child will be registered unless it occurs in this list. A limitation more or less similar prevails in Germany and other European countries.

As regards the surname, custom has universally decreed that a man shall be known by the name of his father. But in England and in some of the United States this custom is not legally binding; there is no law preventing a man from taking whatever name he has a fancy for, nor are there any particular formalities required to be observed on the occasion of the adoption of a fresh surname. If a person adopts a new name and wishes to have it publicly notified and recognized in official circles, the method of procedure usually adopted is that by royal licence, which is subject to duty. If granted, the royal licence is given under the sign manual and privy seal of the sovereign, countersigned by the home secretary. Where there is a more formal adoption of a surname it is usual, for purposes of publicity and evidence, to advertise the change of name in the newspapers and to execute a deed poll setting out the change, and enrol the same in the central office of the supreme court. In the U.S. statutes in many states prescribe an application to a court of record as the method by which a person may change his name. A record of the change is thus certain to be made, but these statutes do not commonly deny an individual his common law right to change his name without resort to the courts.

Both in France and Germany official authorization must be obtained for any change of name. By the German code 1900 (s. 12) if the right to a new name is disputed by another or his interest is injured thereby, the person entitled can compel the abandonment of the new name.

In England and the United States, a wife on marriage adopts the surname of her husband, disregarding entirely her maiden surname; in Scotland the practice usually is for the wife to retain her maiden surname for all legal purposes, adding the name of her husband as an alias. On remarriage the rule is for the wife to adopt the name of the new husband, but an exception to this is made in the case of a title acquired by marriage when the holder remarries a commoner. See in *Cowley* v. *Cowley,* 1901, A.C. 450.

In Spain and in its colonies a man takes the surname of his father, followed by the maiden surname of his mother, joined by "and" (*y*), but this conjunction is often omitted in some colonies.

Peers of Great Britain when signing their names use only their surnames or peerage designations. It is merely a privileged custom, which does not go back further than the Stuart period. Peeresses sign by their Christian names or initials followed by their peerage designation. Bishops sign by their initials followed by the name of the see. In Scotland it is very usual for landowners to affix to their names the designation of their lands, and this was expressly sanctioned by an act of 1672.

See *Ency. Eng. Law,* titles "Christian Name," "Surname"; W. P. W. Phillimore, *Law and Practice of Change of Name* (1905); A. C. Fox-Davies and P. W. P. Carlyon Britton, *Law Concerning Names and Changes of Name* (1906).

NAMPA, largest city of Canyon county, Idaho, U.S.A., in the southwestern part of the state, at an altitude of 2,492 ft., near the Snake river and 20 mi. W. of Boise. It is the junction point of the old Oregon trail (now federal highway 30) and federal highway 95 connecting southwestern Idaho with California points by the most direct possible route. Pop. (1950) 16,142; (1940) 12,149 by federal census. Nampa is in the heart of an extensive and highly productive irrigated section, which in 1949, a typical year, shipped 73,834 carloads of agricultural products. Dairying is the most lucrative agricultural pursuit. Nampa is a subdivision point of the Union Pacific railroad, with passenger service running in six directions out of the city. The railroad also maintains a roundhouse. The Pacific Fruit Express, a Union Pacific subsidiary, employs 600 to 700 men annually in Nampa for repair and manufacture of refrigerator cars. An ice plant and icing platform can ice 110 cars in a few minutes. Other industrial plants are a condensary, creameries, chick hatcheries, meat- and produce-packing plants, grain elevators, flour mills, mattress factories, woodworking plant, a broom factory, bottling works and a butane gas plant. The ghost mining towns of Silver City and DeLamar are reached through Nampa.

NAMUR, one of the nine provinces of Belgium, between Hainaut on one side and Liége and Luxembourg on the other, extends from Brabant up the Meuse to the French frontier. Area, 1,413 sq.mi.; pop. (1947) 356,090 or 252 per sq.mi. It is fertile north of the Meuse and forested in the south. There are a few iron and coal mines between the Sambre and Meuse, and the quarries are

important. Arboriculture, especially fruit-tree plantation, is increasing. There are three administrative arrondissements, Namur, Dinant and Philippeville, 14 cantons and 366 communes.

NAMUR (Flemish, *Namen*), a town of Belgium, capital of the province of Namur. Pop. (1947 census) 31,444. The town lies on the left bank at the junction of the rivers Sambre and Meuse, while the rocky promontory forming the fork between them is crowned with the old citadel, which occupies the site of the old castle of the counts of Namur. This citadel was abandoned for military purposes, and its hill was converted into a park, while the crest was occupied by a hotel reached by a cogwheel railway. Namur is connected with the citadel by two bridges across the Sambre, and from the east side of the promontory there is a fine stone bridge to the suburb of Jambes. This bridge was constructed in the 11th century and rebuilt in the reign of Charles V. It is the only old bridge in existence over the Belgian Meuse. The cathedral of St. Aubain or Albin was built in the middle of the 18th century. The church of St. Loup is a century older, and is noticeable for its columns of red marble from the quarry at St. Rémy near Rochefort. There is a considerable local industry in cutlery, and there are tanneries and glassmaking factories.

In the feudal period Namur formed a marquisate in the Courtenay family. Jousts on stilts were a mediaeval custom that lasted into recent times there. Don John of Austria made Namur his headquarters in the Netherlands, and died here in 1578. Louis XIV took it in 1692 and Vauban renewed the defences but William III retook it in 1695, though the French held it again from 1702–12. In 1893, under the new scheme of Belgian defense, the citadel and its detached works were abandoned, and in their place nine outlying forts were constructed at a distance of from 3 to 5 mi. Namur was the scene of intense fighting in both World Wars I and II.

NANAIMO, a city of British Columbia, on the east coast of Vancouver island, 40 mi. W. of Vancouver and 65 mi. N. of Victoria. The population in 1951 was 7,196. It is connected with Victoria by the Esquimalt and Nanaimo railway, and has a twice daily steamer service to Vancouver. It is in a fruit-farming, dairying and poultry-raising district, and has a good harbour, carrying on trade in coal from the neighbouring mines, and in cured herrings, sent to the east. The industries include sawmills and woodworking shops, breweries, canneries, foundries, brickworks, etc.

NANA SAHIB, the common designation of Dandu Panth, an adopted son of the former peshwa of the Marathas, Baji Rao, who took a leading part in the great Indian mutiny (*q.v.*) and was proclaimed peshwa by the mutineers. Nana Sahib had a grievance against the British government because it refused to continue to him the pension of 800,000 rupees (£80,000), which was promised to Baji Rao by Sir John Malcolm on his surrender in 1818. This pension, however, was intended only to be a life grant to Baji Rao himself. For this refusal the Nana bore the British a lifelong grudge, which he satisfied in the massacres at Cawnpore (*q.v.*). In 1859, when the last rebels disappeared into Nepal, he was among the fugitives. His death was reported some time afterward, but his real fate is obscure.

See G. O. Trevelyan, *Cawnpore* (London and Cambridge, 1865).

NANCHANG, the capital of the province of Kiangsi, China, on the Kankiang, and connected by railway with Kiukiang and with the east-west railway from Chuchow to Hangchow. Nanchang was a centre of commerce for the provincial agricultural products, such as tea, rice, cotton, tobacco, hemp, etc., and had some manufactures. The Japanese occupied Nanchang from 1939 to 1945. The population was given as 266,651 in 1948.

NANCY, a town of northeastern France, the capital formerly of the province of Lorraine, and now of the department of Meurthe-et-Moselle, 219 mi. E. of Paris on the railway to Strasbourg. Pop. (1946) 113,477.

At the close of the 11th century Odelric of Nancy, brother of Gérard of Alsace, possessed at Nancy a castle which enabled him to defy the united assaults of the bishops of Metz and Trèves and the count of Bar. In the 12th century the town was surrounded with walls, and became the capital of the dukes of Lorraine; and in 1477 Charles the Bold was defeated here by René II. (*See* SWITZERLAND: *History.*) Refortified by Charles III. it was taken by the French in 1633. After the peace of Ryswick in 1697 it was restored to Duke Leopold. He founded academies, established manufactures and set about the construction of the new town. But it was reserved for Stanislas Leczinski, the last of the dukes of Lorraine, to make Nancy one of the palatial cities of Europe. The city, which became French in 1766, was occupied by the allies in 1814 and 1815 and put to ransom by the Prussians in 1870. After the Franco-German War the population was greatly increased by the immigration of Alsatians and of people from Metz and its district.

Although Nancy remained outside the area of actual fighting during World War I it was bombarded by German aeroplanes and long-range guns, but the damage was not very serious.

Nancy stands on the left bank of the Meurthe 6 mi. above its junction with the Moselle and on the Marne-Rhine canal. The railway from Paris to Strasbourg skirts the city on the southwest side; other railways—to Metz, to Épinal by Mirecourt, to Château Salins—join the main line near Nancy and make it an important junction. The town consists of two portions—the *Ville-Vieille* in the northwest, with narrow and winding streets, and the *Ville-Neuve* (16th–18th centuries) in the southeast, with wide straight streets. Between the two lies the Place Stanislas, and on all sides rise imposing buildings of the 18th century—the town hall, episcopal palace, etc. A fine triumphal arch erected by Stanislas in honour of Louis XV leads from the Place Stanislas to the Place Carrière, which forms a beautiful tree-planted promenade, containing at its further end the government palace (1760) now the residence of the general commanding the XX army corps, and adjoins the so-called Pépinière (nursery) established by Stanislas.

The cathedral in the Ville-Neuve, built in the 18th century, has a wide façade flanked by two dome-surmounted towers. Of particular interest is the church of the Cordeliers, in the old town, built by René II. about 1482 to commemorate his victory over Charles the Bold. Pillaged during the Revolution period, but restored to religious uses in 1825, it contains the tombs of the counts of Vaudémont. Here also is a chapel built at the beginning of the 17th century to receive the tombs of the princes of the house of Lorraine. The church of St. Epvre, rebuilt between 1864 and 1874 on the site of an old church of the 13th, 14th and 15th centuries, has a fine spire and belfry and good stained glass windows. Of the old ducal palace, begun in the 15th century by Duke Raoul and completed by René II., there remains but a single wing, partly rebuilt after a fire in 1871. The entrance to this wing, which contains the archaeological museum of Lorraine, is Gothic of the early 16th century. One of the greatest treasures of the collection is the tapestry found in the tent of Charles the Bold after the battle of Nancy. Of the old gates of Nancy the most ancient and remarkable is the Porte de la Craffe (1463). The town hall contains a museum of painting and sculpture.

Nancy is the seat of a bishop, a prefect, a court of appeal and a court of assizes, headquarters of the XX. army corps, and centre of an *académie* (educational division) with a university comprising faculties of law, medicine, science and letters, and a higher school of pharmacy. There are also tribunals of first instance and of commerce, a board of trade-arbitrators, and a national school of forestry. The industries of Nancy include printing, brewing, cotton- and wool-spinning and the weaving of cotton and woollen goods, and the manufacture of tobacco (by the State), of boots and shoes, straw hats, pottery, casks, embroidery, machinery, motor cars and spare parts, engineering material, farm implements and iron goods.

NANDI, an East African tribe of mixed Nilotic, Bantu and Hamitic origin. With them are more or less closely allied the Lumbwa (correctly Kipsikīs), Buret (or Puret) and Sotik (Soot) tribes, as well as the Elgonyi (properly Kony) of Mount Elgon. They have also affinities with the Masai. The Nandi-Lumbwa peoples inhabit the country stretching south from Mount Elgon to about 1° S. and bounded east by the escarpment of the eastern rift-valley and west by the territory of the tribes, such as the

Kavirondo, dwelling round the Victoria Nyanza. They have given their name to the Nandi plateau. They have a double administrative system, the chief medicine man or *Orkoiyot* being supreme chief and regulating war affairs, while representatives of the people, called *Kiruogik,* manage the ordinary affairs of the tribe.

The medicine men are of Masai origin and the office is hereditary. The young men form a separate warrior class to whom is entrusted the care of the country. A period of about 7½ years is spent in this class, and the ceremony of handing over the country from one "age" to the succeeding "age" is of great importance. (*See* AGE GRADES.) The arms of the warriors are a stabbing spear, shield, sword and club. Many also possess rifles. All the Nandi are divided into clans, each having its sacred animal or totem. They have no towns, each family living on the land it cultivates. The huts are of circular pattern. The Nandi believe in a supreme deity—Asis—who takes a benevolent interest in their welfare, and to whom prayers are addressed daily. Their language is Nilotic. The primitive hunting tribe known as the Wandorobo speak a dialect closely resembling Nandi.

BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

LUMBWA WARRIOR EQUIPPED TO SPEAR LIONS

See A. C. Hollis, *The Nandi: Their Language and Folk-lore,* with introduction by Sir Charles Eliot (1909), and the works there cited.

NANDU, the Brazilian name for the rhea (*q.v.*).

NANKANA, a people resembling the Bura and the Mampursi, living in the Navoro district of the Northern Territories, Gold Coast, and across the Upper Volta border in the Leo district. They speak a Mossi dialect.

See Cardinal, *The Natives of the Gold Coast.*

NANKEEN, a cotton cloth originally made in China, and now imitated in various countries. The name is derived from Nanking, the city in which the cloth is said to have been originally manufactured. The characteristic yellowish colour of nankeen is attributed to the peculiar colour of the cotton from which it was originally made.

NANKING ("the southern capital"), the name by which Kiang-ning, the chief city in the province of Kiangsu, China, has been known for several centuries. Pop. (1935) 1,019,148. The city is nearly equidistant between Canton and Peking, on the south bank of the Yangtze Kiang 235 mi. from the sea. It dates only from the beginning of the Ming dynasty (1368), although it is built on the site of a city which for more than two thousand years figured under various names in the history of the empire. The more ancient city was originally known as Kin-ling; under the Han dynasty (206 B.C. to A.D. 25) its name was converted into Tan-yang; by the T'ang emperors (A.D. 618–907) it was styled Kiang-nan and Shêng Chow; by the first sovereign of the Ming dynasty (A.D. 1368–1644) it was created the "southern capital" (Nan-king), and was given the distinctive name of Ying-t'ien; and with the accession to power of the Manchu rulers it was officially known as Kiang-ning, though still popularly called Nan-king. It was the seat of the imperial court only during the reigns of the first two emperors of the Ming dynasty, and was deserted for Shun-t'ien (Peking) by Yung-lo, the third sovereign of that line, who in 1403 captured the town and usurped the crown of his nephew, the reigning emperor. The area is 180 sq.mi.

The T'aip'ing rebels, who carried the town by assault in 1853, swept away all the national monuments and most of the public buildings it contained, and destroyed the greater part of the magnificent wall which surrounded it. The wall, of which only small portions remain, was about 70 ft. in height, measured 30 ft. in thickness at the base, and was probably 20 miles in circumference and pierced by thirteen gates. Encircling the north, east and south sides of the city proper was a second wall which enclosed about double the space of the inner enclosure. In the north-east corner of the town stood the imperial palace reared by Hung-wu, the imperial founder of the modern city. After suffering mutilation at the overthrow of the Ming dynasty, this building was burnt to the ground on the recapture of the city from the T'aip'ing rebels in 1864. The most conspicuous public building at Nanking was the famous porcelain tower, which was designed by the emperor Yung-lo (1403–1428) on a previously sacred site to commemorate the virtues of his mother. The building was begun in 1413. In shape the pagoda was an octagon, and was about 260 ft. in height. The outer walls were cased with bricks of the finest white porcelain, and each of the nine stories into which the building was divided was marked by overhanging eaves composed of green glazed tiles of the same material. Hung on chains which stretched from this apex to the eaves of the roof were five large pearls of good augury for the city's safety from flood, fire, storm and civil disturbance.

Nanking was formerly one of the chief literary centres of the empire. It was taken by the British in 1842 and made a treaty port by the French treaty of 1858, but was not formally opened. Its proximity to Chinkiang, where trade had established itself while Nanking was still in the hands of the rebels, made its opening of little advantage. In 1899 it was voluntarily thrown open to foreign trade by the Chinese government, and in 1909 it was connected by railway with Shanghai, and became the southern terminus of the Tientsin-Pukow railway.

The new nationalist government moved the capital of China to Nanking in 1928 and Nanking remained the legal capital when the government moved to the wartime capital of Chungking after the Japanese invasion. After 1928 Nanking developed rapidly and a number of new buildings such as a modern railway station and several ministries were built by the government and broad boulevards were constructed. Modern airfields and shipping facilities increased the importance of Nanking as a communication centre. Outside the city the famous Sun Yat-sen mausoleum was erected in memory of the founder of the Chinese republic. In Nov. 1937 Nanking fell to the Japanese troops. The "rape of Nanking" which followed was fully authenticated by many neutral witnesses. From 1940 to 1945 Nanking was the seat of the puppet government of Wang Ching-wei. Following the defeat of Japan, the government officially returned to Nanking, May 6, 1946, after an absence of eight years.

NANNING, former treaty port in the province of Kwangsi, south China (22° 48′ N., and 108° 15′ E.), and onetime capital of the province, is situated about 30 mi. below the junction of the two branches (Tso-kiang and Yu-kiang) of the south (main) stream of the West river, and about 470 mi. above Canton. Nanning was voluntarily opened to foreign trade by China in 1907 to offset French influence at Lungchow, a treaty port near the Tongking frontier. It is the highest accessible point for steamers on the West river, but the river between Wuchow and Nanning during winter suffers from lack of water so that trade is seriously affected. Numerous small competitive river vessels run between Wuchow and Nanning.

Nanning's economic orientation is toward the Canton delta by the natural route of the Si-kiang, rather than toward the nearer Red river delta of Tongking. The construction, however, of the projected railway from Canton, via Nanning, to connect with the Tongking railway system at Langson (the present terminus) may have the effect of diverting some of the trade of Nanning into Tongking; or again, the construction of a railway may draw much of it to Pakhoi on the Gulf of Tongking, the nearest outlet by sea to Nanning. The value of the whole trade which was 6,623,437 Hk Taels in 1924, had suffered as a result of the Hongkong boycott of 1926. In 1936 it was $70,780 (U.S.), but rose to over $160,000 (U.S.) in 1938 and 1939.

The chief imports of Nanning, to be distributed in W. Kwangsi, and adjacent Yunnan and Tongking, were cotton piece goods, kerosene, clothing, matches and straw mats, while exports comprised chiefly aniseed, beans, hides, groundnut cake, medicines and antimony (the export of which increased greatly). In 1940 Nanning was temporarily occupied by the Japanese and its trade suffered after that. Two main channels served this trade—the Yu-kiang which is navigable for large junks during the summer

flood season as far as Pose-ting (whence a road leads up to the high plateau of Yünnan), and the Tso-kiang which is navigable for large junks and small launches as far as the treaty port of Lungchow, close to the Tongking border.

The population of Nanning was 80,283 in 1939.

NANNY-BERRY (*Viburnum Lentago*), a handsome North American shrub or small tree of the honeysuckle family (Caprifoliaceae), called also black haw, sheep-berry, wild raisin and sweet viburnum, sometimes planted for ornament. It is native to rich soil from Quebec to Hudson bay and southward to New Jersey, Georgia and Colorado. The nanny-berry, though usually a shrub, sometimes grows 30 ft. high, with a trunk diameter of 10 inches. It has slender branches, ovate, long-pointed, finely-toothed leaves and bears small white flowers borne in showy clusters, 2 to 5 in. broad. The oval, bluish-black, sweet, edible fruit ripens in late autumn.

NANSEN, FRIDTJOF (1861–1930), Norwegian scientist, explorer and statesman, was born at Fröen near Christiania, where he spent his childhood, on Oct. 10, 1861. In his fifteenth year his parents removed to Christiania, where he went to school. He entered Christiania university in 1880 and studied zoology; in March 1882 he joined the sealing-ship "Viking" for a voyage to Greenland waters. On his return he became curator of the Bergen Museum, under Daniel Cornelius Danielssen (1815–1894). In 1886 he spent a short time at the zoological station at Naples, during which he wrote papers and memoirs on zoological and histological subjects, for one of which, "The Structure and Combination of the Histological Elements of the Central Nervous System" (Bergen, 1887), the Christiania university conferred upon him the degree of doctor of philosophy. But his voyage in the "Viking" had indicated Greenland as a possible field for exploration, and in 1887 he began preparations for a crossing of the great ice field which covers the interior of that country. Nansen took with him Otto Sverdrup (1855–1930), Captain O. C. Dietrichson, K. K. Trana and two Lapps. The expedition started in May 1888, proceeded from Leith to Iceland, and there joined a sealing-ship bound for the east coast of Greenland. On Aug. 16 began the ascent of the inland ice amid storms, intense cold, and other hardships, they reached the highest point of the journey (8,920 ft.) on Sept. 5, and on the 28th struck the west coast at Ameralik Fjord. They were obliged to winter at the settlement of Godthaab, and Nansen used the opportunity to study the Eskimos and gather material for his book *Eskimo Life* (English translation, London, 1893). The party returned home in May 1889. A report of the scientific results was published in *Petermanns Mitteilungen* (Gotha, 1892). On his return from Greenland Nansen became curator of the Zootomic Museum of Christiania university. In Sept. 1889 he married Eva, daughter of Professor Michael Sars of Christiania university, and a noted singer (d. 1907).

In 1890 he propounded his scheme for a polar expedition before the Norwegian Geographical Society, and in 1892 he laid it before the Royal Geographical Society in London. (*See* "How can the North Polar Region be crossed?" *Geogr. Journal,* vol. i.) His adversely criticized plan succeeded. The Norwegian parliament granted two-thirds of the expenses, and the rest was obtained by subscription from King Oscar and private individuals. His ship, the "Fram" (*i.e.,* "Forward"), was specially built of immense strength and peculiar form, being pointed at bow and stern and having sloping sides, so that the colliding ice-floes would tend, not to crush, but merely to slip beneath and lift her. She sailed from Christiania on June 24, 1893. Otto Sverdrup was master; Sigurd Hansen, a Norwegian naval lieutenant, was in charge of the astronomical and meteorological observations; Henrik Blessing was doctor and botanist. On Sept. 22 the "Fram" was made fast to a floe in 78° 50′ N., 133° 37′ E.; she was frozen in, and the long drift began. She bore the pressure of the ice perfectly. On March 14, 1895, Nansen, being satisfied that the "Fram" would continue to drift safely, left her in 84° N., 101° 55′ E., and started northward on foot with Johansen. On April 8 they turned back from 86° 14′ N., the highest latitude then reached by man; and they shaped their course for Franz Josef Land. They suffered from shortage of food, and were compelled to winter on Frederick Jackson Island (so named by Nansen) in Franz Josef Land from Aug. 26, 1895, to May 19, 1896. They were uncertain as to the locality, but, after having reached 80° N. on the south coast of the islands, they were travelling westward to reach Spitsbergen, when, on June 17, they fell in with Frederick Jackson and his party of the Jackson-Harmsworth expedition, and returned to Norway in his ship, the "Windward," reaching Vardö on Aug. 13. A week later the "Fram" also reached Norway safely, having drifted north to 85° 57′, and returned by the west coast of Spitsbergen. A great welcome awaited Nansen. In England he gave the narrative of his journey at a great meeting in the Albert Hall, London (Feb. 8, 1897), and elsewhere.

In 1896 a professorship of zoology was established for him at the Christiania university; he worked up the results of his expedition and made scientific research in physical geography and oceanography. In the summer of 1900 he took part in an Arctic oceanographic expedition in the S.S. "Michael Sars," headed by Dr. Johan Hjort, and became director of the International Central Laboratory in Christiania for the Research of the Sea. In 1902 he published *The Oceanography of the North Polar Basin,* and in 1904 *The Bathymetrical Features of the North Polar Seas.* In 1905 Nansen took up politics, issuing a manifesto and many articles in connection with the crisis between Norway and Sweden. His attitude may be summarized by the last words of a short work published later in the year: "Any union in which the one people is restrained in exercising its freedom is and will remain a danger" (*Norway and the Union with Sweden,* London, 1905). On the establishment of the Norwegian monarchy Nansen was appointed minister to England (1906), and in the same year was created G.C.V.O. In 1908 he retired from his post and returned to his scientific work as professor of oceanography at Christiania university. In co-operation with Professor Bjorn Helland-Hansen, of the Bergen Museum, he wrote *The Norwegian Sea, its Physical Oceanography* (*Report* on Norwegian Fishery and Marine Investigations, vol. 2, 1909).

In 1910 Nansen made an oceanographic cruise in the "Frithjof" through the northeastern North Atlantic from Ireland to Iceland and back to Norway, and in 1911 published *In Northern Mists* (2 vol.) on the exploration of the northern regions from early times up to the beginning of the 16th century. In 1912 he made a further oceanographic cruise to Spitsbergen and the waters to the north in his yacht the "Veslemoy," and in 1913 he made an expedition through the Arctic and the Kama Seas to the mouth of the Yenisei river and through Siberia and the Amur region.

In 1914, jointly with Helland-Hansen, Nansen made an oceanographic expedition in the eastern North Atlantic to Portugal, Madeira and the Azores and back to Norway. During the World War oceanographic expeditions were impossible. In 1917 Nansen became head of a Norwegian Govt. commission to the United States, and secured a satisfactory agreement with the American Govt. in regard to the import into Norway of essential supplies. After the Armistice (1918) Nansen, as Commissioner of the League of Nations with the executive assistance of the national Red Crosses, was responsible for the repatriation of about 500,000 prisoners of war from Siberia, China and other parts of the world. This work was financed largely by the governments participating in the International Committee for Relief Credits, Paris, of which Lord Bradbury was chairman.

In 1919 Nansen conferred with Hoover on the possibilities of assisting the Russian people, and suggested an organization on the lines of the Belgian Relief Commission. The Supreme Council supported the proposal on the condition that all hostilities in Russia cease. As this was at the time when Kolchak and Denikin were advancing towards Moscow the project was abandoned. In 1921 Nansen was asked by an international conference in Geneva of delegates of 48 Red Cross societies and 12 governments to direct relief work for famine-stricken Russia, and on Aug. 27 he signed an agreement in Moscow with Chicherin, the Soviet Foreign Minister, regarding the method of furnishing relief on a large scale, and visited the famine areas. In Sept. Nansen failed to induce the League of Nations to assist the starving

millions in Russia by raising, under safeguards, an international governmental relief loan. He next visited the chief capitals of Europe, and as a result the European Red Cross societies fed and clothed at the peak of the Russian famine over 1,600,000 inhabitants of the Volga and South Ukraine regions. His publicity campaign had great influence in America, which under Hoover's direction fed at one time 10,000,000 Russian sufferers. Nansen's mission in Russia continued to conduct two agricultural demonstration estates in the former famine areas. In 1923 Nansen published *Russia and the Peace,* setting out the economic position of soviet Russia. As high commissioner for refugees to the League, he was responsible for the protection and settlement of Russian, Armenian and Greek refugees.

In 1923 Nansen was awarded the Nobel peace prize, which he gave to the furtherance of the Nansen agricultural demonstration estates and model farms in Saratov and Ekaterinoslav governments, Russia. In his early manhood Nansen was a great athlete and the popularity of skiing in the Alps is largely due to him; and evidence of his enthusiasm for sport is his work on *Sport in the Polar Regions* and *Wild Norway* (1925). Nansen, as delegate for Norway to the League of Nations, made an impassioned intervention protesting against the occupation of Corfu by Italy in 1923, and at the Fifth Assembly in 1924 he conducted the first informal negotiations for the entry of Germany into the League of Nations. Nansen's interest in education was evidenced by his campaign in favour of Russian professors and universities. In 1925 he was elected lord rector of St. Andrews, and in 1928 published *Armenia and the Near East.* (*See* ARCTIC REGIONS; REFUGEES AND THE EXCHANGE OF POPULATIONS). He died of heart failure at Oslo, on May 13, 1930.

Besides works mentioned above, Nansen described his travels in *The First Crossing of Greenland* (Eng. trans., 1893); *Farthest North* (Eng. trans., 1897); *The Waters of the Northeastern North Atlantic* (*Internationale Revue der gesammten Hydrobiologie und Hydrogeographie,* Leipzig, 1913); *En ferd til Spitzbergen* (1912); *Through Siberia, the Land of the Future* (London, 1914) The scientific results of the various expeditions are given in the following works—the 1888 expedition, in *Petermanns Mitteilungen* (Gotha, 1892); the 1893 expedition, in *The Norwegian North Polar Expedition, 1893–96: Scientific Results* (London, etc., 1900 *sqq*); the 1912 expedition, in *Spitzbergen Waters* (Society of Science, Oslo, 1915); of the 1914 expedition jointly with Helland-Hansen, in *The Eastern North Atlantic* (Geophysic Publication, Academy of Science, Oslo).

NANSEN INTERNATIONAL OFFICE FOR REFUGEES. The Office International Nansen pour les Réfugiés was founded in 1931 as an autonomous body under the League of Nations to carry on the work started in 1921 by Fridtjof Nansen (*q.v.*). At the end of World War I there were more than 2,000,000 refugees in Europe and Asia Minor. Of these, approximately 1,250,000 were political refugees from Russia, several hundred thousand were Armenians expelled from Asia Minor and another substantial number was composed of Greeks who fled into Greece as a result of political circumstances in Asia Minor and the Balkans, where their ancestors had been living for several centuries. The remainder were Assyrians, Assyrian Chaldeans, Bulgars and Turks.

The League of Nations accepted responsibility for the legal protection of these refugees, and in 1921 Nansen, well-known polar explorer, became the first League of Nations high commissioner for refugees. Nansen's work resulted in the development of the international identity certificate known as the "Nansen passport" and he did much of the pioneer work in civil rights and employment and social security rights for refugees.

In 1935 the League brought under the protection of the office the 7,000 refugees who left the Saar as a result of the 1935 plebiscite. Administrative funds were voted by the assembly of the League on a diminishing scale until Dec. 31, 1938, the date set for final liquidation of the office. The League had always considered its interest in refugees to be of a temporary nature and, although it accepted responsibility for their legal protection, it wished to avoid responsibility for their relief.

Nansen's objective had been to make refugees self-supporting. However, the depression of the 1930s made the task of finding employment opportunities for refugees unusually difficult. National governments also wished to avoid relief grants to refugees unable to work, and the depression reduced the funds of private charitable organizations.

Despite these handicaps the Nansen office carried forward its work. In order that the legal protection of refugees might be assured after the closing of the office, the League provided, through the medium of the convention of Oct. 28, 1933, for the issuance of Nansen identity certificates by the governments signing the convention and for rights of residence, employment, social security and relief for Russians, Armenians and assimilated refugees then under the protection of the Nansen office.

Unfortunately this 1933 convention was ratified by only eight states and in some cases with important reservations. It served as a model, however, in drawing up the 1938 convention concerning the status of refugees coming from Germany, and became important after World War II when once again the world was faced with the problem of stateless persons.

The 1938 Nobel peace prize was awarded to the Nansen office. At the close of the office in Dec. 1938, M. Michael Hansson of Norway, president of the Nansen office, reported 600,000 refugees of the foregoing groups still unsettled and without secure civil status. Their situation was worsened as they became part of the larger numbers of refugees displaced by World War II. (*See* also REFUGEES AND THE EXCHANGE OF POPULATIONS.)

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(G. L. W.)

NANTERRE, a suburb 8 mi. northwest of Notre Dame de Paris, with a port on the Seine, in the department of Seine, at the foot of Mount Valérien, 8 mi. N.W. of Paris on the railway to St. Germain. Pop. (1946) 41,860. The principal manufactures are chemicals, tallow and aluminum; stone is quarried in the vicinity; the town is noted also for its cakes. Nanterre (the ancient *Nemptodurum* or *Nemetodurum*) owes its origin to the shrine of Ste. Geneviève (420–512), the patron saint of Paris.

NANTES, a city of western France, capital of the department of Loire-Inférieure, on the Loire, 35 mi. above its mouth, at the junction of the Orléans, Ouest-état and State railways, 55 mi. W.S.W. of Angers by rail. In population (1946, 200,265), Nantes is the first city of Brittany. The Loire there divides into several west branches forming islands over portions of which the city has spread.

History.—Before the Roman occupation Nantes was the chief town of the Namnetes and consisted of *Condovicnum,* lying on the hills away from the river, and of *Portus Namnetum,* on the river. Under the Romans it became a great commercial and administrative centre, though its two parts did not coalesce till the 3rd or 4th century. In the middle of the 3rd century Christianity was introduced by St. Clair. Clotaire I got possession of the city in 560, and placed it under the government of St. Félix, the bishop who caused the Loire to flow under the walls of the castle. After being several times subdued by Charlemagne, Brittany revolted under his successors, and Nominoé, proclaimed king in 842, razed the fortifications of Nantes because it had sided with Charles the Bald. The Normans held the town from 843 to 936. About this time began the rivalry between Nantes and Rennes, whose counts disputed the sovereignty of Brittany. Pierre de Dreux, declared duke of Brittany by Philip Augustus, made Nantes his capital, surrounded it with fortifications and defended it against John of England During the Breton wars of succession Nantes took part first with Jean de Montfort, but afterward with Charles of Blois, and did not open its gates to Montfort till his success was assured and his English allies had retired. In 1560 Francis II granted Nantes a communal constitution. Averse to Protestantism, it joined the league along with the duke of Mercoeur, governor of Brittany, who helped to raise the country into an independent duchy; and it was not till 1598 that it opened its gates to Henry IV, who there signed on May 2 the Edict of Nantes which until its revocation by Louis XIV in 1685 was the charter of Huguenot liberties in France. The city was in 1793 the scene of the *noyades* of J. B. Carrier, envoy of the Committee of Public Safety.

The Port.—The maritime port of Nantes is reached by way of the Loire and the ship canal between the island of Carnet and La Martinière (9½ mi.). Vessels drawing as much as 20 ft. 8 in., and at spring tides, 22 ft., can reach the port, which extends over a length of about 1½ mi. The outer port stretches ½ mi. to Chantenay. The principal quays extend along the right bank of the branch which flows past the town and on the western shore of the island of Gloriette. Their total length used for trading purposes is 5 mi., and warehouses cover an area of 17 ac. A slipway facilitates the repairing of ships.

The river port occupies the St. Félix and Madeleine branches and has quays extending for half a mile. Finally, on the Erdre is a third port for inland navigation. The quays are bounded by railway lines along the right bank of the river, which the railway to St. Nazaire follows. The older quarter of Nantes is situated to the east of the Erdre.

Buildings.—The cathedral, built above a 12th-century crypt, was unfinished till the 19th century. There are two interesting monuments in the transept; Michel Colomb's tomb of Francis II, duke of Brittany, and his second wife Marguerite de Foix (1507) and that of Gen. Juchault de Lamoricière, a native of Nantes, by Paul Dubois (1879). Between the cathedral and the Loire stands the castle of Nantes, founded in the 9th or 10th century. Rebuilt by Francis II and the Duchess Anne, it is flanked by huge towers and by a bastion erected by Philip Emmanuel, duke of Mercoeur, in the time of the league. A fine Gothic façade looks into the courtyard. From being the residence of the dukes of Brittany, the castle became a state prison and is now occupied as the artillery headquarters. The chapel in which the marriage of Louis XII with Anne of Brittany was celebrated was destroyed in 1800.

Nantes has an archaeological collection in the Dobrée museum, and in the museum of fine arts a splendid collection of paintings, modern French masters being well represented. It is the seat of a prefect, of a bishopric under the archbishop of Tours and a court of assizes and headquarters of the 11th army corps; it has tribunals of first instance and of commerce, a board of trade-arbitrators and a chamber of commerce. It has many educational institutions.

Industries.—Among the more important industries of Nantes are sugar-refining, rice-husking, the manufacture of oil, soap, flour pastes and biscuits, chocolate and the preparation of tinned provisions (sardines, vegetables, etc.); the manufacture of tin boxes, tiles, chemical manures, acid, leather, paper, rope, boots and shoes, brushes, porcelain and glass; shipbuilding, metal founding and the construction of engineering material; and wool and cotton-spinning and the manufacture of cotton and other fabrics, rubber goods, hosiery and knitted goods. Coal and petroleum, sugar, coffee, cottonseed, copra, hemp, grain, phosphates and pyrites, timber and pulpwood are imported. Principal exports are machinery, pit props, iron ore, slate, hoops and provisions. The merchandise handled at the port of Nantes slightly increased after 1913 when the amount of goods handled at the port was 1,964,000 tons (metric). In 1924 it was 2,154,000 and in 1925, 2,086,000 metric tons.

NANTES, EDICT OF, the law promulgated in April 1598 by the French king, Henry IV, which secured a large measure of religious liberty to his Protestant subjects, the Huguenots. Its main provisions may be summarized as follows: (1) It gave liberty of conscience to the Protestants throughout the whole of France. (2) It gave them the right of holding public worship in those places where they had held it in 1576 and the earlier part of 1577; also in places where this freedom had been granted by the edict of Poitiers (1577) and the treaties of Nérac (1579) and of Fleix (1580). The Protestants could also worship in two towns in each *bailliage* and *sénéchaussée*. The greater nobles could hold Protestant services in their houses; the lesser nobles could do the same, but only for gatherings of not more than 30 people. In regard to Paris, the Protestants could conduct worship within five leagues of the city instead of ten leagues as previously. (3) Full civil rights were granted them. They could trade freely, inherit property and enter the universities, colleges and schools. All official positions were open to them. (4) To deal with disputes arising out of the edict, a chamber was established in the parliament of Paris (*le chambre de l'édit*). This group was to be composed of ten Roman Catholic and six Protestant members. Chambers for the same purpose, but consisting of Protestants and Roman Catholics in equal numbers, were established in connection with the provincial parliaments. (5) The Protestant pastors were to be paid by the state and to be freed from certain burdens, their position being made practically equal to that of the Roman Catholic clergy. (6) A hundred places of safety were given to the Protestants for eight years, the expenses of garrisoning them being undertaken by the king.

The edict was greatly disliked by the Roman Catholic clergy, and a few changes were made to conciliate them. The parliament of Paris shared this dislike, but was forced by the king to register the edict on Feb. 25, 1599. After similar trouble it was also registered by the provincial parliaments, the last being the parliament of Rouen, which delayed the registration until 1609.

That the strong political position thus secured to the French Protestants was a danger to the state was proved by the troubles which arose during the minority of Louis XIII. After Richelieu had succeeded in crushing the quasi-independent power of the Huguenot lords and cities, however, the French Protestants ceased to be a political danger. With the revocation of the Edict of Nantes, on Oct. 18, 1685, the French Protestants were deprived of all civil and religious liberty.

BIBLIOGRAPHY.—*See* FRANCE: *History;* and HUGUENOTS. For further details see the papers and documents published as *Le Troisième centenaire de l'édit de Nantes* (1898); N. A. F. Puaux, *Histoire du Protestantisme français* (Paris, 1894); H. M. Baird, *The Huguenots and the Revocation of the Edict of Nantes* (London, 1895); A. Lods, *L'Édit de Nantes devant le parlement de Paris* (1899); and C. Benoist, *La Condition des Protestants sous le régime de l'édit de Nantes et après sa révocation* (Paris, 1900).

NANTEUIL, ROBERT (1623–1678), French line-engraver, was born about 1623, or, as other authorities state, in 1630, the son of a merchant of Reims. Having received an excellent classical education, he studied engraving under his brother-in-law, Nicholas Regnesson. He became known by his crayon portraits, and was pensioned by Louis XIV and appointed designer and engraver of the cabinet to that monarch. It was mainly due to his influence that the king granted the edict of 1660, dated from St. Jean de Luz, by which engraving was pronounced free and distinct from the mechanical arts, and its practitioners were declared entitled to the privileges of other artists. He died at Paris in 1678. The plates of Nanteuil, several of them almost life-size, number about 300. In his early practice he imitated the technique of his predecessors, working with straight lines, strengthened, but not crossed, in the shadows, in the style of Claude Mellan, and in other prints cross-hatching like Regnesson, or stippling in the manner of Jean Boulanger. He then gradually acquired an individual style, modelling the faces of his portraits with the utmost precision and completeness, and employing various methods of touch for the draperies and other parts of his plates. Among the finest of his mature works are the portraits of Pomponne de Bellièvre, Gilles Ménage, Jean Loret, the duc de la Meilleraye and the duchess de Nemours.

A list of his works will be found in Dumesnil's *Le Peintre-graveur français*, vol. iv.

NANTICOKE, a city of Luzerne county, Pennsylvania, U.S., on the Susquehanna river and federal highway 11, 8 mi. W.S.W. of Wilkes-Barre. It is served by the Pennsylvania railroad and (through West Nanticoke) by the Lackawanna, and for freight also by the Central of New Jersey. Pop. (1950) 20,160. It is an anthracite-mining centre and has factories making nylon, rayon and cotton yarns, dresses, stockings and cigars. Nanticoke was laid out in 1793 and was incorporated in 1874.

NANTUCKET, an island 28 mi. S. of Cape Cod off the southeast coast of Massachusetts, U.S., for more than a century a principal seat of the whaling industry. In 1830 the town of Nantucket ranked after Boston and Salem as the third commercial city of the state; in 1842 it was the home port of 86 ships and barks, 2 brigs and 2 schooners, with a total capacity of 36,000 tons. Leadership in the industry passed to New Bedford about 1830,

however, and soon after 1840 the decline of whaling began in earnest. Retaining its old atmosphere and a distinctive physical character inherited from years of Quaker dominance and whaling prosperity, Nantucket has become a summer resort. Pop. (1950) 3,484. For the most part the island is sandy and level. It has few trees and few hills, the highest of which is 191 ft. above the sea. Although the length of the island proper is only about 15 mi., and its average width $2\frac{1}{2}$ mi., there are 88 mi. of shore and an excellent harbour, 7 mi. long. The climate is profoundly modified by this insular position.

Nantucket was discovered by Bartholomew Gosnold and purchased, with Martha's Vineyard, by Thomas Mayhew of Watertown in 1641. Thomas Macy led the first band of settlers in 1659, founding a settlement near Capaum which was called Sherburne in 1673. The island at that time belonged to the province of New York. In 1692 it became part of the state of Massachusetts, and in 1710 the town moved from Sherburne to its present site on Nantucket harbour. In 1695 the name was changed to Nantucket, which is the name of the town, county (including the smaller islands of Tuckunuck and Muskeget) and island. Christopher Hussey took the first sperm whale in 1712, and development of the vessel fishery, succeeding the old shore fishery of whales, was rapid. The American Revolution, the War of 1812 and the American Civil War were the only interruptions to the prosperity based upon whaling until its final decline.

BIBLIOGRAPHY.—*See* Obed Macy, *History of Nantucket* (1835); N. S. Shaler, "Geology of Nantucket," *Bulletin No. 53, U.S. Geological Survey* (1889); *Bulletins Nantucket Historical Society* (1894, *et seq.*); R. A. D. Lithgow, *Nantucket, A History* (1914); W. F. Macy, *Story of Old Nantucket* (1915); W. F. Macy and R. B. Hussey, *Nantucket Scrap Basket* (1916); A. Starbuck, *History of Nantucket* (1924).
(H. B. H.; X.)

NANTWICH, a market town and urban district in the Crewe parliamentary division, Cheshire, England, 161 mi. N.W. of London, on the London Midland Region and Western Region railway routes. Pop. (1951) 8,840. Area 1.83 sq.mi. It lies on the river Weaver, in the upper part of its flat, open valley. The church of St. Mary is a cruciform building in red sandstone, of the Decorated and Perpendicular periods, with a central octagonal tower. The fine old carved stalls are said to have belonged to Vale Royal abbey, near Winsford. Nantwich retains a few old timbered houses (16th and 17th centuries), but the town as a whole is modern in appearance. The grammar school, founded in 1611, is now coeducational. The salt industry was so important there in the time of Henry VIII that there were 300 saltworks. Though this industry has lapsed, there are now brine baths, and the former mansion of Shrewbridge Hall is converted into a hotel with a spa. Nantwich manufactures clothing and boots and shoes. There is also a tannery and a corn mill.

Remains found in the district indicate a Roman settlement there, probably because of the salt. The Domesday survey contains a long account of the laws, customs and values of the saltworks. The salting houses were divided between the king, the earl of Chester and certain resident freemen. The name of the town appears variously as Wych Manbank, Wie Malban, Nantwich, Lache Mauban, Wysmanban, Wiens Malbanus and Namptewiche. About the year 1070 William Malbedeng was created baron of Nantwich, but the barony became subdivided later. The only town charter was granted by Queen Elizabeth (1568). There was a gild merchant and also a town bailiff, but the latter office was soon dropped. There is documentary evidence of a castle at Nantwich in the 13th century.

NANTY-GLO, a coal-mining borough of Cambria county, Pennsylvania, U.S., 12 mi. N. of Johnstown; served by the Cambria and Indiana and the Pennsylvania railways. Pop. 5,425 in 1950; 6,217 in 1940 by the federal census.

NAOMI (Hebrew, "pleasant"; also Noemi in Douay version), mother-in-law of Ruth in the old testament Book of Ruth. She was the wife of Elimelech of Bethlehem and the mother of Mahlon and Chilion.

During a famine in Bethlehem, the family went to the country of Moab. After the death of both her husband and her two sons, Naomi returned with her daughter-in-law, Ruth, to Bethlehem in Judah. Ruth was a native of Moab, but she was devoted to her mother-in-law and insisted on remaining with her.

As a result of her misfortunes, Naomi was not recognized readily when she returned to Bethlehem. Whereupon she said, "Call me not Naomi, call me Mara (bitterness); for the Almighty hath dealt very bitterly with me."

During the harvest, Ruth went to work in the corn fields of Boas, a wealthy kinsman of Naomi. After Ruth and Boas met, Naomi advised and encouraged Ruth to remarry and was soon successful. Naomi later became the nurse for Obed, the son who was born to Ruth and Boas.

(*See* RUTH, BOOK OF.)

NAOROJI, DADABHAI (1825–1917), Indian politician, was born at Nasik on Sept. 4, 1825, the son of a Parsi priest. During a long and active life, he played many parts: professor of mathematics at the Elphinstone college (1854); founder of the *Rast Goftar* newspaper; partner in a Parsi business firm in London (1855); prime minister of Baroda (1874); member of the Bombay legislative council (1885); M.P. for Central Finsbury (1892–95), being the first Indian to be elected to the house of commons; and three times president of the Indian National congress. Many of his numerous writings were collected in *Poverty and Un-British Rule in India* (1901).

NAOS, in architecture the Greek name for temple or, more specifically, the enclosed part (cella) of it. When the cella contains but one room, this is the naos; when it contains two, the naos is the larger of these, in which the statue of the deity is placed.

NAP, the pile on cloth, the surface of short fibres raised by special processes, differing with the various fabrics, and then smoothed and cut. Formerly the word was applied to the roughness on textiles before shearing. "Nap" in this sense appears in many Teutonic languages, cf. German *Noppe*, Dutch *nop*, Norwegian *napp;* the verbal form is *noppen* or *nappen*, to trim, cut short. The word nap also means a short sleep or doze (O. Eng. *hnappian*). In "napkin," a square of damask or other linen used for wiping the hands and lips or for protecting the clothes at meals, the second part is a common English suffix, sometimes of diminutive force, and the first is from "nape," Low Lat. *napa* or *nappa*, a corrupt form of *mappa*, tablecloth. "Nape," the back of the neck, is of doubtful origin; it may be a variant of "knap," a knob or protuberance. Nape still survives in "napery," a name for household linen in general.

NAPA, a city of California, U.S., 11 mi. N. of San Pablo bay and 40 mi. N. by E. of San Francisco, at the head of navigation on the tidal Napa river; the county seat of Napa county. It is served by the Southern Pacific railway. The population in 1950 was 13,579; and 7,740 by the federal census of 1940.

Napa is the commercial and industrial centre of the fertile Napa valley, which is famous for its grapes, nuts, prunes, early pears, apples, oats, alfalfa and other ranch products. The city's manufactures include shoes, gloves, shirts, athletic equipment, paper boxes, stone, dried fruits, butter, cheese, mineral water and grape juices. Napa was settled in 1831 and incorporated as a city in 1872.

NAPERVILLE, a city of Du Page county, Illinois, U.S., on the Burlington Route railway, 28 mi. W. of Chicago. Pop. 7,013 in 1950 and 5,272 in 1940 by the federal census. It has greenhouses, nurseries, poultry farms and several factories, and is the seat of North Central college, founded by the Evangelical church in 1861 at Plainfield, Ill., and moved to Naperville in 1870, and of the Evangelical Theological seminary (1910). The city was founded about 1831.

Naperville has a city commission form of government. The mayor and four councilmen are directly elected for terms of four years.

A sewage treatment plant and water works are city-owned and operated. The city also controls distribution of electricity.

Two weekly newspapers, the *Clarion* and the *Sun,* and a semimonthly newspaper, *Organized Farmer*, are published in Naperville. Manufactured products include furniture, carbon, concrete, toys, machine tools and burlap bags. Agricultural products include corn, oats, hay and grain.

NAPHTALI was, according to Gen. xxx, 8, a son of Jacob by Rachel's handmaid Bilhah, and full brother of Dan. This may be no more than a reflection of the fact that geographically the tribes of Dan and Naphtali are closely associated. Not only did the land of Naphtali in northern Palestine border on that of Dan, but there is in Deut. xxxiii, 23, an indication that Naphtali dwelt near to Dan in the older seat of the latter tribe in the southwest. The story of the conflict against Sisera, Judges iv, *et seq.*, associates Zebulon closely with Naphtali, and informs us that from Kadesh, the old Amorite city which was the chief place in Naphtali's territory, came the hero Barak. Naphtali, because of its exposed situation, suffered at the hands of Syria (I Kings xv, 20); it was depopulated by Tiglath-Pileser (II Kings xv, 29). The reference to Naphtali in the Blessing of Jacob, Gen. xlix, 21, is obscure and of uncertain interpretation. (W. L. W.)

NAPHTHA, a word originally applied to the more volatile kinds of petroleum, issuing from the ground in the Baku district of Russia and in Persia. It is the *νάφθα* of Dioscorides, and the *naphtha*, or *bitumen liquidum candidum* of Pliny. By the alchemists the word was used principally to distinguish various highly volatile, mobile and inflammable liquids, such as the ethers, sulphuric ether and acetic ether having been known respectively as *naphtha sulphurici* and *naphtha aceti*.

The term is now seldom used, either in commerce or in science, without a distinctive prefix, as in the following:

1. *Coal Tar Naphtha.*—A volatile commercial product obtained by the distillation of coal tar. (*See* COAL TAR.)
2. *Shale Naphtha.*—Obtained by distillation from the oil produced by the destructive distillation of bituminous shale. (*See* PARAFFIN.)
3. *Petroleum Naphtha.*—A name sometimes given (*e.g.*, in the United States) to a portion of the more volatile hydrocarbons distilled from petroleum. (*See* PETROLEUM.)
4. *Wood Naphtha.*—Methyl alcohol (*q.v.*).

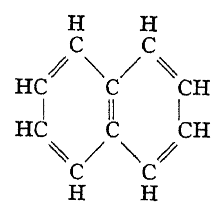
NAPHTHALENE, a hydrocarbon, $C_{10}H_8$, formed when many organic compounds are passed as vapours through a red-hot tube. This accounts for its presence in coal tar (*q.v.*), from the distillates of which it was first isolated by A. Garden in 1819, and also for its formation in modern processes for the high-temperature catalytic cracking of petroleum. Its composition was first determined by Michael Faraday in 1826. Naphthalene is the most abundant single constituent of coal tar, being present to the extent of about 5%. The amount depends on the type of coal used and increases with rising temperature of carbonization. Naphthalene may be carried with the coal gas through the various purifying chambers and deposited in the service pipes to such an extent as to cause partial blockage. For the technical production of naphthalene the appropriate coal-tar distillate, boiling point 170° C. to 230° C., known as middle oil or carbolic oil, is strongly cooled, whereupon the naphthalene crystallizes and may be pressed free from most of the adhering oil. For purification, it is treated with hot caustic soda to remove acidic phenols and then, in the molten state, with a little concentrated sulphuric acid to remove bases and other impurities; it is finally distilled or sublimed.

When the rising demand for naphthalene as a chemical raw material began to create a shortage, substitutes were sought. By a process known as hydroforming the normal paraffin hydrocarbons of petroleum undergo catalytic dehydrogenation and cyclization to aromatic hydrocarbons. In this way a suitable petroleum fraction may be converted into xylenes, from which orthoxylene may be separated and used for the production of phthalic anhydride by vapour-phase oxidation. This gave promise of providing an important new source of phthalic anhydride, formerly manufactured almost entirely by oxidation of naphthalene.

Properties and Uses.—Pure naphthalene crystallizes in lustrous white plates, melting at 80.1° C. and boiling at 218° C. It is almost insoluble in water, sparingly soluble in cold alcohol and in petroleum spirit, but is readily soluble in ether and in hot alcohol. It is characterized by its volatility (also with steam), and it readily sublimes. It forms with picric acid a stable crystalline molecular compound, $C_{10}H_8,C_6H_2(NO_2)_3OH$, melting point 151° C., the formation of which may be used for the characterization and quantitative estimation of naphthalene. The hydrocarbon has a characteristic odour; as "carbon balls" or moth balls, it was formerly used as a moth repellent but was replaced for this purpose by more efficient insecticides such as paradichlorobenzene, D.D.T. and gammexane (benzene hexachloride). Naphthalene has toxic properties, and when administered to rabbits produces a form of cataract, or opalescence of the lenses of the eye. It becomes detoxified by combination with cysteine, forming naphthalene-α-mercapturic acid, which has been isolated from urine. Naphthalene was also shown to undergo metabolic oxidation to 1:2-dihydroxy-1:2-dihydronaphthalene. The products obtained by chemical oxidation of naphthalene vary considerably with the conditions and type of oxidizing agent. Chromic acid in acetic acid gives mainly 1:4-naphthoquinone, whereas potassium permanganate in alkaline solution gives phthalonic acid. In acid solution phthalic acid is the chief product, and this is also formed by oxidation with potassium dichromate and sulphuric acid. Phthalic acid was formerly manufactured by oxidizing naphthalene with hot concentrated sulphuric acid in the presence of mercuric sulphate. This process has been superseded by vapour-phase catalytic oxidation with air, using a vanadium pentoxide catalyst; the phthalic acid which is formed is dehydrated to phthalic anhydride, which sublimes into a condenser.

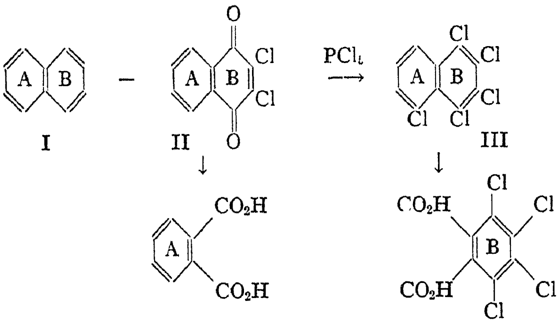
Naphthalene is extensively used as a raw material for the manufacture of dyestuffs and synthetic resins. Phthalic anhydride may be converted into anthranilic acid, an intermediate in the manufacture of indigo; into triphenylmethane dyes; and into anthraquinone and its derivatives, which form the starting material for the preparation of fast vat dyes such as indanthrene and flavanthrene. Phthalic anhydride is also much used for the production of alkyd resins and glyptals in which it is combined with polyhydric alcohols such as glycerol (*see* RESINS). Naphthalene gives rise to a host of substitution products which are important components in the manufacture of azo dyes. These intermediates are principally naphthalene derivatives which contain hydroxyl, amino and sulphonic acid groups in various combinations. One of the earliest of the sulfonamide drugs, prontosil soluble, is an azo dye derived from an aminonaphtholdisulphonic acid. It was subsequently found, however, that the therapeutic effect is in no way dependent on the azonaphthalene grouping, which is in fact disadvantageous.

Constitution.—The empirical formula of naphthalene, $C_{10}H_8$, points to a high degree of unsaturation. The hydrocarbon is, however, not much more unsaturated than benzene, and on treatment with chemical reagents gives mainly substitution products. By catalytic hydrogenation under fairly vigorous conditions, the molecule takes up ten atoms of hydrogen, giving decahydronaphthalene, $C_{10}H_{18}$. This still contains four hydrogen atoms less than the paraffin hydrocarbon, decane, $C_{10}H_{22}$. From these considerations it may be inferred that the molecule of naphthalene contains two rings. That there are, in fact, two rings, each of them a benzene ring, was suggested as early as 1866 by E. Erlenmeyer, Sr., who proposed the following structural formula based on F. A. Kekulé's structure for benzene.



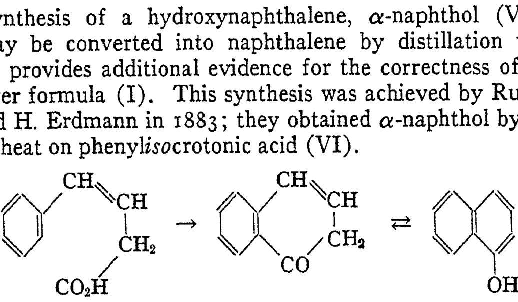
This formula shows two benzene rings combined in such a manner that two carbon atoms are common to both rings. For ease of writing, this formula is usually contracted as shown in formula I. Erlenmeyer's suggestion was confirmed in 1868–69 by C. Graebe, who obtained from naphthalene a series of degradation products which showed conclusively the presence of two distinct benzene rings. He oxidized dichloronaphthoquinone (II), which had been prepared from naphthalene by Auguste Laurent, in 1840, and obtained phthalic acid, or benzene-1:2-dicarboxylic acid (IV). This indicates the presence of an unsubstituted benzene

ring in the dichloroquinone. When the latter was treated with phosphorus pentachloride, there was formed a pentachloronaphthalene, which must be represented by a structure in which four chlorine atoms are attached to one ring and the fifth to the other ring (*e.g.*, III), for oxidation with nitric acid gave tetrachlorophthalic acid (V). Clearly the formation of phthalic acid must involve degradation of one ring (B), and the formation of tetrachlorophthalic acid the degradation of a different ring (A).



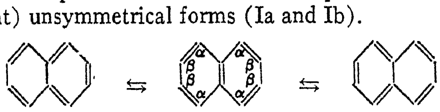
I II III IV V

The synthesis of a hydroxynaphthalene, α-naphthol (VII), which may be converted into naphthalene by distillation with zinc dust, provides additional evidence for the correctness of the Erlenmeyer formula (I). This synthesis was achieved by Rudolf Fittig and H. Erdmann in 1883; they obtained α-naphthol by the action of heat on phenyl*iso*crotonic acid (VI).



VI VII

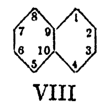
Just as Kekulé suggested that benzene should be represented by a dynamic formula, in which two (equivalent) Kekulé forms represent extreme phases in the vibration of the molecule, so also Erdmann suggested that naphthalene should be similarly represented by a dynamic formula in which the Erlenmeyer symmetrical structure represents an intermediate position between two (equivalent) unsymmetrical forms (Ia and Ib).



Ia I Ib

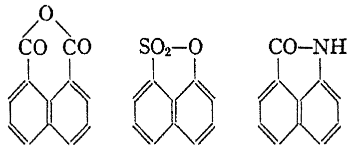
The exact nature of the valence-bond structure of naphthalene has been the subject of much investigation. Some naphthalene derivatives behave as if they have exclusively the Erlenmeyer structure I. This fact may, however, indicate merely the way in which the molecule can be polarized by the attacking reagents in the courses of the reactions in question, and it does not require that, in the unreacting molecule, the bonds be rigidly fixed in the way characteristic of the Erlenmeyer structure. L. C. Pauling approached the problem from the standpoint of the theory of resonance and pointed out that the three bond structures (I, Ia, Ib) are the most stable bond structures, that they have approximately the same energy and that they correspond to approximately the same molecular configuration. They would therefore be expected to contribute, through resonance, about equally to the normal state of the naphthalene molecule. Resonance among these *three* stable structures should, according to Pauling, stabilize the molecule to a greater extent than the Kekulé resonance in benzene, which involves *two* equivalent structures. The resonance energy of naphthalene (63.5 kg.cal./mole) is in fact much greater than that of benzene (39 kg.cal./mole). The chemical reactivity of naphthalene derivatives was interpreted by Pauling in terms of this resonance concept, which led to the conclusion that the bonds between α- and β-carbon atoms (formula I) have $\frac{2}{3}$ double-bond character whereas the others have $\frac{1}{3}$ double-bond character. X-ray crystallographic measurements show the naphthalene molecule to be planar, and a very accurate X-ray analysis by J. M. Robertson revealed small but definite differences between the lengths of the $\alpha\beta$- and $\beta\beta$-bonds. At the present time it is conventional to write the structure of napthalene either in the Erlenmeyer form I, or else, more simply, as two fused hexagons, as in VIII, below.

It follows from the structural formula of naphthalene that the eight hydrogen atoms are not equivalent. They fall into two groups: four occupy α-positions and the other four occupy β-positions (see formula I). Consequently, monosubstitution products exist in two isomeric forms. For di-substituted derivatives theory requires the existence of 10 isomerides if the two substituents are identical, but 14 if they are different. If there are three identical substituents the number of isomerides is 14. The positions of substituents are denoted by numbering the carbon atoms, as in formula VIII. For simple naphthalene derivatives it is unnecessary to number the two "submerged" carbon atoms which are not associated with replaceable hydrogen atoms. In the fully reduced naphthalene derivatives, however, substituents may be attached to these carbon atoms, which are accordingly designated 9 and 10.



VIII

The 1 and 8 positions of naphthalene (*peri* positions) show some similarity to the *ortho* positions of benzene. Thus, naphthalene-1:8-dicarboxylic acid (naphthalic acid), like phthalic acid, readily forms an anhydride (IX). Similar dehydration, with formation of a peri bridge, takes place with 1:8-naphtholsulphonic acid and 1:8-aminonaphthoic acid, which give naphthasultone (X) and naphthastyril (XI), respectively. To this class belongs also the coal tar hydrocarbon, acenaphthene.



IX X XI

Just as 1:8-derivatives are designated *peri-*, so 2:6-derivatives are often designated *amphi-*.

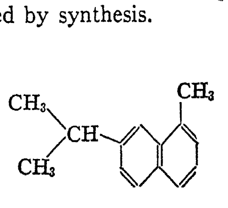
Chemical Reactions.—In its chemical behaviour naphthalene shows the aromatic character associated with benzene and its simple derivatives. Its reactions are mainly reactions of substitution, and naphthalene may be readily chlorinated, brominated, nitrated and sulphonated, and it will undergo the Friedel-Crafts reaction. In reactions such as nitration and halogenation, the substituent enters the more reactive α-positions almost exclusively, although chlorination and bromination lead to a certain extent to β-substitution. Reversible reactions subject to steric hindrance lead to substitution in the less hindered β-positions to an extent which increases with increase in reaction temperature, but varies with the nature of the reagent and sometimes with the solvent. This is exemplified by the Friedel-Crafts reaction. With acetyl chloride and aluminum chloride in carbon disulphide solution at −15° C., naphthalene gives a mixture of α-acetylnaphthalene and β-acetylnaphthalene in a ratio of about 3:1. These may be separated by crystallization of their picrates, the β-compound being much less soluble. In nitrobenzene solution the chief product is the β-ketone. These acetylnaphthalenes may be converted by oxidation with hypochlorite into the corresponding α- and β-naphthoic acids. In the sulphonation of naphthalene the α-sulphonic acid is formed at low temperatures (below the melting point of naphthalene) whereas the β-sulphonic acid is formed at high temperatures (optimum temperature, 160° C. to 170° C.). By heating with sulphuric acid, the α-acid is converted into the β-acid. These temperature effects have been shown to be due to the fact that the α-acid is hydrolyzed about 50 times more rapidly than the β-acid, and the difference becomes more marked with rise of temperature and concentration of sulphuric acid. Increase in temperature or acid concentration thus favours the formation of β-sulphonic acid.

Naphthalene is more reactive than benzene, and substitution reactions usually take place under milder conditions in the case of naphthalene. A striking example of this is given by the Friedel-Crafts reaction between naphthalene and phthalic anhydride, which may be carried out in benzene solution without appreciable formation of *o*-benzoylbenzoic acid. In addition reactions, naphthalene also shows greater reactivity. It is reduced by sodium and ethyl alcohol to the 1:4-dihydride, whereas benzene is unattacked. With sodium and amyl alcohol naphthalene is reduced to the tetrahydro compound (tetralin), and the reaction stops abruptly at this stage because the product is a simple benzene derivative which is resistant to addition of hydrogen. Naphthalene, but not benzene, reacts by addition with alkali metals. Thus, sodium in dimethyl ether at −70° C. to −80° C. gives sodium naphthalene, which appears to be a mixture of two isomerides, for reaction with carbon dioxide gives a mixture of 1:4-dihydronaphthalene-1:4-dicarboxylic acid and 1:2-dihydronaphthalene-1:2 dicarboxylic acid. Naphthalene also adds chlorine more readily than benzene, and by treatment with the dry gas there is formed the tetrachloride, $C_{10}H_8Cl_4$.

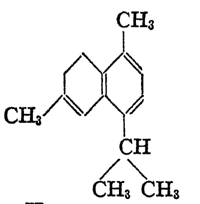
NAPHTHALENE DERIVATIVES

Homologues.—Many of the alkyl derivatives of naphthalene have played an important part in the elucidation of the molecular structures of naturally occurring sesquiterpenes, triterpenes and related compounds. They are also present in coal tar. The simplest of these hydrocarbons are α- and β-methylnaphthalenes, both of which are coal tar constituents. E. A. Coulson described a process by which they may be isolated by fractional distillation of a suitable tar oil fraction, using a column having a rectifying efficiency corresponding with about 100 theoretical plates. α-Methylnaphthalene is a liquid, boiling point 240° C., and β-methylnaphthalene is a low-melting crystalline solid. Eight of the ten possible dimethylnaphthalenes have been isolated from coal tar and two of them (1:6 and 2:6) from Rumanian petroleum. The best known of these are the 1:6-, 2:3-, 2:6- and 2:7-dimethylnaphthalenes. The 1:6- compound is a liquid; the other three are solids which crystallize in colourless glistening plates. Of the trimethylnaphthalenes, the 2:3:6-, 1:3:7- and 2:3:5-compounds have been isolated from coal tar. From the high-boiling fractions of aromatic hydrocarbons obtained by high-temperature catalytic cracking of petroleum there have been isolated α-and β-methylnaphthalenes; 1:2-, 1:6-, 1:7-, and 2:6-dimethylnaphthalenes; and 1:2:5- and 1:2:6- trimethylnaphthalenes.

The sesquiterpenes are hydrocarbons of the formula $C_{15}H_{24}$, which occur in the essential oils of certain plants. Some of them are hydronaphthalene derivatives; among these are cadinene, which is present in oil of cubebs, and selinene, present in celery seed oil. Closely related to the latter is eudesmol, $C_{15}H_{26}O$, an alcohol which occurs in eucalyptus oil, and cyperone, an unsaturated ketone which is a constituent of oil of *Cyperus rotundus*. Selinene, eudesmol and cyperone (after reduction) may be converted by dehydrogenation with sulphur or selenium into eudalene, or 1-methyl-7-isopropylnaphthalene (I). Cadinene under similar conditions gives cadalene or 1:6-dimethyl-4-isopropylnaphthalene (II). The structures of these two naphthalene hydrocarbons have been established by synthesis.



I



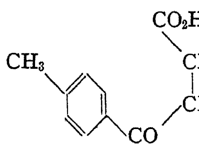
II

Other naturally occurring hydronaphthalene derivatives are santonin, a keto-lactone which is the active principle of wormseed, and its hydroxy derivative Artemisin, which accompanies it in *Artemisia marina*.

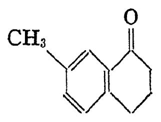
Some monocyclic sesquiterpenes also give eudalene or cadalene by dehydrogenation. The process involves the formation of a second ring. Such compounds are zingiberene, from ginger oil, and bisabolene, from oil of lemons, which both give cadalene. A terpene derivative of a somewhat different type is vitamin A, which gives 1:6-dimethylnaphthalene on heating with selenium. In this case also, the naphthalene hydrocarbon results from the formation of a second ring by cyclization of a side chain under the conditions of the reaction. There are other examples in which both rings of the naphthalene system are formed by cyclization of an unsaturated open chain. Thus, 2:6-dimethylnaphthalene has been obtained by thermal decomposition of the carotenoid pigments β-carotene, zeaxanthin and crocetin dimethyl ester.

The triterpenes are mainly pentacyclic compounds which undergo extensive degradation under the conditions of selenium dehydrogenation. Typical naphthalene derivatives which are formed by this procedure are 2:7-dimethylnaphthalene, 1:2:5-trimethylnaphthalene (agathalene), 1:2:7-trimethylnaphthalene (sapotalene), 6-hydroxy-1:2:5-trimethylnaphthalene and 1:2:5:6-tetramethylnaphthalene. (*See* also TERPENES.)

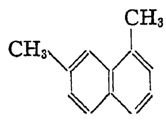
To assist the identification of the naphthalene hydrocarbons formed by the dehydrogenation of terpenes, all of the 14 theoretically possible trimethylnaphthalenes have been synthesized as well as all 10 possible dimethylnaphthalenes. Naphthalene homologues may be synthesized either by introducing alkyl groups into simpler naphthalene derivatives or by building up the second ring from a side chain attached to a suitable benzene derivative. The second method, although more laborious, is more generally serviceable. There are many variants, and a great variety of naphthalene derivatives may be constructed by methods which establish the points of attachment of the substituents. For instance, toluene and succinic anhydride may be caused to interact by the Friedel-Crafts process to give a keto acid (III) which after reduction is cyclized to 1-keto-7-methyl-1:2:3:4-tetrahydronaphthalene (IV). This, with methylmagnesium iodide, gives a carbinol which may be dehydrated and then dehydrogenated to 1:7-dimethylnaphthalene (V).



III

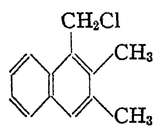


IV

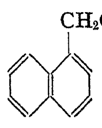


V

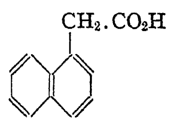
Methyl groups may be introduced into the naphthalene molecule by the action of methyl sulphate on organometallic compounds. Thus, bromination of 2-methylnaphthalene gives the 1-bromo derivative which reacts with lithium to give a lithium compound. This, on treatment with methyl sulphate, gives 1:2-dimethylnaphthalene in excellent yield. Another method consists in chloromethylation followed by reduction. By this means methyl groups may be progressively introduced into the molecule As an example of this method, 2:3-dimethylnaphthalene has been treated with paraformaldehyde and hydrochloric acid to give the chloromethyl derivative (VI), which on reduction gave 1:2:3-trimethylnaphthalene. By a repetition of the process another methyl group was introduced at position 4.



VI



VII



VIII

The chloromethylation reaction may be used for the preparation of other types of naphthalene derivatives. Thus, naphthalene itself gives the 1-chloromethyl compound (VII), which reacts with potassium cyanide to give a nitrile; this is hydrolyzed to α-naphthylacetic acid (VIII), a substance which has found extensive use as a plant-growth substance. It stimulates root formation in a manner similar to the natural plant growth hormone, heteroauxin, or indolyl-3-acetic acid.

Less homogeneous alkylnaphthalenes are prepared industrially

by treating naphthalene with unsaturated hydrocarbons, such as propylene, in the presence of a suitable condensing agent. Sulphonation of the resulting hydrocarbons gives surface-active agents which find application as wetting agents or synthetic detergents.

Naphthylamines, Naphthols and their Sulphonic Acids.—A very wide range of naphthalene derivatives of these types is manufactured for use in the dyestuffs industry, being used mainly as components for azo dyes (*see* DYES, SYNTHETIC). When their potentialities for this purpose were first recognized, their chemistry was very imperfectly understood. Manufacturing processes in many cases gave rise to mixtures which were difficult to separate, and of which the constituents were poorly characterized and the orientation of their substituents only partly determined. In establishing the chemistry of these derivatives of naphthalene on a firm basis, inestimable service was rendered by the classical researches of H. E. Armstrong and W. P. Wynne, who prepared all of the theoretically possible mono-, di- and trichloronaphthalenes (26 in all), established their orientations with absolute certainty and provided a series of reference compounds to which the many naphthalene-, naphthylamine- and naphtholsulphonic acids could be related. P. T. Cleve observed, in 1876, that when a naphthalene-sulphonyl chloride was distilled with phosphorus pentachloride it was converted into the corresponding chloronaphthalene, and that β-naphthol when treated in the same way gave β-chloronaphthalene. Armstrong and Wynne used this as a diagnostic method and showed that bromo- and nitro- substituents were also displaced by chlorine when the compounds containing them were distilled with phosphorus pentachloride. Amino groups could be displaced by chlorine by T. Sandmeyer's method, or replaced by hydrogen through the diazo reaction. By such reactions a naphthalene derivative of unknown structure could be converted into a chlorinated naphthalene of known orientation, from which the positions of substituents in the original compound could be deduced.

The preparation of naphthalene derivatives for use as dyestuffs intermediates involves either nitration or sulphonation of naphthalene as the first stage. As stated above, naphthalene is generally more reactive than benzene, and nitration is very vigorous. This latter reaction is effected by treatment of finely powdered naphthalene with mixed acid (a mixture of concentrated nitric and sulphuric acids), and the temperature should be kept below the melting point of naphthalene (50° C. to 60° C.). This leads to α-nitronaphthalene, which crystallizes in yellow needles, melting point 57.8° C. On further nitration, α-nitronaphthalene yields a mixture of 1:5- and 1:8-dinitronaphthalenes, the substituents always entering α-positions of the naphthalene molecule. β-Nitronaphthalene is of no technical importance, and must be prepared indirectly; for example, by treatment of diazotized β-naphthylamine with potassium nitrite in presence of copper bronze.

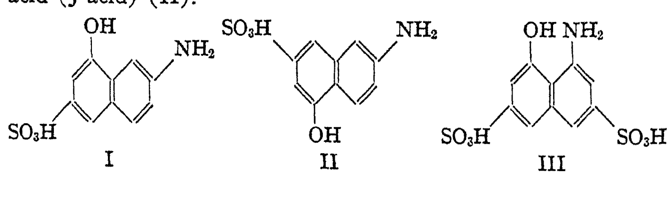
α-Naphthylamine is obtained from α-nitronaphthalene by reduction with iron turnings and water acidulated with hydrochloric acid. After complete reduction, the acid is neutralized and the basic α-naphthylamine is obtained by distillation with superheated steam. It may also be purified by distillation under reduced pressure. It crystallizes in colourless leaflets, melting point 49.2° C. On exposure to air it rapidly acquires a grayish-violet colour and has a somewhat disagreeable odour. α-Naphthylamine and aniline react, when the mixture is heated with a little sulphanilic acid, to give the secondary base, phenyl-α-naphthylamine. This serves, together with alkylated naphthylamines, for the preparation of basic diphenylnaphthylmethane colours of the type of Victoria blue. By heating under pressure with dilute sulphuric acid (200° C.; 14 atm.), α-naphthylamine is hydrolyzed to the corresponding hydroxynaphthalene, α-naphthol. This phenolic substance crystallizes in white lustrous prisms, melting point 96° C., and is used as a dyestuffs intermediate. By submitting the sulphate of α-naphthylamine to a process of baking in a vacuum it is converted into 1-naphthylamine-4-sulphonic acid (naphthionic acid), which, by heating under reflux with sodium bisulphite solution, followed by boiling with 30% caustic soda, is transformed into 1-naphthol-4-sulphonic acid (Neville-Winter acid).

As stated in an earlier section, the position of entry of a sulphonic acid group into the naphthalene molecule is determined by the conditions used. It is very difficult to obtain the pure α-sulphonic acid by direct sulphonation of naphthalene with sulphuric acid on account of the ease with which it is converted into naphthalene-β-sulphonic acid. The latter acid is, however, readily obtained by sulphonation at high temperatures and is an important intermediate. By fusion of the sodium salt with caustic soda, there is formed β-naphthol, and this operation is one of the most important processes in the organic chemical industry. To obtain a good yield and to avoid danger of explosion the caustic soda must be completely free from chlorate. β-Naphthol crystallizes in colourless plates which melt at 122° C. Its methyl ether, nerolin, has a fragrant odour and is used in perfumery. By nitration, followed by reduction, naphthalene-β-sulphonic acid is converted into Cleve's acids, a mixture of 1:6- and 1:7- naphthylaminesulphonic acids, which may be separated by recrystallization of the sodium salts. The salt of the 1:7-acid is less soluble and crystallizes almost completely on the addition of brine.

Sulphonation of β-naphthol leads to 2-naphthol-8-sulphonic acid (Bayer's acid), which is transformed by warm sulphuric acid into 2-naphthol-6-sulphonic acid (Schäffer's acid). With a sufficient excess of sulphuric acid the chief products are 2-naphthol-3:6-disulphonic acid and 2-naphthol-6:8-disulphonic acid, which, because of their property of giving, respectively, red (*rot*) and yellow (*gelb*) colours with diazonium salts, are known, respectively, as R-acid and G-acid. By energetic sulphonation with warm oleum they are both transformed into 2-naphthol-3:6:8-trisulphonic acid. All these acids are important intermediates for azo dyes. The first product of sulphonation of β-naphthol is 2-naphthol-1-sulphonic acid. This, however, is very unstable in presence of excess of sulphuric acid and is rapidly transformed into the 8-sulphonic acid. 2-Naphthol-1-sulphonic acid may, however, be obtained by treatment of naphthalene with chlorosulphonic acid in nitrobenzene solution. By treatment of its sodium salt with ammonia and ammonium sulphite there is obtained the sodium salt of 2-naphthylamine-1-sulphonic acid (Tobias acid).

β-Naphthylamine is another important naphthalene derivative prepared from β-naphthol. The hydroxyl group is replaced by an amino group by means of the Bucherer reaction, whereby β-naphthol is heated in an autoclave at 150° C. and 6 atm. pressure with an ammonium sulphite solution prepared by saturating concentrated ammonia solution with sulphur dioxide and then adding an equal volume of concentrated ammonia solution. β-Naphthylamine crystallizes from alcohol in colourless lustrous scales of melting point 110° C. Unlike the α-isomeride it is odourless when pure. β-Naphthylamine is possibly the agent responsible for causing the bladder cancers to which workers in the dyestuffs industry are sometimes liable. It has been shown experimentally that such bladder tumours can be produced in dogs by administration of β-naphthylamine. The acid sulphate of 1-hydroxy-2-naphthylamine has been isolated from the urine of dogs which were given β-naphthylamine, an example of biochemical hydroxylation of the naphthalene nucleus.

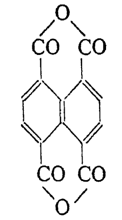
β-Naphthylamine may also be used as the starting point in the preparation of two important aminonaphtholsulphonic acids (γ-acid and J-acid), which may be obtained by various routes from β-naphthol. For instance, β-naphthylamine may be sulphonated to a mixture of the 6:8- and 5:7- disulphonic acids. The nitrite of the former (amino-G-acid) is treated in an autoclave with caustic soda and some water to give, by hydrolysis of the 8-sulphonic acid group, 2:8:6-aminonaphtholsulphonic acid, (γ-acid) (I). By a similar procedure 2-naphthylamine-5:7-disulphonic acid is converted into 2:5:7-aminonaphtholsulphonic acid (J-acid) (II).



I II III

A disulphonic acid of similar type (H-acid) (III) is prepared from naphthalene-2:5:7-trisulphonic acid by nitration, reduction and then displacement of one sulphonic acid group by a hydroxyl. If β-naphthol is treated with sodium nitrite and sulphuric acid it gives 1-nitroso-2-naphthol which, with sodium bisulphite solution, is converted into 1-amino-2-naphthol-4-sulphonic acid. This gives a very stable diazonium salt which may be dried and nitrated without danger. The nitrated product couples with the naphthols to give black dyes. 1-Naphthylamine-4:6:8-trisulphonic acid is an intermediate in the preparation of the drug antrypol (germanin), used in treatment of trypanosomiasis.

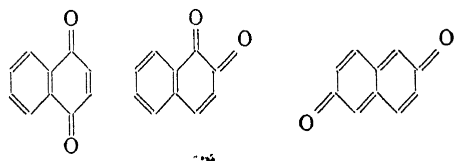
Carboxylic Acids.—Many naphthalenecarboxylic acids have been described, but with few exceptions are of little importance. The monocarboxylic acids, α- and β-naphthoic acids, have been mentioned in an earlier section. They have the usual properties of acids of the aromatic series. Naphthalene-1:8-dicarboxylic acid, naphthalic acid, is obtained by oxidation of the coal tar hydrocarbon, acenaphthene (*q.v.*). In a similar manner, naphthalene-1:4:5:8-tetracarboxylic acid is formed by oxidative degradation of two of the rings of the tetracyclic hydrocarbon, pyrene (*q.v.*). This acid gives a dianhydride (I), which reacts with *o*-phenylene diamine to form a mixture of two isomeric products used as a dyestuff under the name of indanthrene scarlet 2G.



I

Another acid used as a dyestuffs intermediate is 2-hydroxy-3-naphthoic acid, obtained from β-naphthol by the Kolbe-Schmidt reaction.

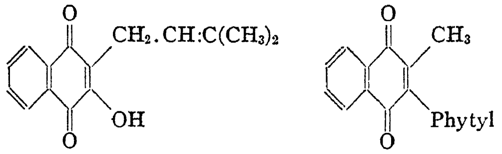
Naphthoquinones.—Six different naphthoquinones, $C_{10}H_6O_2$, are theoretically possible, but the only ones which have been prepared are the 1:4- or α- (I), the 1:2- or β- (II) and the 2:6- or *amphi-* (III) naphthoquinones. 1:4-Naphthoquinone (I) may be obtained by oxidation of naphthalene with chromic acid in acetic acid, but is better prepared by oxidation of 4-amino-1-naphthol. It crystallizes in yellow tablets, melting point 125° C., is volatile in steam and has a characteristic pungent smell. 1:2-



I II III

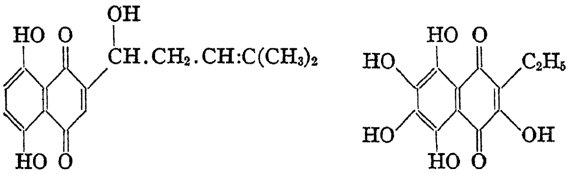
Naphthoquinone, formed by oxidation of 1-amino-2-naphthol, forms golden-yellow needles which decompose at 145° C. to 147° C., and is odourless and nonvolatile. It is somewhat unstable, although more stable derivatives are known; *e.g.*, 3:7-dimethyl-1:2-naphthoquinone. 2:6-Naphthoquinone, also nonvolatile and odourless, forms reddish-yellow crystals. These quinones have the high reactivity associated with quinones of the benzene series, and undergo many reactions of addition. An important example, in the case of the 1:4-quinone, is the Diels-Alder addition of dienes, which furnishes a simple route from the naphthalene series to the anthracene series.

Many derivatives of 1:4-naphthoquinone have been found to occur in nature as pigments. An early known example is juglone, 5-hydroxy-1:4-naphthoquinone, which occurs as the colourless leuco compound in unripe walnut shells. Closely related to this is plumbagin, or 5-hydroxy-2-methyl-1:4-naphthoquinone, a yellow pigment found in roots of *Plumbago* species. It has long been known as the active principle of the medicinal drug, Chita, obtained from this source. Lawsone, extracted from the leaves of henna (*Lawsonia alba*), is 2-hydroxy-1:4-naphthoquinone. Phthiocol, or 2-hydroxy-3-methyl-1:4-naphthoquinone, has been isolated from human tubercle bacilli, but it has been suggested that it may be formed during isolation by degradation of vitamin K. Structurally related to phthiocol is lapachol, a pigment occurring in the grain of a number of African woods (*Bignoniaceae*). Lapachol has been shown to have the structure shown in IV. Introduction of a hydroxyl group into one of the methyl groups of IV gives the structure of lomatiol, the yellow pigment surrounding the nucleus in seeds of Australian *Lomatia*. Vitamin K_1, the antihaemorrhagic factor isolated from hexane extracts of dried alfalfa, is represented by the formula V. The same type of structure has been assigned to vitamin K_2, isolated from decaying fish meal.



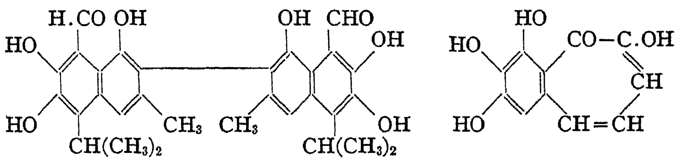
IV V

Another group of natural naphthoquinone pigments is derived from naphthazarin (5:8-dihydroxy-1:4-naphthoquinone), long known as a synthetic dyestuff. To this group belongs alkannin, a brown-red pigment occurring as the angelic ester in the root of *Alkanna tinctoria*. It is optically active (dextrorotatory), and its enantiomorph is shikonin, isolated from *Lithospermum erythrorhizon*. These two pigments have the structure VI. Hydroxydrosérone, which occurs with droserone in *Drosera whittakeri*, a plant growing in the Adelaide district of Australia, is also a naphthazarin derivative (3:5:6-trihydroxy-2-methyl-1:4-naphthoquinone).



VI VII

In many ways the most remarkable of all these substances is echinochrome A, one of several related pigments which have been isolated from sea urchin eggs. It functions as a chemotactic principle and is secreted by the egg to the surrounding sea water to induce motility in spermatozoa with which it comes in contact. It still shows biological activity in dilutions of 1.2×10^9. It is a completely substituted naphthalene derivative of the structure VII, or a tautomeride. Dunnione, from *Streptocarpus dunnii* Mast., is a pigment which has been characterized as an *ortho*-quinone, and is probably derived from 1:2-naphthoquinone. Another natural product derived from naphthalene, although not a quinonoid pigment, is gossypol, the yellow toxic principle of cottonseed. On the basis of an extensive series of degradations Roger Adams assigned to gossypol the structure VIII.

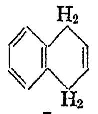


VIII IX

Yet another natural pigment related to naphthalene is purpurogallin, which occurs as glucosides in many galls. It gives naphthalene on distillation with zinc dust. This is the result of a rearrangement of a seven-membered ring, for R. D. Haworth showed that purpurogallin has the structure IX. Concentrated caustic potash converts it into purpurogallone, which is 6:7:8-trihydroxy-1-naphthoic acid.

Hydrogenated Naphthalenes.—As already stated, naphthalene is reduced by sodium and ethyl alcohol to the 1:4-dihydride

(I), and by sodium and amyl alcohol to the tetrahydride (tetralin). The 1:4-dihydride is also formed by hydrolysis of the compound obtained by addition of lithium to naphthalene which is, therefore, the 1:4-dilithium compound. 1:4-Dihydronaphthalene is best purified through its crystalline addition compound with mercuric acetate. When heated with sodium ethoxide in ethanol at 100° C. –105° C., 1:4-dihydronaphthalene is isomerized to 1:2-dihydronaphthalene (II), in which the ethylenic bond is conjugated with the residual benzene ring. The 1:2- and the 1:4-compounds are the only known dihydrides of naphthalene. They are distinguished from one another by their physical constants and their absorption spectra, and their structures are demonstrated by the products which they give on oxidation. The 1:4-dihydride gives *o*-phenylenediacetic acid, whereas the 1:2-dihydride gives *o*-carboxyphenylpropionic acid.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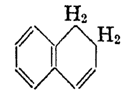
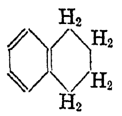
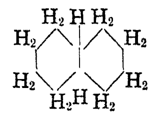

II

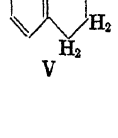
The catalytic hydrogenation of naphthalene is a process of technical importance. By hydrogenation over finely divided nickel at high temperatures, naphthalene readily gives first tetrahydronaphthalene (tetralin) (III) and then decahydronaphthalene (decalin) (IV). The naphthalene must be carefully purified before use, in order to free it from sulphur compounds which poison the catalyst. Both tetralin and decalin are valuable solvents. Many of their derivatives are also known. They are obtained by chemical or catalytic reduction of appropriate naphthalene derivatives, or from simpler compounds by synthetic reactions.


III


IV

The course of reduction or hydrogenation of substituted naphthalenes depends on a number of factors, and the nature of the product is often influenced by the method used. α-Naphthol and α-naphthylamine are reduced by sodium and amyl alcohol in the unsubstituted ring giving, respectively, a phenol and an aromatic amine derived from tetralin. On the other hand, β-naphthol and β-naphthylamine are attacked mainly in the ring to which the substituent is attached and give as predominant products a hydroxy tetralin and an amino tetralin which have the character of an alcohol and an alicyclic primary amine, respectively. When β-naphthylamine is hydrogenated over a nickel catalyst the unsubstituted ring is mainly attacked, the chief product being the aromatic β-amino tetralin.

Oxidation of tetralin takes place by attack on the alicyclic ring, and in the α-position. Cold chromic acid gives α-tetralone (V), which may be synthesized by cyclisation of γ-phenylbutyric acid. The same ketone is doubtless an intermediate in the permanganate oxidation of tetralin to *o*-carboxyphenylpropionic acid and phthalonic acid. α-Tetralone is also formed when a slow stream of air or oxygen is passed through tetralin at 70° C., in the presence of iron phthalocyanine. This oxidation probably takes place through the intermediary of tetralin α-hydroperoxide (VI), which is formed in high yield by auto-oxidation of tetralin. The presence of the peroxide may cause distillation residues from tetralin to explode, and the use of antioxidants to inhibit the auto-oxidation has been suggested.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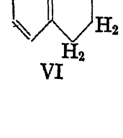
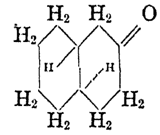
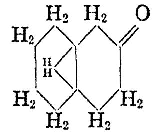

VI

W. Hückel's investigations on decalin derivatives are of fundamental importance in connection with the stereochemistry of fused-ring systems, and provide experimental verification of the theory of H. Sachse and E. Mohr that alicyclic compounds containing more than five carbon atoms in the ring have strainless multiplanar configurations (*see* STEREOCHEMISTRY). Thus, by hydrogenation of β-naphthol under various conditions, four different decahydro-compounds are formed, melting at 75°, 53°, 105° and 18° C., respectively. The first two of these are oxidized to the same ketone (trans-β-decalone), and the difference between them clearly resides in the configuration of the hydroxyl groups; they are, in fact, epimerides. The second pair of carbinols are both oxidized to a ketone (*cis*-β-decalone), which differs from the first-named ketone. The two ketones are stereoisomeric, and differ in the configurations of the rings about the carbon atoms which are common to both rings. In the case of the *trans*-ketone, the hydrogen atoms attached to these two carbon atoms lie on opposite sides of the ring system, and in the *cis*-ketone they are on the same side. The configurations of the two ketones may be represented by the expressions VII and VIII, which denote *trans*- and *cis*- forms, respectively.


VII


VIII

The configurations have been deduced by further oxidation to stereoisomeric *cyclo*hexane-1:2-diacetic acids, only one of which is resolvable into optically active forms. This must have the *trans*- configuration. If the two β-decalones are reduced by E. Clemmensen's method they are converted into isomeric *trans*- and *cis*-decalins, which differ in their physical constants. It has been shown, further, that the decalin formed by catalytic hydrogenation of naphthalene is a mixture of these two stereoisomerides. Hydrogenation at low temperatures (with Adams' platinum oxide catalyst in acetic acid solution) favours the formation of *cis*-decalin, whereas at high temperatures (with a nickel catalyst) the *trans* hydrocarbon is mainly formed. *cis*-Decalin is almost entirely converted into *trans*-decalin by treatment with anhydrous aluminum chloride at room temperature. The hydrogenation of α-naphthol has also been shown to give rise to four stereoisomeric alcohols, two of which are oxidized to *trans*-α-decalone and the other to *cis*-α-decalone. *cis*-α-Decalone is isomerized by heat, or by acid or alkali, to the *trans*-ketone. This rearrangement must involve the formation of an enolic form common to both ketones.

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NAPHTHOLS: *see* NAPHTHALENE.

NAPHTHYLAMINES: *see* NAPHTHALENE.

NAPIER, SIR CHARLES (1786–1860), British admiral, second son of the Hon. Charles Napier, R.N., and grandson of the 5th Lord Napier, was born at Merchiston hall, near Falkirk, on March 6, 1786. He became a midshipman in 1800 and lieutenant in 1805. He was appointed to the "Courageux" (74), serving with her in the West Indies, and later was appointed commander of the "Pultusk" brig (Nov. 30, 1807). In Aug. 1808 he was moved into the "Recruit," and in April 1809 took part in the capture of the "Hautpoult" and was promoted acting post captain. Coming home with a convoy, he was put on half pay and spent some time at the University of Edinburgh, and later visited Portugal. He served in 1811 in the Mediterranean and in 1813 on the coast of America. He spent his leisure in Italy and Paris, but was ruined by speculation in a steamboat company. In 1827 he was appointed to the "Galatea," was at the Azores when they were held by the count de Villa Flor for the queen of Portugal, and accepted the offer of the constitutional leaders to take command of the fleet (Feb. 1833). With it he destroyed

the Miguelite fleet on July 5, and was struck off the English navy list. He commanded the Portuguese land forces in the defence of Lisbon (1834) and was made Count Cape St. Vincent in the peerage of Portugal.

Napier then returned to England, was restored to his former rank in 1836, and received the command of the "Powerful" in 1838. In 1840 he was made K.C.B. for his services as second in command in Syria. He was M.P. for Marylebone from 1842–46. He was promoted rear-admiral in 1846 and commanded the Channel fleet from 1846–48. In the Russian War he received the command of the Baltic fleet, and hoisted his flag in February 1854. He refused to attack Cronstadt, and a great outcry was raised against him for not obeying the orders of the Admiralty. He was not again offered a command. He was M.P. for Southwark from February 1855 until his death on Nov. 6, 1860.

See Major-General E. Napier's *Life and Correspondence of Admiral Sir Charles Napier, K.C.B.* (2 vols., 1862); Napier's own *War in Syria* (2 vols., 1842); *The Navy: its past and present state, in a series of letters,* edited by Sir W. F. P. Napier (1851); and *The History of the Baltic Campaign of 1854, from documents and other materials furnished by Vice-Admiral Sir C. Napier, K.C.B.* (1857). *See* also *The Life and Exploits of Commodore Napier* (1841); and *Life of Vice-Admiral Sir C. Napier* (1854).

NAPIER, SIR CHARLES JAMES (1782–1853), British soldier and statesman, was born in London, the eldest son of Colonel George Napier (a son of the 5th Lord Napier) and Lady Sarah Lennox, on Aug. 10, 1782. He was lieutenant in 1800 and captain in the staff corps under Sir John Moore. He became major in 1806 and served in the Danish campaign (1807) and in Portugal, but was badly wounded at Coa and Busaco. He took part in the pursuit of Masséna and became lieutenant-colonel (1811) of the 102nd regiment, which he thoroughly reorganized. At Bermuda in 1813 he served against the United States, but returned in 1815 and was made C.B. From 1822 to 1830 he was military resident of Cephalonia, where he met Lord Byron, and was recommended as commander-in-chief of the Greek forces. Napier declined, and, after trouble with Sir Frederick Adams, the high commissioner, he became commanding officer in the north of England during the Chartist riots (1839), although his sympathies were on the popular side. He accepted an Indian commission in 1841, and in September 1842 was ordered to Sind.

His command in Sind lasted until August 1847. He at once determined to seek the first opportunity of conquering the amirs. He was to be accompanied by James Outram (*q.v.*) who had been British resident in Sind during the Afghan War. On Feb. 15, 1843, Outram was treacherously assailed at Hyderabad, and on the 17th Napier attacked the Baluch army 30,000 strong, with but 2,800 men. With these 2,800 men, including the 22nd regiment, he won the brilliant and decisive victory of Miani, one of the most amazing in the history of the British army, in which generals had to fight like privates. In March he finally destroyed the army of the amirs at the battle of Hyderabad, and for this service received the K.C.B. Sind, when it came under British rule, was in a state of anarchy, for the Baluchis had formed a tyrannical military government. The native population was protected by Sir Charles Napier. The difficulties of administration were increased by the necessity of repressing the hill tribes, encouraged to lawless acts by the licence which followed the Afghan War; the later years were made very stormy by attacks in England on the policy of the conquest. Napier left Sind in August 1847 after quarreling with nearly every authority in India. His short stay in England was occupied with incessant struggles with the directors of the East India Company, but the panic in England which followed the news of the indecisive victory of Chillianwalla obliged the company to summon the greatest general of the day to command its armies.

Napier left for India at once, only to find that the victory of Gujrat had been won and the Sikh War was over. He was on good terms with the governor-general, Lord Dalhousie, until, in Dalhousie's absence at sea, Napier took upon himself, in face of a threat of mutiny, to alter the regulations regarding allowances to native troops. On Dalhousie's return he reprimanded the commander-in-chief, and reversed his decision. Napier immediately resigned, and, when Wellington repeated the reprimand, he returned to England.

He has been credited with foreseeing the Mutiny of 1857, and on the whole with justice. On one occasion he wrote that mutiny was "one of the greatest, if not the greatest, danger threatening India—a danger that may come unexpectedly, and if the first symptoms be not carefully treated, with a power to shake Leadenhall." On the mutiny of the 66th native regiment at Govindgarh he disbanded it, and handed its colours over to a Gurkha regiment, thus showing that he distrusted the high-class Brahman, and recognized the necessity of relying upon a more warlike and more disciplined race. His constitution was undermined by the Indian climate, and he died at Portsmouth on Aug. 29, 1853. The bronze statue of him by G. G. Adams, which stands in Trafalgar Square, London, was erected by public subscription, by far the greater number of the subscribers being, as the inscription records, private soldiers.

The chief authority for Sir Charles Napier's life is his *Life and Opinions* by his brother (1857); consult also MacColl, *Career and Character of C. J. Napier* (1857); M'Dougall, *General Sir C. J. Napier, Conqueror and Governor of Scinde* (1860); W. N. Bruce, *Sir Charles Napier* (1855); and T. R. E. Holmes, *Four Famous Soldiers* (1889). His own works are *Memoir on the Roads of Cephalonia* (1825); *The Colonies, treating of their value generally and of the Ionian Islands in particular; Strictures on the Administration of Sir F. Adam* (1833); *Colonization, particularly in Southern Australia* (1835); *Remarks on Military Law and the Punishment of Flogging* (1837); *A Dialogue on the Poor Laws* (1838?); *A Letter on the Defence of England by Corps of Volunteers and Militia* (1852); *Lights and Shadows of Military Life* (trans. from the French, 1840); and *A Letter to the Right Honourable Sir J. C. Hobhouse on the Baggage of the Indian Army* (1849); *Defects, Civil and Military, of the Indian Government* (1853); *William the Conqueror, a Historical Romance,* edited by Sir W. Napier (1858). On Sind, consult primarily Sir W. Napier, *The Conquest of Scinde* (1845); *The Administration of Scinde* (1851); *Compilation of General Orders issued by Sir C. Napier* (1850); and Outram, *The Conquest of Scinde, a Commentary* (1846). For his command-in-chief, and the controversy about his resignation, consult J. Mawson, *Records of the Indian Command of General Sir C. J. Napier* (Calcutta, 1851); *Minutes on the Resignation of the late General Sir C. Napier, by Field-Marshal the Duke of Wellington,* etc. (1854); *Comments by Sir W. Napier on a Memorandum of the Duke of Wellington* (1854); Sir William Napier, *General Sir C. Napier and the Directors of the East India Company* (1857); Sir W. Lee Warner, *Life of Lord Dalhousie* (1904).

NAPIER, JOHN (1550–1617), Scottish mathematician, the inventor of logarithms, was born in Merchiston near Edinburgh in 1550, and was the eighth Napier of Merchiston. He matriculated at St. Salvator's college, St. Andrews, in 1563. Very little is known of his life at this time, but it is plain from the "Discourse" which he prefixed to his *Plaine Discovery* that he was already a devoted adherent of the Protestant cause. From St. Andrews he went apparently to study in Paris, and travelled in Italy and Germany. But he was back at Merchiston in 1571, and in the next year married Elizabeth, daughter of Sir James Stirling. The son of this marriage was Archibald, Lord Napier. Elizabeth Napier died in 1579, and soon after Napier married Agnes Chisholm.

Napier was one of the Edinburgh commissioners to the General Assembly in 1588, and on Oct. 17, 1593, was a member of a committee nominated by a convention of delegates to make representations to the king at Jedburgh on the safety of the Church and the punishment of the Roman Catholic earls. He was a member of a similar delegation later in the month. On Jan. 29, 1594, Napier addressed to the king the letter which forms the dedication of his *Plaine Discovery of the whole Revelation of Saint John: set down in two treatises . . .* (Edinburgh, 1593). This book has a great place in the history of theology in Scotland, for it is the first important Scottish work on the interpretation of scripture.

After the publication of the *Plaine Discovery,* Napier seems to have occupied himself with the invention of secret instruments of war, for in the Bacon collection at Lambeth Palace there is a document, dated June 7, 1596, and signed by Napier, giving a list of his inventions for the defence of the country against the anticipated invasion by Philip of Spain. In 1614 appeared *Canonis Descriptio* embodying his invention of logarithms. Their nature is explained by reference to the motion of points in a straight line, and the principle upon which they are based is that of the correspondence of a geometrical and an arithmetical series of numbers.

The table gives the logarithms of sines for every minute to seven figures. This work contains the first announcement of logarithms to the world, the first table of logarithms and the first use of the name logarithm, which was invented by Napier.

In 1617 Napier published his *Rabdologia.* The method which Napier terms "Rabdologia" consists in the use of certain numerating rods for the performance of multiplications and divisions. These rods were commonly called "Napier's bones" The second method, which he calls the "Promptuarium Multiplicationis," involves the use of a number of lamellae or little plates of metal disposed in a box. In an appendix he gives his third method, "local arithmetic," which is performed on a chess-board, and depends, in principle, on the expression of numbers in the scale of radix 2. In the *Rabdologia* he gives the chronological order of his inventions.

John Napier died on April 4, 1617, the same year as that in which the *Rabdologia* was published.

The *Canonis Descriptio* on its publication in 1614 at once attracted the attention of Edward Wright, whose name is known in connection with improvements in navigation, and Henry Briggs, then professor of geometry at Gresham college, London. The former translated the work into English, but he died in 1615, and the translation was published by his son Samuel Wright in 1616. The logarithms introduced by Napier in the *Descriptio* are not the same as those now in common use, nor even the same as those now called Napierian or hyperbolic logarithms. The change from the original logarithms to common or decimal logarithms was made by both Napier and Briggs, and the first tables of decimal logarithms were calculated by Briggs, who published a small table, extending to 1,000, in 1617, and a large work, *Arithmetica Logarithmica*, containing logarithms of numbers to 30,000 and from 90,000 to 100,000, in 1624. (*See* LOGARITHMS.) Napier's *Descriptio* of 1614 contains no explanation of the manner in which he had calculated his table. This account he kept back, as he himself states, in order to see from the reception met with by the *Descriptio* whether it would be acceptable. Though written before the *Descriptio* it had not been prepared for press at the time of his death, but was published by his son Robert in 1619 under the title *Mirifici Logarithmorum Canonis Constructio.* In this treatise (which was written before Napier had invented the name logarithm) logarithms are called "artificial numbers."

Napier's priority in the publication of the logarithms is unquestioned and only one other contemporary mathematician seems to have conceived the idea on which they depend.

An account of the contents of the manuscripts of John Napier in the possession of the family which survived a disastrous fire at the end of the 18th century was given by Mark Napier in the appendix to his *Memoirs of John Napier*, and the manuscripts themselves were edited in their entirety by him in 1839 under the title *De Arte Logistica Joannis Naperi Merchistonii Baronis Libri qui supersunt. Impressum Edinburgi* M.DCCC.XXX.IX., as one of the publications of the Bannatyne club. The *Arithmetica* consists of three books, entitled: (1) De Computationibus Quantitatum omnibus Logisticae speciebus communium; (2) De Logistica Arithmetica; (3) De Logistica Geometrica. At the end of this book occurs the note—"I could find no more of this geometricall pairt among all his fragments." The *Algebra Joannis Naperi Merchistonii Baronis* consists of two books: (1) "De nominata Algebrae parte; (2) De positiva sive cossica Algebrae parte," and concludes with the words, "There is no more of his algebra orderlie sett doun."

Besides the logarithms and the calculating rods or bones, Napier's name is attached to certain rules and formulae in spherical trigonometry. To him also seems to be due the first use of the decimal point in arithmetic. Decimal fractions were first introduced by Stevinus in his tract *La Disme*, published in 1585, but he used cumbrous exponents (numbers enclosed in circles) to distinguish the different denominations, primes, seconds, thirds, etc. In the *Rabdologia* Napier gives an "Admonitio pro Decimali Arithmetica," in which he commends the fractions of Stevinus and gives an example of their use, the division of 861094 by 432. The quotient is written 1993,273 in the work and $1993{,}2'7''3'''$ in the text. The decimal point is, however, used systematically in the *Constructio* (1619), there being perhaps two hundred decimal points altogether in the book.

Napier was in possession of all the conventions and attributes that enable the decimal point to complete so symmetrically our system of notation, viz. (1) he saw that a point or separatrix was quite enough to separate integers from decimals, and that no signs to indicate primes, seconds, etc., were required; (2) he used ciphers after the decimal point and preceding the first significant figure; and (3) he had no objection to a decimal standing by itself without any integer. Napier thus had complete command over decimal fractions and the use of the decimal point.

The bibliography of Napier's work attached to W. R. Macdonald's translation of the *Canonis Constructio* (1889) is complete and valuable. Napier's three mathematical works are reprinted by N. L. W. A. Gravelaar in *Verhandelingen der Kon. Akad. van Wet te Amsterdam* (1899).

NAPIER, SIR WILLIAM FRANCIS PATRICK (1785–1860), British soldier and military historian, third son of Colonel George Napier (1751–1804), was born at Celbridge, near Dublin, on Dec. 17, 1785. He became an ensign in the Royal Irish Artillery in 1800, but at once exchanged into the 62nd, and was put on half-pay in 1802. He afterwards became a cornet in the Blues, but he soon exchanged into the 52nd, which was about to be trained at Shorncliffe. Through Sir John Moore he soon obtained a company in the 43rd, joined that regiment at Shorncliffe and became a favourite with Moore. He served in Denmark, and was present at the engagement of Kioge, and, shortly afterwards bore himself nobly through the retreat to Corunna. In 1809 he became aide-de-camp to the duke of Richmond, lord lieutenant of Ireland, but joined the 43rd when that regiment was ordered again to Spain. With the light brigade (the 43rd, 52nd, and 95th), under the command of General Craufurd, he marched to Talavera and had an attack of pleurisy on the way. He refused to leave Spain, was wounded on the Coa, and shot near the spine at Cazal Nova. After he left the lines of Torres Vedras he became brigade major, was present at Fuentes d'Onor, but had an attack of ague and was obliged to return to England. He married Caroline Amelia Fox, daughter of General Henry Fox. Three weeks afterwards he again started for Spain, and was present at the storming of Badajoz, where his great friend Colonel M'Leod was killed. He took command of the 43rd regiment (he was now a substantive major) and commanded it at the battle of Salamanca. At the battle of the Nivelle he secured the most strongly fortified part of Soult's position, practically without orders. He served with his regiment at the battles of the Nive, where he was wounded, Orthes, and Toulouse. For his services he was made brevet lieutenant-colonel, and one of the first C.B.'s. He then entered the military college at Farnham. He commanded his regiment in the invasion of France after Waterloo, and remained in France with the army of occupation until 1819, when he retired on half-pay. As this was not enough for him to live on with a wife and family, he studied with George Jones, the academician to become an artist.

His career was to be great in literature, not in art. The tendency appeared in a review of Jomini's works (*Edinburgh Rev.*) in 1821, and in 1823 Bickersteth (afterwards Lord Langdale) suggested to him writing a history of the Peninsular War. The duke of Wellington gave him much assistance, and handed over to him the whole of Joseph Bonaparte's correspondence which had been taken at the battle of Vittoria; this was all in cipher, but Mrs. Napier, with great patience, discovered the keys. Marshal Soult also took an active interest in the work and arranged for the French translation of Mathieu Dumas. In 1828 the first volume of the *History* appeared. The publisher, John Murray, was disappointed in the sale of the first volume and Napier published the remainder himself. But the excitement which followed the appearance of each volume is proved by the innumerable pamphlets issued by those who believed themselves to be attacked, and by personal altercations with many distinguished officers. This success was due to a combination of qualities which have justly secured for Napier the title of being the greatest military historian England has produced. When in 1840 the last volume of the

History was published, his fame was safely established.

His life during these years had been chiefly absorbed in his *History,* but he had warmly sympathized with the movement for political reform which was agitating England. The Radicals of Bath and many other cities and towns pressed him to enter parliament, and Napier was invited to become the military chief of a national guard to obtain reforms by force of arms. He refused the dangerous honour on the ground that he was in bad health and had a family of eight children. In 1830 he had been promoted colonel, and in 1842 he was made a major-general and given the lieutenant-governorship of Guernsey. Here he managed the relations between the soldiers and the inhabitants, and worked out proposals for a complete scheme of reform in the government of the island.

In 1845 he published his *History of the Conquest of Scinde,* and in 1851 the corresponding *History of the Administration of Scinde.* In 1847 he resigned his governorship, and in 1848 was made a K.C.B., and settled at Scinde House, Clapham Park. In 1851 he was promoted lieutenant-general. His time was occupied in defending his brother, and in revising the numerous editions of his *History* which were being called for. His energy is the more astonishing when it is remembered that he never recovered from the effects of the wound he had received at Cazal Nova, and that he often had to lie on his back for months together. His domestic life was shadowed by the incurable affliction of his only son. He devoted himself to writing the life of his brother Charles, which appeared in 1857. He died on Feb. 12, 1860. Four months earlier he had been promoted to the full rank of general.

His brother, SIR GEORGE THOMAS NAPIER (1784–1855), entered the army in 1800, and served with distinction under Moore and Wellington in the Peninsula. He became major-general in 1837, K.C.B. in 1838 and lieutenant-general in 1846. He was governor and commander-in-chief at the Cape from 1839 to 1843. He was offered, but declined, the chief command in India after Chillianwalla, and also that of the Sardinian army in 1849. He became full general in 1854. He died at Geneva on Sept. 16, 1855. His autobiography, *Passages in the Early Military Life of General Sir G. T. Napier,* was published by his son, General W. C. E. Napier in 1885.

The youngest brother, HENRY EDWARD NAPIER (1789–1853), served in the navy during the Napoleonic wars, retired as a captain, and wrote a learned *Florentine History from the earliest authentic Records to the Accession of Ferdinand III. of Tuscany* (1846–1847).

For Sir William Napier's life, *see* his *Life and Letters,* edited by H. A. Bruce (Lord Aberdare) (1862).

NAPIER AND ETTRICK, FRANCIS NAPIER, Baron (1819–1898), British diplomatist, descended from the ancient Scottish family of Napier of Merchistoun, was born on Sept. 15, 1819, the son of William John, ninth Lord Napier. He entered the diplomatic service in 1840, and held successive posts at Vienna, Constantinople, Naples, Washington and The Hague. In 1860 he became ambassador at St. Petersburg, and in 1864 at Berlin. In 1866 he was appointed governor of Madras, and was at once confronted with a serious famine in the northern districts. In dealing with this and other problems he showed great activity and practical sense, and he encouraged public works, particularly irrigation. In 1872 he acted for a few months as Viceroy, after Lord Mayo's assassination; and on Lord Northbrook's appointment to the office he returned to England, being created a baron of the United Kingdom (Baron Ettrick of Ettrick) for his services. He was for a time a member of the London School Board, and was chairman of the Crofters' Commission in 1883, the result of which was the appointment of a permanent body to deal with questions affecting the Scottish crofters and cottars. He died at Florence on Dec. 19, 1898.

NAPIER OF MAGDALA, ROBERT CORNELIS NAPIER, 1ST BARON (1810–1890), British field-marshal, son of Major Charles Frederick Napier, was born at Colombo, Ceylon, on Dec. 6, 1810. He entered the Bengal Engineers from Addiscombe College in 1826, and after the usual course of instruction at Chatham, arrived in India in November 1828. For some years he was employed in the irrigation branch of the public works department, and in 1838 he laid out the new hill station at Darjeeling. Promoted captain in January 1841, he was appointed to Sirhind, where he laid out cantonments on a new principle—known as the Napier system—for the troops returning from Afghanistan. In December 1845 he joined the army of the Sutlej, and commanded the Engineers at the battle of Mudki, where he had a horse shot under him. At the battle of Ferozeshah on Dec. 21 he again had his horse shot under him and, joining the 31st regiment on foot, was severely wounded in storming the entrenched Sikh camp. He was present at the battle of Sobraon on Feb. 10, 1846, and in the advance to Lahore. He was chief engineer at the reduction of Kote-Kangra by Brigadier General Wheeler in May 1846 and received the thanks of the government. He was then appointed consulting engineer to the Punjab resident and council of regency, but was again called to the field to direct the siege of Multan. He was wounded in the attack on the entrenched position in Sept. 1848, but was present at the action of Surjkund, the capture of the suburbs, the successful storm of Multan on Jan. 23, 1849, and the surrender of the fort of Chiniot. He then joined Lord Gough, took part, as commanding engineer of the right wing, in the battle of Gujrat in Feb. 1849, accompanied Sir W. R. Gilbert in his pursuit of the Sikhs and Afghans and was present at the passage of the Jhelum, the surrender of the Sikh army and the surprise of Attock. At the close of the war Napier was appointed civil engineer to the board of administration of the annexed Punjab province and carried out many important public works. He commanded a column in the first Hazara expedition in Dec. 1852 and against the Boris in the following year. He was appointed military secretary and adjutant general to Sir James Outram's force for the relief of Lucknow in the Indian mutiny in 1857 and was engaged in the actions which culminated in the first relief of Lucknow. He directed the defense of Lucknow until the second relief, when he was severely wounded in crossing an open space with Outram and Havelock to meet Colin Campbell. He was chief of the staff to Outram in the defense of the Alambagh position and drew up the plan of operations for the attack on Lucknow, which was approved by Campbell and carried out by Napier, as brigadier general commanding the engineers, in March 1858. On the fall of Lucknow Napier was appointed C.B. He joined Sir Hugh Rose as second-in-command in his march on Gwalior, and commanded the 2nd brigade at the action of Morar on June 16. On the fall of Gwalior he was entrusted with the task of pursuing the enemy. With only 700 men he came up with Tantia Topi and 12,000 men on the plains of Jaora Alipur and completely defeated him, capturing all his guns (25), ammunition and baggage. On Rose's departure he took command of the Gwalior division, captured Paori in August, routed Ferozeshah, a prince of the house of Delhi, at Ranode in December, and in January 1859, succeeded in securing the surrender of Man Singh and Tantia Topi, which ended the war. For his services Napier received the thanks of parliament and of the Indian government, and was made K.C.B.

In January 1860 Napier was appointed to the command of the 2nd division of the expedition to China under Sir Hope Grant, and took part in the action of Sinho, the storm of the Peiho forts, and the entry to Peking. For the next four years Napier was military member of the council of the governor-general of India and, on the sudden death of Lord Elgin, for a short time acted as governor-general, until the arrival of Sir W. T. Denison from Madras. In January 1865 he was given the command of the Bombay army; in March 1867 he was promoted lieutenant-general, and, later in that year, appointed to command the expedition to Abyssinia, selecting his own troops and making all the preparations for the campaign. He arrived at Annesley Bay in the Red Sea in January 1868, reached Magdala, 420 m. from the coast, in April; stormed the stronghold, freed the captives, razed the place to the ground, returned to the coast, and on the 18th June the last man of the expedition had left Africa. He received for his services the thanks of parliament, a pension, a peerage, the G.C.B., the G.C.S.I., and many academic honors. He held the command-in-chief in India for six years from 1870, during which

he did much to benefit the army. He was promoted general in 1874, and appointed a colonel-commandant of the royal engineers. In 1876 he was the guest of the German crown prince at the military manoeuvres; and from that year until 1883 he held the government and command of Gibraltar. In the critical state of affairs in 1877 he was nominated commander in chief of the force which it was proposed to send to Constantinople. On Jan. 1, 1883, he was promoted to be field marshal. In Dec. 1886 he was appointed constable of the Tower of London. He died in London on Jan. 14, 1890.

See H. D. Napier, *Field Marshal Lord Napier of Magdala* (London, 1927).

NAPIER, a seaport of New Zealand, on the east coast of North Island, capital of the provincial district of Hawke's Bay, 200 mi. N.E. of Wellington. Pop. (1945) 17,243 (20,297 with suburbs). The town is on a picturesque peninsula known as Scinde Island. The harbour (Port Ahuriri) is sheltered by a breakwater. Much of the town was destroyed by a severe earthquake in 1931 in which 255 persons lost their lives. The entire business section of the town was rebuilt and Napier became a modern, well-planned and attractive small city. It is the seat of the Anglican bishop of Waiapu The district is agricultural, and wool, frozen meats and fruits are exported.

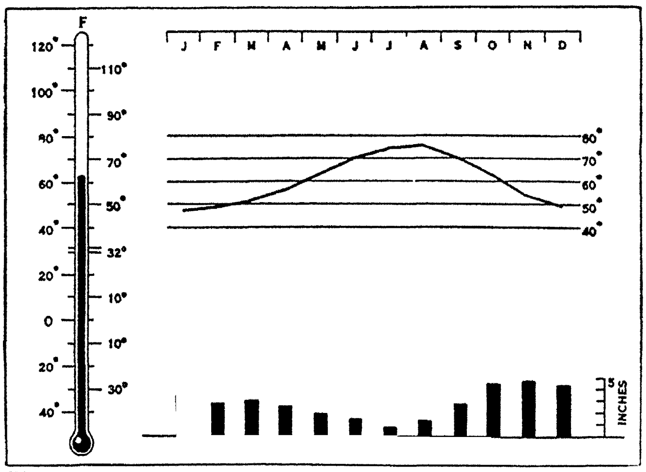
NAPLES (Ital. *Napoli,* and Lat. *Neapolis*), formerly the capital of the kingdom of the Two Sicilies, and since 1860 the chief town of the province which bears its name. It was the largest city in the country in 1901, containing 547,503 inhabitants, but was later outstripped by Milan. Its population in 1936 was 739,349 (town), 865,913 (commune). It is the see of a cardinal archbishop; the residence of the general commanding the X Army corps and of the admiral commanding the second Naval department of Italy; and it possesses also an ancient and important university. In World War II it was heavily bombed by U.S. and British air forces, some 30 times from Nov. 1942–July 1943 alone. It was occupied by U.S. and British forces in Oct. 1943.

Naples disputes with Istanbul the claim of occupying the most beautiful site in Europe. It is situated on the northern shore of the Bay of Naples (*Sinus Cumanus*), in 40° 52′ N., 14° 15′ 45″ E., as taken from the lighthouse on the mole. By rail it is distant 135 mi. from Rome, by the direct line, and 155 by the older line via Cassino. The circuit of the bay is about 35 mi. from the capo di Miseno on the northwest to the Punta della Campanella on the southeast, or more than 52 mi. if the islands of Ischia, at the northwest, and of Capri, at the south entrance, be included. At its opening between these two islands it is 14 mi. broad; while another 4 mi. separates Capri from the mainland at the Punta della Campanella, and from the opening to its head at Portici the distance is 15 mi. It affords good anchorage, with nearly 7 fathoms of water, and is well sheltered, except from winds which blow from points between southeast and southwest.

On the north-east shore east of Naples is an extensive flat, forming part of the ancient *Campania Felix,* and watered by the small stream Sebeto and by the Sarno, which last, in classical times, formed the port of Pompeii. From this flat, between the sea and the range of the Apennines, rises Mt. Vesuvius, at the base of which, on or near the sea-shore, are populous villages as well as the classic sites of Herculaneum and Pompeii. At the south-east extremity of the plain, 3 m. beyond the outlet of the Sarno, a great offshoot of the Apennines, branching from the main range near Cava, and projecting as a peninsula more than 12 m. W., divides the Bay of Naples from the Bay of Salerno (*Sinus Paestanus*), and ends in the bold promontory of the Punta della Campanella (Promontorium Minervae), which is separated by a strait of 4 m. from Capri. On the north slope of this peninsula, where the plain ends and the coast abruptly bends to the west, stands the town of Castellammare di Stabia, at the foot of Mt. Sant' Angelo, which rises to a height of 4,734 ft.

The north-west shore to the west of Naples is more broken and irregular. The promontory of Posilipo, which projects due south, divides this part of the bay into two smaller bays—the eastern, with the city of Naples, and the western, or Bay of Baiae, which is sheltered from all winds. A tunnel through the promontory, 2,244 ft. long, 21 ft. broad, and in some places as much as 70 ft. high, possibly constructed by Marcus Agrippa in 27 B.C., forms the so-called grotto of Posilipo; at the Naples end stands the reputed tomb of Virgil, which has recently been restored. Beyond Posilipo is the small island of Nisida (*Nesis*); and at a short distance inland are the extinct craters of Solfatara and Astroni and the lake of Agnano. Farther west, on the coast, and provided with a convenient harbour, stands Pozzuoli (*Puteoli*), containing many Roman remains, and beyond it, round the Bay of Baiae, are Monte Nuovo, a hill thrown up in a single night in Sept. 1538; the classic site of Baiae; the Lucrine lake; Lake Avernus; the Lake of Fusaro (*Acherusia Palus*); and the port and promontory of Misenum. Still farther to the south-west lie the islands of Procida (*Prochyta*) and Ischia (*Pithecusa, Aenaria* or *Inarime*), which divide the Bay of Naples from the extensive Bay of Gaeta. All this country was comprised in classical times under the title of the *Phlegrean Fields,* and was certainly then more actively volcanic than it now is, although the severe shock of earthquake which occurred in the island of Ischia in 1883, completely destroyed Casamicciola, and did serious damage to Forio, Lacco Ameno and Serrara Fontana, shows that there is great seismic activity in the locality. The whole region abounds with fissures, from which steam highly charged with hydrochloric acid is continually issuing, and in many places boiling water is found at a very few feet below the surface.

The city of Naples is built at the base and on the slopes of a range of volcanic hills, and, rising from the shore like a theatre, is seen to best advantage from the sea. From the summit occupied by the castle of St. Elmo a transverse ridge runs south to form the promontory of Pizzofalcone, and divides the city into two natural crescents. The western crescent, known as the Chiaja ward, though merely a long narrow strip between the sea and Vomero hill, is the fashionable quarter most frequented by foreign residents and visitors. A fine broad street, the Riviera di Chiaja, was begun at the close of the 16th century by Count d'Olivares, and completed by the duke de Medina Celi (1695–1700), running for a mile and a half from east to west, ending



WEATHER GRAPH OF NAPLES. THE MERCURY INDICATES THE NORMAL MEAN TEMPERATURE. THE CURVE SHOWS THE NORMAL MONTHLY MEAN TEMPERATURE. THE COLUMNS INDICATE THE NORMAL MONTHLY PRECIPITATION

in the quarter of Mergellina and Piedigrotta, at the foot of the hill of Posilipo. In front lie the public gardens of the Villa Nazionale, the chief promenade of the city, which were first laid out in 1780, and have been successively extended in 1807, in 1834, and again in recent years; and the whole edge of the bay from the Castel dell' Ovo to Mergellina is lined by a massive embankment and carriage-way, the Via Caracciolo, constructed in 1875–81. The eastern crescent includes by far the largest, as well as the oldest, portion of Naples.

The best known thoroughfare is the historic Toledo (officially Via Roma), which runs almost due north from the Piazza del Plebiscito in front of the Palazzo Reale, till, as Via Nuova di Capodimonte, crossing the Ponte della Sanità (constructed by

Murat across the valley between Santa Teresa and Capodimonte), it reaches the gates of the Capodimonte palace, thus dividing the city into two parts. A fine street, the Corso Vittorio Emmanuele, winds along the slopes behind the city from the Mergellina railway station till it reaches the museum by the Via Salvator Rosa. The character of the shore of the eastern crescent has been much altered by the new harbour works, which, with the wharves and warehouses, have absorbed the Villa del Popolo, or People's Park, originally constructed on land reclaimed from the bay. The two crescents have now been united by the construction of a connecting thoroughfare on the seaward side of the Castel Nuovo, the royal palace, and the hill of Pizzofalcone; while a tunnel (the Galleria della Vittoria) has been cut under this hill, thus further uniting the east and west halves of the city. There is also a metropolitan underground railway between the central station at Naples and Pozzuoli.

The streets of Naples are generally well-paved with large blocks of lava or volcanic basalt. In the older districts there is a countless variety of narrow gloomy streets, many of them steep. The houses are mostly five or six storeys high, are covered with stucco made of a kind of pozzolana, which hardens by exposure, and have large balconies and flat roofs. The castle of S. Elmo (S. Erasmus), which dominates the whole city, had its origin in a fort (Belforte) erected by King Robert the Wise in 1329. The present building, with its rock-hewn fosses and massive ramparts, was constructed by Don Pedro de Toledo in 1537–46, and was long considered practically impregnable. It is now a military prison. On a small island (I. del Salvatore, the *Megaris* of Pliny), now joined to the shore at the foot of the Pizzofalcone by an arch-supported causeway, stands the Castel dell' Ovo, restored in the 16th century. Castel Nuovo, a very picturesque building constructed near the harbour in 1279–82 by Charles I. of Anjou, contains between the round towers of its façade the triumphal arch erected in 1455–58 to Alfonso I. In the interior is a fine Gothic hall. The whole building has recently been restoied. Castel del Carmine was demolished in 1906. The royal palace, begun in 1600 from designs by Domenico Fontana, partly burned in 1837, and repaired and enlarged by Ferdinand II, is an enormous building with a sea frontage of 800 ft. and a main façade 554 ft. long and 95 ft. high, exhibiting the Doric, Ionic and Composite orders in its three stories. It now contains the important National Library (Biblioteca Nazionale Vittorio Emanuele III) with valuable books and mss., including mss. recovered from Austria after they had been removed to Vienna by Charles V. Another royal palace, that of Capodimonte, contains a gallery of modern pictures and a fine collection of 18th century Neapolitan porcelain.

Naples has 237 churches and 57 chapels. Most of the churches are notable rather for rich internal decoration than for architectural beauty. The cathedral of St. Januarius was erected in 1294–1323. The general plan is that of a basilica with a nave and two (Gothic vaulted) aisles separated by pilasters. The western façade was completed in 1906. Beneath the high altar is a subterranean chapel containing the tomb of St. Januarius (San Gennaro), the patron saint of the city; in the right aisle there is a chapel (Cappella del Tesoro) built between 1608 and 1637 in popular recognition of his having saved Naples in 1527 "from famine, war, plague and the fire of Vesuvius"; and in a silver tabernacle behind the high altar of this chapel are preserved the two phials partially filled with his blood, the periodical liquefaction of which forms a prominent feature in the religious life of the city. Accessible by a door in the left aisle of the cathedral is the church of Sta. Restituta, a basilica of the 4th century. Its baptistery contains important mosaics of that period. Santa Chiara (14th century, richly restored in the baroque style in the 18th) is interesting for a fresco ascribed to Giotto (at one time there were many more), and monuments to Robert the Wise, his son's wife, Mary of Valois, and his daughter Mary, empress of Constantinople

San Domenico Maggiore, founded by Charles II. in 1289, but completely restored later, has an effective interior particularly rich in Renaissance sculpture. In the neighbouring monastery is shown the cell of S. Thomas Aquinas. San Filippo Neri or dei Gerolomini, erected in 1592–1619, has a white marble façade and contains the tombstone of Giambattista Vico. Sta. Maria del Parto, in the Chiaja, contains the tomb of Sannazaro, and is named after his poem, *De Partu Virginis*. San Francesco di Paola, opposite the royal palace, is an imitation of the Pantheon at Rome, by Pietro Bianchi of Lugano (1815–18). The church of the Certosa (Carthusian monastery) of San Martino, has now become a museum. Dating from the 14th century, and restored in the 17th, it is a building of extraordinary richness of decoration, with paintings and sculpture by Guido Reni, Lanfranco, Caravaggio, D'Arpino, Solimena, Luca Giordano and Ribera. The monastery has been transformed into a mediaeval museum. The view from the south-western balcony is incomparable.

Other churches with interesting monuments are Sant' Anna dei Lombardi (the church of Monte Oliveto), built in 1414, which contains some splendid marble Renaissance sculpture; Sant' Angelo a Nilo, which contains the tomb of Cardinal Brancaccio, the joint work of Donatello and Michelozzo (1426–28), San Giovanni a Carbonara, built in 1343 and enlarged by King Ladislaus in 1400, which contains among much other remarkable sculpture the tomb of the king, the masterpiece of Andrea da Firenze (1428), and that of Gianni Caracciolo, the favourite of Joanna II, who was murdered in 1432 (the chapel in which it stands has one of the earliest majolica pavements in Italy); San Lorenzo (13th century), the Royal Church of the House of Anjou, and S. Maria Donna Regina, with its frescoes by Pietro Cavallini. The catacombs of S. Gennaro (2nd century) are in many respects not inferior to those at Rome.

Of the secular institutions in Naples none is more remarkable than the National Museum, formerly known as the Museo Borbonico. The building was put to its present use in 1790, when Ferdinand IV. placed in it the Farnese collection, which he had inherited from his father, and all the specimens from Herculaneum, Pompeii, Stabiae, Puteoli, Paestum, etc., which till then had been housed in the palace at Portici. Vast numbers of objects have since been added to it, both by purchase and from excavations, and it is now unique as a treasure house of Italo-Greek and Roman antiquities, besides containing important pictures.

The building, as now arranged, contains the large bronzes and statues on the ground floor; a gallery of Pompeian frescoes and mosaics in the entresol; the picture gallery, papyri, terra cottas and small bronzes, on the first floor; and the glass, jewellery, arms, gems, and the collection of Italo-Greek vases, on the second floor. The large bronzes are almost the only ones which have survived from classical times, the most famous of them being the seated Mercury and the dancing Faun; the marbles reckon among their vast number the Psyche, the Capuan Venus, as well as the huge group called the Toro Farnese (Amphion and Zethus tying Dirce to the horns of the bull), the Farnese Hercules, the excellent though late statues of the Balbi on horseback, and a very fine collection of ancient portrait busts.

The Galleria Umberto I. and Galleria Principe di Napoli somewhat resemble the Milan arcade. The Borsa (or exchange) is a fine building in the Piazza of the same name, bu:' over the remains of the very ancient church of Sant' Aspreno, which are still preserved in the crypt. In front of it is the fine 16th century Fontana Medina.

Educational and Learned Institutions.—The university of Naples was founded by Frederick II. in 1224, and is well equipped with zoological, mineralogical and geological museums, a physiological institute, a cabinet of anthropology, and botanical gardens. The buildings were originally erected in 1557 for the use of the Jesuits. The new building, completed in 1906, faces the Corso Umberto I. (Rettifilo), the street from the Borsa to the railway station. The famous zoological station at Naples, whose aquarium is the principal building in the Villa Nazionale, was founded by Dr. Dohrn in 1872; the marine flora and fauna of the neighbourhood are more varied than those of any district in Europe. The chief universities of the world pay £100 a year for tables to which they send students. The astronomical observatory is situated on the hill of Capodimonte.

The Royal Society of Naples, dating from 1756, is divided into three academies, namely, moral and political; physical and mathematical; letters, archaeology and fine arts. The famous Accademia Pontaniana, founded by Antonio Becardella and J. J. Pontanus in 1442, was restored in 1808 and still exists.

The Royal School for Oriental Languages owes its existence to Matteo Ripa, who in 1732 established a school for Chinese missionaries.

The Royal Conservatory of Music in S. Pietro a Majella has existed in one form or other since 1760, and has had many famous pupils.

Elementary education has been greatly improved. The higher grade schools are numerous, and there are special foreign schools, established by private enterprise.

The State archives in Vico San Severino e Sossio contain all the records of past Governments; the Notarial archives in Via San Paolo contain all the original notarial acts from 1450 onwards, to the number of 800,000. The Società di Storia Patria, established in 1875 to record all details of the history of the locality, has a good library also.

The San Carlo opera house, with its area of 5,157 sq.yd. and its stalls capable of seating 1,000 spectators, is one of the largest in Europe. It was originally built in 1737 under Charles III., but was destroyed by fire in 1816 and completely rebuilt. The Mercadante dates from 1778.

Charitable institutions are numerous in Naples. The Reclusorio or poorhouse was founded in the 18th century, and besides being a refuge for the indigent poor has a series of industrial schools attached, at which foundling boys are educated and taught trades. There are also several hospitals, the largest being the Incurabili, founded in 1519.

Harbour.—At a very early date the original harbour at Naples, now known in its greatly reduced state as Porto Piccolo, and fit only for boats and lighters, became too small. In 1302 Charles II. of Anjou began the construction of the Porto Grande by forming the Molo Grande or San Gennaro, which stretched eastward into the bay, and was terminated by a lighthouse in the 15th century. By the addition of a new pier running north-east from the lighthouse, and protected by a heavily armed battery, Charles III. in 1740 added greatly to the safety of the harbour. In 1826 the open area to the south of the Porto Grande was formed into the Porto Militare by the construction of the Molo San Vincenzo, 1,200 ft. long. The lengthening of the Molo San Vincenzo to a total of more than 5,000 ft., and the construction of curving moles on the east to meet it, has formed a large outer basin, the Avamporto, and an inner harbour (Porto Mercantile). New quays have been made all the way from the old Immacolatella landing-place to the Capitaneria di Porto, close to which is the marine railway station, with piers such that the largest liner can lie alongside the jetty. The depth of this new harbour is from 25 to 30 feet. To the east are dock basins, silos for grain and other warehouses. A modern station for handling passenger traffic was opened Oct. 1, 1936.

In 1937, 9,251 vessels of 13,292,567 tons and with 649,852 passengers arrived, bringing 2,047,548 tons of merchandise; 9,240 ships left with 601,260 tons of merchandise and 615,976 passengers.

Large sections of the harbour were utterly ruined by British and U.S. air raids during World War II.

The specialties of Naples are the manufacture of coral, tortoise-shell, kid gloves and macaroni, but it has been growing also as an industrial centre. The port of Naples is second only to that of Genoa.

Water Supply.—Naples has as fine a water supply as any city in Europe, derived from the hills in the neighbourhood of Avellino. It is received in a covered masonry canal, whence it flows in iron pipes till it reaches five enormous reservoirs constructed just opposite to the entrance gates of the royal palace at Capodimonte. Hence it comes by natural gravitation into the town at a pressure of five atmospheres, so that it supplies the highest parts of the town with abundant water. The supply was brought into the town just after the terrible cholera outbreak of 1884. The effect on the health of the city has been extraordinary. Cholera epidemics, which used to be frequent, have become things of the past, and there is now abundant water.

Modern Growth.—Naples has increased in modern times at an enormous rate. On the large areas reclaimed from the sea, hotels and mansions let in flats have been erected. The gardens at the west end of the town are all built over. The Vomero is now an important suburb. The commune has been built over in every direction, one great incentive being the creation of an industrial zone to the eastward of the city, set aside for the purpose of industrial development. It now contains a large number of factories for spinning silk, cotton, jute and wool, and the making of railway plant, automobiles, the building of ships, etc.

After the cholera epidemic of 1884, Depretis, then premier, visited Naples, and uttered the famous dictum *"Bisogna sventrare Napoli"*—"Naples must be disembowelled!" The worst slums, which lay between the centre of the town and the railway station, were pulled down and a wide street was constructed from the centre of the town to the eastward. A large working-class quarter was erected to the north and beyond the railway station, known as the Rione Vasto.

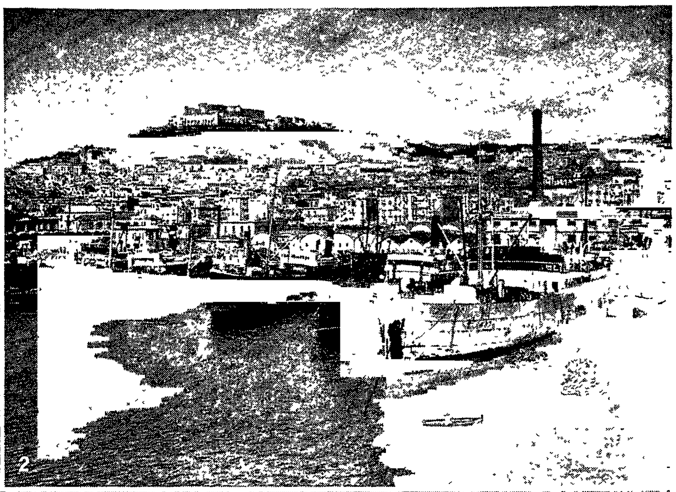
There are also new middle-class quarters at Santa Lucia, Vomero Nuovo and Sant' Efremo, Poggioreale and Fuorigrotta, and better houses on the Riviera di Chiaja, Via Elena and Via Caracciolo at Mergellina, Via Partenope near the Chiatamone, and an aristocratic quarter in the large extensions made in the Rione Amedeo. The narrow alleys of Porto, Pendino and Mercato gradually disappeared, and old Naples vanished day by day.

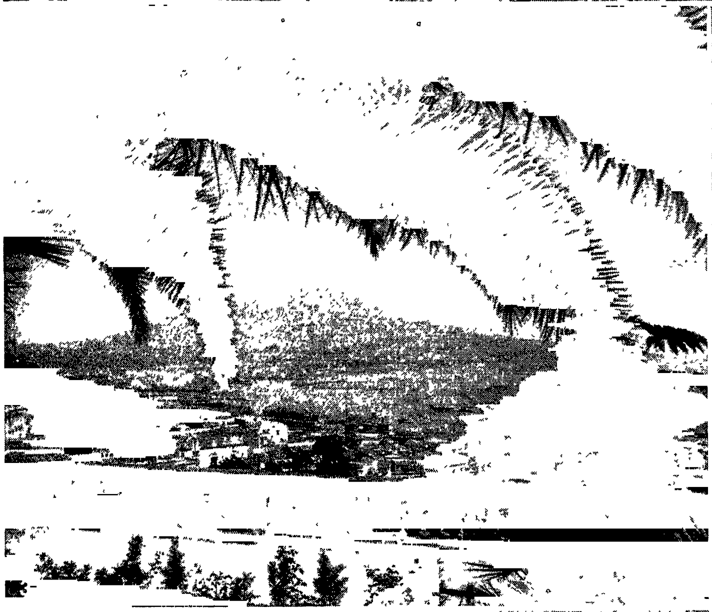
Folk-lore.—The charms against the Evil Eye used by the Neapolitans are derived from classical legends. They are: first, the sprig of rue in silver, with sundry emblems attached to it, all of which refer to the worship of Diana, whose shrine at Capua was of considerable importance; secondly, the serpent charms, which formed part of the worship of Aesculapius, and were no doubt derived largely from the ancient eastern ophiolatry; and lastly, charms derived from the legends of the Sirens.

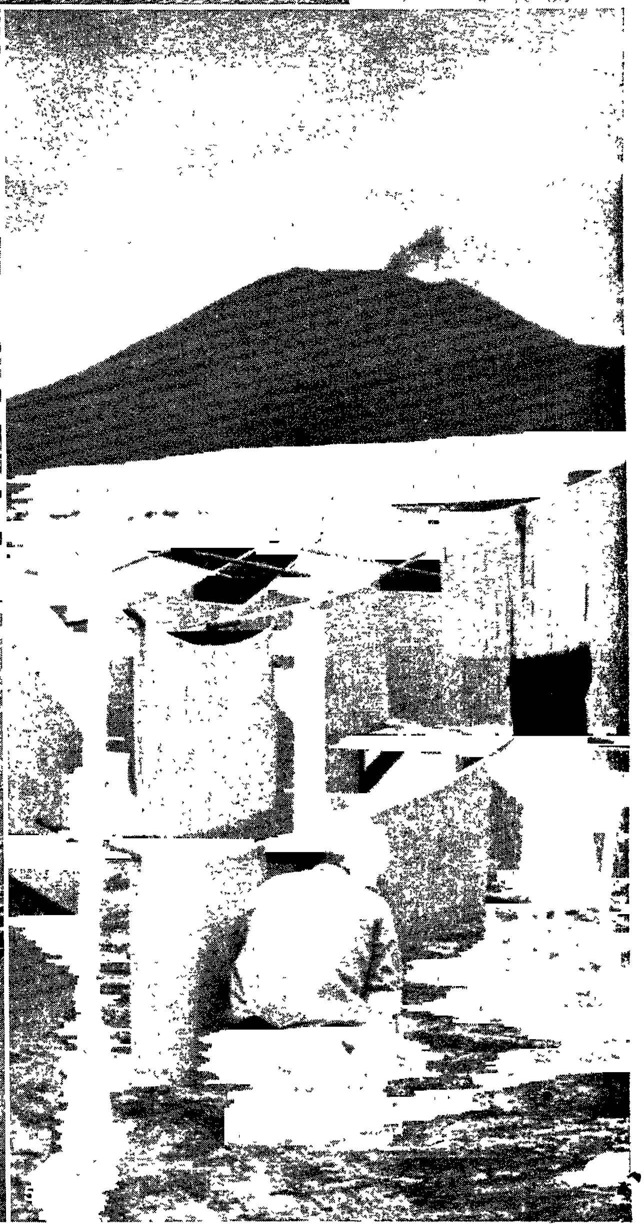
History.—All ancient writers agree in representing Naples as a Greek settlement. The earliest Greek settlement in the neighbourhood was at Pithecusa (Ischia), but the colonists, being driven out of the island by the frequent earthquakes, settled on the mainland at Cumae, where they found a natural acropolis of great strategic value. From Cumae they founded Dicearchia (Pozzuoli) and subsequently Parthenope or Palaeopolis, where Naples now stands, upon the splendid natural acropolis formed by the hill of Pizzofalcone, defended on the land side by a fosse which is now the Strada di Chiaja, and a massive wall, of which remains may still be traced at the back of the existing houses. To the colonists of Parthenope there came afterwards a considerable addition from Athens and Chalcis, and they built themselves a town which they called *Neapolis*, or the "new city," in contradistinction to the old settlement, which in consequence was styled Palaeopolis or the "old city."

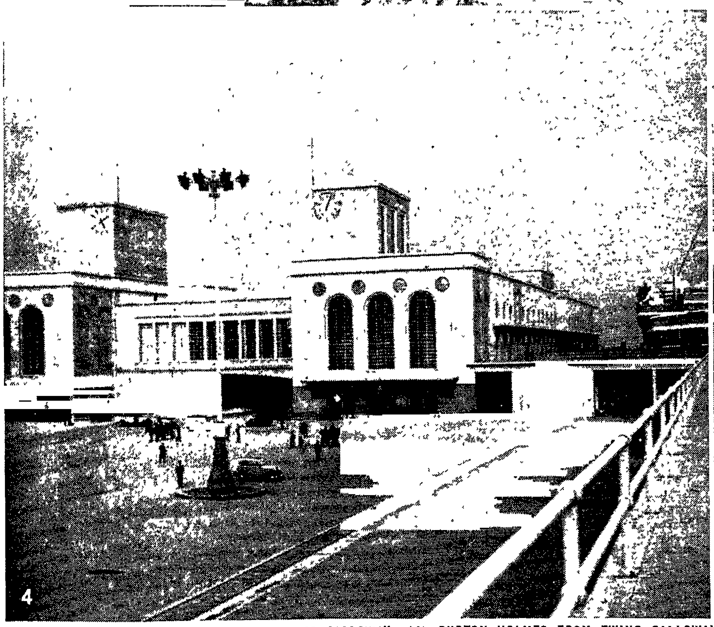
In 328 B.C. the Palaeopolitans having provoked the hostility of Rome by their incursions upon her Campanian allies, the consul Publilius Philo marched against them, and laid regular siege to Palaeopolis; at length the city was betrayed into the hands of the Romans. Neapolis, perhaps, surrendered without resistance, as it was received on favourable terms, had its liberties secured by a treaty, and obtained the chief authority. From that time Palaeopolis totally disappeared from history, and Neapolis became an allied city (*foederata civitas*)—a dependency of Rome, to which it remained faithful. In 280 B.C. Pyrrhus unsuccessfully attacked its walls; and in the Second Punic War Hannibal was deterred by their strength from attempting to make himself master of the town. During the civil wars of Marius and Sulla a body of partisans of the latter, having entered it by treachery (82 B.C.), massacred the inhabitants; but Neapolis soon recovered, as it was again a flourishing city in the time of Cicero.

Neapolis long retained its Greek culture and institutions; and even at the time of Strabo it had gymnasia and quinquennial games, and was divided into *phratriae* after the Greek fashion.









PHOTOGRAPHS, (1) ACME, (2, 3) EWING GALLOWAY, (4) BURTON HOLMES FROM EWING GALLOWAY, (5) EISENSTAEDT-PIX

NAPLES, METROPOLIS OF SOUTHERN ITALY

1. A general view of the city as seen from a hill on the outskirts
2. The harbour, and castle of Sant' Elmo on the hill in the distance
3. A view over the bay, looking toward Mt. Vesuvius
4. Modern pier on the bay
5. Drying spaghetti in a suburb of Naples, near Vesuvius

Many of the Romans of the upper classes, from a love of Greek manners and literature, resorted to Neapolis, either for education and the cultivation of gymnastic exercises or for the enjoyment of music and of a soft and luxurious climate. It was the favourite residence of many of the emperors; Nero made his first appearance on the stage in one of its theatres; Titus assumed the office of its archon; and Hadrian became its demarch. It was chiefly at Neapolis that Virgil composed his *Georgics;* and he desired to be buried on the hill of Pausilypon, the modern Posilipo, in its neighbourhood, though his traditional tomb is really a *columbarium* of some family unknown. It was also the favourite residence of the poets Statius (A.D. 61) and Silus Italicus (A.D. 25), the former of whom was a Neapolitan by birth.

After the fall of the Roman empire, Neapolis suffered severely during the Gothic wars. Having espoused the Gothic cause in the year 536, it was taken, after a protracted siege, by Belisarius, who diverted the water of a subterranean aqueduct, marched into the city through it, and put many of the inhabitants to the sword. In 542 Totila besieged it and compelled it to surrender, but after being recovered by Narses, it long remained a dependency of the exarchate of Ravenna, under the immediate government of a duke, appointed by the East Roman emperors. When the Lombards pushed their conquests in the south, the limits of the Neapolitan duchy were considerably narrowed. In the beginning of the 8th century, at the time of the iconoclastic controversy, the Neapolitans, encouraged by Pope Gregory III., threw off their allegiance to the Eastern emperors, and established a republican form of government under a duke of their own appointment. Under this régime Neapolis retained independence for nearly 400 years, though constantly struggling against the powerful Lombard dukes of Benevento. The Normans, in their turn, gradually superseded all powers in the south of Italy, and checked the Saracens in their advances through Apulia.

From that date the history of Naples becomes that of a kingdom, sometimes separate, sometimes merged with the kingdom of Sicily in that of the Two Sicilies. The city of Naples henceforth formed the metropolis of the kingdom to which it gave its name. (*See* NAPLES, KINGDOM OF.)

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NAPLES, BANK OF, is an autonomous, public utility, non-profit earning foundation, incorporated under a charter granted in 1866. Its origins date back to 1539 when two public-spirited Neapolitans, Aurelio Paparo and Leonardo di Palma, founded in their city a first bank with a capital of 4,000 ducats for granting loans on pledge and without or at a very low rate of interest to free the poorer classes from the evils of usury.

The institution rapidly developed, and survived all the vicissitudes of the kingdom of Naples. After the annexation of Naples to the kingdom of Italy the *Banco di Napoli* remained a bank of issue. Regional interests and the still strong traditions of regional independence maintained this situation until May 6, 1926, when the *Banca d'Italia* became the sole bank of issue.

The *Banco di Napoli* is a foundation organized as a trust, administered by a Board whose members are nominated by the Government, by the province and municipality of Naples, and by the organs representing the commercial activities of the province. Its capital and reserves stood in Dec. 1938 at 1,526 million lire. It affords throughout Italy and colonies every service of a complete bank, and acts as a savings bank, an agricultural credit bank, and a pledge bank for the southern provinces. It also discharges the services connected with emigrant remittances from abroad, for which purposes it has agencies in the U.S.A. Besides it has its own branches and affiliations in New York, Chicago, Buenos Aires and in Albania. Part of its profits are assigned to the purposes of public utility and charity, the bulk going to increase its reserves.

It is now the most powerful instrument for the progress of South Italian agriculture and one of the most effective agencies for economic development. (O. R. A.)

NAPLES, KINGDOM OF, the name conventionally given to the kingdom of Sicily on the Italian mainland (Sicily beyond the Faro), to distinguish it from that of Sicily proper (Sicily on this side of the Faro, *i.e.,* Messina).

The leaders of the Norman house of Hauteville, Robert Guiscard and Richard of Aversa, in 1059 did homage to Pope Nicholas II. (*q.v.*) for all the conquests they made both in the island and upon the mainland. In 1130 Roger de Hauteville (Roger II. as "great count" of Sicily) assumed the style of king as Roger I. In this way the south of Italy, together with the island of Sicily, was converted into one political body.

The Hohenstaufen.—After the death of Tancred, son of William II., the emperor Henry VI., of the house of Hohenstaufen, who by his marriage with Constance or Costanza d'Altavilla, daughter of Roger I. (d. 1154), laid claims to the kingdoms of Naples and Sicily, descended into Italy in 1194. He easily conquered both the mainland and the island, but died in 1197. Costanza then had her son, Frederick (b. 1194) proclaimed king, and obtained the support of the Holy See on condition that the kingdom should be once more recognized as a fief of the Church. The Hohenstaufen kings afterwards refused to admit this claim; thus provoking the persistent hostility of the popes and many foreign invasions. Costanza died in 1198, leaving Pope Innocent III. regent and tutor to her son. In 1209 Frederick married Costanza, daughter of the king of Aragon, with whose help he succeeded in reducing a large part of Sicily to obedience. Two years later he was elected king of the Romans, and in 1220 he was crowned emperor in Rome by Pope Honorius III., but continued to reside in Sicily. In 1227 Gregory IX. excommunicated him because he delayed the crusade which he had promised to undertake. Frederick sailed for Palestine the following year and on his return defeated the army which the pope had sent into Neapolitan territory, peace being made at San Germano in 1230 and the excommunication withdrawn. In 1231 he issued the celebrated Constitutions of the Sicilian kingdom at the parliament of Melfi. He died in 1250.

His son Conrad IV. succeeded to the empire, while to his illegitimate son Manfred he left the principality of Taranto and the regency of the southern kingdom. Conrad died in 1254, leaving an infant son, Conradin (b. 1252), and Manfred was appointed vicar-general during the latter's minority. In 1258, on a rumour of Conradin's death, Manfred was offered and accepted the crown of Naples and Sicily. The rumour was false, but he retained the crown, promising to leave the kingdom to Conradin at his death and to defend his rights.

Angevin and Aragonese.—In 1265 Clement IV., wishing to rid himself of the Hohenstaufen, induced Charles of Anjou, brother of Louis IX. of France, to come to Italy. Agreeing to accept the kingdom of the Two Sicilies as a fief of the Church, Charles, in 1266, marched southward with the privileges of a crusader (*see* CHARLES I., king of Naples and Sicily). Manfred was defeated and killed at Benevento, and Charles was soon master of almost the whole kingdom.

In Sicily, however, Charles's government soon made itself odious by its exactions and the insolence and cruelty of the king's French officials and favourites. The malcontents were led by the Salernitan noble Giovanni da Procida, who had induced Peter III. of Aragon, husband of Manfred's daughter Costanza, to make good his shadowy claims to the crown of Sicily. On Easter day 1282, just as Charles was preparing an expedition to the East, the popular rising known as the Sicilian Vespers broke out at Palermo and resulted in the massacre of nearly all the French in the island. Peter reached Palermo in September. Pope Martin IV. proclaimed a crusade against the Aragonese, and the war continued for many years. The Sicilian fleet under Ruggiero di Lauria defeated that of the Angevins at Malta in 1283, and in 1284 in the Bay of Naples. Charles I. died in 1286; his heir, Charles the Lame, being a prisoner, was not crowned until two years later. (*See* CHARLES II., king of Naples and Sicily, and FREDERICK III., king of Sicily.)

Charles II. died in 1309 and was succeeded by his second son Robert, who became leader of the Guelphs in Italy. War between

Naples and Sicily broke out once more, when Frederick allied himself with the emperor Henry VII. on his descent into Italy and proclaimed his own son Peter heir to the throne. Robert died in 1342; he had been a capable ruler, a scholar, and a friend of Petrarch, but his authority was limited by the rights of a turbulent and rebellious baronage (*see* ROBERT, king of Naples). He was succeeded by his granddaughter Joanna, wife of Andrew of Hungary, who was assassinated in 1345, not without suspicion of Joanna's complicity. Andrew's brother Louis, king of Hungary, attempted to make good his claims on Naples and avenge the murder of Andrew; but as Pope Clement refused to recognize his claims he went back to Hungary in 1348 and Joanna and her second husband Louis of Taranto were crowned at Naples by the pope's legate in 1352, but Niccolò Acciaiuoli, the seneschal, became the real master of the kingdom. Joanna nominated Louis of Anjou her heir, but while the latter was recognized by the anti-pope Clement VII, Pope Urban VI. declared Charles of Durazzo (great-grandson of Charles II.) king of Sicily *al di quà del Faro* (*i.e.* of Naples). Charles conquered the kingdom and took Joanna prisoner in 1381, and had her murdered the following year. Louis failed to drive out Charles, and died in 1384. A period of anarchy followed during the reigns of Charles III. and his son Ladislas, and on the latter's death in 1414 he was succeeded by his sister Joanna II. (*q.v.*), during whose reign the kingdom sank to the lowest depths of degradation. Louis died in 1434 and Joanna in 1435. Alphonso was recognized as king of Naples by Pope Eugene IV. in 1443.

Under Alphonso, surnamed "the Magnanimous," Sicily was once more united to Naples and a new era was inaugurated, for the king was at once a brilliant ruler, a scholar, and a patron of letters. He died in 1458, leaving Naples to his illegitimate son Ferdinand I (*q.v.*) (Don Ferrante), and Sicily, Sardinia, and Aragon to his brother John. Ferdinand died in Jan. 1494, and he was succeeded by Alphonso. In the following September Charles VIII. of France entered Italy and conquered the Neapolitan kingdom without much difficulty. Alphonso abdicated, and his son Ferrandino and his brother Frederick withdrew to Ischia. But Ferrandino, with the help of Ferdinand II. of Spain, was able later to reoccupy his dominions. He died much regretted in 1496 and was succeeded by Frederick. The country was torn by civil war and brigandage, and the French continued to press their claims; until, with Gonzalo de Cordoba's victory on the Garigliano in Dec. 1502, the whole kingdom was in Spanish hands.

Spanish Rule.—On Ferdinand's death in 1516, the Habsburg Charles became king of Spain, and three years later was elected emperor as Charles V.; in 1522 he appointed John de Lannoy viceroy of Naples, which became henceforth an integral part of the Spanish dominions. Spanish rule presently provoked several rebellions. On July 7, 1647, tumults occurred at Naples in consequence of a new fruit tax, and the viceroy, Count d'Arcos, was forced to take refuge in the Castelnuovo. The populace, led by an Amalfi fisherman, known as Masaniello (*q.v.*), obtained arms, erected barricades, and, while professing loyalty to the king of Spain, demanded the removal of the oppressive taxes and murdered many of the nobles. D'Arcos came to terms with Masaniello; but in spite of this, and of the subsequent assassination of Masaniello, the disturbances continued.

In 1670 disorders broke out at Messina, which developed into an anti-Spanish movement; and while the inhabitants called in the French, the Spaniards, who could not crush the rising, called in the Dutch. In 1707 an Austrian army conquered the kingdom and Spanish rule came to an end.

The Bourbons.—In Sicily the Spaniards held their own till the peace of Utrecht, in 1713, when the island was given over to Duke Victor Amadeus of Savoy, who assumed the title of king. In 1718 he had to hand back his new possession to Spain, which, in 1720, surrendered it to Austria and gave Sardinia to Victor Amadeus. In 1733 the treaty of the Escurial between France, Spain, and Savoy against Austria was signed. Don Carlos of Bourbon, son of Philip V. of Spain, easily conquered both Naples and Sicily, and in 1738 he was recognized as king of the Two Sicilies, Spain renouncing all her claims. Charles was well received and, with the Tuscan Bernardo Tanucci as his minister, introduced many useful reforms. In 1759 Charles III., having succeeded to the Spanish crown, abdicated that of the Two Sicilies in favour of his 8-year-old son Ferdinand, who became Ferdinand IV. of Naples and III. of Sicily, with a regency under Tanucci. The regency ended in 1767, and the following year Ferdinand married the masterful and ambitious Maria Carolina, daughter of the empress Maria Theresa. With the help of John Acton, an Englishman whom she made minister in the place of Tanucci, she secured a *rapprochement* with England and Austria.

On the outbreak of the French Revolution the king and queen were not at first hostile to the new movement; but in 1793 they joined the first coalition against France, instituting severe persecutions against all who were remotely suspected of French sympathies. Republicanism, however, gained ground, especially among the aristocracy. In 1798, during Napoleon's absence in Egypt and after Nelson's victory at Aboukir, Maria Carolina induced Ferdinand to go to war with France. The French marched on Naples, but not until Jan. 20, 1799, were the invaders masters of the city. On the 23rd the Parthenopaean republic was proclaimed. The Republicans were men of culture and high character, but doctrinaire and unpractical, and they knew very little of the lower classes of their own country. Meanwhile the court at Palermo sent Cardinal Fabrizio Ruffo to Calabria, to organize a counter-revolution. He succeeded beyond expectation, and with his "Christian army of the Holy Faith" (*Esercito Cristiano della Santa Fede*), consisting of brigands, convicts, peasants and some soldiers, advanced on the capital, whence the French, save for a small force under Méjean, withdrew. On June 13 Ruffo and his hordes reached Naples and, after a desperate battle at the Ponte della Maddalena, entered the city. The French in Castel Sant' Elmo and the Republicans in Castelnuovo and Castel dell' Uovo still held out and finally an armistice was concluded and a capitulation agreed upon, whereby the castles were to be evacuated and the garrisons free to remain in Naples unmolested or to sail for Toulon.

Nelson at Naples.—On June 24 Nelson arrived with his fleet, and on hearing of the capitulation refused to recognize it save in so far as it concerned the French. Ruffo indignantly declared that the treaty had been signed, not only by himself but by the Russian and Turkish commandants and by the British captain, Foote. On the 26th Nelson changed his attitude and informed the cardinal that he would do nothing to break the armistice; while Captains Bell and Troubridge wrote that they had Nelson's authority to state that the latter would not oppose the embarcation of the Republicans, who thereupon embarked on the vessels prepared for them. But on the 28th Nelson, acting on despatches from the court (in reply to his own), held up the vessels and many of the Republicans were arrested. Caracciolo, who commanded the Republican Fleet, was tried by court-martial on board Nelson's flagship, condemned to death, and hanged at the yard arm (*see* CARACCIOLO, FRANCESCO and NELSON, HORATIO NELSON).

On July 8 King Ferdinand arrived from Palermo and the State trials resulted in hundreds of persons being executed, including some of the best men in the country, such as the philosopher Mario Pagano, the scientist Cirillo, Massa, the defender of Castel dell' Uovo, and Ettore Caraffa, the defender of Pescara. After the peace of Amiens in 1802 the court returned to Naples, where it was well received. But when the European war broke out again in the following year King Ferdinand played a double game, appearing to accede to Napoleon's demands while negotiating with Britain. After Austerlitz, Napoleon declared that "the Bourbon dynasty had ceased to reign" and sent an army under his brother Joseph to occupy the kingdom.

Joseph Bonaparte and Murat.—Ferdinand and Maria Carolina fled to Palermo in 1805; in Feb. 1806 Joseph Bonaparte entered Naples as king. A cultivated, well-meaning, not very intelligent man, he introduced many useful reforms and abolished feudalism, but the taxes and forced contributions proved very burdensome. Joseph's authority did not exist throughout a large part of the kingdom, where royalist risings, led by brigand chiefs, maintained a state of anarchy, and a British force, under Sir John

Stuart, defeated the French at Maida in Calabria (July 6, 1806).

In 1808 Napoleon conferred the crown of Spain on Joseph and appointed Joachim Murat king of Naples. Murat continued Joseph's reforms and reorganized the army; and although he introduced the French codes and conferred many appointments and estates on Frenchmen, his administration was more or less native and favoured the abler Neapolitans. The king gained many sympathies; he gradually became estranged from Napoleon and secretly opened negotiations with Austria and Great Britain. In Jan. 1814 he signed a treaty with Austria, and the following month proclaimed his separation from Napoleon. But when Napoleon escaped from Elba, Murat suddenly returned to the allegiance of his old chief, marched into northern Italy, and from Rimini issued his famous proclamation in favour of Italian independence (March 30, 1815). He was subsequently defeated by the Austrians several times and on May 18 sailed from Naples for France (*see* MURAT, JOACHIM). On the 23rd the Austrians entered Naples to restore Bourbon rule.

The Restoration.—Ferdinand and Maria Carolina had continued to reign in Sicily, where the court's extravagance and the odious Neapolitan system of police espionage rendered their presence a burden instead of a blessing to the island. A bitter conflict broke out between the court and the parliament, and the British minister, Lord William Bentinck, forced Ferdinand to resign his authority and appoint his son regent and introduced many valuable reforms. In 1812 a constitution on British lines was introduced, and the queen, who was perpetually intriguing against Bentinck, was exiled. Bentinck, whose memory is still cherished in the island, departed in 1814. Ferdinand dissolved parliament in May 1815, after concluding a treaty with Austria for the recovery of his mainland dominions by means of an Austrian army. On June 9 Ferdinand re-entered Naples and bound himself in a second treaty with Austria not to introduce a constitutional government. At first he abstained from persecution and received many of Murat's old officers into his army. In Oct. 1815 Murat, believing that he still had a strong party in the kingdom, landed with a few companions at Pizzo di Calabria, but was immediately captured by the police and the peasantry, court-martialled, and shot.

Ferdinand proclaimed himself king of the Two Sicilies at the congress of Vienna, incorporating Naples and Sicily into one state, and abolished the Sicilian constitution (Dec. 1816). In 1818 he concluded a Concordat with the Church, by which the latter renounced its suzerainty over the kingdom, but was given control over education, the censorship, and many other privileges. But there was much disaffection throughout the country, and the Carbonarist lodges had made much progress, especially in the army (*see* CARBONARI). In July 1820 a military mutiny broke out at Caserta, the mutineers demanding a Spanish constitution although professing loyalty to the king. Ferdinand, feeling himself helpless to resist, acceded to the demand. The new government's first difficulty was Sicily, where the people had risen in rebellion demanding their own charter of 1812, and although the Neapolitan troops quelled the outbreak with much bloodshed the division proved fatal to the prospects of liberty.

This outbreak seriously alarmed the Powers responsible for the preservation of the peace in Europe. At the congress of Troppau (Oct. 1820) the famous protocol was issued affirming the right of collective "Europe" to interfere to crush dangerous internal revolutions. Both France and Great Britain protested against this dangerous principle; but by general consent King Ferdinand was invited to attend the adjourned congress, fixed to meet at Laibach in the spring of the following year. Under the new constitution the permission of parliament was necessary before the king could leave Neapolitan territory. This was weakly granted, after Ferdinand had sworn the most solemn oaths to maintain the constitution. He was scarcely beyond the frontiers, however, before he repudiated his engagements, as exacted by force. The powers authorized Austria to march an army into Naples to restore the autocratic monarchy. General Pepe commander of the Constitutional forces, was sent to the frontier at the head of 8,000 men, but was completely defeated by the Austrians at Rieti on March 7. On the 23rd the Austrians entered Naples, followed soon afterwards by the king. Every vestige of freedom was suppressed, and the inevitable State trials instituted with the usual harvest of executions and imprisonment. Pepe saved himself by flight. (*See* FERDINAND IV., king of Naples.)

Ferdinand died in 1825 and was succeeded by his son Francis I., an unbridled libertine, under whom the corruption of the administration assumed unheard-of proportions. (*See* FRANCIS I., king of the Two Sicilies.) He died in 1830 and was succeeded by his son, Ferdinand II., who at first awoke hopes that the conditions of the country would be improved; but on the death of his first wife, Cristina of Savoy, he married Maria Theresa of Austria, who encouraged him in his reactionary tendencies and brought him closer to Austria. The desire for a constitution was by no means dead, and the survivors of the old Carbonari gathered round Carlo Poerio, while the *Giovane Italia* society (independent of Mazzini) promoted a few sporadic outbreaks easily crushed. The following year the Venetian brothers Bandiera, acting in concert with Mazzini, landed in Calabria, believing the whole country to be in a state of revolt; they met with little local support and were quickly captured and shot, but their deaths aroused much sympathy, and the whole episode was highly significant as being the first attempt made by Italians from other parts of the country to promote revolution in the south.

Revolution of 1848.—On Jan. 12, 1848, a revolution under the leadership of Ruggiero Settimo broke out in Sicily. These events were followed by demonstrations at Naples, and on Jan. 28 the king granted the constitution. The popular demand was now that Naples should assist the Lombards in their revolt against Austria, for a feeling of Italian solidarity was growing up. Ferdinand declared war against Austria (April 7, 1848); and a Neapolitan army under General Pepe marched towards Lombardy in May, while the fleet sailed for Venice. But a dispute between the king and the parliament concerning the form of the royal oath having arisen, a group of demagogues with criminal folly provoked disturbances and erected barricades (May 14). The king refused to open parliament unless the barricades were removed. A few shots were fired on the 15th, the Swiss regiments stormed the barricades and street fighting lasted all day. By the evening the Swiss and the royalists were masters of the situation. A new ministry under Prince Cariati was appointed. Parliament was dissolved, the National Guard disbanded and the army recalled from the Po.

In Sicily the revolutionists were bitterly hostile to the Neapolitans. The Sicilian assembly met in March 1848, and Settimo in his inaugural speech declared that the Bourbon dynasty had ceased to reign and that Sicily united her destinies to those of Italy; Settimo was elected president of the Government. After the Austrian victories Ferdinand sent a Neapolitan army under Carlo Filangieri (*q.v.*) to subjugate the island. The troops landed at Messina, whose citadel had been held by the royalists throughout, and after three days' desperate fighting the city itself was captured and sacked. Filangieri marched forward, committing many atrocities. In April he reached Palermo while the fleet appeared in the bay, and tumults having broken out within the city the Government surrendered on terms which granted amnesty for all except Settimo and 42 others.

For a few months after the dissolution of the Neapolitan parliament the Government abstained from persecution, but with the crushing of the Sicilian revolution its hands were free; and when the commission on the affair of May 15 had completed its labours thousands of respectable citizens were thrown into prison, such as L. Settembrini, Carlo Poerio, and Silvio Spaventa. The abominable conditions of the prisons in which the best men of the kingdom were immured were made known to the world by the famous letters of W. E. Gladstone, which branded the Bourbon regime as "the negation of God erected into a system of government." In 1857 Carlo Pisacane, an ex-Neapolitan officer who had taken part in the defence of Rome, fitted out an expedition, with Mazzini's approval, from Genoa, and landed at Sapri in Calabria; but the local police assisted by the peasantry attacked the band, killing many, including Pisacane himself, and

capturing most of the rest. The following year, at the instance of Great Britain and France, Ferdinand commuted the sentences of some of the political prisoners to exile. (*See* Ferdinand II., king of the Two Sicilies.)

In May 1859 Ferdinand died and was succeeded by his son, Francis II. (*q.v.*). Victor Emmanuel, king of Sardinia, wrote to him proposing an alliance for the division of Italy, but Francis refused. In June part of the Swiss Guard mutinied and were shot down; and this affair resulted in the disbanding of the whole force—the last support of the autocracy. Various proposals were made for an alliance with Sardinia, but Francis rejected them and indeed began to negotiate with Austria.

Garibaldi.—In the meantime events in Sicily were reaching a crisis destined to subvert the Bourbon dynasty. Mazzini's emissaries, F. Crispi (*q.v.*) and R. Pilo, had been trying to organize a rising in favour of Italian unity and, although they merely succeeded in raising a few armed bands, they persuaded Garibaldi (*q.v.*) that the revolution, which he knew to be imminent, had broken out. Garibaldi, whose hesitation had been overcome, embarked on May 5, 1860, at Quarto, near Genoa, with 1,000 picked followers on board two steamers, and sailed for Sicily. On the 11th the expedition reached Marsala and landed without opposition. Garibaldi was somewhat coldly received by the astonished population; but he set forth at once for Salemi, where he issued a proclamation assuming the dictatorship of Sicily in the name of Victor Emmanuel, with Crispi as secretary of state. On the 15th he attacked and defeated 3,000 of the enemy under General Landi at Calatafimi; the news of this brilliant victory revived the revolutionary agitation throughout the island, and Garibald was joined by Pilo and his bands. By a cleverly devised ruse he avoided General Colonna's force, which expected him on the Monreale road, and entering Palermo from Misilmeri received an enthusiastic welcome. After three days' street fighting the Bourbonist commander, General Lanza, not knowing that the Garibaldians had scarcely a cartridge left, asked for and obtained a 24 hours' armistice (May 30). Garibaldi went on board the British flagship to confer with the Neapolitan generals Letizia and Chrétien; then he informed the citizens by means of a proclamation of what he had done, and declared that he would renew hostilities on the expiration of the armistice. Although unarmed, the people rallied to him as one man, and Lanza became so alarmed that he asked for an unconditional extension of the armistice, which Garibaldi granted; 15,000 Bourbon troops embarked for Naples on June 7, leaving the revolutionists masters of the situation. The Sardinian Admiral Persano's salute of 19 guns on the occasion of Garibaldi's official call constituted a practical recognition of his dictatorship by the Sardinian (Piedmontese) Government. In July further reinforcements of volunteers under Cosenz and Medici, assisted by Cavour, arrived at Palermo with a good supply of arms furnished by subscription in northern Italy. Garibaldi's forces were now raised to 12,000 men, besides the Sicilian *squadre*. Cavour's attempt to bring about the annexation of Sicily to Sardinia failed, for Garibaldi wished to use the island as a basis for an invasion of the mainland. When the Garibaldians advanced eastward they encountered a force of 4,000 of the enemy under Colonel Bosco at Milazzo; on July 20 a desperate battle took place, resulting in a hard-won Garibaldian victory. The Neapolitan Government then decided on the evacuation of the whole of Sicily except the citadel of Messina, which did not surrender until the next year.

The news of Garibaldi's astonishing successes entirely changed the situation in the capital, and on June 25, 1860, the king granted a constitution, and appointed A. Spinelli prime minister. Disorders having taken place between Liberals and reactionaries, Liborio Romano was made minister of police in the place of Aiossa. The king appealed to Great Britain and France to prevent Garibaldi crossing the Straits of Messina, and only just failed (for this episode *see* under Lacaita, Sir James). On Aug. 19 Garibaldi crossed with 4,500 men and took Reggio by storm. He was soon joined by the rest of his troops, 15,000 in all, the Neapolitan army collapsed before Garibaldi's advance, and the people rose in his favour almost everywhere. On Sept. 6 the king and queen sailed for Gaeta; on the 7th Garibaldi entered Naples alone, although the city was still full of soldiers, and was received with delirious enthusiasm; on the 11th a part of the royalists capitulated and the rest retired on Capua. Cavour now decided that Sardinia must take part in the liberation of southern Italy, for he feared that Garibaldi's followers might induce him to proclaim the republic and attack Rome, which would have provoked French intervention; consequently a Piedmontese army occupied the Marche and Umbria and entered Neapolitan territory with Victor Emmanuel at its head. On Oct. 1 and 2, 1860, a battle was fought on the Volturno and the Garibaldians, although inferior in numbers, were victorious. On the 26th he met Victor Emmanuel at Teano and hailed him king of Italy and subsequently handed over his conquests to him. On Nov. 3 a plebiscite was taken, which resulted in an overwhelming majority in favour of union with Sardinia under Victor Emmanuel. Garibaldi departed for his island home at Caprera, while L. C. Farini was appointed viceroy of Naples and M. Cordero viceroy of Sicily. The last remnant of the Bourbon army was concentrated at Gaeta, the siege of which was begun by Cialdini on Nov. 5; on Jan. 10, 1861, the French fleet, which Napoleon III. had sent to Gaeta to delay the inevitable fall of the dynasty, was withdrawn at the instance of Great Britain; the fortress surrendered on Feb. 13 and the royal family departed by sea. The citadel of Messina capitulated a month later and Civitella del Tronto on March 21. On Feb. 18 the first Italian parliament met at Turin and proclaimed Victor Emmanuel king of Italy. Thus Naples and Sicily ceased to be a separate political entity and were absorbed into the united Italian kingdom.

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(L. V.; X.)

NAPOLEON I. (1769–1821), emperor of the French. Napoleon Bonaparte was born at Ajaccio on Aug. 15, 1769, the year following the reunion of Corsica with France. His father, Charles Buonaparte—it was not until after 1796 that the spelling Bonaparte was adopted—came of a good family which had been established in the island since the 16th century. The family origins may perhaps be traced to Tuscany, an Italian province, the relations of which with Corsica had always been close. Napoleon himself, in later years, scoffed at the exaggerated tales invented by flatterers and courtiers, of the lordly status formerly held by the family at Treviso and Bologna. Yet his father was undoubtedly of noble birth, and was the delegate of the Corsican nobility at Paris. Charles Buonaparte married Laetitia Ramolino, a woman of strong character and great personal beauty. He was a lawyer by profession and brought up a large family in difficult times. After the Corsicans had, several times, revolted against their Genoese masters, the republic of Genoa, despairing of ever bringing the rebels to submission, ceded its rights to France, against which the Corsicans, led by Paoli (*q.v.*) at first attempted resistance. Charles Buonaparte joined Paoli's party. He even joined him in his campaign, taking with him his wife and children,

lest they should be seized as hostages by the French. When Paoli was beaten and had to fly Charles Buonaparte became reconciled to French rule and benefited by the protection of M. de Marbeuf, the governor, to whom he was able to make himself useful. In 1779, sent on a mission to Versailles, he took with him his second son, Napoleon, for whom M. de Marbeuf had obtained a bursary at the military academy at Brienne.

EARLY LIFE

These facts enable us to understand the character of Napoleon. He was born a Frenchman, of a family which, unwilling at first to become French, afterwards unreservedly accepted the *fait accompli.* From the age of ten he was educated with other boys of his own class by French people according to French ideas. Though we must make due allowance for heredity, family influence, and the impressions of early childhood, it is an exaggeration to explain Napoleon, as historians since Stendhal have been too much inclined to do, entirely in the light of his Corsican and Tuscan origin, and to see in him the incarnation of a *condottiere,* or of a 14th century Italian city despot, a modern Castruccio Castracani. It is more important to bear in mind that young Bonaparte, born in an island which had only just become part of France, shared neither the traditions nor the prejudices of his new country.

In 1789, at the age of 20, he came into the Revolution with an open mind, feeling neither like nor dislike for many things which other Frenchmen either regretted or frankly detested. If he remained Corsican in temperament he was, by virtue of the instruction he had received, and the books he had read, preeminently a man of the 18th century. His occasional early philosophical writings leave no doubt as to this side of his character, which is also illustrated by the life-long habit of epigrammatic, well-turned, often paradoxical expression, a trait which he had in common with Chamfort and Rivarol; witness his celebrated definition of love as *"une sottise faite à deux."* Further, having lost his father in 1785, and having been designated by him as the head of the family, although he was the second and Joseph the eldest son, he had known poverty and the responsibility of helping to provide for his mother, brothers and sisters. Success was more necessary to him than to others, and the upheaval of 1789 favoured the ambitious.

We must realize therefore that he entered the Revolution in rather an unusual frame of mind, occasionally ardent, joining the Jacobins without hesitation, but also capable of coolly judging events as when on June 20, at the capture of the Tuileries, he was moved to scorn by the weakness of Louis XVI. We must also remember that, having begun his studies at the cadet school at Brienne, he completed them at the *Ecole Militaire* in Paris, where (1784–5) he received a solid grounding in the work of an artilleryman and an officer. It would be wrong to look on him as a kind of self-taught genius, a god of war, who might be said to have discovered, taught, and even created strategy and tactics.

The Artillery Officer.—He himself acknowledged, modestly and loyally, his debt to his teachers. He had studied the treatises of Bourcet and of Guibert, who had evolved from modern armaments new principles and methods of warfare. As a sub-lieutenant at Auxonne, after leaving the *Ecole Militaire,* he received at first hand instruction from baron du Teil, brother of the author of a remarkably advanced work on the use of modern artillery. He profited by the instruction, and always spoke of it with appreciation. However gifted a man may be, he still needs inspiration and counsel, and learns more from his predecessors than he himself passes on to his contemporaries and to posterity. The genius of Napoleon was not least evident in the way in which he made use of the instruction which he received. Curiously enough, Guibert in his *Système de guerre moderne* had predicted that a great man would arise to put into practice the military theories which were then taking shape. These facts, which place Napoleon in his proper intellectual environment, seem to the writer to throw more light on his mind and his character than would countless anecdotes of his childhood and schooldays, such as that at Brienne he was nicknamed *Paille au nez* by his companions because of the way in which he pronounced *Napolione.*

Between his spells of garrison duty at Valence and at Auxonne as a young artillery officer, a part of his early career of which little is known was passed in the leave which he spent on more than one occasion in Corsica, where the somewhat complicated affairs of his family demanded his presence. At Ajaccio in Sept. 1789, he found his elder brother Joseph deep in the affairs of the democratic party which had inevitably, with the progress of the Revolution, become the party of France. Paoli, who had at first thought that events in France would bring about Corsican independence, had soon been disillusioned, Jacobinism being essentially a unifying and centralising force. He inclined therefore to the counter-revolution and entered the opposite camp.

Napoleon, promoted lieutenant in 1791 on the reorganization of the artillery, was stationed for another three months at Valence, where he continued his studies, and even wrote an essay on a subject set for competition by the academy of Lyons: "What are the principles and institutions most likely to bring about the greatest happiness of mankind?" He treated the subject in the style and according to the principles of Jean Jacques Rousseau. When, years afterwards, Talleyrand showed him the essay, he threw it into the fire.

He was again in Corsica from Sept. 1791 to May 1792. Feeling ran high in the island, as a result of the disestablishment of the Catholic Church. He plunged into political intrigue, outstayed his leave, and became liable to the penalties in force against deserters and émigrés. On April 20, 1792, however, the legislative assembly had declared war on Austria. Officers were needed. Instead of undergoing any penalty, Bonaparte, whose zeal for the Revolution was well known, was made a captain. In this capacity he remained in Paris for several months, and witnessed the great events of the Revolution. After the September massacres, he went to Ajaccio to take home his sister Elisa from the convent of Saint Cyr which had just been closed. This was his last visit to his native country. The break with Paoli was now complete. Bonaparte was on the side of the *"patriotes,"* while the old champion of independence was appealing to the English against the Republic, One and Indivisible. Paoli was victorious. Bonaparte and his family, now entirely ruined, had to fly from the island and take refuge in France. This was the termination of what we may call his "insular" period. As he himself said afterwards, once he had left Ajaccio, more important affairs left him little time to think of Corsica and Paoli.

Early Military Opportunities.—In Sept. 1793, Napoleon Bonaparte was still unknown to the world which was to ring with his name. Amazed himself at his extraordinary career, and the incredible swiftness of his rise to power, he said in Saint Helena to Las Cases, "Centuries will pass before the unique combination of events which led to my career recur in the case of another." Favourable circumstances were also required to bring the young artillery officer to the front, and these were not lacking. The republic, which had challenged half Europe, had to face foreign and civil war, under conditions of anarchy. Bonaparte was a Jacobin, with a great reputation as an artillery officer. At Beaucaire, on his way to Paris, he had written a pamphlet, the *Souper de Beaucaire,* in which he had refuted the arguments of three Southern federalists or counter-revolutionaries. It is probable that it reflects a conversation which actually took place in an inn of the little town beside the Rhone. Its publication attested the patriotism of its author. The good word of Robespierre's brother and of Napoleon's compatriot, the deputy Salicetti, were also of assistance. At this juncture it was necessary to recapture Toulon, the inhabitants of which had rebelled against the Convention and called in the assistance of an English squadron. An able officer of artillery was required to direct the siege operations. Bonaparte was chosen.

There has since grown up the legend of "the great Napoleon at the siege of Toulon," though the part which he really played was essentially that of a technical expert. He found in command General Carteaux, formerly an artist, who was too ignorant even to understand that to take Toulon he must capture the position which commanded the roadstead. Things were no better under

his successor, Doppet, and until the arrival of General Dugommier, a soldier of greater experience, who, together with Gasparin, the people's commissary, recognized the knowledge and good sense of the young artillery officer.

On the fall of Toulon in Dec. 1793, Napoleon was promoted general of brigade, and in Feb. 1794 he was given the command of the artillery of the army of Italy. These were still subordinate positions, offering little opportunity for prominence. He spent the next few months—the period of the Terror—in inspecting fortifications and was even for a time "suspect" for having reconstructed an old fort at Marseilles, a town which had also risen against the Convention. He had rejoined the army of Italy, when fresh disaster seemed imminent. After the 9th Thermidor, his relations with the Jacobins became compromising. Accused of having disclosed certain plans to the younger Robespierre, he was arrested, but, in default of evidence, was released on Carnot's instructions. Nevertheless his position at this juncture was extremely precarious. Under the nerveless leadership of Schérer, he had no opportunity of distinguishing himself in the Italian campaign except at Saorgio and on the Roja. He was marking time, in fact. Like a true soldier he detested the campaign in la Vendée, and he refused the command of an infantry brigade which was to be sent against the Western royalists. Aubry, the minister of war, removed him from the active list in consequence.

Reverses.—He now experienced real poverty, and had to sell his books and his watch. He thought of taking service with the sultan to re-organize the Turkish army. Madame Tallien, wife of the member of the Convention, whom he met at this time, interested herself in him and made his peace with the authorities. When Kellermann lost the lines of the Apennines it was remembered that Bonaparte knew Italy, he was taken into consultation, and joined the topographical service of the army.

At this time, in the autumn of 1795, Hoche, Marceau and Joubert were already famous; Bonaparte was still unknown. It looked almost as if fortune were definitely against him. The only thing which he had brought back from his campaigns was the itch and, probably, the malaria, which made him very ill. He was obliged to shave his head, which was later on to bring him the nickname of *"le petit tondu."* Small in stature, thin, yellow-faced, badly dressed, his person was unimposing and no one would have seen in him the future emperor of the French.

The Insurrection of 1795.—It needed a day of revolution and of civil war to bring him into prominence, by giving him the chance to do the Republican Government a service, the vital service of saving the Republic. In the autumn of 1795 the majority of the people of Paris were chafing against dear food, *assignats* and never-ending war. The Convention, by declaring for a constitution designed to keep its own members in power, provoked an insurrection, which, owing to the weakness of General Menou, very nearly succeeded. The Convention then placed the deputy Barras in command of the home forces. He, having known and learnt to value Bonaparte at the siege of Toulon, asked for, and obtained, his appointment as second in command. The young general at once assumed complete control, issued rapid orders, forestalled the insurgents who were about to capture the artillery parked at Les Sablons, and shot them down in the rue Saint-Honoré, on the steps of the church of Saint-Roch. In less than a day he had subdued a serious royalist rising (*13 Vendémiaire*—Oct. 4, 1795). He had saved the republic and earned the nickname *Général Vendémiaire.*

ITALIAN AND EGYPTIAN CAMPAIGNS

Italy.—His first reward was the hand of Josephine, a beautiful Creole, widow of the viscount de Beauharnais, who had been guillotined during the Terror. Josephine, whose morals were none too strict, was living at this time mainly by her wits. The general was six years younger than she, but he seemed to be on the threshold of a brilliant career, and the marriage freed her from poverty. He had, in fact, as his second reward been appointed commander in chief of the Army of Italy. Like Josephine, the government of the Republic was at the end of its financial resources. At this moment, indeed, there was difficulty enough in feeding the troops; it was hoped they would live on the conquered territory. At the beginning of March 1796 Bonaparte married Josephine. At the end of the month he arrived at his headquarters at Nice.

His army consisted of thirty thousand starving soldiers, in want of everything. He issued to them the famous proclamation:—"You are badly fed and all but naked. . . . I am about to lead you into the most fertile plains in the world. Before you are great cities and rich provinces; there we shall find honour, glory, and riches." He entered Italy on April 10. His plan of campaign—the separation of the Piedmontese from the Austrians —was very simple; he executed it successfully after severe actions at Montenotte, Millesimo and Dego.

While he was conducting the campaign, he did not forget that he was a general of the Revolution, and issued to the Italian people proclamations which, while treating the Catholic religion with respect, spoke the language of liberty. The king of Sardinia took fright, and, on the advice of the Archbishop of Turin, sued for peace to an army "with neither artillery, cavalry, nor shoes to its feet." The pope and the dukes of Parma, Modena and Tuscany were not long in following the example of Victor Amadeus. Great political schemes were taking shape in Bonaparte's mind, but first he had to beat the Austrians. This was, indeed, his first experience of large-scale operations. The crossing of the bridge of Lodi was a bold achievement which made his name known in a day all over France and indeed all over Europe. That day, by an old camp custom, his soldiers dubbed him corporal, and another nick-name, the *"petit caporal,"* stuck to him.

New Republics.—In May, some weeks after the setting out of his ragged army, he entered Milan in triumph. He could write to the directory: "The republic holds all Lombardy." At that same moment he received from Paris orders which upset all his plans Sure that his resignation would not be accepted, he sent it in, and, while waiting for the answer, harried the Austrians, whose generals "faithful to the old system of warfare, scattered their troops in small detachments before a man who practised mass-movement." The further Bonaparte advanced with so small an army, the greater was the need for skill and boldness. At Arcola he suffered in his own person, by falling into a swamp. These "miracles of genius and courage" were crowned by the victory of Rivoli, followed by the preliminary negotiations of Leoben (April 18, 1797). "No other general could show such fourteen months." He had forced Austria to sue for peace. He had founded the Cispadane, the Cisalpine, and the Ligurian republics, which brought a large part of Italy under the same *régime* as France, and preparations were begun for its annexation. He had been able to provide for his army by requisitioning; to conquer without costing the treasury anything, and had even sent money to Paris. Finally when the Republicans, having lost their majority in the Councils, were in need of help, Bonaparte, though he had cause for complaint against the directory, sent them his subordinate Augereau, for the *coup de force* of Fructidor (Sept. 1797) directed against the royalists and the moderates. True, the royalists and moderates wanted peace, while Bonaparte agreed with the Jacobins, and aspired to secure France's "natural frontiers."

He was able to congratulate himself on fulfilling both desires by the Treaty of Campo-Formio (Oct. 17, 1797). By it the emperor ceded to France both Belgium and the left bank of the Rhine. Glorious as it was, however, and in keeping with Revolutionary foreign policy, the treaty, far from ending the war, perpetuated it. To assure the permanence of these conquests the goodwill of England was necessary, and England was not in a position to give it; compulsion was therefore necessary. The whole story of Napoleon up to Waterloo turns on this. Henceforth he was to struggle against England, and in that struggle he was in the end to be vanquished.

England and Egypt.—The brusqueness of his manner, and still more his popularity with the masses made him an object of suspicion, in spite of the services which he had rendered the Republic. He, on his side, despised the corrupt government of the directory, "a government of lawyers," whether Jacobin or moderate. He soon realised that their plans for an invasion of England

had no chance whatever of success. In any case he thought it prudent to quit France for a time. The East had always fascinated him. "Only in the East can one do great things," he said. Reading and reflection had convinced him that Egypt was one of the keys of the world. This idea had already emerged in the days of Louis XIV., and was taken up again during the 18th century wars between France and England; there too Napoleon had his forerunners. He planned to strike at the power of England through Egypt and the route to India, and to stir the imagination of his own country-men. The directory accepted the scheme.

The Egyptian expedition was thus indirectly to be the means of forcing the British government to recognise the territorial acquisitions of the Revolution. The weakness of this plan, a weakness inherent in the whole struggle with England, was that France had no navy. Though Bonaparte, by a fortunate combination of circumstances, was able to land his army near Alexandria (July 1, 1798), Nelson, a month later (Aug. 1), destroyed the French fleet at Aboukir. From that moment the Egyptian expedition, instead of being *"le commencement d'une grande chose"* was merely an adventure. In vain Bonaparte executed a brilliant campaign, capturing Cairo, and subduing the country in three weeks. Of the great expedition nothing has endured but famous sayings, such as "Soldiers, from these pyramids forty centuries look down on you"; the Institute of Egyptology; the diffusion of the French language in the valley of the Nile; and, in Bonaparte's own case, a romantic touch of orientalism, symbolised by his faithful mameluke Roustan. Nevertheless, to carry through his great scheme, he undertook the conquest of Syria. Acre, under Admiral Sidney Smith, held out. "That man made me miss my destiny," he said later.

18th BRUMAIRE AND THE CONSULATE

The Coup d'État.—The expedition was, in fact, a failure. Bonaparte realized that there was nothing to be done in Egypt. At the same time came news which told him that there was work for him in France. The directory was in difficulties both at home and abroad. Disorder was rampant, finance and currency desperate, discontent everywhere. The Government, not knowing which way to turn, swayed one day to the Jacobins, the next to the moderates. In Germany the war continued, and in Italy the Republican armies suffered a series of reverses, and invasion was only checked with difficulty by Brune at Bergen, and by Masséna at Zürich. The restoration of the monarchy seemed inevitable. The republic could be saved only by a military leader.

"I seek a sword," said Sieyès, one of the five directors, racking his brains for a general to whom he could confide the defence of the Republic. At that crucial moment Bonaparte decided to return. He went boldly on board a frigate, slipped through the English cruisers in the Mediterranean, and landed at Fréjus on Oct. 8, 1799. He was greeted with shouts of "Long live the republic." He was the man of the hour for all those who desired an end of anarchy but were opposed to the return of the Bourbons. Without him the Revolution was a lost cause. This consideration is essential to the understanding of the famous *coup d'état* of the *18 Brumaire* (Nov. 9, 1799).

The *coup d'état* was organized, indeed, from within. Not only had Bonaparte accomplices among those in power, he had not even to offer or to impose himself; he was sought out. Baudin, a deputy from the Ardennes, and a staunch Republican, died of joy when he heard of the return of *"Général Vendémiaire,"* who was once more to save the Republic. Of the five directors, Sieyès, though a regicide, had given up hope of saving the country except by a dictatorship, of which he hoped to be the head, with Bonaparte as his strong right hand. Roger-Ducos was of the same opinion. The third, Barras, was corrupt, and would do anything for money. Only the remaining two, Moulin and Gohier, were immovable in their Jacobinism, and had to be silenced. Resistance could come only from political circles, the assemblies, or perhaps from part of the army, where Jacobinism was still strong. The conspirators were assured in advance of the support of public opinion. It is, therefore, essential to note that the *coup d'état* was conceived and organized by Sieyès, who took charge of the parliamentary side, while Bonaparte was an executive agent charged with assuring the support of the army. We must not forget that from its origin to the days of *Fructidor* and *Prairial,* the Revolution had undergone many forcible changes and had violated its different constitutions over and over again.

The pretext for the transference of the two legislative assemblies from Paris to Saint Cloud on the *18 Brumaire* was a terrorist plot invented for the occasion. The plan, though well laid, all but miscarried. On the first day, that of *18 Brumaire,* all went well, and, as the Convention had done in *Vendémiaire,* the assemblies placed Bonaparte in command of their forces. On the morrow at Saint Cloud, affairs took a dangerous turn. The Upper Chamber or Council of the "Ancients" had been won over, but the lower or Council of the Five Hundred, whose Jacobin members had had time to summon their forces, greeted the general with shouts of "Down with the dictator! Outlaw him!" Bonaparte lost the thread of his speech, lost countenance, and for a moment was surrounded by a threatening crowd of deputies. Soldiers came to his assistance; however, the day would have been lost but for his brother Lucien, who had made his way in politics and was president of the assembly. Declaring that the right of free speech had been outraged, he dramatically threw off his insignia and rushed into the court of the Orangery to harangue the still hesitating soldiers. Bonaparte, having recovered from a fainting condition, appeared, his face bleeding where, in his agitation, he had scratched it. This made the soldiers think that he had been wounded. General Leclerc, his brother-in-law, thus charged at the head of his grenadiers and cleared the hall of the refractory deputies. That very evening Bonaparte, Sieyès and Roger-Ducos were elected "consuls" by the Council of the Ancients.

The Revolution was not over. Bonaparte was to continue it under monarchical forms, and to give it at last a government. Sieyès dreamed of giving a constitution to France, but France had worn out so many constitutions during the last ten years! Bonaparte, who had used the "ideologues" as stepping stones to power, now made it clear to them that they had a master; and of Sieyès' constitution, only such portions as suited him remained. Authority was narrowing its limits. Five directors had given place to three consuls.

First Consul.—Immediately after, Napoleon became the first, the only one, elected for ten years. Public opinion gave him what was practically unlimited power. Disillusion and anxiety made him master of France. Some were tired of violence and disorder. Others, who had profited by the Revolution to possess themselves of national property, feared the return of the Bourbons and its restoration to its former owners. The mass of the people therefore, desired the consolidation of the new *régime.* Had it not been for the *18 Brumaire,* it is probable that the restoration of the legitimate branch would have taken place much sooner, before the Napoleonic empire had consolidated the results of the revolution by permanent institutions. The great mistake of the royalists was to look upon Bonaparte as another General Monk. He replied with disdain to the overtures of the comte de Provence—the future Louis XVIII. The royalists in their turn hastened to resume the struggle against him, thus definitely marking him as the representative of the "revolution in arms."

The Revolution was further indissolubly bound to its idea of "natural frontiers," and could not surrender the conquests which the rest of Europe refused to recognise. The war had to go on, whether they liked it or not—a fact which entailed government by a soldier. With the rest of his heritage, Bonaparte had to accept the necessity which had made the weak directory as warlike as the Convention. His term of power served merely to postpone the inevitable catastrophe.

Reforms.—His first work was to restore order and to regulate the administration of government. Here his lack of prejudice helped the first consul. As has already been said, being of French education, but not of French origin, he neither disliked nor regretted the old *régime.* He was thus able to adopt the strong points of the old monarchical system and reject the weaknesses of revolutionary democracy. The Revolution had made the system of election universal, in the civil service, in the magistracy, and

in the police: a fault which killed successive governments. Bonaparte replaced the elected committees by prefects and sub-prefects, thus re-establishing and multiplying the old *intendants*. Unwilling to restore completely the independence of the magistracy, of which the parlements had availed themselves against the crown, he gave the government the right to nominate magistrates, while making them, in the interests of justice, irremovable. Thus, making use of the experience both of the monarchy and of the revolution, Bonaparte framed the system known as the constitution of the year VIII. based on administrative centralization which subordinated the nation to the State, and which has been so convenient for governments that it has been kept in being by all the succeeding régimes. Altered only in detail, it subsists today.

At the outset Bonaparte justified the hopes aroused by his *coup d'état*. The mass of the people longed for peace at home and abroad. He appeared to fill the rôle of peacemaker. Having rid himself of Sieyès, he associated with himself, for form's sake, two other consuls, Cambacérès and Lebrun, men of ripe age and moderate views, the latter of whom had been secretary to Chancellor Maupeou under Louis XV. When a plebiscite was taken, the First Consul was approved by three million votes. He immediately reassured both the solid middle class, and the revolutionaries who had enriched themselves during the Revolution. He wiped out the last relics of Jacobinism, by suppressing the progressive forced loans, and the law of hostages. He re-opened the churches and pacified the Vendée by putting an end to religious persecution and thus indicating a forthcoming *concordat* with the Pope. With the help of a former official of the monarchy, Gaudin, who became duke of Gaeta, he reorganised the finances, and prepared the way for a return to a stable currency.

Marengo and Hohenlinden.—Abroad his task was more difficult. There is no reason to think that Bonaparte was not sincere in trying to put an end to hostilities, though he may have wished to prove to the peace party that peace was unobtainable. The proof, in any case, was quickly forthcoming. The emperor of Russia having retired from the coalition, it remained to deal with England and Austria. The first consul offered a cessation of hostilities. It was a mistake to think that England, so long as she remained mistress of the seas, would ever allow France to retain possession of the mouths of the Scheldt. Pitt refused. Then Bonaparte made another miscalculation. A smashing victory on the Continent would, he thought, compel England to yield. He persisted in this erroneous idea until Waterloo. His history henceforth is a striving for the impossible, *i.e.*, the capitulation of Great Britain on a point she had never admitted—the annexation of Belgium—by a France, which was powerless at sea.

Seven months after the *18 Brumaire,* he boldly crossed the Alps by the Great Saint Bernard to compel Austria to make peace. On June 14, 1800, the hardly won victory of Marengo made him once more master of Italy. Together with Moreau's victory at Hohenlinden in December, it forced the Emperor Francis to sign the treaty of Lunéville, by which Austria recognized all the conquests of the Revolution. The left bank of the Rhine became part of France, and was divided into departments. This was the triumph of Bonaparte and of the revolution. For the first time in history France had regained her "natural frontiers," those of Gaul as known to Caesar.

By the treaty of Lunéville, the British government lost her last Continental ally. The war was costing dear, and many people were weary of it. Trade was severely affected. The first consul, who knew this, resumed in appearance the preparations for invasion, which had been begun in 1797. When, after the fall of Pitt, negotiations were begun with the London cabinet, he strove to drive a bargain, renouncing all claims on Egypt. In March 1802, the treaty of Amiens was signed. It was, and could only be a truce, but the French saw in it definitive peace, and the prestige of the first consul was increased.

Extensions of Power.—In the midst of his success there was one seed of anxiety. He was in power only for ten years. Three had already passed, and opposition was beginning to make itself felt. A Jacobin conspiracy was discovered. Soon after he narrowly escaped being killed by an infernal machine. Former terrorists were thought to be responsible, but Fouché, the minister of police, found that the criminals were royalists instigated by the irreconcilable Cadoudal. Then the Tribunate instituted by Sieyès, opposed Bonaparte's favourite ideas; the Concordat with the Pope, the Order of the Legion of Honour, the Civil Code. Their opposition would become more formidable as the ten year period drew to a close. Definitely to establish the Consulate, and to make it safe from attack, permanence was desired. Thus by a natural progression opinion tended towards the revival of the monarchy in favour of the first consul. He himself was silent, asked for nothing, and let his friends work for him. This they did most effectively.

After the triumph of the peace of Amiens, they proposed a national token of gratitude. The Senate accorded only a prolongation of power for a further ten years. This was a discomfiture. Then Cambacérès thought of consulting the people whether Napoleon Bonaparte (his Christian name was beginning to be used officially) should be made consul for life. It was carried by three and a half million to less than ten thousand votes. The first consul also received the right to choose his successor (Aug. 1802). Although he then had no children, there was nothing to prevent him from choosing his son, if he should have one.

Hereditary monarchy was thus on the point of being re-established, after so many solemn protestations to the contrary. From that time the sovereigns of Europe began to regard Bonaparte as one of themselves. They watched him "climbing step by step towards the throne," though there were to be further happenings before he reached it. It would be an error to accuse him of having sought to gain the crown by means of a new war. The establishment of the empire was an indirect consequence of the renewal of hostilities in May 1803, the immediate cause of which was a dispute over Malta and the interpretation of the treaty of Amiens, though for reasons easily understood, and beyond the control of statesmen, peace could never have been more than a truce. Could England allow France to remain in permanent possession of the finest coast line and most valuable ports of the Continent from Rotterdam to Genoa? To put the question is to answer it. And we must remember that Napoleon had received Belgium and Holland in trust for the Revolution.

Counterplots.—France and England slowly prepared for a struggle which this time must be carried to the bitter end. The twice abandoned plan of invading Great Britain was again resumed, and a camp was formed at Boulogne. Meanwhile the irreconcilable royalists, encouraged by the first consul's new difficulties, conspired with General Pichegru to assassinate him. Georges Cadoudal, who had landed in France, succeeded in implicating the celebrated Moreau, jealous of the first consul. The discovery of this plot infuriated Bonaparte. He accused the *émigrés* of ingratitude, publicly affirmed his republican sympathies, and declared that the intention was to destroy the revolution in his person. He determined to strike.

A young prince of the house of Condé, the duke of Enghien one of the Bourbons, was forcibly seized on the territory of the duchy of Baden, summarily tried and shot. Bonaparte has been universally condemned for this judicial murder, which set "a ditch filled with royal blood" between the older dynasty and the throne upon whose steps he stood. His regicide monarchy was no longer suspect even to the fiercest republicans. Just as the infernal machine had contributed to the success of the first plebiscite, the conspiracy of Cadoudal and Pichegru facilitated the proclamation of the empire. The first consul had escaped the conspirators, and the danger helped his cause.

THE FIRST EMPIRE

The consulate for life seemed too precarious; a Napoleonic dynasty would survive its founder. Since his enemies, who were the enemies of the revolution, wished to destroy him "he must be made king or emperor, so that heredity should reinforce his power by ensuring him of natural and unquestioned successors and, by rendering useless crimes against his person, should remove the temptation to commit them." (Thiers.)

Thus France returned to hereditary monarchy, approved by a

unanimous vote of the Senate, and by a plebiscite. The empire was proclaimed on May 18th, 1804, the title of emperor being chosen because the word king was inseparably connected with the Bourbons, and because it sounded more impressive, more military. It evoked, moreover, memories of Rome and of Charlemagne. And, like Charlemagne, Napoleon wished to be crowned by the Pope, not in Rome but in Paris. After some hesitation Pius VII. granted his request. On Dec. 2, at Notre Dame the amazing ceremony took place, and the soldier of the revolution became the anointed of the Lord. Moreover he took the crown from the hands of the Pope, and placed it on his own head. And Josephine the Creole adventuress, became empress. But Napoleon could dare all. He built up a new nobility, he gathered together a court. France approved of everything. When the wife of Marshal Lefebvre (the celebrated *Madame Sans-Gêne,* who had been a washer-woman) became the duchess of Dantzig he dared even ridicule.

Boulogne, Ulm and Cadiz.—The empire united the old France with the new; in it revolutionary and monarchical ideas were combined. There was general satisfaction. Prosperity had returned with ordered government. No one troubled about the one weak point. The empire could not be really established, nor the conquests of the revolution assured, without the defeat of the British power. Napoleon did not forget it, and in the midst of his re-organization of home affairs, his thoughts were on the camp at Boulogne. He knew that to settle finally with England he must overcome her on her own ground, and must have therefore, were it only for one day, free passage across the Channel. A third coalition was forming. He could, he was sure, defeat its forces by land, but this new victory would be no more effective than earlier ones, so long as the British navy was undefeated. With the help of Admiral Decrès, Napoleon had laboured since the days of the consulate to re-establish the French navy, ruined by the Revolution. But a navy is not built in a day. Failure at Boulogne was to change the fortunes of the empire.

Yet the plan was bold and simple. France had two squadrons. The destruction of one mattered little if, while it fought, the other could slip into the Channel and for 24 hours assure the transport of the troops gathered at Boulogne. On this strategy everything turned; it failed. Villeneuve failed Napoleon, as Grouchy was to fail him at Waterloo. The admiral was uneasy about his equipment, his officers, and his raw and untrained crews. His anxiety was shared by Decrès, the minister of marine. Napoleon spent the month of Aug. 1805 in cruel suspense. Villeneuve, he learnt at last, had not dared to enter the Channel and instead of bearing towards Brest, was making sail to the south. Once more the invasion of England must be abandoned, or at least postponed. Austria was openly threatening, Russia was arming, Prussia could not be depended upon. Austria must be brought to the knees without delay. Napoleon broke up the camp at Boulogne, marched into Germany with amazing rapidity ("The emperor makes war with our legs," said his soldiers) and forced General Mack to surrender at Ulm on Oct. 19.

Two days later this magnificent victory, with all those which were to follow it, was nullified. Villeneuve, blockaded by Nelson in Cadiz, had tried to escape. The British fleet, though smaller in numbers, had destroyed the Franco-Spanish off Cape Trafalgar. From that day the French empire was doomed. Napoleon was faced with the hopeless task of subduing England, absolute mistress of the seas. All his future was governed by that impossibility.

Austerlitz and Jena.—Because he had not crossed the Straits of Dover, he was to go in vain even to Moscow. In vain he sought to triumph first over the Continental powers, hoping then to find the British government discouraged and in a mood for compromise. The Russians having offered battle, he defeated them, and also a fresh Austrian army, in the most brilliant of his victories, that of Austerlitz (Dec. 2, 1805), exactly a year after his coronation. In a few weeks the third coalition was wiped out.

The armies of France, under the single command of a man who was a military genius and an absolute sovereign, seemed invincible. Napoleon, and perhaps he alone, knew that no decision had been reached. He rejected Talleyrand's plan for a reconciliation with Austria, and, returning to the idea which had inspired his Egyptian expedition, planned to strike at England through the East. By the peace of Pressburg he made of a subjugated and diminished Austria a means of communication with Constantinople. The vision was taking shape. To realize it, however, he must dominate all Europe. Within a few years he exhausted the Empire in the attempt. With the conquest of Belgium as a starting point, the revolution urged its successor to vast enterprises, for which neither the military genius of Napoleon nor his political ability would suffice. It was not mania for conquest but the logical development of these schemes which led him to annexations and dangerous territorial adjustments which disquieted all Europe. His brother Joseph became king of Naples, his brother Louis king of Holland. He formed the states of Southern Germany into the Confederation of the Rhine, with himself as president. Prussia, charged with closing the Baltic to the English, was promised Hanover, and the Bourbons, dethroned in Naples, were to have the Balearic isles. After the death of Pitt, he tried to conciliate England by offering secretly to restore Hanover. These diplomatic moves served only to make him two enemies, Prussia, which he had humoured for so long, and Spain, a former ally.

The Prussian campaign saw another of the lightning strokes which he understood so well. The Prussian Army, which had lived on the reputation gained under the great Frederick, was routed at Jena (Oct. 1806). In a few weeks the defence had collapsed, and Napoleon was master of the greater part of Prussia.

The Subjugation of Europe.—Since Prussia had refused to lend herself to his schemes, he would make northern Germany another annex to his empire, himself closing the Baltic and eventually all Europe, to English commerce. From Berlin he promulgated the Continental blockade, an idea arising naturally out of the situation, simple, easy to set out on paper, but entailing the suppression of the independence of all the nations of Europe, since the prohibition of trade with England to be effective must be general. The Continental blockade was the consequence of and the counter-strike to Trafalgar.

But Napoleon was caught in a net from which there was no escape. He had set himself an endless task. After Ulm had to come Austerlitz, after Austerlitz, Jena. After Jena he had to complete the conquest of Prussia, and to complete it, to defeat Russia, penetrate further into the East, cross the Vistula. At Eylau (Feb. 8, 1807), three hundred leagues away from France, he fought in the snow a bloody and inconclusive battle. A new effort, the calling up of next year's conscripts was demanded of Frenchmen "that peace might be won." In June at Friedland, the *grande armée* was again victorious.

Once more Napoleon had the illusion that the goal was reached, that he was master of Europe and could hold England to ransom. The tzar Alexander, highly strung and impressionable, was now won over to the idea of an agreement with the emperor of the French for a policy of partition on 18th century lines. This time Turkey was to be divided instead of Poland. Napoleon was convinced that, allied with Russia against England, able to close the Mediterranean against her, threatening her even in India, he would force her to her knees. The meeting at Tilsit, and the conclusion of the pact of friendship between the emperor of the East and the emperor of the West, seemed to justify the costly victories which had led the French army as far as the Niemen.

Spain, Prussia and Austria.—The first disappointment was that the Franco-Russian alliance determined England to fight more fiercely than ever; her answer was a declaration of war against Russia, and the bombardment of Copenhagen. The Continental blockade everywhere led to increasing difficulties. Portugal showed no eagerness to shut out English trade. Junot had to be sent there with an army. Spain was also giving trouble, and Napoleon determined to drive the Bourbons from Madrid. As if he were transferring prefects, he placed his brother Joseph on the throne of Charles IV., and succeeded him at Naples by Murat, who had married Caroline Bonaparte. At the same time the occupation of the Papal States by General Miollis, charged with enforcing the blockade, embroiled him with the Pope. The

system drove Napoleon to increasing severity. To hold Germany and Italy, together with the Adriatic coasts, and the Spanish peninsula, would soon require a standing army of a million men, while the patience with which his conquests and his violence were endured would decrease in proportion to the dispersion of his troops.

Spain gave the signal for resistance. The Spanish people refused to recognise Joseph, and a wide spread insurrection broke out. When, in July 1808 General Dupont surrendered at Baylen, the Napoleonic empire suffered its first military reverse. The news resounded all over Europe. At the same time an English army landed in Portugal and Junot succumbed to superior numbers. Napoleon's desire to direct and control Spanish affairs had not only caused the English to be received as liberators, but had committed himself to an endless struggle against a people in arms. The uprising of the Spanish nation was infectious. In Prussia, in Tirol, in Dalmatia, patriotism was extolled, and the idea of a holy war for national independence took root and grew. In later days the emperor realized that Spain had been his first check, and that the limit of his power had been attained. In spite of a fresh interview at Erfurt, at which the two emperors paraded their friendship before an audience of kings, the Franco-Russian alliance languished. The partition of Turkey was hindered by the question of Constantinople, which neither emperor wished to see in the power of the other. Alexander was beginning to doubt the power of his new friend. Napoleon, feeling that the ill-success of his policy in Spain was injuring his prestige, determined himself to cross the Pyrenees, and re-establish Joseph in Madrid.

Incited by England and lavishly supplied with English money, Austria took advantage of his absence to re-enter the struggle. Napoleon had to return in haste from the Ebro to the Danube. The Austrian plans were carefully laid, and their opposition was far from negligible. Essling was a difficult, and Wagram (July 1809) a costly victory, but in both he carried the day.

Russia.—From these very successes, however, there arose a further complication. Napoleon had made use of Poniatowski and his Poles against the Austrians. Alexander, who, in any case, had remained neutral, feared that Napoleon was planning the reconstitution of Poland. Abandoning his former ally, he denounced the Continental blockade, and had in his turn to be encountered. The idea of conquering England by Europe and Asia, the sea by the land, had brought about a result which, though it seems at first absurd, was yet the logical conclusion.

It was with no light heart that Napoleon decided to carry the war into Russia. He still hoped that it might not be necessary, if Spain were subdued and if the United States, to whom he had ceded Louisiana and promised Florida, declared war on England, which, attacked in its vital interests by the Continental blockade, would at last sue for peace. There was no doubt that the blockade was having a disastrous effect on British trade; its results on the commerce of other nations were no less serious. Holland refused to enforce it, and Napoleon was obliged to resume control from his brother Louis, who had espoused the cause of his new subjects. He annexed the country, and divided it into departments, thus giving England a fresh reason for remaining under arms. In this way the Continental blockade led either to fresh wars or to expansions of territory which the English inevitably refused to recognise, since they had never recognised those revolutionary conquests which the new ones consolidated.

France was growing uneasy. Common sense made it clear that this extension of territory and of war could not go on indefinitely, and yet no end was in sight. Far-seeing members of the emperor's own circle, such as Talleyrand and Fouché, began to fear that affairs were going wrong. "If it only lasts," said Laetitia Ramolino, *Madame Mère*. Yet the empire never seemed so great, nor the future so secure as in 1810.

Marie-Louise.—Already on a level with kings, Napoleon in his second marriage equalled the proudest dynasties. The head of the house of Habsburg gave him the hand of his daughter. Josephine, though she was loved by the people and her dethronement regretted, was growing old and she had given him no heir. He was tired of her, and anxious to ensure the succession. The emperor of Austria must have shared his confidence in the future, since he was willing to accept the "Corsican ogre" as his son-in-law. The marriage contract with the archduchess was modelled on that of Louis XVI. and Marie-Antoinette, into whose family he was now admitted, in one of the most extraordinary episodes of even his life. The following year Marie-Louise bore him a son; the empire had an heir, who was given the title king of Rome, as the heir to the Holy Roman Empire had been named king of the Romans. But in 1811 Rome was but the capital of the department of the Tiber. The pope had been deported to Savona and was about to be imprisoned at Fontainebleau. By the Continental blockade the restorer of Catholicism in France had been led to alienate Catholics all over the world. Nevertheless, excommunicated, having driven the Bourbons from Naples and from Madrid, the man who 20 years before had been an insignificant officer with neither name nor fortune, married a daughter of the Habsburgs. Confident in his star, he carried all before him.

Though his marriage gratified his ambition, Napoleon had decided upon it only after the failure of negotiations for an alliance with a sister of Alexander. He would have preferred a Russian princess, for more than one old veteran of the Revolution, remembering Marie-Antoinette, asked why the "little corporal" should marry another "Austrian." But the Russian emperor was gradually disengaging himself from the alliance, on which Napoleon was ceasing to rely.

Moscow.—Realising that the Russians would never consent to the extension of the French empire, which under the necessity of the Continental blockade had ended by annexing the Hansa towns of Bremen and Hamburg, and making them the principal cities of two of its hundred and thirty departments, he saw that war was inevitable. French territory now stretched to the Baltic, and the nearer its boundaries approached those of Russia, the greater was the danger of conflict. Difficulties arose continually over Oldenburg, Poland, the East, and the reluctance of Russia to abandon trade with England. The two allied emperors were arming against each other. These preparations were themselves a further offence. Convinced that this new struggle had been decreed by fate, and that his work would not be accomplished till he had vanquished Russia as he had vanquished Prussia and Austria, Napoleon now assembled for the campaign of 1812 the greatest army which the world had yet seen, an army of "twenty nations" made up of contingents from all the peoples allied to or dependent on France, a sort of Western crusade against Asiatic Russia. By natural inclination, as much as by policy, Napoleon raised again for this crusade the battle cry of the Revolution, the liberation of nationalities, of which the reconstitution of Poland was to be the token. He forgot that the Spaniards were already fighting for their independence, and that the nationalism, awakened by principles of the Revolution, was stirring the people of Germany. Alexander, who could play many parts, also spoke the language of liberalism, invoked justice, enlisted on his side the countries defeated and subjugated by France or in rebellion against her, and prepared for peace with Prussia and Austria by complicity in the partition of the Polish provinces. Napoleon was thus to stake everything on the inevitable Russian campaign. Victorious, he would be master of the East, of Constantinople, of all Europe, and would at last force the English to capitulate. Defeated, he himself would have given the signal for the debacle. The war which began in 1792, having carried the French to the gates of Moscow was to return by a swift and violent revulsion to the gates of Paris.

In June 1812 the *grande armée* crossed the Niemen. According to their custom, the Russians declined battle. Alexander had said that he would retire if necessary beyond Tobolsk, while Napoleon imagined himself dictating peace from Moscow. The Russians set fire to the city, and made no peace. Then began a retreat which after the passage of the Beresina became a disaster. In the month of December, Ney and Gérard arrived at Königsberg almost alone. The *grande armée* had melted away. Realising the extent of the catastrophe, and its probable effects in Europe and in France itself, the emperor had secretly left the army, which was kept in ignorance of his departure. The news of General Malet's

conspiracy, which had reached him in Russia, had shown him how precarious was his position and how much weakened his prestige.

The Loss of Germany.—The subsequent history of the Empire is the story of a rapid return to the conditions under which Napoleon had assumed the dictatorship in 1799. The Republicans themselves on the *18th Brumaire* had entrusted him with the task of saving the Revolution and its conquests. To this end France had allowed him to take the crown, to found a dynasty, to overrun three-quarters of Europe and to raise countless armies. All in vain. In a few months he was back at his starting point.

The Spanish insurrection of 1809 had encouraged England to persevere, and had revived the resistance of the conquered peoples. The disasters of the Grand Army in 1813 spurred on his enemies still more. "A few more sacrifices," said the English, "and our end is accomplished." Not even the long hoped for declaration of war by the United States, due not to French diplomacy but to the doctrine of the freedom of the seas as opposed to the English "tyranny at sea," could affect the determination of the British government. Everything pointed to a vast change of fortune in favour of the cause of which England, at one moment, had remained the sole champion. Nationalist propaganda was bearing fruit in Germany. Prussia, while still protesting fidelity to Napoleon, had shifted her allegiance, and secretly reconstituted her army. A Prussian corps in French service, commanded by General York, went over to the Russians. Its defection made a great sensation in Germany and hastened the continued retreat to the Elbe of the remnants of the French army. The Prussian government then unmasked and, obedient to popular opinion, proclaimed a war of liberation and independence.

Napoleon chose to consider his Russian defeat as an accident. In Germany it would always be easy for him, he thought, to beat the Prussians and the Russians; having raised and trained a fresh army he did, in fact, beat them at Lutzen and at Bautzen. The campaign of 1813 opened well. He was, however, justly apprehensive of Austria, and instead of following up these fresh successes he agreed to an armistice, so as to be ready for the third adversary. A coalition of Austria, Prussia and Russia had no terrors for him. He wished to settle with it as quickly as possible, thinking that he held enough cards to secure even from England a favourable peace. The victory of Dresden (Aug. 27) seemed to justify this. But, one after the other, his generals, badly served by their contingents from the Germanic Confederation, were beaten in the field, and his plans were delayed. At Leipzig, where he had returned to prevent the junction of his three opponents, Napoleon fought a three days' battle (Oct. 16–19), during which his Saxon troops went over to the enemy. Having lost this immense battle, and all Germany with it, he had to fall back to the Rhine. In November what had been the *grande armée* entered Mainz, after fighting its way through the Bavarians who in their turn had betrayed him.

Was it possible, on the banks of the Rhine, to secure peace on the basis of "natural frontiers"? The question had been identical under the Revolution. Prussia showed herself at last as the German power most fiercely opposed to France, and England insisted on the renunciation of Antwerp. This was, as it had been during twenty years of war, the question at stake.

Disintegration.—Holland had risen against French rule. Belgium was tired of conscription and of taxes, and there also was awaking an old, invincible consciousness of nationality. The British government, well informed on the condition of France, was aware of her exhaustion. Everything, they knew, had been organized for conquest, nothing for defence. The Allies were much superior in numbers. Even within its own boundaries the Napoleonic empire was tottering. Their determination to finish the business once and for all carried even more weight than Prussia's hatred, and the negotiations which took place before the Allied entry into Paris were for that reason insincere. It had been clear since 1798 that, with England undefeated, France could make peace only on returning to her former frontiers.

No one knew better than Napoleon himself that he was, as the Convention and the directory had been, bound hand and foot by the war and its conquests. He must defend those conquests to the end, or perish with them, as the Revolution had perished. The very nature of his power and the conditions on which he had received it, forbade him that honourable and prudent peace which he has been vainly reproached for failing to achieve. First the allies would have none of it, though their unwillingness was veiled to give the impression in France that only the insensate ambition of the emperor stood in the way; secondly, no government of revolutionary origin could accept the former boundaries. The situation was the same as in 1799. "As things are," said Napoleon, "no one but a Bourbon can succeed me."

The Bourbons, however, succeeded him for another reason. When the Allies invaded France in 1814, they were not in agreement on the form of government. They had not made war for the re-establishment of the monarchy before or now. The Austrian emperor preferred the regency of his daughter Marie-Louise, which would have given him control of French policy. The emperor of Russia dreamed of a king of his making, such as Bernadotte, one of the luckiest adventurers of the Revolution, who by an unprecedented combination of circumstances had become crown prince of Sweden and had betrayed Napoleon. Prussia, concerned only with her own aggrandisement, cared little who ruled in France provided that she obtained her share of the spoils.

Thus Castlereagh, who wished to see France smaller, but free and in subjection neither to Austria nor to Russia, became convinced that a Bourbon monarchy alone would fulfil England's conditions, since, according to Albert Sorel, "this government of principles and not of expedients would be neither the debtor nor the client of any of the Allies." Unknown to, or uncomprehended by the French, this was the reason for the restoration, which to them seemed to be arbitrarily imposed by the enemy, though, in accordance with the English theory of the balance of power, it was intended to preserve their national independence.

Napoleon's campaign in France, the most brilliant of them all, was a barren masterpiece. Albert Sorel has compared his victories, Brienne, Champaubert, Montmirail, Montereau, to that of Valmy. The Allies hesitated and wondered whether to negotiate. But just as the Revolution had demanded that the enemy should quit French territory, so Napoleon insisted on the guarantee of "natural frontiers." He could do no less, but the object of the coalition was to deprive France of them. "We must reassume the uniform and the courage of '93," he said in Feb. 1814. He clung instinctively to the Revolution, and welcomed the proffered assistance of Carnot, former comrade of Robespierre, and one of the few revolutionaries who had held aloof from the empire. The allies on their side remembered that when, after Valmy, the invaders had retired behind the Rhine, Revolutionary France had decided to pursue them. This recollection stiffened their determination, and strengthened their alliance. The four powers bound themselves afresh by the pact of Chaumont, and resumed the offensive, determined to dictate terms of peace.

Everything was crumbling around Napoleon. With the last levies which France could give him, scarcely more than children, he again tried to hold back the enemy, then to outflank and defeat them. His plans failed for want of men. On March 30 the Allies were masters of Paris, and a German wrote from Montmartre, "Nine and a half centuries ago our emperor Otto planted his eagles on these hills."

Abdication.—On April 11, 1814, at Fontainebleau, Napoleon abdicated. Not only had his Senate, the child of the *Corps Législatif* of *Brumaire*, itself the child of the Convention, deserted him and declared for the Bourbons, but his marshals fiercely urged him to renounce his sovereignty and leave the country. They had returned to the position before the *18 Brumaire*, from which the Directory had sought to escape. It is again Albert Sorel who notes that the empire ended, as the consulate began, by one of those "days" which had overthrown so many revolutionary governments. On May 5, Louis XVIII. entered Paris, while the fallen emperor landed on the island of Elba where his sovereignty was recognized. The former master of Europe now reigned over a few square miles. But he was only forty-five and in the full force

of his powers. A man of such immense energy and such ardent imagination could not resign himself so easily to defeat.

Only 25 years separated the beginning of the revolutionary era from his fall. A quarter of a century, however crowded with events, is a short space of time. What had happened? In the part of its programme which included republican government, and "natural frontiers," the Revolution had doubly failed: first, when to save itself it had had recourse after the 18th *Brumaire* to a dictatorship, to absolute sovereignty, to the empire; and again when after incessant fighting for "natural frontiers," the empire had ended by laying France itself open to invasion. Conditions which the Revolution would never accept even though the refusal involved a military despotism, were now imposed. France was obliged to return to her former boundaries, and this involved the restoration of the Bourbons. It was the only possible solution, and there were few in 1814 who did not accept it. Talleyrand, who was far from being a legitimist, played a principal part in the restoration, simply because he realized that it was the only solution. Any government, whether republican or imperial, which sprang from the revolution, was doomed to war, and France had already waged war to the limit of her strength. The monarchy alone could assume the heavy responsibility of concluding peace on the terms offered. Hence when the French had forgotten the disasters and the despotism of the empire arose the reproach that the Bourbons had "returned in the baggage waggons of the enemy."

The return of Louis XVIII. was accompanied by the grant of the "Charter," and representative government. He did not restore the institutions of pre-revolutionary France, but on the contrary, retained those of Napoleon, of the year VIII., even confirming the greater number of his prefects in their office. It remained to make peace in Europe. Louis XVIII. and Talleyrand, making use of the jealousies which had arisen among the allies, sought to make the general settlement as favourable as possible to France. The Congress of Vienna was still sitting when, early in March 1815, the news came "like a bombshell" that "Bonaparte" had escaped from Elba. It had all to be done over again.

There are few examples in history of such sentimental and passionate episodes as the return from Elba. Though the good sense of the French protested against the adventure, it caught at their hearts. Napoleon brought with him so many memories, and with them the tricolor. The daring of his landing in France recalled the return from Egypt. He had only to appear, and almost all France rushed to support him. Yet moderate men realized that the emperor's new adventure was all but hopeless, and would end in a catastrophe even worse than that of 1814. Liberals regretted the loss of the "Charter." France was sick of war, and the abolition of conscription had been the most insistent demand made on the Bourbons. Napoleon maintained that he had been recalled by the people, universally dissatisfied with the restored monarchy. There was, of course, unavoidable friction between the old émigré society and the new. There were in particular soldiers who had held out alone in Germany, Holland and Italy, and had not returned to France till after the convention of April 23. These had not witnessed the invasion, and felt that the fall of the emperor had been undeserved. There was also to be reckoned with, the discontent of the officers who had been placed on half pay.

None of this was really serious, however. Only the presence of Napoleon himself, escaped from his island prison, could have brought about the flood of popular feeling by which he re-conquered France in three weeks. He had only to appear and all was forgotten, the disasters of yesterday and those which his return implied, the slaughter which had brought curses on his name, the detested conscription. Officers and men rallied round him. He had not lost his power of appealing to them, and he stirred their hearts by memories of past glory. After the first moments of hesitation the detachments first sent against him declared for him. Grenoble, then Lyons opened its gates. Marshal Ney, who had undertaken to apprehend him and to bring him back if necessary in a cage, wavered, was carried away, and fell into his arms.

The Hundred Days.—Having landed in the gulf of Juan with a handful of men on March 1, 1815, he was at the Tuileries on the 20th, and Louis XVIII. had fled to Ghent.

A hundred days: the adventure lasted no longer, and was doomed from the outset. Three months' madness. To understand why Napoleon, who, ten months before, had been deserted and denied by all, became the master of France in three weeks in a rush of passionate enthusiasm, we must take into account the change in himself, and the new rôle which he played in opposition to the Bourbons. He was not only a military genius. He was a supremely able politician, and his talents had been perfected during the revolution. He now awoke its memory, talking to the soldiers of glory and to the people of peace and liberty. The former despotic emperor returned a demagogue. Two things menaced him. There was first the fear that the allies would again take up arms, but that he assured the people would be prevented by his father-in-law, the emperor of Austria. Then there was his own despotism. But he told the peasants that they were threatened with the revival of tithes, seigniorial privileges and rights. "I come," he said, "to free you from bondage and serfdom." He who had restored the rights of the Church, and founded a new nobility now incited the mob against the nobles and the priests. To the Liberals he promised representative government, the freedom of the press, everything which Louis XVIII. had already granted, but with a new revolutionary tinge. The idea of a liberal Napoleon conformable with the principles of the Revolution, remained in men's minds. From it dates that alliance of the Bonapartists with the Liberals which disturbed the restoration and the reign of Louis Philippe, and paved the way to the era of Napoleon III.

Abroad the consequences of the return from Elba were no less grave. The allies at Vienna learned the news on March 13. They immediately declared the emperor an outlaw. The pact of Chaumont was renewed. Resumption of the war was certain, and new disasters probable for France. Talleyrand, the French representative at the Congress, was in a cruel position. Foreseeing the event, he associated himself with the allies in order at least to keep the conditions of the Treaty of Paris, and to prevent the next treaty from being made even more severe. It was easy afterwards to pillory this prudent decision, and to assert that the Bourbons had joined with the enemies of the French people. When those who had compromised themselves in the Hundred Days sought for an excuse, they used this treacherous argument.

DOWNFALL AND CAPTIVITY

Waterloo.—Napoleon had never held the illusion that the allies would permit him to reign, nor that he could reign, over a France reduced to its former boundaries. He was still subject to the law which had in the past driven him incessantly to battle. Outlawed by Europe, he prepared to fight. He could still command his followers, but the enthusiasm of the early days had evaporated and there were sinister forebodings. There were many abstentions from the plebiscite held, as before, to approve the supplementary Act to the constitution. The assembly of the *Champ de Mai* resuscitated as the festival of Federation, was gloomy. The spirit of the people was exhausted, their minds disturbed, and Napoleon's supporters uneasy. To prevent a new invasion, the Emperor left for Belgium on June 12 with the intention of separating Wellington and Blücher, who had a hundred thousand men more than he, and defeating them successively. In spite of a success at Ligny, he failed to prevent the junction of the English and the Prussians. This was partly due to what is usually called ill-fortune, but is really the resultant of many forces. Grouchy, a second-rate general to whom Napoleon had given a command in reward for political services, blundered, and remained inactive during the great battle which took place on June 18 at Waterloo—the name of a disaster unparalleled since Trafalgar. On his return to Paris on June 20 no other course but a second abdication was open to Napoleon. All was over. The Napoleonic drama culminated in disaster.

It would appear that in order to strike the imagination of mankind a hero's life should end with a great misfortune. If he had died a natural death in his palace, or fallen on the field of battle, Napoleon would never have become to posterity the figure we know. Lives like his must end in martyrdom, which crowns them with the pity caused by human suffering and the respect due

NAPOLEON I

PHOTOGRAPHS, (1, 4) GIRAUDON, (3, 6) ALINARI, (5, 7) FROM SLOANE, "LIFE OF NAPOLEON" (CENTURY COMPANY AND MACMILLAN, LONDON)

NAPOLEON BONAPARTE

1. Death Mask of Napoleon, now in the Invalides, Paris
2. Upper left: miniature portrait of Napoleon in 1812, by Isabey. Upper right; miniature portrait of Josephine in 1813, by Isabey. Below: engraving by G. Fiesinger, after a miniature portrait of Napoleon by Guerin, deposited in the National Library, Paris, in 1799
3. "The Last Days of Napoleon," sculpture portrait by V. Vela; now at Versailles
4. "Napoleon I," statue by Philippe-Laurent Roland. In the Paris Institut
5. House in the Place Letizia, Ajaccio, Corsica, in which Napoleon Bonaparte was born. From the drawing by Eric Pape
6. "Napoleon Crossing the Alps," by J. L. David. At Versailles
7. "Longwood," Napoleon's residence at St. Helena. Drawing by Harry Pena, from a photograph belonging to L. C. Billings

to misfortune. Saint Helena idealised the emperor's memory, and his gaolers unwittingly prepared for him a sort of poetic immortality. Though his imprisonment in a distant island was a punishment relatively slight as compared with the torture of Joan of Arc, and though the man who placed the imperial crown upon his own head had little in common with the young girl who led her king to his crowning at Reims, there is some similarity in the moral effect and the historical renown of their death. The last phase of Napoleon's life may be regarded as his transfiguration.

After Waterloo, the energy which his presence had re-awakened relaxed. On his return to Paris he felt himself abandoned. The Chamber declared itself against him, and appointed an executive commission to govern with the ministers. He must either forcibly dissolve it, or abdicate. He decided to abdicate in favour of his son, the king of Rome, and made known his intention of going to the United States. The executive commission replied that two frigates, then in waiting at Rochefort, were at his disposal, and requested him to hasten his departure. He remained a week longer at Malmaison, then, as a last despairing throw of the dice, offered his sword against the invaders as a simple general. He then undertook to leave for America. His offer was refused. He left Malmaison on June 29 and arrived at Rochefort on July 3.

The two frigates were there, but the "Bellerophon" and other English ships were cruising before the harbour and blocked the outlet. One hope was left, to slip past and get out to sea. Napoleon would not run the risk of arrest as a fugitive. Thanking all those who offered to help him to escape, he decided on a plan he had had in mind several days, which seemed to him to be the most worthy of him as having an element of greatness, namely to demand asylum from the British government. Maitland, the commander of the "Bellerophon," had let him know that the request would be well received. Thus Napoleon wrote his famous letter to the prince regent:—

"Your Royal Highness, Exposed to the factions which distract my country and to the enmity of the greatest powers of Europe, I have ended my political career, and I come, like Themistocles, to appeal to the hospitality of the British people. I put myself under the protection of their laws, and beg your royal highness, as the most powerful, the most determined and the most generous of my enemies, to grant me this protection."

The allies at this moment were in agreement on only one point of their treatment of Napoleon. There must be no new return from Elba, and it would be perhaps even easier to return from America. The victors, to tell the truth, did not know what to do with him, and every solution presented difficulties. Their secret hope was that he would commit suicide, or perish on his way, the victim of a "White Terror." Or they would have liked Louis XVIII. on his return to Paris to have him summarily tried, condemned and executed. "We wish," wrote Lord Liverpool to Castlereagh, "that the king of France would have Bonaparte shot or hanged. It would be the best end to the business." But no one wished to take the responsibility, and Louis XVIII. less than anyone else. And Alexander I. and Wellington were working to save Napoleon's life. So the fate of the man regarded as an outlaw, "outside human society," *hostis generis humani*, had still to be decided. By his surrender to England the "Corsican ogre" laid on her the task of custody which Lord Liverpool would willingly have left to others.

Louis XVIII., who had returned to Paris on July 9, was anxious for the matter to be settled as quickly as possible, without taking the odium on himself. He ordered the prefect of Rochefort to keep the ex-emperor on the frigate *La Saale,* and to give him up to Commander Maitland, on the latter's requisition. Napoleon thought it more dignified to surrender without waiting for summons or arrest. On July 15 wearing the green coat of the *chasseurs de la garde,* and the small hat, his favourite uniform, and that in which he is always popularly represented he went on board the "Bellerophon."

One wonders if he deceived himself as to his fate and believed that the British government would allow him to go to America, or to remain at liberty in England, which had always welcomed exiles and was looked on as a political asylum. He may have remembered Paoli and Theodore, king of Corsica for a brief period, who had come to London, to die. Strangely enough there has been found among his papers a short literary exercise, an imaginary letter from Theodore asking Walpole for protection. In his school exercise books is also the phrase "Saint Helena, a little island."

The Voyage.—If Napoleon had hoped to remain at liberty he was undeceived when the "Bellerophon" arrived at Plymouth. Admiral Keith delivered to him, in the name of the British government a letter which informed "General Bonaparte" that in order to deprive him of further opportunities of disturbing the peace of Europe, it was necessary to restrain his personal liberty, and that to this end Saint Helena had been chosen as his future residence. He might take with him three companions, from among those who had accompanied him to England, and a surgeon. The emperor, on receipt of the letter, protested that he was the guest and not the prisoner of the British government, and that the rights of hospitality were being violated in his person. He then resigned himself, and set an example of stoicism to his followers. He did no more than put into writing the verbal protest which he had made to Admiral Keith.

Napoleon took with him into his captivity General Bertrand, a former grand marshal of the palace, Count Montholon, aide de camp, and General Gourgaud, and a civilian, the count de Las Cases. Countess Bertrand and Countess Montholon were of the party, as well as Las Cases the younger, and several servants. On Aug. 7 they embarked on the "Northumberland," commanded by Admiral Cockburn, and almost immediately set sail. The voyage lasted more than two months. Napoleon preserved his impassibility, even though the officers and crew had been ordered to refrain from paying him marks of respect, and he was addressed merely as "General." On arriving at Saint Helena Cockburn even said to General Bertrand, "I know of no emperor living in this island, nor of any person with a right to that position, having, as you say, travelled with me on the Northumberland."

Reading was Napoleon's chief distraction, during this long and monotonous voyage which was bearing him for ever from France and from his family. He had read to him from the *Encyclopædia Britannica* everything concerning Saint Helena and the countries near which the ship was passing. After a turn on deck he would lean against a gun, which the midshipmen soon called "the emperor's gun," and talk at length of his past life, telling stories of his career. Las Cases, who kept a journal was thus led to begin his *Memorial of Saint Helena.* Soon Napoleon himself decided to dictate his recollections, beginning with his Italian campaign.

Saint Helena.—On Sunday, Oct. 15 the "Northumberland" dropped anchor before Saint Helena. Napoleon looked through his glasses at the island which was to be his tomb, without, says Las Cases, showing the slightest emotion, and then worked as usual. They landed the next day. The dwelling intended for the prisoner was called Longwood, and, as it was in bad repair and not ready for his reception he stayed temporarily at the small house "The Briars," of which Las Cases says: "The Emperor Napoleon, who was once so powerful, and master of so many crowns, found himself reduced to a little hovel a few square feet in dimensions, with neither curtains, shutters, nor furniture. He had to sleep, dress, eat, work, live there, and if there was cleaning to be done he had to go out of doors." Napoleon protested more than once against this "infamous treatment," against the fact that he was treated as a prisoner of war, though he had himself taken refuge under the English flag, and against the prohibition of news of his wife and son. In December, Longwood was ready at last, and the little company moved there, together with Doctor O'Meara of the Northumberland who had asked to share Napoleon's exile, since no other doctor was available. He also has written an interesting account of the captivity.

Longwood, which had been a farm, was larger and a little more comfortable than "The Briars." Napoleon remained there till his death, spending his time in talking over his past career, dictating his reminiscences, reading, doing a little gardening, riding in the narrow limits permitted him, and even in learning English, which

he read fairly fluently, but would never speak. His chief troubles were the prohibition of correspondence with his family, and the badness of the food. His imprisonment became still more rigorous when, in April 1816, Admiral Cockburn was replaced by Hudson Lowe. The new Governor, obsessed with the fear of losing his prisoner, and, seeing nothing but espionage and plans of escape, made himself detested. Under his petty persecution Napoleon remembered with regret the régime of Admiral Cockburn. First Las Cases, accused of having organised a correspondence with the outer world, was deported to the Cape; O'Meara, the next to go, was replaced by the Corsican doctor, Antommarchi. In 1818 Gourgaud, who could not agree with his companions, left Saint Helena. Only Bertrand and Montholon stayed till the end.

Napoleon's health was suffering. It is possible that the climate, the food and mental anguish assisted the tendency towards cancer which he inherited from his father. His strength rapidly declined. In March 1821, he took to his bed. In April he dictated his will. "It is my wish," he said "that my ashes shall be laid to rest on the banks of the Seine among the French people whom I have loved so well." He added "I am dying before my time, murdered by the English oligarchy and its hired assassin" (Hudson Lowe). He died on the morning of May 5 in his 52nd year. His body was dressed in his favourite uniform, that of the *chasseurs de la garde,* and covered with the cloak he had worn at Marengo. He was buried in a lonely spot near a spring shaded by two weeping willows. He had often walked there. "Here lies" was on the stone. No name.

The Napoleonic Legend.—He had said one day, "What a romance my life has been." Napoleon knew mankind too well, he was in fact too great an artist not to realise that his captivity and his martyrdom gave him a magnificent opportunity of impressing himself upon posterity. On that lonely rock he was seized by an idea as great as were his plans of campaign or the *Code civil.* He would prepare, if not for himself, at least for someone of his race, something better than a return from Elba. He foresaw the nineteenth century, and would catch its imagination. Two thousand leagues away from France he divined the medley of sentiment and emotion forming there:—Austerlitz and Waterloo, the triumph and humiliation of the tricolor, the Revolution of 1789 ending in the return of the Bourbons, all the longings for liberty and for glory which would torture the people of France. Buried desires would rise again, resuscitated by regret and the magic of remembrance. Napoleon had always known how to appeal to the French people. He had not lost the art.

So the *Memorial of Saint Helena* was to become the Gospel of Saint Helena. During the hundred days he had already allied himself with the Liberals and the Republicans. The great Carnot had wept on his shoulder after the second abdication. He spent his years of exile in reviving the Napoleonic legend, in confounding it with liberalism, in "changing the eagle's plumage." He dreamed sometimes that he was working for himself, and that the people aroused by his promises would drive out their Kings and come to deliver him. "We are martyrs to an immortal cause," he said. "We struggle against oppression and the voice of the nations is for us."

In the conversations which were published to the world by his companions in captivity, he made himself the apostle of a new political doctrine, which, inspired by the principles of 1789, had the character and the fascination of a religion. It was a vast idealistic programme, a declaration of the rights and duties of the French people, a reshaping of Europe on the principles of liberty, equality, fraternity and justice. He identified his cause with that of universal freedom. The peoples must be set free, and a holy alliance of nations substituted for a holy alliance of Kings. "There are" he said "strivings for nationhood which must be satisfied sooner or later." No people should be left under the domination of another, and different sections of the same race, which wish to unite, ought not in the future to be separated. "Though they are scattered there are in Europe more than thirty million Frenchmen, fifteen million Spaniards, fifteen million Italians and thirty million Germans. I should like to have made each of these peoples a single united nation." He re-told his own story, giving it a humanitarian and idealistic bias. He represented his dictatorship as that of a liberal, or "crowned Washington," a despot in spite of himself and for the world's good, waging war to found the United States of Europe. He called himself the Messiah of the Revolution whose name would be for the peoples "the emblem of their hopes."

This lofty incarnation triumphed. Popular imagination represented Napoleon at Saint Helena as on a sort of Mount Sinai. Béranger's songs, Victor Hugo's poems added to the glamour. In 1840 the government of Louis-Philippe obeyed the national will by sending the prince de Joinville to bring back the remains of the emperor. The "return of the ashes" was a historic day. Since then, Napoleon rests in the Invalides. Another poet, Lamartine, warned Louis-Philippe that this return foreshadowed another. And, indeed, thanks to the legend woven by his uncle, after the revolution of 1848, Louis Napoleon was elected president of the republic, and then restored the empire, accomplishing in foreign policy, by his support of Italian unity, the programme of nationalities, though the integration of Italy was not yet completed. Thus the Napoleon of Saint Helena survived.

THE NAPOLEONIC RECORD

The Soldier.—We must now briefly consider this man, whose personality was in every respect far above the mean, as a commander and as a legislator—as soldier and sovereign.

His master concepts may be gathered from his various sayings. "The art of war" he said "is simple and wholly executive. There is nothing ideological about it." And again "The whole art of war consists of a careful and well-thought out defensive, together with a swift and bold offensive." Simplicity and rapidity are the dominating features both of his campaigns and his battles. "The art of war" he said at the beginning of his career "consists, with inferior forces, in always having larger forces than the enemy at the point of attack or defence." To do this rapidity of movement is required. "Energy, rapidity" was his constant admonition to subordinates. One must concentrate one's own forces, keep them together, lead the enemy to give battle in the most unfavourable conditions; then, when his last reserves are engaged, destroy him by a decisive attack and end the war as quickly as possible.

As Napoleon himself said, all these precepts could be compressed in a very small book. He had, in fact, a method, not a system. "One of the characteristic features of Napoleonic strategy," says Marshal Franchet d'Esperey, "is that, the goal once chosen and boldly chosen, the method does not vary, though, being supple, it adapts itself to circumstances." One might just as well say "the measure of the method is the commander's measure." Napoleon's power of rapidly summing up a situation and making his decision, explains his victories. As Clausewitz has well said: "On the field of battle everything depends on a decision made in a few minutes." Napoleon summed up everything, including himself, in the words: "No precise rules can be laid down. Everything depends on the character of the general, his abilities, his weakness, the quality of his troops, the range of their weapons, the weather and a thousand other circumstances which never repeat themselves." Hence before the battle his meticulous study of the position, of alternative suppositions, a keen examination of the psychology of his opponent, and the rigorous use of information, material and moral. The weak point was that everything depended on Napoleon. He saw everything, did everything, took account of the most insignificant details, himself directly gave all the orders. His lieutenants, having the habit of obedience, were merely executants who took no initiative. Berthier, although he held the position of chief of staff, said that he counted for nothing with the army. Therefore, an indisposition of the emperor was sufficient to disorganize the machine.

Then, from 1812 onwards, the number of troops involved became too large, and the commander's vision no longer sufficiently sure. It was a war of armies, not of army corps. The Napoleonic system began to give less favourable results. An exaggerated belief in his "star" and his genius, and his heavy demands on an exhausted France, explain the final catastrophe. He had long profited from the concentration of power in his own person. He

himself rejoiced in being almost the only great captain to hold absolute authority over a rich and populous country, and command its resources both of men and money. Yet in spite of his enormous intellectual energy he gave way in the end under the burden. He insisted on regulating the minutest details of his government. Thus the decree which still governs the *Theâtre Français* was signed at Moscow. Moreover his empire was precarious. Founded on victory and success, it could not survive defeat. Remembering after Waterloo Louis XIV. unshaken by misfortune, he said, "If I had been my own grandson, I could have retreated as far as the Pyrenees."

The Sovereign.—Yet he did more than win and lose battles. He gave to France laws which for the most part still endure. We have seen that when he became first consul, France had fallen practically into anarchy. The ancient laws, excessively complicated, because they differed from province to province and were customary and traditional, had been wiped out by the revolution. The new laws, so far as they existed at all, were too revolutionary in character and unadapted to normal society. The *code civil* united what in Roman law and in tradition was best suited to France under the conditions engendered by the Revolution. It may be said to be a systemization of good sense, at the same time logical and historical. Napoleon had no legal training, and his share in the work should not be exaggerated, but he intervened continually with the dominating idea that, though the work of the revolution must not be undone, order must be restored in France. Here again he profited by his lack of prejudice and his trained intelligence. He carried out the transition from old to new France. Probably he alone could have re-established the conditions necessary to settled government without being accused of relinquishing the "civil victories of the revolution." He was able to reimpose indirect taxation and in particular food taxes, the most unpopular of all, the abolition of which had made it impossible to place the finances of the Republic on a sound basis.

The council of state, the public accounts office, the courts of justice, the universities, the rights of the *Banque de France,* all these were established, counterbalancing the work of the revolutionary demagogues, and they serve to this day as restraining influences on the occasional over-violence of democracy. On the other side of the picture we see excessive centralization which stifled provincial life and local characteristics, cast the whole country in the same mould, and made the State supreme over the entire people—a system singularly favourable to "étatisme." Thus as a legislator, and as a legendary figure, Napoleon appeared as the restorer of order and authority and the embodiment of progress.

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(J. Bai.)

NAPOLEON II.: *see* Reichstadt, Napoleon Francis Joseph Charles, Duke of.

NAPOLEON III. [Charles Louis Napoleon Bonaparte] (1808–1873), emperor of the French, was born on April 20, 1808, in Paris at 8 rue Cerutti (now rue Laffitte), and not at the Tuileries, as the official historians state. He was the third son of Louis Bonaparte (*see* Bonaparte), brother of Napoleon I., and king of Holland (1806–10), and of Hortense de Beauharnais (*q.v.*). Of the two other sons of Louis Bonaparte and Hortense, the elder, Napoleon Charles (1802–1807), died in infancy; the second, Napoleon Louis (1804–1831), died in the insurrection of the Romagna, leaving no children.

Exile of Hortense.—After Waterloo, Hortense, suspected by the Bourbons of having arranged the return from Elba, had to go into exile. The ex-king Louis, who now lived at Florence, had compelled her by a scandalous law-suit to give up to him the elder of her two children. With her remaining child she wandered, under the name of duchesse de Saint-Leu, from Geneva to Aix, Carlsruhe and Augsburg. In 1817 she bought the castle of Arenenberg, in the canton of Thurgau, on a wooded hill looking over the Lake of Constance. Hortense supervised her son's education in person. The young prince also studied at the gymnasium at Augsburg, and there he acquired his slight German accent.

In 1823 he accompanied his mother to Italy, visiting his father at Florence, and his grandmother Letitia at Rome, and dreaming with Le Bas on the banks of the Rubicon. He returned to Arenenberg to complete his military education under Colonel Armandi and Colonel Dufour, who instructed him in artillery and military engineering. At the age of twenty he was a "Liberal," an enemy of the Bourbons and of the treaties of 1815; but he was dominated by the cult of the emperor, and for him the liberal ideal was confused with the Napoleonic.

Revolution of 1830.—The July revolution of 1830, of which he heard in Italy, roused all his young hopes. He could not return to France, for the law of 1816 banishing all his family had not been abrogated. But the liberal revolution knew no frontiers. Italy shared in the agitation. He had already met some of the conspirators at Arenenberg, and it is practically established that he now joined the associations of the Carbonari. Following the advice of his friend the Count Arese and of Menotti, he and his brother were among the revolutionaries who in February 1831 attempted a rising in Romagna and the expulsion of the pope from Rome. They distinguished themselves at Civita Castellana, a little town which they took; but the Austrians arrived in force, and during the retreat Napoleon Louis, the elder son, took cold, followed by measles, of which he died. Hortense hurried to the spot and took steps which enabled her to save her second son from the Austrian prisons. He escaped into France, where his mother, on the plea of his illness, obtained permission from Louis Philippe for him to stay in Paris. But he intrigued with the republicans, and Casimir-Périer insisted on the departure of both mother and son. In May 1831 they went to London, and afterwards returned to Arenenberg.

For a time he thought of responding to the appeal of some of the Polish revolutionaries, but Warsaw succumbed (September 1831) before he could set out. Moreover the plans of this young and visionary *enfant du siècle* were becoming more definite. The duke of Reichstadt died in 1832. His uncle, Joseph, and his father, Louis, showing no desire to claim the inheritance promised them by the constitution of the year XII., Louis Napoleon henceforth considered himself as the accredited representative of the family. He endeavoured to define his ideas, and in 1833 published his *Rêveries politiques, suivies d'un projet de constitution,* and *Considérations politiques et militaires sur la Suisse;* in 1836, as a captain, in the Swiss service, he published a *Manuel d'artillerie,* in order to win popularity with the French army.

Strasbourg Conspiracy.—With the aid of his friend Fialin and of Eléonore Gordon, a singer, and of certain officers, such as Colonel Vaudrey, an old soldier of the Empire, commanding the 4th regiment of artillery, and Lieutenant Laity, he tried to bring about a revolt of the garrison of Strasbourg (Oct. 30, 1836). The conspiracy was a failure, and Louis Philippe, fearing lest he might make the pretender popular either by the glory of an acquittal or the aureole of martyrdom, had him taken to Lorient and put on board a ship bound for America, while his accomplices were brought before the court of assizes and acquitted (February 1837). The prince was set free in New York in April; by the aid of a false passport he returned to Switzerland in August, in time to see his mother before her death on Oct. 3, 1837.

At any other time this attempt would have covered its author with ridicule. Such, at least, was the opinion of the whole of the family of Bonaparte. But his confidence was unshaken, and in the woods of Arenenberg the romantic-minded friends who remained faithful to him still honoured him as emperor. And now the government of Louis Philippe, by an evil inspiration, began to

act in such a way as to make him popular. In 1838 it caused his partisan Lieutenant Laity to be condemned by the Court of Peers to five years' imprisonment for a pamphlet which he had written to justify the Strasbourg affair; then it demanded the expulsion of the prince from Switzerland, and when the Swiss government resisted, threatened war. Having allowed the July monarch to commit himself, Louis-Napoleon at the last moment left Switzerland voluntarily. All this served to encourage the mystical adventurer. In London, where he had taken up his abode, together with Arese, Fialin (says Persigny), Doctor Conneau and Vaudrey, he was at first well received in society, being on friendly terms with Count d'Orsay and Disraeli, and frequenting the *salon* of Lady Blessington. He was evolving his programme of government, and in 1839 wrote and published his book: *Des Idées napoléoniennes,* a curious mixture of Bonapartism, socialism and pacificism, which he represented as the tradition of the First Empire. He also noted the fluctuations of French opinion.

Boulogne Conspiracy.—The pretender, again thinking that the moment had come, formed a fresh conspiracy in 1840. With a little band of fifty-six followers he attempted to provoke a rising of the 42nd regiment of the line at Boulogne, hoping afterwards to draw General Magnan to Lille and march upon Paris. The attempt was made on Aug. 6, but failed; he saw several of his supporters fall on the shore of Boulogne, and was arrested together with Montholon, Persigny and Conneau. This time he was brought before the Court of Peers with his accomplices; he entrusted his defence to Berryer and Marie, and took advantage of his trial to appeal to the supremacy of the people, which he alleged, had been disregarded, even after 1830. He was condemned to detention for life in a fortress, his friend Aladenize being deported, and Montholon, Parquin, Lombard and Fialin being each condemned to detention for twenty years. On Dec. 15, the very day that Napoleon's ashes were deposited at the Invalides, he was taken to the fortress of Ham. On the whole the régime imposed upon him was mild. He corresponded with Louis Blanc, George Sand and Proudhon, and collaborated with the journalists of the Left, Degorge, Peauger and Souplet. For six years he worked very hard "at his University of Ham," as he said. He wrote some *Fragments historiques,* studies on the sugar-question, on the construction of a canal through Nicaragua, and on the recruiting of the army, and finally, in the *Progrès du Pas-de-Calais,* a series of articles on social questions which were later embodied in his *Extinction du paupérisme* (1844). But the same persistent idea underlay all his efforts. On May 25, 1846, he escaped to London, giving as the reason for his decision the dangerous illness of his father. On July 27 his father died.

Return to France.—He was again well received in London and he "made up for his six years of isolation by a furious pursuit of pleasure." The duke of Brunswick and the banker Ferrère interested themselves in his future, and gave him money, as did also Miss Howard, whom he later made comtesse de Beauregard, after restoring to her several millions. At the first symptoms of revolutionary disturbance he returned to France; on Feb. 25, he offered his services to the Provisional Government, but, on being requested by it to depart at once, resigned himself to this course. But Persigny, Mocquard and all his friends devoted themselves to an energetic propaganda in the press, by pictures and by songs. After May 15 had already shaken the strength of the young republic, he was elected in June 1848 by four departments, Seine, Yonne, Charente-Inférieure and Corsica. In spite of the opposition of the executive committee, the Assembly ratified his election. But he had learnt to wait. He sent in his resignation from London, merely hazarding this appeal: "If the people impose duties on me, I shall know how to fulfil them." This time events worked in his favour; the industrial insurrection of June made the middle classes and the mass of the rural population look for a saviour, while it turned the industrial population towards Bonapartism, out of hatred for the republican *bourgeois.*

Presidency of the Republic.—On Sept. 26 he was re-elected by the same departments; on Oct. 11 the law decreeing the banishment of the Bonapartes was abrogated; on the 26th he made a speech in the Assembly defending his position as a pretender, and cut such a sorry figure that Antony Thouret contemptuously withdrew the amendment by which he had intended to bar him from rising to the presidency. Thus he was able to be a candidate for this formidable power. The former rebel of the Romagna, the Liberal *Carbonaro,* was henceforth to be the tool of the priests. In his very triumph appeared the ultimate cause of his downfall. On Dec. 10 he was elected president of the Republic by 5,434,226 votes against 1,448,107 given to Cavaignac. On Dec. 20, he took the oath "to remain faithful to the democratic Republic . . . to regard as enemies of the nation all those who may attempt by illegal means to change the form of the established government." From this time onward his history is inseparable from that of France. But, having attained to power, he still endeavoured to realize his cherished project. All his efforts (Dec. 10, 1848 to Dec. 2, 1852) tended towards the acquisition of absolute authority, which he wished to obtain, ostensibly from the people.

It was with this end in view that he co-operated with the party of order in the expedition to Rome for the destruction of the Roman republic and the restoration of the pope (March 31, 1849), and afterwards in all the reactionary measures against the press and the clubs, and for the destruction of the Reds. But in opposition to the party of order, he defined his own personal policy. "The name of Napoleon," he said on this occasion, "is in itself a programme; it stands for order, authority, religion and the welfare of the people in internal affairs, and in foreign affairs for the national dignity."

In spite of this alarming assertion of his personal policy, he still remained in harmony with the Assembly (the Legislative Assembly, elected on May 28, 1849) in order to carry out "a Roman expedition at home," *i.e.,* to clear the administration of all republicans, put down the press, suspend the right of holding meetings and, above all, to hand over education to the Church. But he knew where to stop and how to keep up a show of democracy. When the Assembly, by the law of May 31, 1850, restricted universal suffrage and reduced the number of the electors from 9 to 6 millions, he was able to throw upon it the whole responsibility for this *coup d'état bourgeois.*

In fact, while trying to compass the destruction of the republican movement of the Left, he was taking careful steps to win classes. At his side were his accomplices, men ready for anything, whose only hopes were bound up with his fortunes, such as Morny and Rouher; his paid publicists, such as Romieu, the originator of the "red spectre"; his cudgel-bearers, the "Ratapoils" immortalized by Daumier, who terrorized the republicans.

Coup d'État.—He next entered upon that struggle with the Assembly, now discredited, which was to reveal to all the necessity for a change, and a change in his favour. In January 1851 he deprived Changarnier of his command of the garrison of Paris. "The Empire has come," said Thiers. The pretender would have preferred, however, that it should be brought about legally, the first step being his re-election in 1852. The Constitution forbade his re-election; therefore the Constitution must be revised. On the 19th of July the Assembly threw out the proposal for revision, thus signing its own death-warrant, and the *coup d'état* was resolved upon. He prepared for it systematically. The cabinet of Oct. 26, 1851 gave the ministry for war to his creature Saint-Arnaud. All the conspirators were at their posts—Maupas at the prefecture of police, Magnan at the head of the troops in Paris. At the Elysée, Morny, adulterine son of Hortense, a hero of the Bourse and successful gambler, supported his half-brother by his energy and counsels. The ministry proposed to abrogate the electoral law of 1850, and restore universal suffrage; the Assembly by refusing made itself still more unpopular. By proposing to allow the president of the Assembly to call in armed force, the questors revealed the Assembly's plans for defence, and gave the Elysée a weapon against it ("donnent barre contre elle à l'Elysée"). The proposition was rejected (November 17), but Louis-Napoleon saw that it was time to act. On Dec. 2 he carried out his *coup d'état.*

Proclamation as Emperor.—But affairs developed in a way which disappointed him. By dismissing the Assembly, by offering the people "a strong government," and re-establishing "a France

regenerated by the Revolution of '89 and organized by the emperor," he had hoped for universal applause. But both in Paris and the provinces he met with the resistance of the Republicans, who had reorganized in view of the elections of 1852. He struck at them by mixed commissions, deportations and the whole range of police measures. The *décrets-lois* of the year 1852 enabled him to prepare the way for the new institutions. On Dec. 2, 1852 he became in name what he was already in deed, and was proclaimed Emperor of the French.

The aim which the emperor had in view was, by a concentration of power which should make him "the beneficent motive force of the whole social order" (constitution of the 14th of January 1852; administrative centralization; subordination of the elected assemblies; control of the machinery of universal suffrage) to unite all classes in "one great national party" attached to the dynasty. His success, from 1852 to 1856, was almost complete. The nation was submissive, and a few scattered plots alone showed that republican ideas persisted among the masses. As "restorer of the overthrown altars," he won over the "men in black," among them Veuillot, editor-in-chief of *l'Univers,* and allowed them to get the University into their hands. By the aid of former Orleanists, such as Billault, Fould and Morny, and Saint-Simonians such as Talabot and the Pereires, he satisfied the industrial classes, extended credit, developed means of communication, and gave a strong impetus to the business of the nation. By various measures, such as subsidies, charitable gifts and foundations, he endeavoured to show that "the idea of improving the lot of those who suffer and struggle against the difficulties of life was constantly present in his mind." His was the government of cheap bread, great public works and holidays. The imperial court was brilliant. The emperor, having failed to obtain the hand of a Vasa or Hohenzollern, married, on Jan. 29, 1853, Eugénie de Montijo, comtesse de Teba, aged twenty-six and at the height of her beauty.

Foreign Policy.—France was "satisfied" in the midst of order, prosperity and peace. The foreign policy of the Catholic party, by the question of the Holy Places and the Crimean War (1853–1856), gave him the opportunity of winning the glory which he desired, and the British alliance enabled him to take advantage of it. In January 1856 he had the good fortune to win a diplomatic triumph over the new tsar, Alexander II. It was at Paris (February 25–March 30) that the conditions of peace were settled. The emperor was now at the height of his power. He appeared to the people as the avenger of 1840 and 1815, and the birth to him of a son, Eugène Louis Jean Joseph, on March 16, 1856, assured the future of the dynasty. It was then that, strong in "the esteem and admiration with which he was surrounded," and "foreseeing a future full of hope for France," he dreamed of realizing the Napoleonic ideal in its entirety. This disciple of the German philologists, this crowned *Carbonaro,* the friend of the archaeologists and historians who were to help him to write the *Histoire de César,* dreamed of developing the policy of nationalism, and of assisting the peoples of all countries to enfranchise themselves.

From 1856 to 1858 he devoted his attention to the Rumanian nationality, and supported Alexander Cuza. But it was above all the deliverance of Italy which haunted his imagination. But the Catholics feared that the Italian national movement, when once started, would entail the downfall of the papacy; and in opposition to the emperor's Italian advisers, Arese and Prince Jerome Napoleon, they pitted the empress, who was frivolous and capricious, but an ardent Catholic. Napoleon III. was under his wife's influence, and could not openly combat her resistance. It was the Italian Orsini who, by attempting to assassinate him as a traitor to the Italian nation on Jan. 14, 1858, gave him an opportunity to impose his will indirectly by convincing his wife that in the interests of his own security he must "do something for Italy." Events followed each other in quick succession, and now began the difficulties in which the Empire was to be irrevocably involved. Not only did the Italian enterprise lead to strained relations with Great Britain, the alliance with whom had been the emperor's chief support in Europe, and compromised its credit; but the claims of parties and classes again began to be heard at home.

The Italian war aroused the opposition of the Catholics. After Magenta (June 4, 1859), it was the fears of the Catholics and the messages of the empress which, even more than the threats of Prussia, checked him in his triumph and forced him into the armistice of Villafranca (July 11, 1859). But the spread of the Italian revolution and the movement for annexation forced him again to intervene. He appealed to the Left against the Catholics by the amnesty of April 17, 1859. His consent to the annexation of the Central Italian states, in exchange for Savoy and Nice (Treaty of Turin, March 24, 1860) exposed him to violent attacks on the part of the ultramontanes, whose slave he had practically been since 1848. At the same time, the free-trade treaty with Great Britain (January 5, 1860) aroused a movement against him among the industrial *bourgeoisie.*

From this time onward, in face of a growing opposition, anxiety for the future of his régime paralysed his initiative. Placed between his Italian counsellors and the empress, he was ever of two minds. His plans for remodelling Europe had a certain generosity and grandeur; but internal difficulties forced him into endless manoeuvre and temporization, which led to his ruin. Thus in October 1862, after Garibaldi's attack on Rome, the clerical coterie of the Tuileries triumphed. But the replacing of M. Thouvenel by M. Drouin de Lhuys did not satisfy the more violent Catholics, who in May 1863 joined the united opposition. Thirty-five opposers of the government were appointed, Republicans, Orleanists, Legitimists or Catholics. The emperor dismissed Persigny, and summoned moderate reformers such as Duruy and Béhic. But he was still possessed with the idea of settling his throne on a firm basis, and uniting all France in some glorious enterprise which should appeal to all parties equally, and "group them under the mantle of imperial glory." From January to June 1863 he sought this appearance of glory in Poland, but only succeeded in embroiling himself with Russia. Then, after Syria and China, it was the "great inspiration of his reign," the establishment of a Catholic and Latin empire in Mexico, enthusiasm for which he tried in vain from 1863 to 1867 to communicate to the French.

But while the strength of France was wasting away at Puebla in Mexico, Bismarck was founding German unity. In August 1864 the emperor, held back by French public opinion, which was favourable to Prussia, and by his idea of nationality, allowed Prussia and Austria to seize the duchies of Schleswig and Holstein. After his failure in Poland and Mexico and in face of the alarming presence of Germany, only one alliance remained possible for Napoleon III., namely with Italy. He obtained this by the convention of the 15th of September 1864 (involving the withdrawal of the French troops from Rome). But the Catholic party redoubled its violence, and the pope sent out the encyclical *Quanta Cura* and the *Syllabus,* especially directed against France. In vain the emperor sought in German affairs a definitive solution of the Italian question. At Biarritz he prepared with Bismarck the Franco-Prussian alliance of April 1866; and hoped to become arbiter in the tremendous conflict which was about to begin. But Königgrätz came as a bolt from the blue to ruin his hopes. French interests called for an immediate intervention. But he resigned himself to the annexation by Prussia of northern Germany. "Now," said M. Drouin de Lhuys, "we have nothing left but to weep."

The Third Party.—Henceforth the brilliant dream, a moment realized, the realization of which he had thought durable, was at an end. The Empire had still an uncertain and troubled brilliancy at the Exhibition of 1867. But Berezowski's pistol shot, which accentuated the estrangement from the tsar, and the news of the death of Maximilian at Queretaro, cast a gloom over the later fêtes. In the interior the industrial and socialist movement, born of the new industrial development, added fresh strength to the Republican and Liberal opposition. The moderate Imperialists felt that some concessions must be made to public opinion. In opposition to the absolutist "vice-emperor" Rouher, whose influence over Napoleon had become stronger and stronger since the death of Morny, Émile Ollivier grouped the Third Party. Anxious, changeable and distraught, the emperor made the Liberal

concessions of Jan. 19, 1867 (right of interpellation), and then, when Ollivier thought that his triumph was near, he exalted Rouher (July) and did not grant the promised laws concerning the press and public meetings till 1868. The opposition gave him no credit for these tardy concessions. There was an epidemic of violent attacks on the emperor; the publication of the *Lanterne* and the Baudin trial, conducted by Gambetta, were so many death-blows to the régime. The *Internationale* developed its propaganda. The election of May 1869 resulted in 4,438,000 votes given for the government, and 3,355,000 for the opposition, who also gained 90 representatives. The emperor, disappointed and hesitating, was slow to return to a parliamentary régime. It was not till December that he instructed Ollivier to "form a homogeneous cabinet representing the majority of the Corps Législatif" (ministry of the 2nd of January 1870). But, embarrassed between the *Arcadiens,* the partisans of the absolute régime, and the republicans, Ollivier was unable to guide the Empire in a constitutional course. At the Tuileries Rouher's counsel still triumphed. It was he who inspired the ill and wearied emperor, now without confidence or energy, with the idea of resorting to the *plébiscite.* "To do away with the risk of a revolution," "to place order and liberty upon a firm footing," "to ensure the transmission of the crown to his son," Napoleon III. again sought the approbation of the nation. He obtained it with brilliant success, for the last time, by 7,358,786 votes against 1,571,939, and his work now seemed to be consolidated.

War With Prussia.—A few weeks later it crumbled irrevocably. Since 1866 he had been pursuing an elusive appearance of glory. Since 1866 France was calling for "revenge." He felt that he could only rally the people to him by procuring them the satisfaction of their national pride. Hence the mishaps and imprudences of which Bismarck made such an insulting use. Hence the negotiations of Nikolsburg, the "note d'aubergiste" (innkeeper's bill) claiming the left bank of the Rhine, which was so scornfully rejected; hence the plan for the invasion of Belgium (August 1866), the Luxemburg affair (March 1867), from which M. de Moustier's diplomacy effected such a skilful retreat; hence the final folly which led his government into the war with Prussia (July 1870).

The war was from the first doomed to disaster. It might perhaps have been averted if France had had any allies. But Austria, a possible ally, could only join France if satisfied as regards Italy; and since Garibaldi had threatened Rome (Mentana, 1867), Napoleon III., yielding to the anger of the Catholics, had again sent troops to Rome. Negotiations had taken place in 1869. The emperor, bound by the Catholics, had refused to withdraw his troops. It was as a distant but inevitable consequence of his agreement of December 1848 with the Catholic party that in 1870 the emperor found himself without an ally.

His energy was now completely exhausted. Successive attacks of stone in the bladder had ruined his physique; while his hesitation and timidity increased with age. The influence of the empress over him became supreme. On leaving the council in which the war was decided upon the emperor threw himself, weeping, into the arms of Princess Mathilde. The empress was delighted at this war, which she thought would secure her son's inheritance.

Deposition.—On July 28 father and son set out for the army. They found it in a state of utter disorder, and added to the difficulties by their presence. The emperor was suffering from stone and could hardly sit his horse. After the defeat of Reichshoffen, when Bazaine was thrown back upon Metz, he wished to retreat upon Paris. But the empress represented to him that if he retreated it would mean a revolution. An advance was decided upon which ended in Sedan. On Sept. 2 Napoleon III. surrendered with 80,000 men, and on the 4th of September the Empire fell. He was taken as a prisoner to the castle of Wilhelmshöhe, near Cassel, where he stayed till the end of the war. After the intrigues of Bazaine, of Bismarck, and of the empress, the Germans having held negotiations with the Republic, he was *de facto* deposed. On March 1, the assembly of Bordeaux confirmed this deposition, and declared him "responsible for the ruin, invasion and dismemberment of France."

Restored to liberty, he retired with his wife and son to Chislehurst in England. Unwilling even now to despair of the future, he still sought to rally his friends for a fresh propaganda. He had at his service publicists such as Cassagnac, J. Amigues and Hugelmann. He himself also wrote unsigned pamphlets justifying the campaign of 1870. It may be noted that, true to his ideas, he did not attempt to throw upon others the responsibility which he had always claimed for himself. He dreamed of his son's future. But he no longer occupied himself with any definite plans. He interested himself in pensions for workmen and economical stoves. At the end of 1872 his disease became more acute, and a surgical operation became necessary. He died on Jan. 9, 1873, leaving his son in the charge of the empress and of Rouher. The young prince was educated at Woolwich from 1872 to 1875, and in 1879 took part in the English expedition against the Zulus in South Africa, in which he was killed. By his death vanished all hope of renewing the extraordinary fortune which for twenty years placed the nephew of the great emperor, the *Carbonaro* and dreamer, at once obstinate and yet hesitating, on the throne of France.

BIBLIOGRAPHY.—The *Oeuvres* of Napoleon III. have been published in four volumes (1854–57) and his *Histoire de Jules César* in two volumes (1865–69); this latter work has been translated into English by T. Wright. *See* also Ebeling, *Napoleon III. und sein Hof* (1891–94); H. Thirria, *Napoléon III. avant l'Empire* (1895); Sylvain-Blot, *Napoléon III.* (1899); Giraudeau, *Napoléon III. intime* (1895); Sir W. A. Fraser, *Napoleon III.* (London, 1895); A. Forbes, *Life of Napoleon III.* (1898); A. Lebey, *Les Trois coups d'état de Louis Napoléon Bonaparte* (1906); *Louis Napoléon Bonaparte et la révolution de 1848* (1908); and F. A. Simpson, *The Rise of Louis Napoleon* (1909). General works which may be consulted are Taxile-Delord, *Histoire du second Empire* (1868–75); P. de La Gorce, *Histoire du second Empire* (1894–1905); A. Thomas, *Le Second Empire* (1907); and E. Ollivier, *L'Empire libéral* (14 vols., 1895–1909).

NAPOLEON, a city of northwestern Ohio, U.S., on the Maumee river and federal highways 6 and 24; 36 mi. S.W. of Toledo; county seat of Henry county; served by the Detroit, Toledo and Ironton and the Wabash railways. Pop. 5,326 in 1950; 4,825 in 1940. It is the trade centre of a rich grain-growing district, is a railway division point, and has a number of factories

NAPOLEON, a round game of cards (known colloquially as "nap"). Any number may play. The cards rank as at whist, and five are dealt to each player. The deal being completed, the player to the dealer's left looks at his hand and declares how many tricks he would play to win against all the rest, the usual rule being that more than one must be declared; in default of declaring he says "I pass," and the next player has a similar option of either declaring to make more tricks or passing, and so on all round. A declaration of five tricks is called "going nap." The player who declares to make most has to try to make them, and the others, but without consultation, to prevent him. The declaring hand has the first lead, and the first card he leads makes the trump suit. The players, in rotation, must follow suit if able. If the declarer succeeds in making at least the number of tricks he stood for he wins whatever stakes are played for; if not he loses. If the player declaring nap wins he receives double stakes all round; if he loses he only pays single stakes all round. Sometimes, however, a player is allowed to go "Wellington" over "nap," and even "Blücher" over "Wellington." In these cases the caller of "Wellington" wins four times the stake and loses twice the stake, the caller of "Blücher" receives six times and loses three times the stake. Sometimes a player is allowed to declare *misère, i.e.,* no tricks. This ranks, as a declaration, between three and four, but the player pays a double stake on three, if he wins a trick, and receives a single on three if he takes none.

NAPOLEONIC CAMPAIGNS. The era of the Revolutionary and Napoleonic Wars falls into two main divisions, the first of which (1792–1801) is dealt with under the heading FRENCH REVOLUTIONARY WARS. In the present article are described the campaigns in central and eastern Europe, directed by Napoleon—no longer one amongst many French generals, nor even a simple *primus inter pares,* but "Emperor" in the fullest sense—between the years 1805 and 1814. Napoleon's short

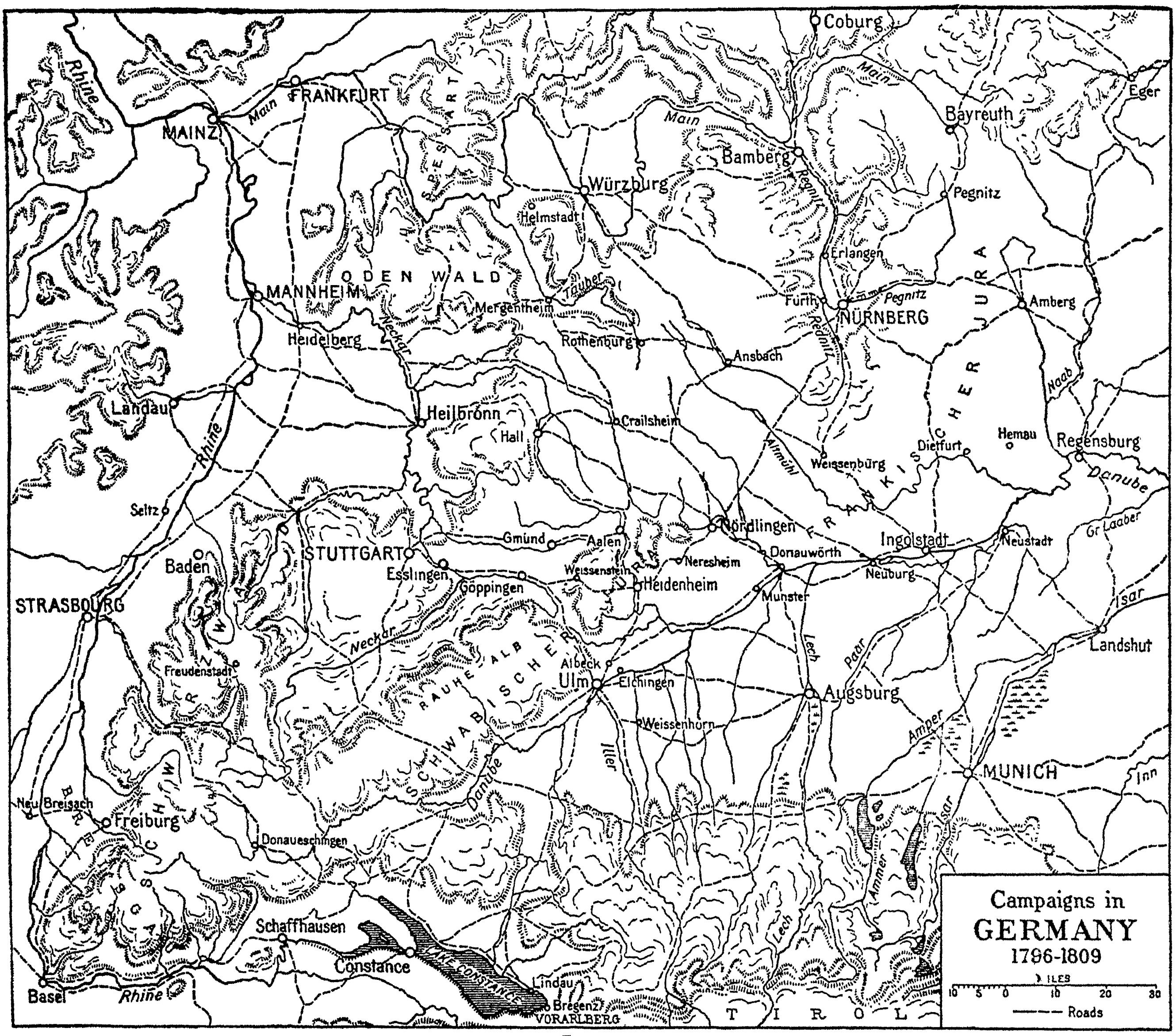

FIG. 1

Spanish Campaign of 1809 is dealt with under Peninsular War (this article covering the campaigns in Spain, Portugal and southern France 1808–1814), and for a discussion of the events that led to the final drama of Waterloo the reader is referred to Waterloo Campaign, 1815.

The campaigns described below are therefore—

(*a*) The Austrian War of 1805 (Ulm and Austerlitz).
(*b*) The Conquest of Prussia and the Polish Campaign (Jena, Auerstädt, Eylau and Friedland).
(*c*) The Austrian war of 1809 (Eckmühl, Aspern and Wagram).
(*d*) The Russian War of 1812 (Borodino and the retreat from Moscow).
(*e*) The German "War of Liberation," culminating in the Battle of the Nations around Leipzig.
(*f*) The last campaign in France, 1814.

The naval history of 1803–1815 includes the culmination and the sequel of the struggle for command of the sea which began in 1793 and continued for more than a decade with results increasingly disappointing to the ambitions of Napoleon, finally reaching a decisive climax on the day of Trafalgar.

THE CAMPAIGN OF 1805

This may be regarded as a measure of self-defence forced upon Napoleon by the alliance of Russia (April 11), Austria (August 9) and other powers with Great Britain. The possibility had long been before the emperor, and his intention in that event to march straight on Vienna by the valley of the Danube is clearly indicated in his reply (November 27, 1803) to a Prussian proposal for the neutralization of the South German states. In this he says, "It is on the road from Strasbourg to Vienna that the French must force peace on Austria, and it is this road which you wish us to renounce." When, therefore, on Aug. 25, 1805, he learnt definitely that Villeneuve (see *Naval Operations* below) had failed in his purpose of securing the command of the Channel, which was the necessary preliminary to the invasion of England, it was but the affair of a few hours to dictate the dispositions necessary to transfer his whole army to the Rhine frontier as the first step in the march which he had determined to make to the Danube. On the date of this decision the army actually lay in the following positions:—

I.	Corps	Bernadotte	Hanover (Göttingen)
II.	"	Marmont	Holland
III.	"	Davout	Camp of Boulogne and other points on the English Channel
IV.	"	Soult	
V.	"	Lannes	
VI.	"	Ney	
VII.	"	Augereau	
Guard		Bessières	Paris

The corps were, however, by no means fit for immediate service. Bernadotte's corps in Hanover was almost in the position of a

beleaguered garrison, and the marshal could only obtain his transport by giving out that he was ordered to withdraw to France. Marmont and Davout were deficient in horses for cavalry and artillery, and the troops in Boulogne, having been drawn together for the invasion of England, had hardly any transport at all, as it was considered this want could be readily supplied on landing. The composition of the army, however, was excellent. The generals were in the prime of life, had not yet learnt to distrust one another, and were accustomed to work under the emperor and with one another. The regimental officers had all acquired their rank before the enemy and knew how to manage their men, and of the men themselves nearly two-thirds had seen active service. The strength of the army lay in its infantry, for both cavalry and artillery were short of horses, and the latter had not yet acquired mobility and skill in manoeuvring. Napoleon's determination to undertake the invasion of England has often been disputed, but it is hard to imagine what other operation he contemplated, for the outbreak of hostilities with his continental enemies found him ill-supplied with intelligence as to the resources of the country he had then to traverse. To remedy this, Murat and other general officers as well as minor agents were sent ahead and instructed to travel through South Germany in plain clothes with a view to collecting information and mastering the topography. The emperor was, moreover, imperfectly acquainted with the degree of preparation of his adversaries' designs, and when he dictated his preliminary orders he was still unaware of the direction that the allies' advance would assume. On Aug. 26, however, he learnt that 100,000 Russians were about to enter Bohemia thence to unite with an Austrian army of 80,000 near the junction of the Inn and Danube, and this information drove him to alter the general direction of his advance so as to traverse the defiles of the Black Forest north of the Neckar, cavalry only observing the passes to the south.

Austrian Army.—The Austrians after the defeats of 1800 had endeavoured to reorganize their forces on the French model, but they were soon to learn that in matters of organization the spirit is everything, the letter very little. They had copied the organization of the French corps, but could find no corps commanders fit to assume the responsibility for these commands. As always in such conditions, the actual control of the smallest movements was still centralized in the hands of the army commanders, and thus the rate of marching was incredibly slow. They had decided that in future their troops in the field should live by requisition, and had handed over to the artillery, which needed them badly, a large number of horses thus set free from the transport service, but they had not realized that men accustomed to a regular distribution of rations cannot be transformed into successful marauders and pillagers by a stroke of the pen; and they had sent away the bulk of their army, 120,000 under their best general, the archduke Charles, into Italy, leaving Mack von Leiberich in Germany, nominally as chief of the staff to the young Prince Ferdinand, but virtually in command, to meet the onset of Napoleon at the head of his veterans. Mack had the distinction of having risen from the ranks in the most caste-ridden army in Europe.

The March on Ulm.—The outbreak of the campaign was hastened by the desire of the Austrian government to feed their own army and leave a bare country for Napoleon by securing the resources of Bavaria. It was also hoped that the Bavarians with their army of 25,000 men would join the allies. In the latter hope they were deceived, and the Bavarians under General Wrede slipped away to Bamberg in time. In the former, however, they were successful, and the destitution they left in their wake almost wrecked Napoleon's subsequent combinations. Mack's march to Ulm was therefore a necessity of the situation, and his continuance in this exposed position, if foolhardy against such an adversary, was at any rate the outcome of the high resolve that even if beaten he would inflict crippling losses upon the enemy. Mack knew that the Russians would be late at the rendezvous on the Inn. By constructing an entrenched camp at Ulm and concentrating all the available food within it, he expected to compel Napoleon to invest and besiege him, and he anticipated that in the devastated country his adversary would be compelled to separate and thus fall an easy prey to the Russians. For that blow he had determined to make his own army the anvil. But these views obviously could not be published in army orders, hence the discontent and opposition he was destined to encounter.

Movements of the French.—It was on Sept. 21 that Napoleon learnt of Mack's presence in Ulm. On that date his army had crossed the Rhine and was entering the defiles of the Black Forest. It was already beginning to suffer. Boots were worn out, greatcoats deficient, transport almost unattainable and, according to modern ideas, the army would have been considered incapable of action.

On Sept. 26 its deployment beyond the mountains was complete, and as Napoleon did not know of Mack's intention to stay at Ulm and had learned that the Russian advance had been delayed, he directed his columns by the following roads on the Danube, between Donauwörth and Ingolstadt, so as to be in a position to intervene between the Austrians and the Russians and beat both in detail.

	Sept. 28	Oct. 6	Oct. 9	Oct. 16
Bernadotte	Würzburg	Anspach	Nürnberg	Regensburg
Marmont	Würzburg	Anspach	Nürnberg	Regensburg
Davout .	Mannheim	Mergentheim	Anspach	Dietfurt
Ney . .	Selz	Crailsheim	Weissenburg	Ingolstadt
Lannes .	Strassburg	Gmund	Nördlingen	Neuburg
Soult .	Landau	Aalen	Donauwörth	

On Oct. 7 this movement was completed—the Austrians abandoned the Danube bridges after a show of resistance, retreating westward—and Napoleon, leaving Murat in command of the V. and VI. corps and cavalry to observe the Austrians, pressed on to Augsburg with the others so as to be ready to deal with the Russians. Learning, however, that these were still beyond striking radius, he determined to deal with Mack's army first, having formed the fixed conviction that a threat at the latter's communications would compel him to endeavour to retreat southwards towards Tirol. Bernadotte in his turn became an army of observation, and Napoleon joining Murat with the main body marched rapidly westward from the Lech towards the Iller.

Austrian Plans.—Mack's intentions were not what Napoleon supposed. He had meanwhile received (false) information of a British landing at Boulogne, and he was seriously deceived as to the numbers of Napoleon's forces. He was also aware that the exactions of the French had produced deep indignation throughout Germany and especially in Prussia whose neutrality had been violated. All this, and the almost mutinous discontent of his generals and his enemies of the court circle, shook his resolution of acting as anvil for the Russians, of whose delay also he was aware, and about Oct. 8 he determined to march out north-eastward across the French lines of communication and save his sovereign's army by taking refuge if necessary in Saxony. Believing implicitly in the rumours of a descent on Boulogne and of risings in France which also reached him, and knowing the destitution he had left behind him in his movement to Ulm, when he heard of the westward march of French columns from the Lech he told his army, apparently in all good faith, that the French were in full march for their own country.

Actually the French at this moment were suffering the most terrible distress—up to the Danube they had still found sufficient food for existence, but south of it, in the track of the Austrians, they found nothing. All march discipline disappeared, the men dissolved into hordes of marauders and even the sternest of the marshals wrote piteous appeals to the emperor for supplies, and for permission to shoot some of their stragglers. But to all these Berthier in the emperor's name sent the stereotyped reply—"The emperor has ordered you to carry four days' provisions, therefore you can expect nothing further—you know the emperor's method of conducting war."

Action of Albeck or Haslach.—Meanwhile Murat, before the emperor joined him, had given Mack the desired opening. The VI. corps (Ney) should have remained on the left bank of the

Danube to close the Austrian exit on that side, but by mistake only Dupont's division had been left at Albeck, the rest being brought over the river. Mack on the 8th had determined to commence his withdrawal, but fortune now favoured the French. The weather during the whole of October had been unusually wet, the swollen Danube overflowed the low ground and the roads had become quagmires. On the south bank, owing to better natural drainage and a drier subsoil, movement was fairly easy, but the Austrians found it almost impossible. On Oct. 11, when they began their march, the road along the Danube was swept into the river, carrying with it several guns and teams, and hours were consumed in passing the shortest distances. At length in the afternoon they suddenly fell upon Dupont's isolated division at Albeck, which was completely surprised and severely handled. The road now lay completely open, but the Austrian columns had so opened out owing to the state of the roads that the leading troops could not pursue their advantage—Dupont rallied and the Austrians had actually to fall back towards Ulm to procure food.

Elchingen.—For three more days Mack struggled with an unwilling staff and despondent men to arrange a further advance. During these very three days, through a succession of staff blunders, the French failed to close the gap, and on the morning of Oct. 14 the armies, each renewing its advance, came in contact at the bridge of Elchingen. This bridge, all but a few road-bearers, had been destroyed, but now the French gave an example of that individual gallantry which was characteristic of the old revolutionary armies. Running along the beams under a close fire a few gallant men forced their way across. The floor of the bridge was rapidly relaid, and presently the whole of the VI. corps was deploying with unexampled rapidity on the farther side. The Austrians, still in their quagmire, could not push up reinforcements fast enough, and though Mack subsequently alleged deliberate obstruction and disobedience on the part of his subordinates, the state of the roads alone suffices to explain their defeat. Only the right column of the Austrians was, however, involved; the left under General Werneck, to whom some cavalry and the archduke Ferdinand attached themselves, did indeed succeed in getting away, but without trains or supplies. They continued their march, famished but unmolested, until near Heidenheim they suddenly found themselves confronted by what from the diversity of uniforms they took to be an overwhelming force; at the same time the French cavalry sent in pursuit appeared in their rear. Utterly exhausted by fatigue, Werneck with his infantry, some 8,000 strong, surrendered to what was really a force of dismounted dragoons and foot-sore stragglers improvised by the commanding officer on the spot to protect the French treasure chests, which at that moment lay actually in the path of the Austrians. The young archduke with some cavalry escaped.

Mack Surrounded.—The defeat at Elchingen on Oct. 14 sealed the fate of the Austrians, though Mack was still determined to endure a siege. As the French columns coming up from the south and west gradually surrounded him, he drew in his troops under shelter of the fortress and its improvised entrenched camp, and on the 15th he found himself completely surrounded. On the 16th the French field-guns fired into the town, and Mack realized that his troops were no longer under sufficient control to endure a siege. When, therefore, next morning, negotiations were opened by the French, Mack, still feeling certain that the Russians were at hand, agreed to an armistice and undertook to lay down his arms if within the next twenty-one days no relief should arrive. To this Napoleon consented, but hardly had the agreement been signed when he succeeded in introducing a number of individual French soldiers into the fortress, who began rioting with the Austrian soldiery. Then, sending in armed parties to restore order and protect the inhabitants, he caused the guards at the gates to be overpowered, and Mack was thus forced into an unconditional surrender.

On Oct. 22, the day after Trafalgar, the remnant of the Austrian army, 23,000 strong, laid down its arms. About 5,000 men under Jellachich had escaped to Tirol, 2,000 cuirassiers with Prince Ferdinand to Eger in Bohemia, and about 10,000 men under Werneck had surrendered at Heidenheim. The losses in battle having been insignificant, there remain some 30,000 to account for—most of whom probably escaped individually by the help of the inhabitants, who were bitterly hostile to the French. Napoleon now hastened to rejoin the group of corps he had left under Bernadotte in observation towards the Russians, for the latter were nearer at hand than even Mack had assumed. But hearing of his misfortune they retreated before Napoleon's advance along the right bank of the Danube to Krems, where they crossed the river and withdrew to an entrenched camp near Olmütz to pick up fresh Austrian reinforcements. The severe actions of Dürrenstein (near Krems) on Nov. 11, and of Hollabrünn on Nov. 16, in which Napoleon's marshals learned the tenacity of their new opponents, and the surprise of the Vienna bridge (November 14) by the French, were the chief incidents of this period in the campaign.

Campaign of Austerlitz.—Napoleon continued down the right bank to Vienna, where he was compelled by the condition of his troops to call a halt to refit his army. After this was done he continued his movement to Brünn. Thither he succeeded in bringing only 55,000 men. He was again forced to give his army rest and shelter, under cover of Murat's cavalry. The allies now confronted him with upwards of 86,000 men, including 16,000 cavalry. About Nov. 20 this force commenced its advance, and Napoleon concentrated in such a manner that within three days he could bring over 80,000 French troops into action around Brünn, besides 17,000 or more Bavarians under Wrede. On the 28th Murat was driven in by the allied columns. That night orders were despatched for a concentration on Brünn in expectation of a collision on the following day; but hearing that the whole allied force was moving towards him he decided to concentrate south-east of Brünn, covering his front by cavalry on the Pratzen heights. Meanwhile he had also prepared a fresh line of retreat towards Bohemia, and, certain now of having his men in hand for the coming battle, he quietly awaited events.

The allies were aware of his position, and still adhering to the old "linear" system, marched to turn his right flank (*see* AUSTERLITZ). As soon as their strategic purpose of cutting him off from Vienna became apparent, the emperor moved his troops into position, and in the afternoon issued his famous proclamation to his troops, pointing out the enemy's mistakes and his plan for defeating them. At the same time he issued his orders for his first great battle as a supreme commander. The battle of Austerlitz began early next morning and closed in the evening with the thorough and decisive defeat of the allies.

PRUSSIAN AND POLISH CAMPAIGNS

Around the Prussian army, and particularly the cavalry, the prestige of Frederick the Great's glory still lingered; but the younger generation had little experience of actual warfare, and the higher commanders were quite unable to grasp the changes in tactics and in the conduct of operations which had grown out of the necessities of the French Revolution. The individual officers of the executive staff were the most highly trained in Europe, but there was no great leader to co-ordinate their energies. The total number of men assigned to the field army was 110,000 Prussians and Saxons. They were organized in corps, but their leaders were corps commanders only in name, for none were allowed any latitude for individual initiative. Ill-judged economies had undermined the whole efficiency of the Prussian army. Two-thirds of the infantry and one-half of the cavalry were allowed furlough for from ten to eleven months in the year. The men were unprovided with greatcoats. Most of the muskets had actually seen service in the Seven Years' War, and their barrels had worn so thin with constant polishing that the use of full charges at target practice had been forbidden. Above all, the army had drifted entirely out of touch with the civil population. The latter, ground down by feudal tradition and law, and at the same time permeated by the political doctrines of the late 18th century, believed that war concerned the governments only, and formed no part of the business of the "honest citizen." In this idea they were supported by the law itself, which protected the civilian against the soldier, and forbade even in war-time the requisition-

ing of horses, provisions and transport, without payment. Up to the night of the battle of Jena itself, the Prussian troops lay starving in the midst of plenty, whilst the French everywhere took what they wanted. This alone was a sufficient cause for all the misfortunes which followed.

During the campaign of Austerlitz Prussia, furious at the violation of her territory of Anspach, had mobilized, and had sent Haugwitz as ambassador to Napoleon's headquarters. He arrived on Nov. 30, and Napoleon, pleading business, put off his official reception till after the battle of Austerlitz. Of course the ultimatum was never presented, as may be imagined; Haugwitz returned and the king of Prussia demobilized at once. But Napoleon, well knowing the man he had to deal with, had determined to force a quarrel upon Prussia at the earliest convenient opportunity. His troops therefore, when withdrawn from Austria, were cantoned in south Germany in such a way that, whilst suspicion was not aroused in minds unacquainted with Napoleonic methods, they could be concentrated by a few marches behind the Thuringian forest and the upper waters of the Main. Here the Grande Armée was left to itself to recuperate and assimilate its recruits, and it is characteristic of the man and his methods that he did not trouble his corps commanders with a single order during the whole of the spring and summer.

As the diplomatic crisis approached, spies were sent into Prussia, and simultaneously with the orders for preliminary concentration the marshals received private instructions, the pith of which cannot be better expressed than in the following two quotations from Napoleon's correspondence:—

"Mon intention est de concentrer toutes mes forces sur l'extrémité de ma droite en laissant tout l'espace entre le Rhin et Bamberg entièrement dégarni, de manière à avoir près de 200,000 hommes réunis sur un même champ de bataille; mes premières marches menacent le coeur de la monarchie prussienne" (No. 10,920). "Avec cette immense supériorité de forces réunis sur un espace si étroit, vous sentez que je suis dans la volonté de ne rien hasarder et d'attaquer l'ennemi partout où il voudra tenir. Vous pensez bien que ce serait une belle affaire que de se porter sur cette place (Dresden) en *un bataillon carré de* 200,000 *hommes*" (Soult, No. 10,941).

Advance of the Grande Armée.—On Oct. 7 the *Grande Armée* lay in three parallel columns along the roads leading over the mountains to Hof, Schleiz and Kronach; on the right lay the IV. corps (Soult) about Bayreuth, with his cavalry in rear, and behind these the VI. corps (Ney) at Pegnitz; in the centre, Bernadotte's I. corps from Nordhalben, with the III. corps (Davout) Lichtenfels; Guard and headquarters, Bamberg. The left column was composed of the V. (Lannes) at Hemmendorf, with the VII. (Augereau) extending south to the Main at Burgebrach.

Napoleon's object being surprise, all the cavalry except a few vedettes were kept back behind the leading infantry columns and these latter were ordered to advance, on the signal being given, in "masses of manoeuvre," so as to crush at once any outpost resistance which was calculated upon the time required for the deployment of ordinary marching columns. This order has never since found an imitator, but deserves attentive study as a masterpiece (*see* H. Bonnal, *Manoeuvre d'Iéna*).

To meet the impending blow the Prussians had been extended in a cordon along the great road leading from Mainz to Dresden, Blücher was at Erfurt, Rüchel at Gotha, Hohenlohe at Weimar, Saxons in Dresden, with outposts along the frontier. An offensive move into Franconia was under discussion, and for this purpose the Prussian staff had commenced a lateral concentration about Weimar, Jena and Naumburg when the storm burst upon them. The emperor gathered little from the confused reports of their purposeless manoeuvres, but, secure in the midst of his "battalion square" of 200,000 men, he remained quite indifferent, well knowing that an advance straight on Berlin must force his enemy to concentrate and fight, and as they would bring at most 127,000 men on to the battlefield the result could hardly be doubtful. On Oct. 9 the cloud burst. Out of the forests which clothe the northern slopes of the Thuringer Wald the French streamed forth, easily overpowering the resistance of the Prussian outposts on the upper Saale, and once the open country was reached the cavalry under Murat trotted to the front, closely followed by Bernadotte's corps as "general advance guard." The result of the cavalry scouting was, however, unsatisfactory. On the night of the 10th, the emperor was still unaware of the position of his principal foe, and Murat with Bernadotte behind him was directed on Gera for the 11th, the remainder of the army continuing along the roads previously assigned to them.

In the meanwhile, however, the Saxons had been moving from Naumburg through Gera on Jena, Hohenlohe was near Weimar, and all the other divisions of the Prussian army had closed in a march eastwards, the idea of an offensive to the southward which Napoleon had himself attributed to them having already disappeared.

Reaching Gera at 9 A.M. Murat reported the movement of the Saxons on the previous day, but omitted to send a strong detachment in pursuit. The traces of the Saxons were lost, and Napoleon, little satisfied with his cavalry, authorized Lasalle to offer up to 6,000 frs. reward for information of the Prussian point of concentration. At 1 A.M. of the 12th Napoleon issued his orders: Murat and Bernadotte via Zeitz to Naumburg; Davout (III. corps and a dragoon division) also to Naumburg; Lannes to Jena, Augereau following; Soult to Gera.

In the meantime the Prussians were effecting their concentration. Rüchel, who with 15,000 men had been sent into the mountains as an advance guard for the projected offensive, was recalled to Weimar, which he reached on the 13th. The main body were between Weimar and Apolda during the 12th, and the Saxons duly effected their junction with Hohenlohe in the vicinity of Vierzehnheiligen, whilst the latter had withdrawn his troops, all but some outposts from Jena, to the plateau about Capellendorf, some 4m. to the N.W. The whole army, of over 120,000 men, could therefore have been concentrated against Lannes and Augereau by the afternoon of the 13th, whilst Soult could

FIG. 2.—JENA CAMPAIGN

only have intervened very late in the day, and Davout and Bernadotte were still too distant to reach the battlefield before the 14th. All the French corps, moreover, were so exhausted by their rapid marches over bad roads that the emperor actually ordered (at 1 A.M. on the 13th) a day of rest for all except Davout, Bernadotte, Lannes and Murat.

The Prussian headquarters, however, spent the 12th and 13th in idle discussion, whilst the troop commanders exerted themselves to obtain some alleviation for the suffering of their starving men. The defeats undergone by their outpost detachment had

profoundly affected the nerves of the troops, and on the afternoon of the 11th, on the false alarm of a French approach, a panic broke out in the streets of Jena, and it took all the energy of Hohenlohe and his staff to restore order. On the morning of the 12th the Saxon commanding officers approached Hohenlohe with a statement of the famishing condition of their men, and threatened to withdraw them again to Saxony. Hohenlohe pointed out that the Prussians were equally badly off, but promised to do his best to help his allies. Urgent messages were sent off to the Commissary von Goethe (the poet), at Weimar for permission to requisition food and firewood. These requests, however, remained unanswered, and the Prussians and Saxons spent the night before the battle shivering in their miserable bivouacs.

The 13th of October.—During the early morning of the 13th the reports brought to Napoleon at Gera partially cleared up the situation, though the real truth was very different from what he supposed. However, it was evident that the bulk of the Prussians lay to his left, and instructions were at once despatched to Davout to turn westward from Naumburg towards Kösen and to bring Bernadotte with him if the two were still together. The letter, however, ended with the words "but I hope he is already on his way to Dornburg." Now Bernadotte had neglected to keep the emperor informed as to his whereabouts. He was still with Davout, but, concluding that he had missed an order directing him to Dornburg, he thought to conceal his error by assuming the receipt of the order evidently alluded to in the last words, and as a result he marched towards Dornburg, and his whole corps was lost to the emperor at the crisis of the next day's battle.

On the road from Gera to Jena Napoleon was met by intelligence from Lannes announcing his occupation of Jena and the discovery of Prussian troops to the northward. Knowing the emperor's methods, he wisely restrained the ardour of his subordinates and asked for instructions whether to attack or wait. The emperor rode forward rapidly, reached Jena about 3 P.M., and with Lannes proceeded to the Landgrafenberg to reconnoitre. From this point his view was, however, restricted to the immediate foreground, and he only saw the camps of Hohenlohe's left wing. At this moment the Prussians were actually on parade and ready to move off to attack, but just then the "evil genius" of the Prussian army, Massenbach, an officer of the Headquarters Staff, rode up and claiming to speak with the authority of the king and commander-in-chief, induced Hohenlohe to order his troops back to camp. Of all this Napoleon saw nothing, but from all reports he came to the conclusion that the whole Prussian army was actually in front of him, and at once issued orders for his whole army to concentrate towards Jena, marching all night if need be. Six hours earlier his conclusion would have been correct, but early that morning the Prussian headquarters, alarmed for the safety of their line of retreat on Berlin by the presence of the French in Naumburg, decided to leave Hohenlohe and Rüchel to act as rear-guard, and with the main body to commence their retreat towards the river Unstrutt and the Eckhardtsberge where Massenbach had previously reconnoitred an "ideal" battlefield. This belief in positions was the cardinal principle of Prussian strategy in those days. The troops had accordingly commenced their march on the morning of the 13th, and now at 3 P.M. were settling down into bivouac; they were still but a short march from the decisive field.

Battle of Jena.—On the French side, Lannes' men were working their hardest, under Napoleon's personal supervision, to make a practicable road up to the Landgrafenberg, and all night long the remaining corps struggled through darkness towards the rendezvous. By daybreak on the 14th, the anniversary of Elchingen, upwards of 60,000 men stood densely packed on the narrow plateau of the mountain, whilst, below in the ravines on either flank, Soult on the right, and Augereau on the left, were getting into position. Fortunately a dense fog hid the helpless masses on the Landgrafenberg from sight of the Prussian gunners. Hohenlohe had determined to drive the French into the ravine at daybreak, but had no idea as to the numbers in front of him. For want of room, only a few Prussian battalions were sent forward, and these, delaying their advance till the fog had sufficiently lifted, were met by French skirmishers, and small columns, who rapidly overlapped their flanks and drove them back in confusion. Hohenlohe now brought up the remainder of his command, but in the meanwhile the French had poured across the neck between the Landgrafenberg and the main plateau, and the troops of Soult and Augereau were working up the ravines on either hand. In view of these troops the Prussian line, which had advanced faultlessly as if on parade, halted to prepare its bayonet attack by fire, and, once halted, it was found impossible to get them to go on again. The French, who had thrown themselves into houses, copses, etc., picked off the officers, and the flanks of the long Prussian lines swayed and got into confusion. The rival artilleries held each other too thoroughly to be able to spare attention to the infantry, whilst the Prussian cavalry, which had forgotten how to charge in masses of eighty or more squadrons, frittered away their strength in isolated efforts. By 10 A.M. the fourteen battalions which had initiated this attack were outnumbered by three to one, and drifted away from the battlefield. Their places were taken by a fresh body, but this was soon outnumbered and outflanked in its turn. By 2 P.M. the psychological moment had come, and Napoleon launched his guards and cavalry to complete the victory and initiate pursuit. Rüchel's division now arrived and made a most gallant effort to cover the retreat, but their order being broken by the torrent of fugitives, they were soon overwhelmed by the tide of the French victory and all organized resistance had ceased by 4 P.M.

Briefly summarized, the battle came to this—in four successive efforts the Prussians failed because they were locally outnumbered. This was the fault of their leaders solely, for, except for the last attack, local superiority was in each case attainable. Organization and tactics did not affect the issue directly, for the conduct of the men and their junior officers gave abundant proof that in the hands of a competent leader the "linear" principle of delivering one shattering blow would have proved superior to that of a gradual attrition of the enemy here, as on the battlefields of the Peninsula and at Waterloo, and this in spite of other defects in the training of the Prussian infantry which simultaneously caused its defeat on the neighbouring field of Auerstädt.

Battle of Auerstädt.—Here the superiority of French mobility showed its value most conclusively. Davout in obedience to his orders of the previous morning was marching over the Saale at Kösen, when his advanced guard and that of the Prussian main army came unexpectedly in contact. The latter with at least 50,000 men was marching in two columns, and ought therefore to have delivered its men into line of battle twice as fast as the French, who had to deploy from a single issue, and whose columns had opened out in the passage of the Kösen defile and the long ascent of the plateau above. But the Prussians attacked at the old regulation speed of seventy-five paces to the minute, and the French manoeuvred at the quick or double of 120 or 150. The consequence was that the French always succeeded in reinforcing their fighting line in time to avert disaster. Nevertheless by mid-day their strength was well-nigh exhausted, whilst the Prussian reserve, eighteen battalions of guards under Kalckreuth, stood intact and ready to engage. But at the critical moment the duke of Brunswick fell mortally wounded, and Scharnhorst, his chief of the staff, was at the time absent on another part of the field. Meanwhile rumours from the battlefield at Jena, magnified as usual, began to reach the staff, and these may possibly have influenced Kalckreuth, for when called upon to attack with his eighteen battalions and win the day, he declined to move without the direct order of the commander-in-chief to do so, alleging that it was the duty of a reserve to cover the retreat and he considered himself personally responsible to the king for the guards entrusted to his care. Even then the day might possibly have been saved had Blücher been able to find even twenty squadrons accustomed to gallop together, but the Prussian cavalry had been dispersed amongst the infantry commands, and at the critical moment it proved impossible for them to deliver a united and decisive attack

Seeing further efforts hopeless, Scharnhorst in the duke's name initiated the retreat and the troops withdrew north-west towards Buttelstedt almost unmolested by the French, who this day had

put forth all that was in them, and withstood victoriously the highest average punishment any troops of the new age of warfare had as yet endured. So desperate had been their resistance that the Prussians unanimously stated Davout's strength at double the actual figure. Probably no man but Davout could have got so much out of his men, but why was he left unsupported?

Bernadotte, we have seen, had marched to Dornburg, or rather to a point overlooking the ford across the Saale at the village of

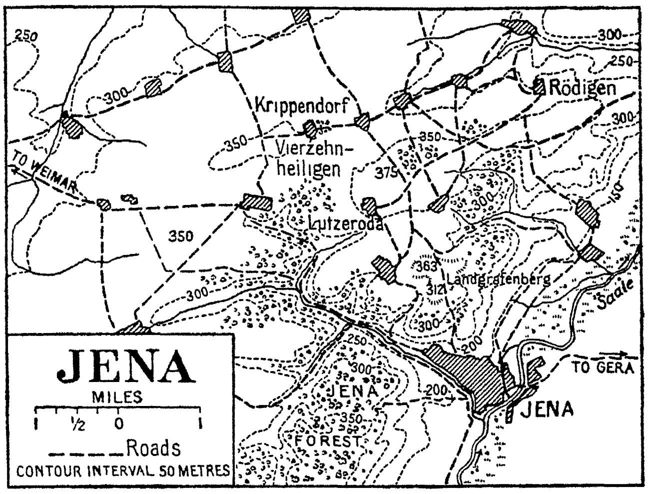

FIG. 3.—JENA

that name, and reached there in ample time to intervene on either field. But with the struggle raging before him he remained undecided, until at Jena the decision had clearly fallen, and then he crossed the river and arrived with fresh troops too late for their services to be required.

Prussian Retreat.—During the night the Prussians continued their retreat, the bulk of the main body to Sömmerda, Hohenlohe's corps towards Nordhausen. The troops had got much mixed up, but as the French did not immediately press the pursuit home, order was soon re-established and a combined retreat was begun towards the mouth of the Elbe and Lübeck. Here help was expected to arrive from England, and the tide might ultimately have turned, for the Russian armies were gathering in the east. It was now that the results of a divorce of the army from the nation began to be felt. Instead of seizing all provisions and burning what they could not remove, the Prussian generals enforced on their men the utmost forbearance towards the inhabitants, and the fact that they were obeyed, in spite of the inhumanity the people showed to their sick and wounded countrymen, proves that discipline was by no means so far gone as has generally been believed. The French marching in pursuit were received with open arms, the people even turning their own wounded out of doors to make room for their French guests. Their servility awakened the bitterest contempt of their conquerors and forms the best excuse for the unparalleled severity of the French yoke. On Oct. 26 Davout reached Berlin, having marched 166m. in twelve days including two sharp rearguard actions, Bernadotte with his fresh troops having fallen behind. The inhabitants of Berlin, headed by their mayor, came out to meet him, and the newspapers lavished adulation on the victors and abuse on the beaten army. On the 28th Murat's cavalry overtook the remnant of Prince Hohenlohe's army near Prenzlau (north of Berlin) and invited its capitulation. Unfortunately the prince sent Massenbach to discuss the situation, and the latter completely lost his head. Murat boasted that he had 100,000 men behind him, and on his return Massenbach implored his chief to submit to an unconditional surrender, advice which the prince accepted, though as a fact Murat's horses were completely exhausted and he had no infantry whatever within call. Only Blücher now remained in the field, and he too was driven at length into Lübeck with his back to the sea where he capitulated Nov. 7.

Campaigns in Poland and East Prussia.—Hitherto the French had been operating in a rich country, untouched for half a century past by the ravages of war, but as the necessity for a campaign against the Russians confronted the emperor, he realized that his whole supply and transport service must be put on a different footing. After the wants of the cavalry and artillery had been provided for, there remained but little material for transport work. Exhaustive orders to organize the necessary trains were duly issued, but the emperor seems to have had little conception of the difficulties the tracks—there were no metalled roads—of Poland were about to present to him. Moreover, it was one thing to issue orders, but quite another to ensure that they were obeyed, for they entailed a complete transformation in the mental attitude of the French soldier towards all that he had been taught to consider his duties in the field. Experience only can teach the art of packing wagons and the care of draught animals, and throughout the campaign the small ponies of Poland and East Prussia broke down by thousands from over loading and unskilful packing.

The Russian Army formed the most complete contrast to the French that it is possible to imagine. Though clad, armed and organized in European fashion, the soldiers retained in a marked degree the traditions of their Mongolian forerunners, their transport wagons were in type the survival of ages of experience, and their care for their animals equally the result of hereditary habit. The intelligence of the men and regimental officers was very low, but on the other hand service was practically for life, and the regiment the only home the great majority had ever known. Hence obedience was instinctive and initiative almost undreamt of. Moreover, they were essentially a war-trained army, for even in peace time their long marches to and fro within the empire had most thoroughly inured them to hardship and privation. Napoleon might have remembered his own saying, "La misère est l'école du bon soldat." Their artillery was numerous and for the most part of heavy calibre—18- and 24-pounders were common—but the strength of the army lay in its infantry, with its incomparable tenacity in defence and its blind confidence in the bayonet in attack. The traditions of Suvarov and his victories in Italy (*see* FRENCH REVOLUTIONARY WARS) were still fresh, but there was no longer a Suvarov to lead them.

Advance to the Vistula.—Napoleon had from the first been aware of the secret alliance between Prussia and Russia, sworn

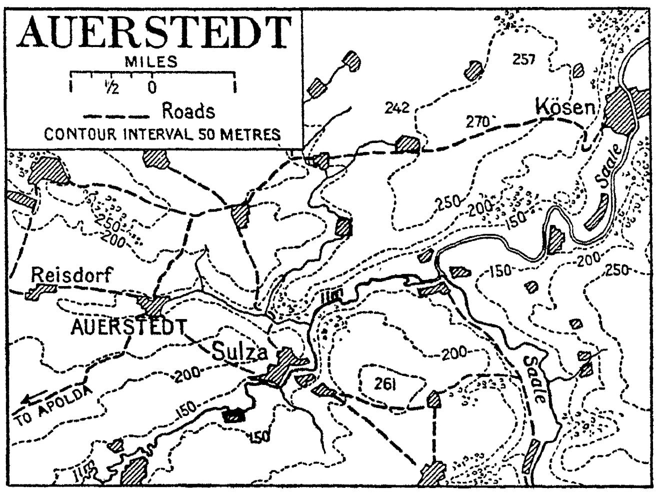

FIG. 4.—AUERSTEDT

by their respective sovereigns over the grave of Frederick the Great, and this knowledge had been his principal reason for precipitating hostilities with the former. He remained, however, in complete ignorance of the degree of preparation attained on the Russian side, and as the seizure of Warsaw together with the control of the resources of Poland in men and material its occupation would afford, was the chief factor in his calculation, he turned at once to the eastward as soon as all further organized resistance in Prussia was ended by the surrender of Prenzlau and Lübeck. Scarcely leaving his troops time to restore their worn-out foot-

gear, or for the cavalry to replace their jaded horses from captured Prussian resources, he set Davout in motion towards Warsaw on Nov. 2, and the remainder of the army followed in successive echelons as rapidly as they could be despatched.

The cavalry, moving well in advance, dispersed the Prussian depots and captured their horses, as far as the line of the Vistula, where at last they encountered organized resistance from the

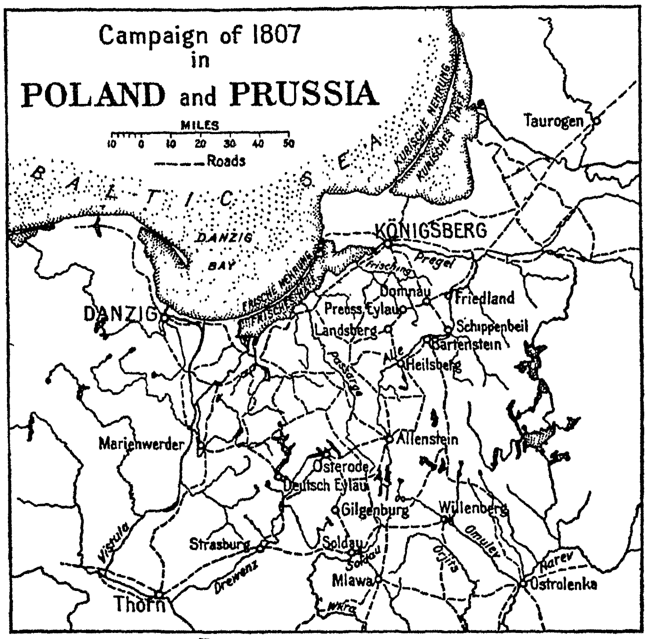

FIG. 5.—CAMPAIGN OF 1807

outposts of Lestocq's little corps of 15,000 men—all that was left of Frederick the Great's army. These, however, gave way before the threat of the advancing French and, after a few trifling skirmishes, Davout entered Warsaw on Nov. 30, being followed by the V., IV., and Guard corps during the succeeding fortnight, whilst the VI. and VII. were echeloned to their left, and the VIII. (Mortier) and IX. (Jerome Napoleon) and X. (Lefebvre), all new formations since the outbreak of the war, followed some marches in the rear. Jerome's corps was composed of the Bavarians, Württembergers and Badensers.

Behind these all Prussia was overrun by newly formed units, (3rd and 4th battalions) raised from depot companies, conscripts for 1807, and old soldiers rejoining after sickness or wounds. Napoleon caused these to be despatched to the front immediately after their formation. He had much territory to occupy, and on the long march of on an average 85 days, he considered that they could be organized, equipped and drilled *en route*.

Pultusk.—The Russians meanwhile had been moving slowly forward in two bodies, one under Bennigsen (50,000), the other under Buxhowden (25,000), and the French being at this time in Warsaw, they took up threatening positions about Pultusk, Plock and Prassnitz. From this triangle they harried the French communications with Berlin, and to secure a winter's rest for his men Napoleon determined to bring them to action. On Dec. 23 operations were commenced, but the difficulties of securing information and maintaining communication between the respective columns, so unlike what any of the French had previously encountered, led to a very partial success. The idea had been to induce the Russians to concentrate about Pultusk and, turning their position from its left, ultimately to cut them off from Russia, and if possible to surround them. But in this new and difficult country the emperor found it impossible to time his marches. The troops arrived late at their appointed positions, and after a stubborn rearguard action at Pultusk itself and undecisive fighting elsewhere (Golymin and Soldau) the Russians succeeded in retreating beyond the jaws of the French attack, and Napoleon for the first time found that he had exceeded the limit of endurance of his men. Indeed, the rank and file bluntly told him as much as he rode with the marching columns. Yielding to the inevitable, but not forgetting to announce a brilliant victory in a bulletin, he sent his troops into winter quarters along the Passarge and down the Baltic, enjoining on his corps commanders most strictly to do nothing to disturb their adversary.

Campaign of Eylau.—Bennigsen, now commanding the whole Russian army which with Lestocq's Prussians amounted to 100,000, also moved into winter quarters in the area Deutsch Eylau-Osterode-Allenstein, and had every intention of remaining there, for a fresh army was already gathering in Russia, the first corps of which had reached Nur about 50m. distant from the French right.

Unfortunately, Ney with his VI. corps about Gilgenberg had received the most poverty-stricken district in the whole region, and to secure some alleviation for the sufferings of his men he incautiously extended his cantonments till they came in contact with the Russian outposts. Apparently seeing in this movement a recommencement of hostilities, Bennigsen concentrated his troops towards his right and commenced an advance westwards towards Danzig, which was still in Prussian hands. Before his advance both Ney and Bernadotte (the latter, between Ney and the Baltic, covering the siege of Danzig) were compelled to fall back. It then became necessary to disturb the repose of the whole army to counter the enemy's intentions. The latter by this movement, however, uncovered his own communication with Russia, and the emperor was quick to seize his opportunity. He received the information on Jan. 28. His orders were at once issued and complied with so rapidly that by the 31st he stood prepared to advance with the corps of Soult, Ney, Davout and Augereau, the Guard and the reserve cavalry (80,000 men on a front of 60m.) from Myszienec through Willenberg to Gilgenberg; whilst Lannes on his right towards Ostrolenka and Lefebvre (X.) at Thorn covered his outer flanks.

Bernadotte, however, was missing, and this time through no fault of his own. His orders and the despatch conveying Napoleon's instructions fell into the hands of the Cossacks, and just in time Bennigsen's eyes were opened. Rapidly renouncing his previous intentions, he issued orders to concentrate on Allenstein; but this point was chosen too far in advance and he was anticipated by Murat and Soult at that place on Feb 2. He then determined to unite his forces at Joukendorf, but again he was too late. Soult and Murat attacked his rearguard on the 3rd, and Bennigsen, learning from his Cossacks that the French corps were designing to swing round and enclose him, he withdrew by a night march and ultimately succeeded in getting his whole army, with the exception of Lestocq's Prussians, together in the strong position along the Alle, the centre of which is marked by Preussisch-Eylau. The opportunity for this concentration Bennigsen owed to the time gained for him by his rearguard at Joukendorf, for this had stood just long enough to induce the French columns to swing in to surround it, and the next day was thus lost to the emperor as his corps had to extend again to their manoeuvring intervals. The truth is that the days were too short and the roads too bad for Napoleon to carry out the full purpose his "general advance guard" was intended to fulfil. It was designed to hold the enemy in position by the vigour of its attack, thus neutralizing his independent will power and compelling him to expend his reserves in the effort to rescue the troops engaged. But in forests and snowdrifts the French made such slow progress that no sufficient deployment could be made until darkness put a stop to the fighting. Thus, when late on Feb. 7, 1807 Murat and Soult found the enemy's rearguard near Eylau (*q.v.*) the fighting was severe but not prolonged. This time, however, Bennigsen, with over 60,000 men in position and 15,000 Prussians expected to arrive next morning, had no desire to avoid a battle, and deployed for action.

During the night Augereau and the Guards had arrived, and Ney and Davout were expected on either flank in the forenoon. This time the emperor was determined that his enemy should not escape him, and about 8 A.M. ordered Soult and Augereau on the left and right respectively to assail the enemy, Murat and the Guards remaining in the centre as reserve. Napoleon's own forces thus became the "general advance guard" for Ney and

Davout, who were to close in on either side and deliver the decisive stroke. But here too the weather and the state of the roads operated adversely, for Ney came up too late, while Davout, in the full tide of his victorious advance, was checked by the arrival of Lestocq, whose corps Ney had failed to intercept, and the attack of Augereau's corps (VII), made in a blinding snowstorm, failed with appalling loss. Bennigsen, however, drew off on Ney's arrival, and the French were too much exhausted to pursue him. Again the emperor had to admit that his troops could do no more, and, bowing to necessity, he distributed them into winter quarters, where, however, the enterprise of the Cossacks, who were no strangers to snow and to forests, left the outposts but little repose. A protracted period of rest followed, during which the emperor exerted himself unremittingly to re-equip, reinforce and supply his troops. Hitherto he had been based on the entrenched camp of Warsaw, but he had already taken steps to organize a new line of supply and retreat via Thorn, and this was now completed. At the same time Lefebvre was ordered to press the siege of Danzig with all vigour, and on May 5, after a most gallant resistance, Kalckreuth, who redeemed here his failure of Auerstädt, surrendered. English assistance came too late. By the beginning of June the French had more than made good their losses and 210,000 men were available for field service.

Heilsberg and Friedland.—Meanwhile Bennigsen had prepared for a fresh undertaking, and leaving Lestocq with 20,000 Prussians and Russians to contain Bernadotte, who lay between Braunsberg and Spandau on the Passarge, he moved southward on June 2, and on June 3 and 4 he fell upon Ney, driving him back toward Guttstadt, while with the bulk of his force he moved toward Heilsberg, where he threw up an entrenched position. It was not till June 5 that Napoleon received tidings of his advance, and for the moment these were so vague that he contented himself by warning the remainder of his forces to be prepared to move on June 6. Next day, however, all doubts were set at rest, and as the Russians advanced south of Heilsberg, he decided to wheel his whole force to the right, pivoting on the III corps, and cut Bennigsen off from Königsberg and the sea. On June 8 the VI, III, VIII and Guard corps, together with a new cavalry reserve corps under Lannes, in all 147,000, stood ready for the operation, and with Murat and Soult as general advanced guard the whole moved forward, driving the Russian outposts before them. Bernadotte, who was to have attacked Lestocq, again failed to receive his orders and took no part in the following operations.

Murat attacked the Russians, who had halted in their entrenched position, on June 11 and drove in their outposts, but did not discover the entrenchments. Meanwhile, Soult had followed with his infantry in close support, and, the emperor himself arriving, ordered him to attack at once. Now the Russians uncovered their entrenchments, and in the absence of artillery preparation Soult's leading troops received most severe punishment. Fresh troops arriving were sent in to his support, but these also proved insufficient, and darkness alone put an end to the struggle, which cost the French 12,000 killed and wounded.

Bennigsen, however, learning that his right was threatened by the III corps, and not having as yet completed his concentration, retreated in the night to Bartenstein, and the following day turned sharp right toward Schippenbeil. The emperor now pressed on toward Friedland, where he would completely control the Russian communications with Königsberg, their immediate base of supply, but for once the Russians outmarched him and covered their movement so successfully that for the next three days he seems to have completely lost all knowledge of his enemy's whereabouts. Lestocq in the meantime had been forced northward toward Königsberg, and Soult with Murat was in hot pursuit. The III, VI, VIII and Guard corps followed the main road toward Königsberg, and the former had reached Mühlhausen and the remainder were about Preussich-Eylau, when Latour Maubourg's dragoons sent in intelligence which pointed to the presence of Bennigsen about Friedland. This was indeed the case. The Russians after passing Schippenbeil had suddenly turned northward, and on the evening of June 13 were taking up a strong position on the river Alle with Friedland as a centre.

What followed presents perhaps the finest instance of the Napoleonic method. The enemy lay directly to his right, and Murat, the IV and III corps had well overshot the mark. Lannes's reserve corps (cavalry), to whom Latour Maubourg reported, lay at Domnau about 10 mi. to the right. The latter at once assumed the role of advanced guard cavalry and was ordered to observe the enemy at Friedland, Ney following in close support. Davout was turned about and directed on the enemy's right, and the VIII corps (Mortier), the Guards and the reserve cavalry followed as main body. On June 14 (the anniversary of Marengo) Lannes carried out his role of fighting advanced guard or screen, the emperor's main body gradually came up, and the battle of Friedland (*q.v.*), notable chiefly for the first display of the new artillery tactics of the French, ended with a general attack about 5 P.M. and the retreat of the Russians, after severe losses, over the Alle. Lestocq was, meanwhile, driven through Königsberg (which surrendered on June 15) on Tilsit, and now that he was no longer supported by the Russians, the Prussian commander gave up the struggle.

THE AUSTRIAN WAR OF 1809

Ever since Austerlitz the Austrian officers had been labouring to reconstitute and reform their army. Much had been done to create an efficient staff, but though the idea of the army corps command was now no new thing, the senior generals entrusted with these commands were far from having acquired the independence and initiative of their French opponents. Hence the extraordinary slowness of their manoeuvres, not because the Austrian infantrymen were bad marchers, but because the preparation and circulation of orders were still far behind the French standard. The infantry adopted the highly manoeuvrable formations of the French—skirmishers and columns—but it was easier to adopt the formations than to acquire the initiative which gave these their vital energy. The light cavalry had been much improved and the heavy cavalry on the whole proved a fair match for their opponents.

After the peace of Tilsit the *Grande Armée* was gradually withdrawn behind the Rhine, leaving only three commands, totalling 63,000 men, under Davout in Prussia, Oudinot in west central Germany and Lefebvre in Bavaria, to assist the princes of the Confederation of the Rhine in the maintenance of order and the enforcement of the French law of conscription, which was rigorously insisted on in all the states comprised in this new federation. In exchange for the subsistence of the French troops of occupation, a corresponding number of these new levies were moved to the south of France, where they commenced to arrive at the moment when the situation in Spain became acute. The Peninsular War (*q.v.*) called for large forces of the old *Grande Armée* and for a brief period Napoleon directed operations in person; and the Austrians took advantage of the dissemination and weakness of the French forces in Germany to push forward their own preparations with renewed energy.

But they reckoned without the resourcefulness of Napoleon. The moment news of their activity reached him, while still in pursuit of Sir John Moore, he dispatched letters to all the members of the confederation warning them that their contingents might soon be required, and at the same time issued a series of decrees to General Clarke, his war minister, authorizing him to call up the contingent of 1810 in advance, and directing him in detail to proceed with the formation of 4th and 5th battalions for all the regiments across the Rhine. By these means Davout's, Oudinot's and Lefebvre's commands were augmented, while in February and March new corps were formed and rapidly pushed toward the front.

On his return from Spain, seeing war imminent, he issued a series of march orders (which deserve the closest study in detail) by which on April 15 his whole army was to be concentrated for manoeuvres between Regensburg, Landshut, Augsburg and Donauwörth, and sending on the Guard in wagons to Strasbourg, he despatched Berthier to act as commander in chief until his

own arrival.

Austrian Offensive.—The position of assembly was excellently chosen, but unfortunately the Austrians took the initiative. On April 9 their main body of six corps crossed the Inn between Braunau and Passau and simultaneously two additional corps moved from Pilsen in Bohemia on Regensburg. At this moment Davout was entering Regensburg with his leading troops, the remainder still some marches in rear, and it was evident that the whole concentration could no longer be carried out before the Austrians would be in a position to intervene. Berthier received the news while still on his way to the front, and quite failed to grasp the situation. Reaching Donauwörth at 8 P.M. on April 13, he ordered Davout and Oudinot to remain at Regensburg, whilst Lefebvre and Wrede (Bavarians) who had fallen back before the Austrians were directed to reoccupy Landshut. This was in direct contradiction to the instructions Napoleon had given on March 28 in view of this very emergency. Davout obeyed, but remonstrated. On the 16th Berthier went on to Augsburg, where he learned that Lefebvre's advanced troops had been driven out of Landshut, thus opening a great gap seventy-six miles wide between the two wings of the French army. Meanwhile Napoleon, who had left Paris at 4 A.M. on April 13, was hastening towards the front, but remained still in ignorance of Berthier's doings until on the 16th at Stuttgart he received a letter from the Marshal dated the 13th, which threw him into consternation. In reply he immediately wrote: "You do not inform me what has rendered necessary such an extraordinary measure which weakens and divides my troops" —and—"I cannot quite grasp the meaning of your letter yet, I should have preferred to see my army concentrated between Ingolstadt and Augsburg, the Bavarians in the first line, with the duke of Danzig in his old position, until we know what the enemy is going to do. Everything would be excellent if the duke of Auerstädt had been at Ingolstadt and the duke of Rivoli with the Württembergers and Oudinot's corps at Augsburg, . . . so that just the opposite of what should have been done has been done" (C. N. to Berthier, Ludwigsburg, 16th April).

Napoleon Takes Command.—Having despatched this severe reprimand he hastened on to Donauwörth, where he arrived at 4 A.M. on the 17th, hoping to find Berthier, but the latter was at Augsburg. Nevertheless, at 10 A.M. he ordered Davout and Oudinot to withdraw at once to Ingolstadt; and Lefebvre and Wrede on the right to support the movement. About noon Berthier returned and after hearing his explanation Masséna received orders to move from Augsburg toward Ingolstadt. "To-morrow will be a day of preparation spent in drawing closer together, and I expect to be able by Wednesday to manoeuvre against the enemy's columns according to circumstances."

Meanwhile the Austrians had approached so near that by a single day's march it would have been possible to fall upon and crush by superior numbers either wing of the French army, but though the Austrian light cavalry successfully covered the operations of the following troops they had not yet risen to a conception of their reconnoitring mission, and the archduke, in ignorance of his opportunity and possessed, moreover, with the preconceived idea of uniting at Regensburg with the two corps coming from Bohemia, moved the bulk of his forces in that direction, leaving only a covering body against Davout altogether insufficient to retain him. Davout, however, had left a garrison of 1,800 men in Regensburg, who delayed the junction of the Austrian wings until the 20th inst., and on the same day the emperor, having now reunited his whole right wing and centre, overwhelmed the covering detachments facing him in a long series of disconnected engagements lasting forty-eight hours, and the archduke now found himself in danger of being forced back into the Danube. But with the Bohemian reinforcements he had still four corps in hand, and Napoleon, whose intelligence service in the difficult and intersected country had lamentably failed him, had weakened his army by detaching a portion of his force in pursuit of the beaten right wing, and against the archduke's communications.

Eckmühl.—When, therefore, the latter, on the 22nd, marched southward to reopen his communications by the defeat of the enemy's army, he actually reached the neighbourhood of Eckmühl with a sufficient numerical superority had he only been prompt enough to seize his opportunity. But the French had been beforehand with him. Napoleon, who had personally taken part in the fighting of the previous day, and followed the pursuit as far as Landshut, whence he had despatched Masséna to follow the retreating Austrians along the Isar, seems to have realized about

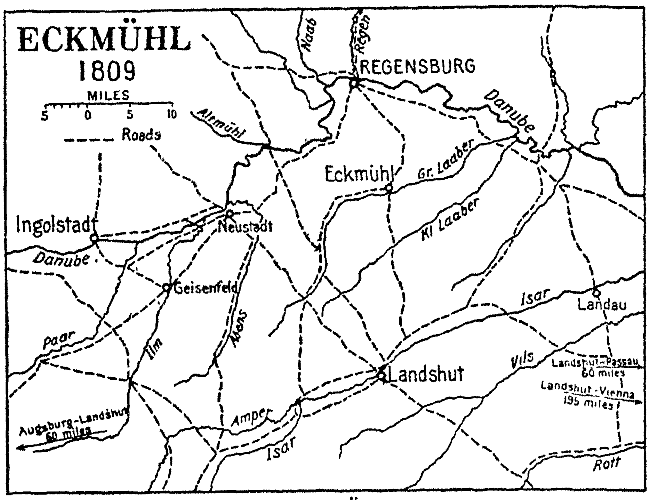

FIG. 6.—ECKMÜHL, 1809

3 A.M. in the morning that it was not the main body of the enemy he had had before him, but only its left wing, and that the main body itself must still be northward towards Regensburg. Issuing orders to Davout, Oudinot and his cavalry to concentrate with all speed towards Eckmühl, he himself rode back along the Regensburg road and reached the battle-field just as the engagement between the advance troops had commenced. Had the Austrians possessed mobility equal to that of the French the latter should have been overwhelmed in detail, but whilst the French covered 17 and 19m. the Austrians only marched 10, and, owing to their defective assimilation of the new tactical training the troops actually on the ground could not hold out long enough for their reserves to arrive. The retreat of the front lines involved the following ones in confusion, and presently the whole mass was driven back in considerable disorder. It seemed as if nothing could save the Austrians from complete disaster, but at the critical moment the emperor, yielding to the protestations of his corps commanders, who represented the excessive fatigue of their troops, stopped the pursuit, and the archduke made the most of his opportunity to restore order amongst his demoralized men and crossed to the north bank of the Danube during the night.

On the following morning the French reached Regensburg and at once proceeded to assault its mediaeval walls, but the Austrian garrison bravely defended it till the last of the stragglers was safely across on the north bank. It was here that, for the only time in his career, Napoleon was slightly wounded. Then, leaving Davout to observe the archduke's retreat, the emperor himself rode after Masséna, who with the major portion of the French army was following the Austrian weaker wing under Hiller. The latter was not so shaken as Napoleon believed, and turning at bay at Ebelsberg inflicted a severe check on its pursuers. Thus covered by his rearguard Hiller gained space and time to pass his troops over to the north bank of the Danube and remove all boats on the river. This left the direct road to Vienna open, and Napoleon, hoping to find peace in the enemy's capital, pushed the whole of his army down the right bank, and with Murat's cavalry entered the city on May 12, after somewhat severe resistance lasting three days. Meanwhile the archduke and Hiller, both now unmolested, effected their junction in the vicinity of Wagram, picketing the whole line of the Danube with their outposts and collecting all the boats.

Aspern and Wagram.—The reconnaissance of the river was at once taken in hand by the French upon their arrival in Vienna, and a point opposite the island of Lobau selected for the crossing.

Thanks to the Austrian precautions it took four days to collect the necessary material to span the main branch of the river, here some 2,000yd. across, and though Napoleon personally spurred on all to activity nearly four days more were required for its construction. It was not till the night of May 19 that orders for the passage were finally issued, and during the night the troops commenced to occupy the island of Lobau. Surprise, of course, was out of the question, but the Austrians did not attempt to dispute the passage, their object being to allow as many French as they felt they could deal with to pass over and then to fall on them. Thus on May 21 the battle of Aspern (*q.v.*) or Essling began. It ended on the night of the 22nd with the defeat of Napoleon, the first ever inflicted upon him. The French retreated into the island of Lobau. By nightfall upwards of 100,000 men, encumbered with at least 20,000 wounded, were crowded together on the little island scarcely a mile square, short of provisions and entirely destitute of course of all hospital accessories. The question then arose whether the retreat was to be continued across the main stream or not, and for the second time in his career Napoleon assembled his generals to take their opinion. They counselled retreat, but having heard them all he replied, in substance: "If we leave here at all we may as well retire to Strassburg, for unless the enemy is held by the threat of further operations he will be free to strike at our communications and has a shorter distance to go. We must remain here and renew operations as soon as possible."

Immediate orders were despatched to summon every available body of troops to concentrate for the decisive stroke. Practically the lines of communication along the Danube were denuded of combatants, even Bernadotte being called up from Passau, and the viceroy of Italy, who driving the archduke Johann before him (action of Raab) had brought up 56,000 men through Tirol, was disposed towards Pressburg within easy call. The arsenal of Vienna was ransacked for guns, stores and appliances, and preparations in the island pushed on as fast as possible. By the end of June 200,000 troops were stationed within call, and on July 4 the French began to cross over to the left bank of the Danube. The events which followed are described under WAGRAM. The great battle at this place, fought on July 5 and 6, ended in the retirement of the Austrians. The only other event which occurred before peace was made was an unimportant action at Znaym on July 11.

THE RUSSIAN WAR OF 1812

Whilst the campaign of 1809 had shaken the faith of the marshals and the higher ranks in the infallibility of the emperor's judgment, and the slaughter of the troops at Aspern and Wagram had still further accentuated the opposition of the French people to conscription, the result on the fighting discipline of the army had, on the whole, been for good. The panics of Wagram had taught men and officers alike a salutary lesson. Aware of the growing feeling against war in France, Napoleon had determined to make his allies not only bear the expenses of the coming campaign, but find the men as well, and he was so far master of Europe that of the 363,000 who on June 24 crossed the Niemen no less than two-thirds were Germans, Austrians, Poles or Italians. But though the battlefield discipline of the men was better, the discipline in camp and on the march was worse, for the troops were no longer eager to reach the battlefield, and marched because they were compelled, not of their own goodwill. The result was apparent in a sudden diminution in mobility, and a general want of punctuality which seriously influenced the course of the campaign. On the other hand, the Russians, once their fatherland was invaded, became dominated by an ever-growing spirit of fanaticism, and they were by nature too obedient to their natural leaders, and too well inured to the hardships of campaigning, to lose their courage in a retreat.

By the middle of June 1812 the emperor had assembled his army along the line of the Niemen. On the extreme right stood the Austrian contingent under Schwarzenberg (34,000 men). Next, centring about Warsaw, a group of three corps (70,000 men) under the chief command of Napoleon's brother Jerome. Then the main army under Napoleon in person (220,000 men; with 80,000 more under the viceroy of Italy on his right rear); and on the extreme left at Tilsit a flanking corps, comprising the Prussian auxiliary corps and other Germans (in all 40,000 strong). The whole army was particularly strong in cavalry; out of the 450,000, 80,000 belonged to that arm, and Napoleon, mindful of the lessons of 1807, had issued the most minute and detailed orders for the supply service in all its branches, and the forwarding of reinforcements, no less than 100,000 men being destined for that purpose in due course of time.

Information about the Russians was very indifferent; it was only known that Prince Bagration (with 43,000 men) lay grouped about Wolkowysk; Barclay de Tolly (who had about 130,000) about Vilna; and on the Austrian frontier lay a small corps under Tormassov (40,000) in process of formation, while far away on the Turkish frontiers hostilities with the sultan retained Tschitschagov with 50,000 more. Of the enemy's plans Napoleon knew nothing, but, in accordance with his usual practice, the dispositions he had chosen met all immediate possible moves.

Opening of the Campaign.—On June 24 the passage of the Niemen began in torrid heat which lasted for a few days. The main army, with the emperor in person, covered by Murat and the cavalry, moved on Vilna, whilst Jerome on his right rear at once threatened Bagration and covered the emperor's outer flank. From the very first, however, the inherent weakness of the vast army, and the vicious choice of time for the beginning of the advance, began to make themselves felt With crops still green, and nothing else available as forage for the horses, an epidemic of colic broke out amongst them, and in ten days the mounted arms had lost upwards of one-third of their strength; men died of sunstroke in numbers, and serious straggling began. Still everything pointed to the concentration of the Russians at Vilna, and Jerome, who on July 5 had reached Grodno, was ordered to push on. But Jerome proved quite inadequate to his position, listening to the complaints of his subordinates as to want of supplies and even of pay; he spent four whole days in absolute inertia, notwithstanding the emperor's reprimands. Meanwhile the Russians covered by stubborn rearguards made good their retreat—Barclay towards the entrenched camp of Drissa on the Dvina, Bagration towards Mohilev.

The emperor's first great *coup* thus failed. Jerome was replaced by Davout, and the army resumed its march, this time in the hope of surrounding and overwhelming Barclay, whilst Davout dealt with Bagration. The want of mobility, particularly in the cavalry,

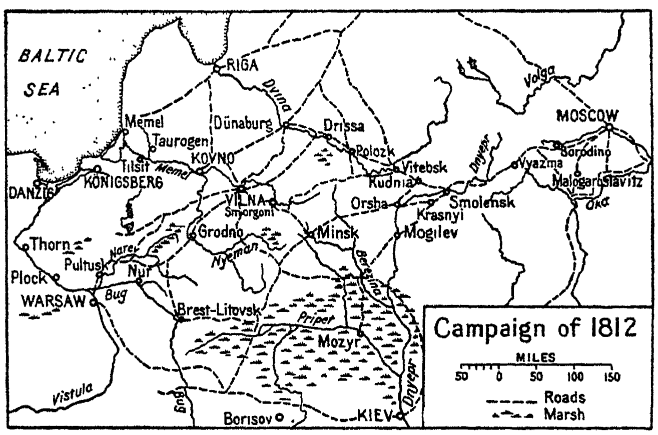

FIG. 7.—CAMPAIGN OF 1812

now began to tell against the French. With horses only just recovering from an epidemic, they proved quite unequal to the task of catching the Cossacks, who swarmed round them in every direction, never accepting an engagement but compelling a constant watchfulness for which nothing in their previous experience had sufficiently prepared the French.

Before their advance, however, the Russian armies steadily retired, Barclay from Vilna via Drissa to Vitebsk, Bagration—narrowly evading Davout—from Wolkowysk to Mohilev. Again arrangements were made for a Napoleonic battle; behind Murat's

cavalry came the "general advanced guard" to attack and hold the enemy, whilst the main body and Davout were held available to swing in on his rear. Napoleon, however, failed to allow for the psychology of his opponents, who refused to be drawn into engagements and steadily withdrew from every position when the French gained touch with them. Thus the manoeuvre against Vitebsk again miscarried, and Napoleon found himself in a far worse position, numerically and materially, than at the outset of the campaign. Then he had stood with 420,000 men on a front of 160m., now he had only 229,000 men on a 135m. front; he had missed three great opportunities of destroying his enemy in detail, and in five weeks, during which time he had only traversed 200m., he had seen his troops reduced numerically at least one-third, and, worse still, his army was now far from being the fighting machine it had been at the outset.

Meanwhile the Russians had not lost a single gun and the *moral* of their men had been improved by the result of the many minor encounters with the enemy; further, the junction of Bagration and Barclay was now assured in the vicinity of Smolensk. Towards this place the French advance was now resumed, and the Russian generals at the head of a united force of 130,000 men marched forward towards Rudnia to meet them. Here, however, the inefficiency of the Russian staff actually saved them from the disaster which must certainly have overtaken them had they realized their intention of fighting the French. The Russians marched in two columns, which lost touch of one another, and as it was quite impossible for either to engage the French single-handed, they both retired again towards Smolensk, where with an advanced guard in the town itself—which possessed an old-fashioned brick *enceinte* not to be breached by field artillery alone—the two columns reunited and deployed for action behind the unfordable Dnieper.

Murat and Ney as "general advanced guard" attacked the town in the morning of Aug. 16, and the main body was swung round to place itself on the Russian rear astride the road to Moscow. The whole of the 17th was required to complete the movement, and as soon as its purpose was sufficiently revealed to the Russians the latter determined to retreat under cover of night. Their manoeuvre was carried out with complete success, and then began a series of rearguard actions and nocturnal retreats which completely accomplished their purpose of wearing down the French army. The Russian government, however, failed to see the matter in its true light, and Marshal Kutusov was sent to the front to assume the chief command. His intention was to occupy a strong position and fight one general action for the possession of Moscow, and to this end he selected the line of the Kalatscha where the stream intersects the great Moscow road.

Borodino.—Here he was overtaken by Murat and Ney, but the French columns had straggled so badly that four whole days elapsed before the emperor was able to concentrate his army for battle and then could only oppose 128,000 men to the Russians' 110,000. About 6 A.M. on Sept. 7 the battle (*see* BORODINO) began, but Napoleon was suffering from one of those attacks of illness and depression which henceforth became such an important factor in his fate. Till about midday he followed the course of the action with his usual alertness; then he appears to have been overcome by a kind of stupor and allowed his marshals to fight by themselves. There was no final decisive effort as at Wagram and the Guard was not even called on to move. Ultimately the sun went down on an undecided field on which 38,000 Russians and 25,000 French had fallen, but the moral reaction on the latter was far greater than on the former. Kutusov continued his retreat, and Murat with his now exhausted horsemen followed as best he might. Sebastiani, commanding the advanced guard, overtook the Russians in the act of evacuating Moscow, and agreed with the latter to observe a seven hours' armistice to allow the Russians to clear the town, for experience had shown the French that street fighting in wooden Russian townships always meant fire and the consequent destruction of much-needed shelter and provisions. Towards nightfall Napoleon reached the scene, and the Russians being now clear the troops began to enter, but already fires were observed in the farther part of the city. Napoleon passed the night in a house in the western suburb and next morning rode to the Kremlin, the troops moving to the quarters assigned to them, but in the afternoon a great fire began and, continuing for two days, drove the French out into the country again.

The emperor was now in the direst perplexity. Kutusov was hovering on the outskirts of the city, his main body at Kaluga, some marches to the south-west, where he was in full communication with the richest portion of the empire; and now news arrived that St. Cyr, who had relieved Macdonald on his extreme left, had only 17,000 men left under arms against upwards of 40,000 Russians under Witgenstein; and to the south Tschitschagov's army, being no longer detained on the Turkish frontier, where peace had been made, was marching to join Tormassov about Brest-Litovsk with forces which would bring the total of the two well over 100,000 men. Meanwhile Schwarzenberg's force opposing these had dwindled to a bare 30,000.

The French army was thus disposed almost in an equilateral triangle with sides of about 570m., with 95,000 men at the apex at Moscow opposed to 120,000, 30,000 about Brest opposite 100,000, and 17,000 about Drissa confronted by 40,000, whilst in the centre of the base at Smolensk lay Victor's corps, about 30,000. From Moscow to the Niemen was 550 miles. In view of this situation Napoleon on Oct. 4 sent General Lauriston to the Russian headquarters to treat. While waiting his return Murat was enjoined to skirmish with Kutusov, and the emperor himself worked out a scheme to assume the offensive with his whole army towards St. Petersburg, calling in Victor and St. Cyr on the way. This project was persisted with, until on the 18th Murat was himself attacked and severely handled (action of Tarutino or Vinkovo). On the morning of the 19th the whole army moved out to accept this challenge, and the French were thoroughly worsted on the 24th in the battle of Maloyaroslavetz.

The Retreat from Moscow.—Then began the celebrated retreat. It has generally been forgotten that the utter want of march discipline in the French, and not the climatic conditions, was responsible for the appalling disasters which ensued. Actually the frost came later than usual that year, Oct. 27, and the weather was dry and bracing; not till Nov. 8 did the cold at night become sharp. Even when the Beresina was reached on Nov. 26, the cold was far from severe, for the slow and sluggish stream was not frozen over, as is proved by the fact that Eblé's pioneers worked in the water all through that terrible day. But the French army was already completely out of hand, and the degree to which the panic of a crowd can master even the strongest instinct of the individual is shown by the conduct of the fugitives who crowded over the bridges, treading hundreds under foot, whilst all the time the river was easily fordable and mounted men rode backwards and forwards across it.

To return to the actual sequence of events. Kutusov had been very slow in exploiting his success of the 24th and indeed had begun the pursuit in a false direction; but about Nov. 2, headquarters of the French being at Vyazma, the Cossacks became so threatening that the emperor ordered the army to march (as in Egypt) in hollow square. This order, however, appears only to have been obeyed by the Guards, with whom henceforward the emperor marched.

Kutusov had now overtaken the French, but fortunately for them he made no effort to close with them, but hung on their flank, molesting them with Cossacks and picking up stragglers. Thus the wreck of the *Grande Armée,* now not more than fifty thousand strong, reached Smolensk on the 9th and there rested till the 14th. The march was then resumed, the Guard leading and Ney commanding the rearguard. Near Krasnoi on the 16th the Russian advanced guard tried to head the column off. Napoleon halted a whole day to let the army close up; and then attacked with his old vigour and succeeded in clearing the road, but only at the cost of leaving Ney and the rearguard to its fate. By a night march of unexampled daring and difficulty Ney succeeded in breaking through the Russian cordon, but when he regained touch with the main body at Orcha only 800 of his 6,000 men were still with him (21st).

The Beresina.—From here Napoleon despatched orders to Victor to join him at Borisov on the Beresina. The cold now gave

way and thaw set in, leaving the country a morass, and information came that Tschitschagov from the south had reached Borisov. He now selected Viesselovo as the point of passage and at 1 A.M. on the 23rd sent orders to Oudinot to march thither and construct bridges. In the execution of these orders Oudinot encountered the Russian advanced guard near Borisov and drove the latter back in confusion, though not before they had destroyed the existing bridge there. This sudden reassumption of the offensive threw Tschitschagov into confusion. Thus time was gained for Victor also to come up and for Oudinot to construct the bridges at Studienka near the above-mentioned place, but a spot in many respects better suited for the purpose. Thither therefore Napoleon sent his pontonniers under General Eblé, but on their arrival they found that no preparations had been made and much time was lost. Meanwhile Victor, in doubt as to the real point of passage, had left the road to Studienka open to Wittgenstein, who had followed hard on his heels.

By 4 P.M. on the 26th the bridges were finished and the passage began, but not without resistance by the Russians, who were gradually closing in. The crossing continued all night, though interrupted from time to time by failures of the bridges. All day during the 27th stragglers continued to cross, covered by such combatants as remained under sufficient discipline to be employed. At 8 A.M. on the 28th, however, Tschitschagov and Wittgenstein moved forward on both banks of the river to the attack, but were held off by the splendid self-sacrifice of the few remaining troops under Ney, Oudinot and Victor, until about 1 P.M. the last body of regular troops passed over the bridges, and only a few thousand stragglers remained beyond the river.

The number of troops engaged by the French that day cannot be given exactly. Oudinot's and Victor's men were relatively fresh and may have totalled 20,000, whilst Ney can hardly have had more than 6,000 of all corps fighting under him. How many were killed can never be known, but three days later the total number of men reported fit for duty had fallen to 8,800 only.

Final Operations.—Henceforward the retreat of the army became practically a headlong flight, and on Dec. 8, having reached Smorgoni and seeing that nothing further could be done by him at the front, the emperor handed over the command of what remained to Murat, and left for Paris to organize a fresh army for the following year. Travelling at the fullest speed, he reached the Tuileries on the 18th, after a journey of 312 hours. After the emperor's departure the cold set in with increased severity, the thermometer falling to 23°. On Dec. 8, Murat reached Vilna, whilst Ney with about 400 men and Wrede with 2,000 Bavarians still formed the rearguard; but it was quite impossible to carry out Napoleon's instructions to go into winter quarters about the town, so that the retreat was resumed on the 10th and ultimately Königsberg was attained on Dec. 19 by Murat with 400 Guards and 600 Guard cavalry dismounted. Meanwhile on the extreme French right Schwarzenberg and his Austrians had drifted away towards their own frontier, and the Prussian contingent, which under Yorck formed part of Macdonald's command about Riga, had entered into a convention with the Russians at Tauroggen (Dec. 30) which deprived the French of the last support upon their left. Königsberg thus became untenable, and Murat fell back to Posen, where on Jan. 10 he handed over his command to Eugène Beauharnais and returned to Paris. The Russian pursuit practically ceased at the line of the Niemen, for the Russian troops also had suffered terrible hardships and a period of rest had become an absolute necessity.

The War of Liberation.—The Convention of Tauroggen became the starting-point of Prussia's regeneration. As the news of the destruction of the *Grande Armée* spread, and the appearance of countless stragglers convinced the Prussian people of the reality of the disaster, the spirit generated by years of French domination burst out. For the moment the king and his ministers were placed in a position of the greatest anxiety, for they knew the resources of France and the boundless versatility of their arch-enemy far too well to imagine that the end of their sufferings was yet in sight. To disavow the acts and desires of the army and of the secret societies for defence with which all north Germany was honeycombed would be to imperil the very existence of the monarchy, whilst an attack on the wreck of the *Grande Armée* meant the certainty of a terrible retribution from the new armies now rapidly forming on the Rhine.

But the Russians and the soldiers were resolved to continue the campaign, and working in collusion they put pressure on the not unwilling representatives of the civil power to facilitate the supply

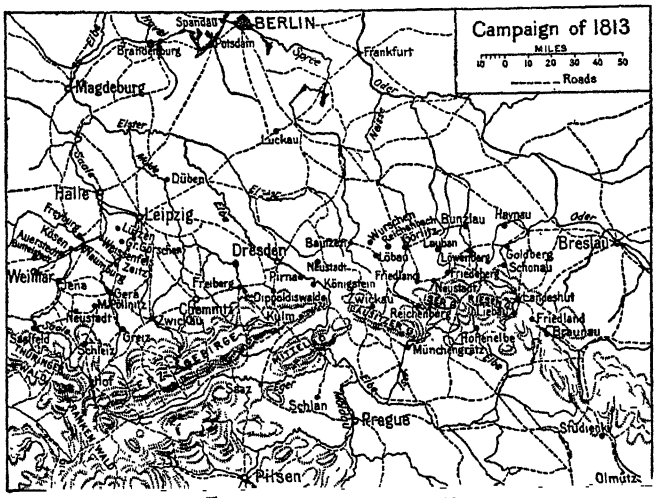

FIG. 8.—CAMPAIGN OF 1813

and equipment of such troops as were still in the field; they could not refuse food and shelter to their starving countrymen or their loyal allies, and thus by degrees the French garrisons scattered about the country either found themselves surrounded or were compelled to retire to avoid that fate. Thus it happened that the viceroy of Italy felt himself compelled to depart from the positive injunctions of the emperor to hold on at all costs to his advanced position at Posen, where about 14,000 men had gradually rallied around him, and to withdraw step by step to Magdeburg, where he met reinforcements and commanded the whole course of the lower Elbe.

Napoleon's Preparations.—Meanwhile the emperor in Paris had been organizing a fresh army for the reconquest of Prussia. Thanks to his having compelled his allies to fight his battles for him, he had not as yet drawn very heavily on the fighting resources of France, the actual percentage of men taken by the conscriptions during the years since 1806 being actually lower than that in force in continental armies of the early twentieth century. He had also created in 1811–12 a new National Guard, organized in "cohorts" to distinguish it from the regular army, and for home defence *only,* and these by a skilful appeal to their patriotism and judicious pressure applied through the prefects, became a useful reservoir of half-trained men for new battalions of the active army. Levies were also made with rigorous severity in the states of the Rhine Confederation, and even Italy was called on for fresh sacrifices. In this manner by the end of March upwards of 200,000 men were moving towards the Elbe,[1] and in the first fortnight of April they were duly concentrated in the angle formed by the Elbe and Saale, threatening on the one hand Berlin, on the other Dresden and the east.

The allies, aware of the gradual strengthening of their enemy's forces but themselves as yet unable to put more than 200,000 in the field, had left a small corps of observation opposite Madgeburg and along the Elbe to give timely notice of an advance towards Berlin; and with the bulk of their forces had taken up a position about Dresden, whence they had determined to march down the course of the Elbe and roll up the French from right to left. Both armies were very indifferently supplied with information, as both were without any reliable regular cavalry capable of piercing the screen of outposts with which each endeavoured to conceal his disposition, and Napoleon, operating in a most unfriendly country, suffered more in this respect than his adversaries.

[1]Napoleon always gave their number as 300,000, but this was never attained.

On April 25 Napoleon reached Erfurt and assumed the chief command. On this day his troops stood in the following positions: Eugène, with Lauriston's, Macdonald's and Regnier's corps, on the lower Saale; Ney in front of Weimar, holding the defile of Kösen; the Guard at Erfurt, Marmont at Gotha, Bertrand at Saalfeld, and Oudinot at Coburg, and during the next few days the whole were set in motion towards Merseburg and Leipzig, in the now stereotyped Napoleonic order, a strong advanced guard of all arms leading, the remainder—about two-thirds of the whole—following as *masse de manoeuvre,* this time, owing to the cover afforded by the Elbe on the left, to the right rear of the advanced guard.

Meanwhile the Russians and Prussians had concentrated all available men and were moving on an almost parallel line, but somewhat to the south of the direction taken by the French. On May 1 Napoleon and the advance guard entered Lützen. Wittgenstein, who now commanded the allies in place of Kutusov, hearing of his approach, had decided to attack the French advanced guard, which he took to be their whole force, on its right flank, and during the morning had drawn together the bulk of his forces on his right in the vicinity of Gross-Görschen and Kaya.

Battle of Lützen.—About 9 A.M. on May 2 he began an attack on the French advance guard in Lützen, whilst the remainder of his army was directed against Napoleon's right and rear. Just as the latter were moving off the heads of the French main body suddenly appeared, and at 11 A.M. Napoleon, then standing near the Gustavus Adolphus monument on the field of Lützen, heard the roar of a heavy cannonade to his right rear. He realized the situation in a moment, galloped to the new scene of action, and at once grouped his forces for decisive action—the gift in which he was supreme. Leaving the leading troops to repulse as best they might the furious attack of both Russians and Prussians, and caring little whether they lost ground, he rapidly organized for his own control a battle-reserve. At length when both sides were exhausted by their efforts he sent forward nearly a hundred guns which tore asunder by their case-shot fire the enemy's line and marched his reserve right through the gap. Had he possessed an adequate cavalry force the victory would have been decisive. As it was, the allies made good their retreat and the French were too exhausted for infantry pursuit.

Perhaps no battle better exemplifies the inherent strength of the emperor's strategy, and in none was his grasp of the battlefield more brilliantly displayed, for, as he fully recognized, "These Prussians have at last learnt something—they are no longer the wooden toys of Frederick the Great," and, on the other hand, the relative inferiority of his own men as compared with his veterans of Austerlitz called for far more individual effort than on any previous day. He was everywhere, encouraging and compelling his men—it is a legend in the French army that the persuasion even of the imperial boot was used upon some of his reluctant conscripts, and in the result his system was fully justified, as it triumphed even against a great tactical surprise.

Bautzen.—As soon as possible the army pressed on in pursuit, Ney being sent across the Elbe to turn the position of the allies at Dresden. This threat forced the latter to evacuate the town and retire over the Elbe, before blowing up the stone bridge across the river. Napoleon entered the town hard on their heels, but the broken bridge caused a delay of four days, there being no pontoon trains with the army. Ultimately on May 18 the march was renewed, but the allies had continued their retreat in leisurely fashion, picking up reinforcements by the way. Arrived at the line of the Spree, they took up and fortified a very formidable position about Bautzen (*q.v.*). Here, on the 20th, they were attacked and fixed by Napoleon; but the intended decisive coup by which Ney was to arrive on their right rear on the 21st missed its mark owing to Ney's want of initiative and rigid adherence to the letter of his orders. As a result the allies were able to break off the action at their own time and retire in such good order that the emperor failed to capture a single trophy as proof of his victory. The enemy's escape annoyed him greatly, the absence of captured guns and prisoners reminded him too much of his Russian experiences, and he redoubled his demands on his corps commanders for greater vigour in the pursuit. This led the latter to push on without due regard to tactical precautions, and Blücher took advantage of their carelessness when at Haynau (May 26), with some twenty squadrons of Landwehr cavalry, he surprised, rode over and almost destroyed Maison's division. The material loss inflicted on the French was not very great, but its effect in raising the *moral* of the raw Prussian cavalry and increasing their confidence in their old commander was enormous.

Still the allies continued their retreat and the French were unable to bring them to action. In view of the doubtful attitude of Austria, Napoleon became alarmed at the gradual lengthening of his lines of communication and opened negotiations. The enemy, having everything to gain and nothing to lose thereby, agreed finally to a six weeks' suspension of arms. This was perhaps the gravest military error of Napoleon's whole career, and his excuse for it, "want of adequate cavalry," was the strongest testimony as to the value of that arm.

As soon as a suspension of arms (to Aug. 15) had been agreed to, Napoleon hastened to withdraw his troops from the dangerous position they occupied with reference to the passes leading over the mountains from Bohemia, for he entertained no doubt now that Austria was also to be considered as an enemy. Finally he decided to group his corps round Görlitz and Bautzen whence they could either meet the enemy advancing from Breslau or fall on his flank over the mountains if he attempted to force his way into Saxony by the valley of the Elbe. This latter manoeuvre depended, however, on his maintenance of Dresden, and to this end he sent the I. Corps up the Elbe to Pirna and Königstein to cover the fortifications of Dresden itself. His instructions on this point deserve the closest study, for he foresaw the inevitable attraction which a complete entrenched camp would exercise even upon himself, and, therefore, limited his engineers to the construction of a strong bridge head on the right bank and a continuous enceinte, broken only by gaps for counter attack, around the town itself.

Then he turned his attention to the plan for the coming campaign. Seeing clearly that his want of an efficient cavalry precluded all ideas of a resolute offensive in his old style, he determined to limit himself to a defence of the line of the Elbe, a position of waiting from which he could make a spring, of not more than a few days' duration, at any target the enemy might present.

Reinforcements had been coming up without ceasing and at the beginning of August he calculated that he would have 300,000 men available about Bautzen and 100,000 along the Elbe from Hamburg via Magdeburg to Torgau. With the latter he determined to strike the first blow, by a concentric advance on Berlin (which he calculated he would reach on the 4th or 5th day), the movement being continued thence to extricate the French garrisons in Küstrin, Stettin and Danzig. The moral effect, he promised himself, would be prodigious, and there was neither room nor food for these 100,000 elsewhere. Towards the close of the armistice he learned the general situation of the allies. The crown prince of Sweden (Bernadotte), with his Swedes and various Prussian levies, 135,000 in all, lay in and around Berlin and Stettin; and knowing his former marshal well, Napoleon considered Oudinot a match for him. Blücher with about 95,000 Russians and Prussians was about Breslau, and Schwarzenberg, with nearly 180,000 Austrians and Russians, lay in Bohemia. In his central position at Bautzen he felt himself equal to all his enemy's combinations.

Dresden.—The advance towards Berlin began punctually with the expiration of the armistice, but with the main army he himself waited to see more clearly his adversaries' plans. At length becoming impatient he advanced a portion of his army towards Blücher, who fell back to draw him into a trap. Then the news reached him that Schwarzenberg was pressing down the valley of the Elbe, and, leaving Macdonald to observe Blücher, he hurried back to Bautzen to dispose his troops to cross the Bohemian mountains in the general direction of Königstein, a blow which would have had decisive results. But the news from Dresden, where the construction of the defences was still incomplete, was so alarming that at the last moment he changed his mind, and

sending Vandamme alone over the mountains, he hurried with his whole army to the threatened point. This march remains one of the most extraordinary in history, for the bulk of his forces moved, mainly in mass and across country, 90m. in 72 hours, entering Dresden on the morning of the 27th, only a few hours before the attack of the allies commenced. For the events which followed *see* DRESDEN: *Battle of Dresden.*

Dresden was the last great victory of the First Empire. By noon on Aug. 27 the Austrians and Russians were completely beaten and in full retreat, the French pressing hard behind them, but meanwhile Napoleon himself again succumbed to one of his unaccountable attacks of apparent intellectual paralysis. He seemed unaware of the vital importance of the moment, crouched shivering over a bivouac fire, and finally rode back to Dresden, leaving no specific orders for the further pursuit. The allies, however, continued to retreat, but unfortunately Vandamme, with his single corps and unsupported, issued out of the mountains on their flank, threw himself across their line of retreat near Kulm, and was completely overwhelmed by sheer weight of numbers (29th). In spite of this misfortune, Napoleon could claim a brilliant success for himself, but almost at the same moment news reached him that Oudinot at Grossbeeren near Berlin, and Macdonald on the Katzbach opposed to Blücher, had both been severely defeated.

Napoleon's Movements.—During the next two days the emperor examined his situation and, after discussing on paper the respective hypotheses of a spring at Prague or at Berlin, summed up in favour of the second. But his consideration of this project was interrupted by news which indicated that the consequences of Macdonald's defeat had been far more serious to the *moral* of that command than he had imagined. He immediately rode over to establish order, and his manner and violence were so improper that Caulaincourt had the greatest difficulty in concealing the scandal. Blücher, however, hearing of his arrival, at once retreated and the emperor followed, thus uncovering the passes over the Bohemian mountains, a fact of which Schwarzenberg was quick to take advantage. Learning of his approach, Napoleon again withdrew to Bautzen. Then hearing that the Austrians had counter-marched and were again moving towards Dresden, he hastened back there, concentrated as many men as could conveniently be handled, and advanced beyond Pirna and Königstein to meet him. But the Austrians had no intention of attacking him, for time was now working on their side and, leaving his men to starve in the exhausted district, the emperor again returned to Dresden, where for the rest of the month he remained in an extraordinary state of vacillation. On Oct. 4 he again drew up a review of the situation, in which he apparently contemplated giving up his communications with France and wintering in and around Dresden, though at the same time he was aware of the distress amongst his men for want of food.

Campaign of Leipzig.—In the meanwhile Blücher, Schwarzenberg and Bernadotte were working round his flanks. Ney, who had joined Oudinot after Grossbeeren, had been defeated at Dennewitz (Sept. 6), the victory, won by Prussian troops solely, giving the greatest encouragement to the enemy. Suddenly Napoleon's plans are again reviewed and completely changed. Calling up St. Cyr, whom he had already warned to remain at Dresden with his command, he decided to fall back towards Erfurt, and go into winter quarters between that place and Magdeburg, pointing out that Dresden was of no use to him as a base and that if he had a battle, he had much better have St. Cyr and his men with him than at Dresden. He then on Oct. 7 drew up a final plan, and this he immediately proceeded to put into execution, for he was now aware of the danger threatening his line of retreat from both Blücher and Schwarzenberg and the North Army; yet only a few hours afterwards the portion of the order relating to St. Cyr and Lobau was cancelled and the two were finally left behind at Dresden. From the 10th to the 13th Napoleon lay at Düben, again a prey to the most extraordinary irresolution, but on that day he thought he saw his opportunity. Blücher was reported near Wittenberg, and Schwarzenberg was moving slowly round to the south of Leipzig. The North Army under Bernadotte, unknown to Napoleon, lay on Blücher's left around Halle. The emperor decided to throw the bulk of his force on Blücher, and, having routed him, turn south on Schwarzenberg and sever his communications with Bohemia. His concentration was effected with his usual sureness and celerity, but whilst the French moved on Wittenberg, Blücher was marching to his right, indifferent to his communications as all Prussia lay behind him. This move on the 14th brought him into touch with Bernadotte, and now a single march forward of all three armies would have absolutely isolated Napoleon from France; but Bernadotte's nerve failed him, for on hearing of Napoleon's threat against Wittenberg he decided to retreat northward, and not all the persuasions of Blücher and Gneisenau could move him. Thus if the French movement momentarily ended in a blow in the air, it was indirectly the cause of their ultimate salvation.

The "Battle of the Nations."—On the 15th Napoleon concentrated his forces to the east of Leipzig, with only a weak detachment to the west, and in the evening the allies were prepared to attack him. Schwarzenberg had 180,000 men available at once and 60,000 on the following day; Blücher had about 60,000, but Bernadotte now could not arrive before the 18th.

Napoleon prepared to throw the bulk of his force upon Schwarzenberg and massed his troops south-east of the town, whilst Schwarzenberg marched concentrically against him down the valleys of the Elster and Pleisse, the mass of his troops on the right bank of the latter and a strong column under Giulay on the left working round to join Blücher on the north. The fighting which followed was most obstinate, but the Austrians failed to make any impression on the French positions, and indeed Giulay felt himself compelled to withdraw to his former position. On the other hand, Blücher carried the village of Möckern and came within a mile of the gates of the town. During the 17th there was only indecisive skirmishing, Schwarzenberg waiting for his reinforcements coming up by the Dresden road, Blücher for Bernadotte to come in on his left, and by some extraordinary oversight Giulay was brought closer in to the Austrian centre, thus opening for the French their line of retreat towards Erfurt, and no information of this movement appears to have been conveyed to Blücher. The emperor when he became aware of the movement, sent the IV. corps to Lindenau to keep the road open. On the 18th the fighting was resumed and by about noon Bernadotte came up and closed the gap to the N.E. of the town between Blücher and the Austrians. At 2 P.M. the Saxons, who had remained faithful to Napoleon longer than his other German allies, went over to the enemy. All hope of saving the battle had now to be given up, but the French covered their retreat obstinately and by daybreak next morning one-half of the army was already filing out along the road to Erfurt which had so fortunately been left for them.

It took Blücher time to extricate his troops from the confusion into which the battle had thrown them, and the garrison of Leipzig and the troops left on the right bank of the Elster still resisted obstinately—hence no direct pursuit could be initiated, and the French, still upwards of 100,000 strong, marching rapidly, soon gained distance enough to be reformed. Blücher followed by parallel and inferior roads on their northern flank, but Schwarzenberg knowing that the Bavarians also had forsaken the emperor and were marching under Wrede, 50,000 strong, to intercept his retreat, followed in a most leisurely fashion. Blücher did not succeed in overtaking the French, but the latter, near Hanau, found their way barred by Wrede with 50,000 men and over 100 guns in a strong position. To this fresh emergency Napoleon and his army responded in most brilliant fashion. As at Krasnoi in 1812, they went straight for their enemy and after one of the most brilliant series of artillery movements in history, directed by General Drouot, they marched right over their enemy, practically destroying his whole force. Henceforward their march was unmolested, and they reached Mainz on Nov. 5.

THE CAMPAIGN IN FRANCE IN 1814

When the last of the French troops had crossed to the western bank of the Rhine, divided counsels made their appearance at the headquarters of the allies. Everyone was weary of the war, and

many felt that it would be unwise to push Napoleon and the French nation to extremes. Hence a prolonged halt arose, utilized by the troops in renewing their equipment and so forth, but ultimately the Young German party, led by Blücher and the principal fighting men of the army, triumphed, and on Jan. 1, 1814, the Silesian army (50,000) began its passage of the Rhine at Kaub. They were to be supported by Schwarzenberg with 200,000 men,

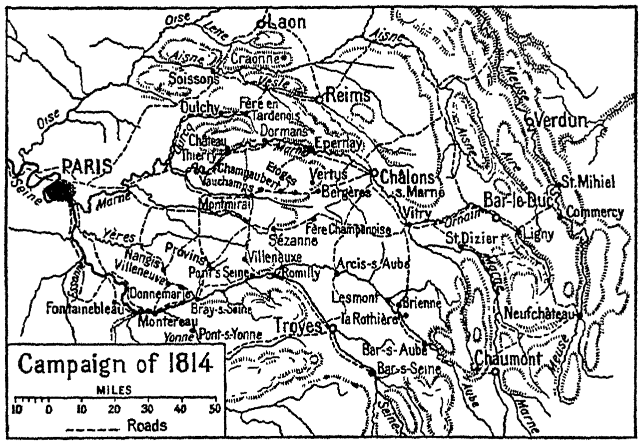

FIG. 9.—CAMPAIGN OF 1814

who was to advance by Basel and Neu Breisach to the south, and Bernadotte with the Northern army, about 120,000, was to move in support on the right flank through the Netherlands and Laon; this force was not yet ready and did not, in fact, reach the latter place till March. To meet these forces the emperor could not collect 200,000 men in all, of whom upwards of 100,000 were held by Wellington on the Spanish frontier, and 20,000 more were required to watch the debouches from the Alps. Hence less than 80,000 remained available for the east and north-eastern frontier. If, however, he was weak in numbers, he was now again operating in a friendly country, able to find food almost everywhere and practically indifferent as to his communications.

On Jan. 25 Blücher entered Nancy, and, moving rapidly up the valley of the Moselle, was in communication with the Austrian advanced guard near La Rothière on the afternoon of the 28th. Here his headquarters were surprised and he himself nearly captured by a sudden rush of French troops, and he learnt at the same time that the emperor in person was at hand. He accordingly fell back a few miles next morning to a strong position covering the exits from the Bar-sur-Aube defile. There he was joined by the Austrian advance guard, and together they decided to accept battle—indeed they had no alternative, as the roads in rear were so choked with traffic that retreat was out of the question. About noon Feb. 2 Napoleon attacked them, but the weather was terrible, and the ground so heavy that his favourite artillery, the mainstay of his whole system of warfare, was useless and in the drifts of snow which at intervals swept across the field, the columns lost their direction and many were severely handled by the Cossacks. At nightfall the fighting ceased and the emperor retired to Lesmont, and thence to Troyes, Marmont being left to observe the enemy.

Montmirail.—Owing to the state of the roads, more perhaps to the extraordinary lethargy which always characterized Schwarzenberg's headquarters, no pursuit was attempted. But on Feb. 4 Blücher, chafing at this inaction, obtained the permission of his own sovereign to transfer his line of operations to the valley of the Marne; Pahlen's corps of Cossacks were assigned to him to cover his left and maintain communication with the Austrians. Believing himself secure behind this screen, he advanced from Vitry along the roads leading down the valley of the Marne, with his columns widely separated for convenience of subsistence and shelter—the latter being almost essential in the terrible weather prevailing. Blücher himself on the night of the 7th was at Sézanne, on the exposed flank so as to be nearer to his sources of intelligence, and the rest of his army were distributed in four small corps at or near Épernay, Montmirail and Étoges; reinforcements also were on their way to join him and were then about Vitry.

In the night his headquarters were again surprised, and he learnt that Napoleon himself with his main body was in full march to fall on his scattered detachments. At the same time he heard that Pahlen's Cossacks had been withdrawn forty-eight hours previously, thus completely exposing his flank. He himself retreated towards Étoges endeavouring to rally his scattered detachments, but Napoleon was too quick for him and in three successive days he defeated Sacken at Montmirail, Yorck at Champaubert and Blücher and his main body at Étoges, pursuing the latter towards Vertus. These disasters compelled the retreat of the whole Silesian army, and Napoleon, leaving Mortier and Marmont to deal with them, hurried back to Troyes with his main body to strike the flank of Schwarzenberg's army, which had meanwhile begun its leisurely advance, and again at Mormant on Feb. 17, Montereau the 18th and Méry the 21st, he inflicted such heavy punishment upon his adversaries that they fell back precipitately to Bar-sur-Aube.

In the meantime Blücher had rallied his scattered forces and was driving Marmont and Mortier before him. Napoleon, as soon as he had disembarrassed himself of Schwarzenberg, countermarched his main body and moving again by Sézanne, fell upon Blücher's left and drove him back upon Soissons. This place had been held by a French garrison, but had capitulated only twenty-four hours beforehand, a fact of which Napoleon was naturally unaware. The Silesian army was thus able to escape, and marching northwards combined with Bernadotte at Laon—this reinforcement bringing the forces at Blücher's disposal up to over 100,000 men. On March 7 Napoleon fell upon the advance guard of this force at Craonne and drove it back upon Laon, where a battle took place on the 9th. Napoleon was here defeated, and with only 30,000 men at his back he was compelled to renounce all ideas of a further offensive, and he retired to rest his troops at Reims. Here he remained unmolested for a few days, for Blücher was struck down by sickness, and in his absence nothing was done. On March 14, however, Schwarzenberg, becoming aware of Napoleon's withdrawal to Reims, again began his advance and had reached Arcis-sur-Aube when the news of Napoleon's approach again induced him to retreat to Brienne.

The Allies March on Paris.—Thus after six weeks' fighting the allies were hardly more advanced than at the beginning. Now, however, they began to realize the weakness of their opponent, and, still more, the weakening of his political stability. Napoleon, coincidently, aware of the limitations of a strategy of continual parrying, was seized with the idea of a decisive coup against Schwarzenberg's communications. He determined to move eastward to St. Dizier, rally what garrisons he could find, and raise the whole country against the invaders, and had actually started on the execution of this plan when his instructions fell into the enemy's hands and his projects were exposed. The Czar Alexander called a council of war at which General Toll in opposition to his seniors, urged that instead of following Napoleon the allies should disregard the threat to their rear and advance by forced marches on Paris, whose people were reported to be "tired of the war and of Napoleon." His arguments for this moral objective won over the Czar and at his instigation the allies marched straight for the capital. Marmont and Mortier with what troops they could rally took up a position on Montmartre heights to oppose them, but seeing further resistance to be hopeless they gave way on March 31, just as Napoleon, with the wreck of the Guards and a mere handful of other detachments, was hurrying across the rear of the Austrians towards Fontainebleau to join them.

This was the end of the First Empire. The story of the WATERLOO CAMPAIGN, 1815, is told under its own heading.

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NAVAL OPERATIONS

The Peace of Amiens in 1802 was productive of but a brief truce. Napoleon's ambitions and actions were such as quickly to re-awaken European suspicions, and his refusal to evacuate the Netherlands was alone enough to arouse England and cause her to declare war on him as early as May 18, 1803. From then onwards, for over two years, the war took the form of a gigantic scheme, on the part of Napoleon, for an invasion of England—a scheme which led to the movements known as the Trafalgar Campaign which, in its turn, led to the Battle of Trafalgar. Boulogne was chosen as the base for the French operations; along the coast on either side an army of some 150,000 men was encamped, and specially-constructed flat-bottomed boats for their transport were brought from all parts of France. The army was given constant practice in embarkation and disembarkation, and, in the meantime, it proved impossible for the British ships to do much damage to this armament owing to the shallow water on the coastline. In order, however, to carry through his scheme successfully, Napoleon had got to obtain at least a temporary control of the Channel, and this meant either defeating the British fleet on equal terms in action, or, by some means, causing the various parts of it to scatter on some wild-goose chase, so giving himself the chance to bring every available ship to the Channel and overwhelm the British fleet there by sheer weight of numbers. French fleets were stationed at Brest, Rochefort, L'Orient and Toulon; all of them were watched by British blockading squadrons. From the end of 1804, when Spain entered the war on his side, Napoleon was able to add to this total Spanish squadrons at Corunna, Ferrol, Cadiz and Cartagena, all of which the British blockaded. The total number of ships at Napoleon's command was about 60, the English had an approximately equal number employed in blockading them. His plan, then, took the form of attempting to elude these blockading squadrons and make them scatter to various parts of the world in search of his escaped squadrons which would, after concentrating at a given rendez-vous, return to the Channel to crush Cornwallis and the English Channel Fleet, if indeed that had not scattered too, after the presumed escape of the Brest Fleet which it was blockading. In either case Napoleon might hope to achieve his object—control of the Channel for long enough to enable him to take his troops across, while the British squadrons returned from the various parts of the world to which he seemed to think they might sail. The scheme was an exceedingly weak one, and postulated a gross ignorance of naval strategy on the part of that country that had been its greatest exponent. The British Admiralty upset it by a single order. The various blockading squadrons, if they were eluded by the squadrons they were blockading, were to fall back on Cornwallis. Thus if all the French squadrons united at the appointed rendez-vous (which was Martinique) and sailed for the Channel, they would merely find Cornwallis with an equally concentrated fleet, and the extent of the British concentration would depend on, and be equal to, that of the French.

The first move occurred in January 1805 when the Rochefort squadron of five ships escaped and sailed for the West Indies, but it proved an isolated effort. On March 30, however, Admiral Villeneuve used a gale to elude Nelson who was watching him off Toulon, and got clear away with eleven ships which he increased to eighteen by picking up the Cadiz Squadron, reaching Martinique on May 14. He was joined on June 1, by two ships from Rochefort, but no others put in an appearance. He should have waited until nearly the end of the month before sailing back to Europe to try and pick up those squadrons which failed to join him, preliminary to making for Brest, whence Admiral Gantheaume was trying unsuccessfully to emerge from time to time. Only a week later, however, information reached Villeneuve that Nelson was already in the West Indies in search of him, and he decided to make for European waters immediately. Nelson, after having been evaded off Toulon should, according to his orders, have fallen back on Cornwallis, but he preferred, not for the first time, to follow his own course. It has often been said that Villeneuve induced Nelson to follow him and that, in doing so, the latter was playing into Napoleon's hands. The foolishness of this can be seen in the fact that the mere information that Nelson was in the neighbourhood caused Villeneuve to make for home a considerable time before he was due to depart, and any hope of a West Indian concentration was thus lost. When Napoleon hoped that the English blockading squadrons would scatter, he meant to places where the French had not gone. Foiled by false information of his hope of catching Villeneuve, Nelson sent a fast brig home to warn the Admiralty of the former's return, and himself sailed for Gibraltar. The Admiralty despatched Sir Robert Calder to intercept Villeneuve; this he did, off Finisterre, and, in a not very satisfactory action, fought in a fog, deprived him of two Spanish battleships, but let him make Ferrol. Here the French Admiral received reinforcements, and his next move, according to his programme, should have been to make for the Channel in an attempt to unite with the Brest fleet. But he conceived, rightly, that Napoleon's scheme had already been foiled and that his task would be impossible; thus when he left Ferrol he made, not for the Channel, but for Cadiz. Here he was blockaded by Nelson and Collingwood. The Trafalgar Campaign, as a campaign, was over, and the invasion scheme was a failure. Napoleon broke up his camp and marched his troops against Austria. A natural corollary of the Trafalgar Campaign was the battle of Trafalgar, but it must be realised that it was the former that saved England from invasion. In the autumn Napoleon needed a fleet in the Mediterranean and ordered Villeneuve to proceed there. The latter, after a protest, attempted to comply, and was beaten, as all the world knows, on Oct. 21, 1805 with a loss of twenty ships.

The victory of Trafalgar, while it did not end the war, conferred upon England the complete command of the sea. Thereafter naval activity was most pronounced, and the British Navy was employed in numerous undertakings in all parts of the world; but it becomes impossible to trace out any broad policy. It only remains to point out some of the more prominent incidents. Napoleon's operations with Russia produced some naval activity. England attempted to assist that country when in 1807 Napoleon was preparing a final blow against her, by forcing the Dardanelles —Turkey being then allied with France. Admiral Duckworth was selected for the operation, and he actually silenced the batteries in the Straits and appeared off Constantinople. There he was helpless for lack of bombships, and had to retire under a damaging fire. Later in the same year the third coalition against France came to a final end when Napoleon and the Tsar of Russia signed the Treaty of Tilsit, by which they agreed to cease war and both plot for England's overthrow. One scheme they hatched was to seize all the neutral fleets in Europe and employ them against their common enemy. The largest neutral navy was Denmark's, and Canning, having providentially heard of this peculiar arrangement, anticipated a Franco-Russian breach of Danish neutrality by sending Admiral Gambier to "borrow" this fleet for the duration of the war. Gambier bombarded Copenhagen and returned with 70 out of 72 of the Danes' fighting ships.

Napoleon's Berlin and Milan Decrees, by which he hoped to break England's merchant marine, and England's reply with the Orders in Council, also gave the British navy opportunities to

show its command of the sea. Napoleon forbade continental countries to import British goods either in British or foreign ships. England in turn seized neutral ships that called at a continental port without also calling at a British port. The struggle forced England to open new markets in the east and South America, but several countries rebelled against Napoleon's system and England was always ready to help. The revolt of Portugal began in 1808 and produced the Peninsular War, which ought to be thought of as partly a naval operation, for the fleet took off the army after Corunna, was always behind the duke of Wellington's lines at Torres Vedras and finally followed, as nearly as possible, his victorious advance.

The revolt of Austria in 1809 produced the combined expedition against Antwerp, commanded by Admiral Strachan and Lord Chatham, which hoped to find some sympathy among the Netherlanders for their Austrian former rulers. Walcheren and Flushing were captured, but the expedition had to retreat after the collapse of Austria. Finally, England's resistance to Napoleon's decrees involved it in 1812 in war with the United States, which considered itself ill-treated in the matter of the seizure of ships.

The British lost many single-ship actions with the Americans, their only success being that of the "Shannon" over the "Chesapeake," but the United States let its very natural jubilation rather blind it to the fact that its coasts were blockaded without serious challenge.

This is but a small selection from the numerous incidents that make up the naval side of the Napoleonic War after Trafalgar. The main point is that British sea supremacy was unchallenged after that battle, and the royal navy remained Napoleon's worst enemy to the end, for it was the British "Bellerophon" which intercepted him when, after Waterloo, he sought to escape to the United States to carve out an empire in a new world.

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NAPOLEONITE, or Corsite, a gabbro showing orbicular structure from Santa Lucia di Tallano, Corsica.

The rock when cut and polished makes a beautiful ornamental stone, examples of which are to be found in most petrographical museums. Although often referred to as a diorite, corsite in its mineral and chemical composition corresponds to a hornblende gabbro. The orbicules, remarkable for their uniformity in structure, range from three-fourths inch to two inches in diameter and are set in a matrix of variable grain size built up of green hornblende, cummingtonite and bytownite feldspar (An_{75}).

The core of these structures consists of material mineralogically similar to the matrix but richer in feldspar; it is followed by a series of broad and narrow zones, respectively, of radiate plagioclase and green hornblende-cummingtonite intergrowths also radially arranged. Both the plagioclase of the core and of the broad zones is distinctly more calcic (An_{88}) than that of the matrix. These relations are in accord with the concept that the orbicules developed in a crystallizing liquid and the structure itself has probably arisen by rhythmic crystallization.

Orbicular or spheroidal structures, though by no means common, have been found in the crystalline rocks of Sweden, Finland, the U.S.S.R. and America. They have been particularly closely studied by the petrologists of Finland and are there known as esboites. The mutual relations in composition and structure of orbicule and matrix in some of these rocks, especially those of Finland, have led to the opinion that the structures are metamorphic in origin, the orbicules developing in a solid or quasi-solid matrix which has in part been converted into a migmatite by metasomatic replacement.

See P. Eskola, "On the Esboitic Crystallization of Orbicular Rocks," *J. Geol.*, vol. xlvi, pp. 448–485 (1938). (C. E. T.)

NAPRAPATHY is a system of manipulative drugless treatment founded in 1907 by Oakley Smith, based on a theory that connective tissue which has become shrunken as the result of injury is the basic cause of disease. A shrunken strand of connective tissue is called a ligatight and may occur in the spine, thorax, pelvis or elsewhere. It is claimed that such tissue can be corrected by naprapathic treatment, which aims at stretching the shrunken strands.

Study of a set of charts showing types of ligatights and manipulations to correct them are held to be an important part of the practitioner's training.

NAPRAVNIK, EDWARD (1839–1915), Czech conductor and composer, was born at Beisht in Bohemia on Aug. 26, 1839. In 1861 he went to St. Petersburg (Leningrad) as conductor to Prince Youssipov. Through the influence of Liadov he obtained a post at the Marinsky theatre and in 1869 succeeded him as first conductor there. He died Nov. 10, 1915.

Napravnik wrote several operas, including *Francesca di Rimini*, op. 71; four symphonies; and orchestral, choral and piano pieces.

NAQUET, ALFRED JOSEPH (1834–1916), French chemist and politician, was born at Carpentras (Vaucluse) on Oct. 6, 1834. In 1863 he was made professor of medicine in Paris, and of chemistry in Palermo. In 1867 he was imprisoned for 15 months and lost his professorships for his share in a secret society, and in 1869 took refuge in Spain on the prosecution of his book *Religion, propriété, famille.*

Naquet became secretary of the commission of national defense, sitting on the extreme left in the national assembly. By his efforts in the senate, where he sat from 1883, in 1886 divorce became legal after three years of definite separation, on the demand of one of the parties concerned. In 1890 he resigned from the senate and took his seat with the Boulangist deputies in the chamber of deputies.

Naquet wrote *Principes de chimie fondés sur les théories modernes* (1865); *Socialisme collectiviste et socialisme libéral; Loi du divorce* (1903).

NARA, an important water channel in Sind, India, probably representing a former bed of the Indus, though now traversing the desert far east of the river. A perennial stream 262 mi. long, with 631 mi. of canals, it irrigates an area of more than 250,000 ac.

NARA, a town of Japan, in the province of Yamato, 25½ mi. from Osaka by rail. Pop. (1950) 77,866. It lies on the slope of a range of picturesque hills, beautifully wooded with cryptomerias and evergreen oaks. Nara remained the metropolis during seven consecutive reigns (709 to 784), and its 75 years of favoured existence sufficed for the building and furnishing of several imposing shrines and temples, for the laying out of a noble park and for the casting of a colossal image of Buddha. In Nara and its environs there have been preserved important and beautiful remains of architecture dating back to the 7th and 8th centuries, such as parts of the Buddhist monasteries called Hōryūji, Yakushiji, Kōfukuji and Tōdaiji, together with remarkable examples of sculpture of similar age, notable among which are such celebrated Buddhist images as the Kudara Kwannon, the Chūgūji Kwannon, bronze Shaka trinity of A.D. 623 and many other distinguished works of art.

Many articles and ornaments used in the Nara palaces have been preserved for nearly 1,200 years in a storehouse, the Shōsō-in. They give a picture of the court life of those days and show evidence of cultural relations not only with China but with western Asia. The Shinto shrine of Kasuga, doubtless many times rebuilt, still preserves in its shape and decoration features of the primitive style of Japanese architecture. Nara has a fine park, and efforts are made to preserve the ancient characteristics of the town.

NARBADA (Nerbudda), a river of India. It is regarded as the boundary between Hindustan proper and the Deccan. It rises on the summit of Amarkantak hill in Rewa state, and for the first 200 mi. of its course winds among the Mandla hills, which

form the head of the Satpura range; then at Jubbulpore, passing through the "Marble Rocks," it enters its proper valley between the Vindhyan and Satpura ranges, and pursues a direct westerly course to the Gulf of Cambay. Its total course through the Central Provinces and Gujarat amounts to about 800 m., and it falls into the sea in the Bombay district of Broach. It receives the drainage of the northern slopes of the Satpuras, but not that of the Vindhyan tableland, the streams from which flow into the Ganges and Jumna. After leaving the Central Provinces, the river widens out in the fertile district of Broach, with an average breadth of ½ m. to 1 m. Below Broach city it forms an estuary which is 13 m. broad where it enters the Gulf of Cambay. The Narbada is nowhere utilized for irrigation, and navigation is confined to the lower section. In the rainy season boats of considerable size sail about 60 m. above Broach city. In sanctity the Narbada ranks only second to the Ganges among the rivers of India, and along its whole course are special places of pilgrimage. The most meritorious act that a pilgrim can perform is to walk from the sea to the source of the river and back along the opposite bank.

The Narbada has given its name to a division of the Central Provinces, comprising the five districts of Narsinghpur, Hoshangabad, Nimar, Betul and Chindwara. Area, 18,534 sq.mi.; pop. (1921) 2,013,021.

NARBONNE, a city of France, capital of an arrondissement in the department of Aude, in a vine-growing plain 5 mi. from the Mediterranean, 37 mi. E. of Carcassonne. Pop. (1946) 29,975. Narbonne was the capital of the Volcae Tectosages. There the Romans in 118 B.C. founded their first colony in Gaul, named *Narbo Martius;* they built great works to protect the city from inundation and to improve its port, situated on a lake now filled up. The capital of Gallia Narbonensis, the seat of a proconsul and a station for the Roman fleet, Narbo Martius became the rival of Massilia. But the division of Gallia Narbonensis into two provinces lessened its importance. Alans, Suevi, Vandals, each held the city, and at last, in 413, it was occupied by the Visigoths, whose capital it afterwards became. In 719, after a siege of two years, it was captured and extended by the Saracens. Charles Martel, after the battle of Poitiers, and Pippin the Short, in 752, were both repulsed from its walls; but on a new attempt, after an investment of seven years, the Franks again forced their way into Narbonne. Charlemagne made the city the capital of the duchy of Gothia, and divided it into three lordships—one for the bishop, another for a Frankish lord and the third for the Jews. In the 13th century the archbishopric was seized by the pope's legate, Arnaud Amaury, who took the title of viscount of Narbonne. Simon de Montfort, however, deprived him of this dignity, receiving from Philip Augustus the duchy of Narbonne along with the county of Toulouse. By his expulsion of the Jews Philip the Fair hastened the decay of the city; and about the same period the Aude, which had formerly been diverted by the Romans, ceased to flow towards Narbonne and the harbour was silted up. United to the French crown in 1507, Narbonne was enclosed by a new line of walls under Francis I but had the last portions of its ramparts demolished in 1870. The archbishopric was founded about the middle of the 3rd century, its first holder being Sergius Paulus; it was suppressed in 1790. The Robine canal, a branch of the Canal du Midi, divides Narbonne into the *bourg* and the *cité.* The former 13th century cathedral (St. Just), consists only of a choir 130 ft. high and transept. The towers (194 ft. high) at each end of the transept date from 1480. The apse of the cathedral was formerly joined to the fortifications of the archiepiscopal palace, and the two buildings are still connected by a mutilated cloister of the 14th and 15th centuries. Part of the palace now serves as *hôtel de ville,* and the palace garden contains many fragments of Roman work; the Musée Lapidaire in the Lamourguier buildings has similar Roman remains. The church of St. Paul, though partly Romanesque, is for the south of France a rare example of a building of the early 13th century in the Gothic style of the north. It possesses some ancient Christian sarcophagi and fine Renaissance wood carving. Narbonne has a subprefecture, tribunals of first instance and of commerce, a board of trade arbitrators and a chamber of commerce. It has a good trade in wine and spirituous liquors, salt, tartar, almonds and leather. The industries include cooperage, sulphur-refining, brandy-distilling and the manufacture of bricks and tiles.

NARBOROUGH, SIR JOHN (d. 1688), English naval commander, was descended from an old Norfolk family. He received his commission in 1664, and in 1666 was promoted lieutenant for gallantry in the action with the Dutch fleet off the Downs in June of that year. After the peace he was chosen to conduct a voyage of exploration in the South Seas. He set sail from Deptford on Nov. 26, 1669, and entered the Straits of Magellan in October 1670 but returned home in June 1671 without accomplishing his original purpose. A narrative of the expedition was published in 1694 under the title *An Account of several late Voyages and Discoveries to the South and North.* During the second Dutch War Narborough was second captain of the lord high-admiral's ship the "Prince," and distinguished himself at Southwold Bay in May 1672. In 1675 he was sent to suppress the Tripoline piracies, and by the bold expedient of despatching gun-boats into the harbour of Tripoli at midnight and burning the ships he induced the bey to agree to a treaty. Shortly after his return he undertook a similar expedition against the Algerines. In 1680 he was appointed commissioner of the navy, an office he held till his death in 1688.

See J. Charnock, *Biographia Navalis,* vol. i. (6 vols., 1794–98).

NARCEINE, $C_{23}H_{27}NO_8+3H_2O$, an alkaloid of opium discovered by P. J. Pelletier (1832). It forms silky needles melting at 170° C., and is genetically related to narcotine (*q.v.*), from which it may be prepared by the action of alkali on the methochloride derivative. It has no uses in medicine, but is of considerable theoretical importance for the structure of narcotine. (L. F. Sl.)

NARCISSUS, in Greek mythology, son of the river god Cephissus and the nymph Leiriope, distinguished for his beauty. The seer Teiresias told his mother that he would have a long life, provided he never looked upon his own features. His rejection of the love of the nymph Echo (*q.v.*), or of his lover Ameinias drew upon him the vengeance of the gods. Having fallen in love with his own reflection in the waters of a spring, he pined away (or killed himself) and the flower that bears his name sprang up where he died. According to Pausanias, Narcissus, to console himself for the death of a favourite twin sister, his exact counterpart, sat gazing into the spring to recall her features by his own.

It is a very plausible suggestion of Frazer (*Golden Bough,* iii. p. 94) that this story is to be connected with the widespread belief that it is unlucky, or even fatal, to see one's own reflection. This superstition existed in Greece, *see* Iamblichus, *Protrept.,* 21; Boehm, *de Symbolis Pythagoreis,* p. 51 (1905); Artemidorus, *Oneirocr.* ii., 7 (p. 91, 1, Hercher).

Hence is derived the term *narcissism,* used by psychologists, especially Freudians, for a morbid condition in which the subject is intensely interested in his own body.

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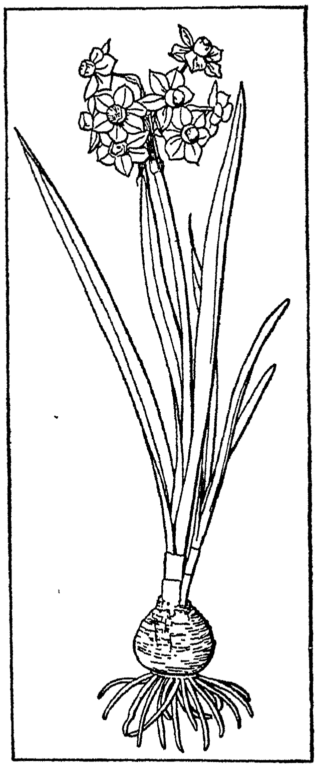
NARCISSUS (d. A.D. 54) was a freedman of Claudius, and his secretary *ab epistulis.* Narcissus and Messallina between them exercised an unbounded influence over the emperor, and arranged the execution or exile of their opponents almost at pleasure. Narcissus was sent to Britain to subdue the mutiny of the soldiers of A. Plautius. He was not well received, but the mutiny subsided. Narcissus was almost solely responsible for the ultimate downfall of Messallina in the Silius affair. It was he who made Claudius alarmed for his own safety, who succeeded in hardening him against Messallina's appeals, and who finally gave the order for her execution when Claudius hesitated. For this he received the insignia of praetor. Eventually he made a false move over Claudius' second marriage, for which he supported Aetia Petina, and further antagonized Agrippina by backing the claims of Britannicus to the throne. As a result he was put to death on Nero's accession in A.D. 54. Narcissus' importance is an early example of the power of the freedmen-secretaries of the emperor's household, and represented the first step towards the transforma-

tion of the emperor's personal staff into an imperial civil service.
See Sac. *Ann.* xi., xii., xiii., 1.; Dio Cass. ix.; Suet. *Claudius.*

NARCISSUS, a genus of bulbous plants belonging to the family Amaryllidaceae, natives of central Europe, and the Mediterranean region; one species *N. Tazetta,* extends through Asia to Japan. From some of these, by cultivation and hybridization, have arisen the very numerous modern varieties. The plants have long narrow leaves springing from the bulb and a central scape bearing one or more generally large, white or yellow, drooping or inclined flowers. The flowers are regular, with a perianth springing from above the ovary, tubular below, with spreading segments and a central corona; the six stamens are inserted within the tube. The most interesting feature botanically is the "corona" or "cup," which springs from the base of the flower-segments and this gives the special character to the flower. There are five well-marked sections:

(1) The hoop-petticoat narcissi are not more than from 4 to 12 in. in height and have grassy foliage and yellow or white flowers. These have the corona in the centre of the flower very large in proportion to the other parts, and much expanded, like the old hooped petticoats. They are all regarded as varieties or forms of the common hoop-petticoat, *N. Bulbocodium,* which has comparatively large bright yellow flowers.

(2) A second group is that of the pseudo-narcissi, of which the daffodil, *N. pseudo-narcissus,* is the type. The daffodil is common in woods and thickets in most parts of the north of Europe. Its leaves are about 1 ft. in length and 1 in. in breadth, and have a blunt keel and flat edges. The stem is about 18 in. long and the spathe single-flowered. The flowers are large, yellow, scented and a little drooping, with a corolla deeply cleft into six lobes and a bell-shaped corona which is crisped at the margin; they appear in March or April. In this species the corona is also very large and prominent.



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NARCISSUS (NARCISSUS TAZETTA)

(3) Another group, with coronas of medium size, includes the fine and numerous varieties of *N. incomparabilis,* one of which, with large, double flowers, is known as butter-and-eggs; *N. odorus,* known as the campernelle jonquil, has two to four uniform bright yellow flowers and is considered a hybrid between *N. Jonquilla* and *N. pseudo-narcissus* although it is found wild in France and Spain.

(4) The polyanthus or bunch narcissi form another well-marked group, whose peculiarity of producing many flowers on the stem is indicated by the name. In these the corona is small and shallow as compared with the perianth. *N. Tazetta* is the type of this group. They are general favourites among spring flowers. The "Chinese sacred lily" or joss flower is a variety of *N. Tazetta.* The jonquil, *N. Jonquilla,* with yellow flowers, a native of south Europe and Algeria, is also grown in pots for early flowering, but does well outside in a warm border.

(5) There remains another little group, the poet's or pheasant's-eye narcissi (*N. poeticus*), in which the perianth is large, spreading and conspicuous and the corona very small and shallow. These pheasant's-eye narcissi, of which there are several well-marked varieties, blossom in succession during April and May and all do well in the open borders as permanent hardy bulbs. They are often grown in rock gardens.

See F. W. Burbridge, *The Narcissus* (1875); a scientific treatment of the genus will be found in J. G. Baker's *Handbook of Amaryllideae* (1888); *see* also J. Weathers, *Practical Guide to Garden Plants* (1901); Sanders, *Encyclopaedia of Gardening* (1912); L. H. Bailey, *The Standard Cyclopedia of Horticulture* (1933) and the group system adopted by the Royal Horticultural society (1929).

NARCOTICS, a general term for substances which produce lethargy or stupor and the relief of pain. In a restricted sense, the term applies to opium (*q.v.*) or coca leaves or any compound, manufacture, salt or preparation thereof, even though their action is not narcotic. Prescriptions for these substances in most countries require that the prescribing physician be registered with the proper governmental agency (department of internal revenue in the U.S.) and comply with the regulations furnished by that agency. (*See* DRUG ADDICTION; MEDICAL LEGISLATION.)

(F. L. A.)

NARCOTINE, $C_{22}H_{23}NO_7$, an alkaloid (*q.v.*) found in opium, in amounts varying from 1% to 10%. It was first isolated pure by Pierre Robiquet in 1817 but was not synthesized until 1911 (W. H. Perkin, Jr., and Robert Robinson). It belongs to the benzylisoquinoline group of alkaloids and differs from hydrastine (*q.v.*) only in containing an additional methoxyl (OCH_3) group. Narcotine crystallizes from alcohol in colourless prisms melting at 176° C.; it is slightly soluble in hot water, sparingly in alcohol or benzene and soluble in chloroform. The specific rotation is −198° (in chloroform), but solutions in acids are dextrorotatory. Narcotine is a weak base, without effect on litmus, and as such its salts with acids are largely broken down into the components by water. It dissolves in hot alkali, but is thereby changed chemically (hydrolysis of a lactone ring). Narcotine is relatively inert physiologically, and is used chiefly in the manufacture of cotarnine. The latter is formed, together with opianic acid $C_{10}H_{10}O_5$, through an oxidative hydrolysis, by the action of nitric acid, manganese dioxide or other oxidizing agents. Cotarnine, $C_{12}H_{15}NO_4$, discovered by Friedrich Wöhler (1844), forms colourless needles that melt at 132° C. The salts with acids are formed with loss of a molecule of water and are yellow. Cotarnine chloride (stypticin), $C_{12}H_{14}NO_3Cl+2H_2O$, and the phthalate (styptol) are used as haemostatic agents to check uterine bleeding.

(L. F. SL.)

NARDI, JACOPO (b. 1476), Florentine historian, occupied various positions in the service of the Florentine republic after the expulsion of the Medici in 1494, and even on their return in 1512 he continued in the public service.

In 1527 he joined in the movement for the expulsion of the family and was instrumental in defeating the Medicean troops under Cardinal Passerini, who were attacking the Palazzo della Signoria. When the Medici again definitely became masters of Florence in 1530, Nardi was exiled from the city and his property confiscated. He spent the rest of his days in various parts of Italy, chiefly in Venice, and wrote a statement of the claims of the Florentine exiles against the Medici, addressed to the emperor Charles V. His chief work was *Istorie della Città di Firenze,* covering the period from 1498 to 1538, in part based on Biagio Buonaccorsi's *Diario.*

L. Arbib's edition of Nardi's history (Florence, 1842) and Agenore Gelli's edition (Florence, 1888) contain a biography of the author.

NARDINI, PIETRO (1722–1793), Italian violinist and composer, was born at Fibiana in Tuscany in 1722. He studied violin and composition at Leghorn and later became a pupil of Giuseppe Tartini at Padua.

For 15 years he held an appointment at the court of Stuttgart as solo violinist. In 1767 he settled at Leghorn and was with Tartini in his last illness. He became music director to the duke of Tuscany in 1770 and enjoyed great fame as a performer and composer. He died at Florence on May 7, 1793. Nardini is remembered as Tartini's most famous pupil, and as the composer of many graceful compositions for the violin. His music is melodious and eminently playable, and has an educational value in respect of technique. Modern reprints of the sonatas are found in Alard's *Maîtres classiques,* in David's *Hohe Schule des Violinspiels* and in Jensen's *Classische Violinmusik.*

NARES, SIR GEORGE STRONG (1831–1915), English arctic explorer, son of a captain in the navy, was educated at the Royal Naval college at New Cross and entered the navy in 1846. He served on the Australian station, was mate of the "Resolute" in the arctic expedition of 1852 and then served in the Crimea. He was then employed in surveying work on the northeast coast of Australia and in the Mediterranean. While in command of the "Challenger" (1872–74), in the famous voyage of deep-sea exploration round the world, he was ordered home to take command of the arctic expedition which set sail in the spring of 1875 in the ships "Alert" and "Discovery." For his services he was made K.C.B. (1876). Two years later he was sent in command of the "Alert" to survey Magellan strait. He retired from active service in 1886, and became a vice-admiral in 1892. He died at Surbiton, Surrey, on Jan. 15, 1915.

He published *Reports on Ocean Soundings and Temperature* (1874–75); and *Narrative of a Voyage to the Polar Sea during 1875–76*, 2 vol. (1878).

NARES, JAMES (1715–1783), English organist and composer, was born at Stanwell, Middlesex, in 1715. His family moved to Oxfordshire, and Nares, as chorister in the Chapel Royal, became a student of William Croft (*q.v.*) and Bernard Gates; he was later a student of John Christopher Pepusch (*q.v.*).

In 1734 Nares, who had been assistant to Francis Pigott, organist at St. George's chapel, Windsor, was appointed organist of York cathedral. Named organist and composer to the king in 1756, he became in 1757 master of the children at Chapel Royal, succeeding his former teacher, Bernard Gates. The Catch club, founded in London in 1761 to encourage the composition and performance of vocal music, awarded him a prize in 1770 for his glee "To all Lovers of Harmony." In July 1780 he resigned from his post at Chapel Royal, and on Feb. 10, 1783, he died in London.

Nares's works include three collections of harpsichord lessons (1748, 1758, 1759); two treatises on singing; *Il Principio, or, A Regular Introduction to Playing on the Harpsichord or Organ* (1759); *The Royal Pastoral* (1767), a dramatic ode; a collection of catches and glees (*c.* 1780); six organ fugues; 20 anthems (1778); and a number of services, canons, and rounds.

NAREW, BATTLES OF THE. The battles on the river Narew, north-east of Warsaw, in July and Aug. 1915, were a part of the great offensive planned by Falkenhayn against Russia. During May and June, Mackensen had driven the Russian armies in Galicia from Tarnów on the Dunajec to the east of Lemberg (*see* DUNAJEC SAN, BATTLES OF THE; LEMBERG, BATTLES OF). In July the group of armies under his command was directed north-east toward Brest-Litovsk against the communications of the Russian forces which still held the Warsaw salient (*see* BREST-LITOVSK, BATTLES OF). Hindenburg, who commanded the group of armies on the northern part of the eastern front, was now ordered to strike a blow on the north side of the salient. Falkenhayn hoped thus by driving in the flanks of the salient to cut off large numbers of Russians in its apex about Warsaw. The realization of this hope depended, of course, on the rapidity with which the flanks could be forced.

Rival German Plans.—The operation against the Narew line provoked a controversy between the two men who had most influence on German strategy during the war, Falkenhayn and Ludendorff. The former was at this time chief of the German Great General Staff, and thus responsible for the supreme direction of the war; the latter was chief of staff to Hindenburg. Ludendorff had long cherished the idea of a Napoleonic manoeuvre against the Russian rear by Kovno and Wilno on Minsk, and considered the proposed Narew offensive as timid and ineffectual; Falkenhayn, with heavier responsibilities on his shoulders, mistrusted both the feasibility and the expedience of the Wilno adventure. He could not afford to become so deeply involved in the Eastern theatre as to be unable to withdraw troops to meet the coming offensive in the West. After a discussion of the alternative plans held in the presence of the kaiser, Falkenhayn's views were approved; and Hindenburg was ordered to carry out the Narew attack.

A formidable water barrier protects Russian Poland against invasion from East Prussia, formed by the Niemen, the Bobr, the Narew and the lower course of the Bug, and thence the Vistula to the frontier. The Russians had fortified this river line. Besides the fortresses of Kovno and Grodno, Osoweic, Lomza and Nowa-Georgiewsk, there were fortified bridge-heads on the Narew at Ostroleka, Rozan, Pultusk and Zegrze. Though the river was fordable in the summer at many points, marshes along its length increased its effectiveness as an obstacle.

The German Attack.—Gallwitz's army, which was to make the attack, comprised six corps (14 divisions). Opposite to it, on the lower Vistula, lay the Russian I. Army (Litvinov) with three corps and a cavalry corps.

The tactical details of the fighting are not of any special interest. On July 13 Gallwitz delivered his first attack on the approximate line Przasnysz-Ciechanów, aiming at Pultusk. The Russians, over-weighted both in numbers and heavy artillery, at once fell back more than half-way to the Narew line. They were attacked again on July 15, and during July 18 and 19 withdrew across the river, the Russian XII. Army on their right conforming to the movement. Reinforcements had now arrived and resistance stiffened. Though the Germans stormed the bridge-heads of Pultusk and Rozan on July 23, and secured crossings over the river, their further progress was limited by violent Russian counter-attacks, and they were unable to reach the line Wyszków-Ostrów (on the lower Bug), at which they were aiming. An attempt to force a passage further east at Ostroleka on July 30 failed, and it was not until Aug. 4 that this bridge-head fell. Losses were heavy on both sides; but the Russians had secured time and space sufficient to evacuate the Warsaw salient without danger.

Hindenburg and Ludendorff naturally claimed that the result of the battle vindicated their opinion on the mistaken strategy of the Supreme Command. Falkenhayn retorted that the operations would have had the desired effect of intercepting the Russian retreat had Hindenburg used the full force available and given Gallwitz 20 divisions instead of 14. It seems doubtful, however, whether the communications would have allowed the effective employment of so large a force.

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NARNI (anc. Umbrian *Nequinum*, Rom. *Narnia*), a town and episcopal see of the province of Terni, Italy, 65 m. N. of Rome by rail. Pop. (1936) 4,306 (town), 17,660 (commune). It is picturesquely situated on a lofty rock (787 ft.). The cathedral and the portico of S. Maria Impensole are Romanesque; the former has some good Renaissance sculptures. There are other interesting churches and some picturesque Gothic houses and palaces. There are factories of linoleum and calcium carbide.

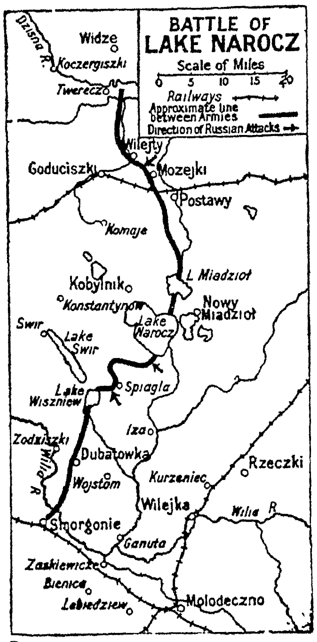
The Umbrian Nequinum was taken by the Romans in 299 B.C., and a colony planted there against the Umbrians. It was situated on the Via Flaminia, and one of the finest bridges of antiquity crosses the river below the town. The original main road ran to Nuceria by Mevania; a branch by Interamna and Spoletium joined it at Forum Flaminii. According to some authors, the emperor Nerva was born at Narnia. The town played a considerable part in military history. In the middle ages Narni was under the papal power. It was the birthplace of the well-known condottiere Erasmo Gattamelata (d. 1443), whose statue by Donatello is at Padua.

See G. Eroli, *Miscellanea Storica Narnese* (2 vols., Narni, 1858–1862), and other works by the same author.

NAROCZ, BATTLE OF LAKE. Lake Narocz, in Poland, 62 mi. E.N.E. of Wilno (Vilna), gives its name to a great offensive by the Russian 2nd Army in the spring of 1916. (*See* WORLD WAR I: *From Verdun to the Entry of America.*)

General Situation on the Eastern Front.—The river Pripet formed the dividing line between the German and Austrian commands. At the beginning of March there were 42 German and

two Austrian divisions on the front north of the Pripet, the total length of which was about 250 miles. The Russians had organized their armies into three groups: the northern (12th and 5th Armies) on the Dvina, the western (1st, 2nd, 10th, 4th and 3rd Armies) extending to south of the Pinsk marshes and the south-western (8th, 11th, 7th and 9th Armies) up to the Rumanian border. Their main strength was concentrated on the northern and western fronts, where it had been decided that the principal efforts of the year should be made. The losses of 1915 in men and material had been made good; guns and munition were available on a larger scale than previously, though still insufficient for the requirements of trench warfare.



PLAN OF THE BATTLE OF LAKE NAROCZ, MARCH 18, 1916

Plan of Operations.—The general idea of the battle was for the 2nd Army to attack on either side of Lake Narocz, where the German line formed a slight salient; the two wings were eventually to join and to continue their advance westwards to Panevežys (some 80m. N. of Wilno [Vilna] and 100m. W. of the original line), where the 5th Army, which was to attack from the Jakobstadt bridgehead on the Dvina, was to join them. The operation seems to have been planned originally to take place later in the year, when all the Allies proposed to attack simultaneously. But on Feb. 21 the German assaults on Verdun began, and the Russians chivalrously hurried on their preparations and attacked to relieve the pressure on the French, at the worst possible time of the year—when the annual thaw, which renders all communications practically impossible for a period, might be expected at any moment.

Description of the Terrain.—Lake Narocz (8m. by 6m.) is the largest of a whole series of small lakes in which the tributaries of the Wilia and the Dzisna rise. It drains into the River Narocz, which flows south to join the Wilia east of Smorgonie. The greater part of the trench line between Dvinsk and Smorgonie (over 100m. in a straight line) was protected by lake, stream or marsh, and stretches of dry ground wide enough for a large scale offensive were few. On either side of Lake Narocz, however, were gaps of four miles or so in the water line, where the terrain was comparatively favourable for attack, though communications were poor. The northern gap was ten miles to the north of Lake Narocz; the southern was between the lake itself and Lake Wiszniew.

Dispositions of the Opposing Forces.—The 2nd Army was divided into three groups: the right group (under Gen. Plyeshkov), opposite the northern gap, consisted of three corps and a cavalry corps; the centre group (under Gen. Sirelius), of two corps; and the left group (under Gen. Baluev), of three corps. Four corps were available behind these groups to exploit any success gained. The right and left groups were to attack the north and south faces of the salient respectively, while the centre group assisted by minor assaults and demonstrations. The army commander, Smirnov, fell sick just before the battle and his place was taken by Gen. Ragoza.

The 2nd Army was opposed by Von Eichhorn's 10th Army on a front of some 85 miles, comprising 11 divisions and two cavalry divisions. The Germans were aware of the Russian concentration.

The Russian Attacks.—A thaw set in on March 17, but the offensive was nevertheless begun on the 18th. After a bombardment of several hours, massed infantry attacks were made both by Plyeshkov's group north of Lake Narocz and by Baluev's group in the south. In the thickly wooded and enclosed terrain the insufficiently trained Russian infantry soon lost cohesion, and their assaults were ill-timed and disjointed. Though the German first-line trenches were in several cases occupied, they could not be held under the concentrated fire of the German artillery, which was extremely skilfully handled. By nightfall the Russians were back in their original positions, having suffered very heavy casualties without result. After two days of further artillery preparation and minor attacks intended to mislead the enemy, renewed heavy assaults were made on the nights of March 19–20 and 20–21.

On Plyeshkov's front no ground was permanently gained in spite of terrible losses, but Baluev's group in the south made an advance of over a mile on a front of about 2½ miles. The weather conditions were by now terrible; it thawed from the 17th to the 22nd, and the whole area of operations became a sea of mud. The battle was, however, continued till March 27, when the Russians at last desisted from their fruitless and costly attacks. In April a German counterstroke retook all the ground gained by Baluev. Meanwhile the attacks of the 5th Army from Jakobstadt, March 21–26, were equally unsuccessful and almost equally wasteful of life.

Results of the Operations.—The operations resulted in a complete and disastrous failure for the Russians. Their losses were over 100,000 and they accomplished nothing. The offensive did not cause the Germans to move a single man from the Western Front, and so brought no relief to the French. Both time and place were ill-chosen; the staff work was bad; and the artillery, in spite of a greater concentration of heavy guns on a narrow front and a more liberal expenditure of ammunition than ever before, failed to give proper support to the infantry, who, as usual, paid the price in terrible losses. The result was, in fact, a bitter disillusionment to the Russian high command, to the Russian soldier and to the Russian people.

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NARRA or **ASANÁ,** the local names (Philippine dialect) applied to some of the best timber trees, *Pterocarpus indicus*, *P. echinatus* and *P. blancoi* (family Leguminosae) in the Philippine archipelago. The wood is commonly known as "Philippine mahogany," and is in great demand for cabinet-work; it is usually of a beautiful red or rose colour, often variegated with yellow, and is hard and heavy. The trunk is surrounded (or, occasionally, supported) by huge buttresses extending outward and upward for 10 to 20 ft.; these are sometimes made into table-tops, the pattern of the grain and the colouring being hardly equalled by any other timber. The wood-cells contain a peculiar substance: a minute chip placed in a bottle of water soon gives an opalescent colour to the liquid. Narra is known as Burmese rosewood, Andaman redwood and Kiabooca-wood.

NARRAGANSETT PIER, a summer resort of Washington county, Rhode Island, U.S.A., on the west shore of Narragansett bay, 30 mi. S. of Providence. It is on federal highway 1, and is served by the Narragansett Pier railroad, connecting at Kingston (9 mi. N.W.) with the New York, New Haven and Hartford. The town of Narragansett, in which it is situated, had a resident population of 2,275, 1950 (federal census). "The Pier" consists of a group of hotels, a casino and a bathing pavilion, on a crescent-shaped beach (one of the finest on the Atlantic coast), and an avenue (lined on both sides with palatial summer "cottages") running down the rocky promontory to Point Judith (5 m. S.), where there is a lighthouse and a country club. Narragansett Pier was so named from the wharves built late in the 18th century to provide a port for southern Rhode Island, but none of them are left. Development as a summer resort began about the middle of the 19th century, and the railroad from Kingston was completed in 1876. It has always had a considerable number of visitors from the South.

NARSES (*c.* 478–573), an important officer of Justinian, in the 6th century. He was a eunuch of Persamenia, and apparently born about 478. If the statement that he died at the age of ninety-five be correct, he was probably brought young to Constantinople,

and attained a footing in the *officium* of the grand chamberlain. He rose to be one of the three "chartularii," a position involving the custody of the archives of the household. Hence, probably in middle life, he became "praepositus sacri cubiculi."

In 532 the insurrection known as the Nika broke out in Constantinople, when for some hours the throne of Justinian seemed doomed to overthrow. It was saved partly by the courage of his wife, Theodora, and partly by the timely prodigality of Narses, who with large sums of money bribed the leaders of the "blue" faction, which was aforetime loyal to the emperor, to shout as of old "Justiniane Auguste tu vincas." He defeated Totila in 552, with whom fell the last hopes of the Gothic kingdom of Italy.

NARSINGARH, an Indian state in the Bhopal agency of Central India. Area 731 sq.mi.; pop. (1941) 125,178. The chief, whose title is rajah, is a Rajput of the Umat clan. The state was founded about 1681 by a minister of Rajgarh, who compelled the ruler of that state to transfer to him half his territory. The rajah has a salute of 11 guns. The town of Narsingarh had a population in 1931 of 9,241.

NARTHEX, in architecture, a long, narrow porch, usually colonnaded or arcaded, at the entrance of a church. In the early days of Christianity it was the only portion of the church to which catechumens and penitents were admitted. Occasionally an additional vestibule exists within the church building proper. In this case, the inner vestibule is called the narthex and the outer porch an exonarthex. The narthex is common in basilican, Byzantine and some Romanesque churches, particularly in Italy; in the Gothic period its use had almost entirely disappeared, but during the Renaissance it is again found, although its ritual usage had entirely died out, and it had become a simple porch or vestibule.

NARVA, a seaport of Estonia in 59° 23′ N., 28° 12′ E., on the Narova river, 8 mi. above the entry into Narva bay on the Gulf of Finland. Est. pop. (1939) 24,200. With it is associated Narva-Joesuu (Hungerburg) in 59° 28′ N., 28° 2′ E. Pop. 1,635. Vessels of 15½ to 16 ft. draught can load in its harbour. The chief imports are cotton, rye, salt, herrings and coal, and the exports textiles, timber (pit-props, battens, etc.,) spirits and bricks. Fortress Hermann on the west bank and fortress Ivangorod directly across the river dominate the town. The textile mills just above Narva escaped general destruction in World War I partially because of production for the Tsarist army. The cotton mills were closed for two years but eventually resumed production with only 2,000 workers as against 11,000 in 1914. The woollen, flax and jute mills were similarly reduced because Russia, previously the best customer, ceased buying. Estonia developed as a dairy country, and the textile industry was only partially revived. Founded by the Danes in 1223, the town changed hands among the Teutonic Knights, Danes, Swedes and Russians until its capture by Peter the Great in 1704, after which it remained under Russian rule until Estonia obtained independence in 1918–20. Russia again occupied Narva in 1940–41, and it was captured in 1941 by the Germany army.

NARVACÁN, a municipality (with administrative centre and 31 *barrios* or districts) of the province of Ilocos Sur, Luzon, Philippine Islands, near the coast and on the main road 13 mi. S.S.E. of Vigan, the provincial capital. Pop. (1939) 22,769; three were white. It lies in a level valley surrounded by mountains, and the soil of the locality produces palay (rice), maize (corn), cotton, tobacco, maguey and sugar. The women weave cotton cloth for trade with the primitive mountaineers. Ilocano is the vernacular. Of the inhabitants aged 6 to 19 inclusive, 42·8% were reported in 1939 as attending school, while 56·2% of the population 10 years old and over was reported as literate.

NARVAEZ, PÁNFILO DE (*c.* 1480–1528), Spanish adventurer, born at Valladolid. He helped Velasquez in the reduction of Cuba and was put at the head of the force sent to the Aztec coast to compel Cortes to renounce his command. He was defeated by his compatriot and made prisoner (1520). On his return to Spain he obtained from Charles V. a grant of Florida as far as the river of Palms: landing near Pensacola bay in April 1528, he struck inland with some 300 of his followers and reached "Apalache" on June 25. Disillusioned in their hopes of fabulous wealth, they made for the coast, arriving in July at the Bahia de los Caballos, at or near St. Mark's. Having built rude boats, the much-reduced company sailed on Sept. 22, for Mexico, but the vessel which carried Narvaez perished in the storm. His lieutenant, Cabeza de Vaca, and three others ultimately reached the Gulf of California by way of Texas. (*See* FLORIDA.)

See W. H. Prescott, *Conquest of Mexico;* H. H. Bancroft, *Mexico* (1882–90); *Naufragio de Alvaro Nunez Cabeza de Vaca* (Bib. de Autores Esp., xxii.).

NARVAEZ, RAMÓN MARÍA (1800–1868), Spanish soldier and statesman, born at Loja, Granada on Aug. 4. 1800. He served under Mina in Catalonia in 1822. As one of the Conservative supporters of Isabella II. he achieved great popularity by his victory over Gomez, the Carlist general, near Arcos, in Nov. 1836, and after clearing La Mancha of brigands in 1838 he was appointed captain-general of Old Castile, and commander-in-chief of the army of reserve. After taking part in the Seville insurrection (1840) against Espartero and the Progresista party, he fled to France and planned with Maria Cristina the expedition of 1843, which led to the overthrow of his adversary. Prime minister, field-marshal, and duke of Valencia in 1844, his reactionary policy culminated in his having to quit office in Feb. 1846. He became ambassador at Paris, returned (1847) to preside over the council of ministers and resigned (1848) through misunderstandings with Maria Cristina. His ministry succeeded O'Donnell's in 1856–57, 1864–65 and in July 1866. He died at Madrid April 23, 1868.

NARVIK, an ice-free seaport on the Ofoten fjord of the northwest coast of Norway, in Nordland *amt* (county), 68° 30′ N. Pop. (1936) 10,500. It is wholly modern, developed by the construction and completion (1903) of the Lapland railway, the most northerly in the world. From the extensive quays is shipped the iron ore from the Kiruna-Gellivara region across the mountains in Sweden. Narvik is 167 mi. N.W. of Gellivara, 982 mi. from Stockholm by rail. In the warfare of April and May, 1940 British and French recaptured the city and most of the railway from the Germans, then withdrew because of the threat in France.

NARWHAL, a cetacean (*Monodon monoceros*), characterized by the presence in the male of a long horn-like tusk. In the adult of both sexes there are only two teeth, both in the upper jaw, which lie horizontally side by side, and in the female remain throughout life concealed in cavities of the bone. In the male the right tooth usually remains similarly concealed, but the left is immensely developed, attaining a length equal to nearly that of the entire animal. It projects forwards from the head in the form of a cylindrical or slightly tapering, pointed tusk, composed of ivory, with a central cavity reaching almost to the apex, without enamel, and with the surface marked by grooves and ridges running in a left-handed spiral. Occasionally both left and right tusks are developed. In young animals several small additional teeth are present, but these generally disappear soon after birth.

The head is short and rounded; the fore limbs or paddles are small and broad, and (as in the Beluga) a dorsal fin is wanting. The general colour is dark grey variously marbled and spotted with grey.

The narwhal is an Arctic whale rarely seen south of 65° N. lat. Like most cetaceans it is gregarious and usually met with in "schools" of 15 or 20 individuals. Its food appears to be cuttlefishes, small fishes and crustaceans. The purpose served by the tusk is uncertain. The narwhal is extremely playful, individuals frequently elevating their tusks and crossing them with each other as in fencing. They have never been known to charge and pierce the bottom of ships with their weapons as the swordfish does. The ivory of the tusk is of good quality, but owing to the central cavity, only fitted for the manufacture of objects of small size. The entire tusks are sometimes used for decorative purposes. (*See* CETACEA.)

NASCIMENTO, FRANCISCO MANOEL DE (1734–1819), Portuguese poet, known as Filinto Elysio, his "Arcadian" name, though he was never a member of the Arcadia and later was a leader of the revolt against it, was born in Lisbon, the son of a lighterman. As a boy he acquired an extensive knowledge

of national literature and folklore, the foundation of his rich Portuguese vocabulary and of a deep and enduring patriotism. He was ordained priest in 1754, and became treasurer of the Chagas church in Lisbon. Nascimento was soon the centre of a literary group which opposed the ruling group of the Arcadia, and fought for the recognition of Camoens as the greatest of Portuguese poets. But in June 1778 an order was issued by the inquisition for the arrest of Nascimento on the ground of heterodoxy and the reading of "modern philosophers who follow natural reason." He escaped to a French ship in the harbour, found his way to Havre and then to Paris, where he spent the rest of his life, with the exception of five years in the house of the Portuguese ambassador at The Hague. Lamartine addressed an ode to him; he enjoyed the esteem of Chateaubriand; and his admirers at home, who imitated him extensively, were called after him *Os Filintistas.* Exile and suffering had enlarged his ideas and given him a sense of reality, making his best poems those he wrote between the ages of 70 and 85, and when he died it was recognized that Portugal had lost her foremost contemporary poet.

Garrett declared that Nascimento was worth an academy in himself by his knowledge of the language, adding that no poet since Camoens had rendered it such valuable services; but his truest title to fame is that he brought literature once more into touch with the life of the nation. By his life, as by his works, Nascimento links the 18th and 19th centuries, the Neo-Classical period with Romanticism. Wieland's *Oberon* and Chateaubriand's *Martyrs* opened a new world to him, and his *contos* or scenes of Portuguese life have a real romantic flavour; they are the most natural of his compositions, though his noble patriotic odes—those "To Neptune speaking to the Portuguese" and "To the liberty and independence of the United States"—are the most quoted and admired. On leaving Portugal, he abandoned the use of rhyme as cramping freedom of thought and expression; nevertheless, his highly-polished verses are generally robust to hardness and overdone with archaisms.

BIBLIOGRAPHY.—The most useful edition of his collected works is that in 22 vols., 1836–40. *See* Innocencio da Silva, *Diccionario bibliographico Portuguez,* ii. 446–457 and ix. 332–336; also Pereira da Silva, *Filinto Elysio e a sua Epoca* (Rio, 1891); and Dr. Theophilo Braga, *Filinto Elysio* (Oporto, 1891).

NASEBY, a village of Northamptonshire, England, 7m. S.S.W. of Market Harborough, famous as the scene of the battle of June 14, 1645, which decided the issue of the first Civil War (*see* GREAT REBELLION). The army of King Charles I. was less than 10,000 strong, while the "New Model" army of the parliament, commanded by Sir Thomas Fairfax, numbered some 13,000. Yet it was not without considerable hopes of victory that the Royalists drew up for battle, for although Lieutenant-General Cromwell had made the New Model cavalry formidable indeed, the Royalist foot had become professionalized in several years of war, whereas the Parliamentarian foot was newly organized, and in part at least but half-trained. Fairfax and Cromwell, however, were still more confident, and with better reason. The battlefield lies between Naseby and Sibbertoft (3m. N. of Naseby) and is an undulating ridge which, near the centre of England, forms the "divide" between the Avon and the Welland rivers. Across this ridge the two armies were drawn up, the New Model facing north and the king's army south, the horse on the flanks and the foot in the centre of each army.

At the first shock the Royal foot asserted its superiority over the opposing infantry, four out of five regiments in the first line were broken, and Skippon, the major-general of the foot, was wounded. But Fairfax's regiment held its ground, until the second line of infantry advanced and re-established the front. Meantime the Royalist right wing of horse, led by Prince Rupert, had completely routed the horse of Colonel Ireton which opposed them. But the victors as usual indulged in a disorderly pursuit, and attempted to overpower the baggage guard of the enemy near Naseby village. Their incoherent attack was repulsed, and when Rupert, gathering as many of his men as he could, returned to the battlefield, the decisive stroke had been delivered by Cromwell and the right wing of Parliamentary horse. In front of him, in somewhat broken ground, was Sir Marmaduke Langdale's cavalry, which the lieutenant-general with his own well-trained regiments scattered after a short, fierce encounter. Cromwell's "godly" troopers did not scatter in pursuit. A few squadrons were ordered to keep the fugitives on the run, and with the rest, and such of Ireton's broken troops as he could gather, Cromwell attacked the Royalist centre in rear while Fairfax and his foot pressed it in front. Gradually the Royalist infantry, inferior in numbers, was disintegrated into small groups, which surrendered one after the other. But one brigade, called the "Bluecoats," held out to the last, and was finally broken by a combined charge of Fairfax's regiment of foot, led by Cromwell, and the general's personal escort, led by Fairfax himself, who captured a colour with his own hand. The remnant of the king's army, re-formed by Rupert, stood inactive and irresolute while its infantry was being destroyed and then fled. The spoils included 100 standards and colours and the king's private papers. But more important than trophies was the practical annihilation of the last field army of which the king disposed. Half the Royalists were captured, and about 1,000 fell in the battle and the pursuit. In addition all the artillery and the muskets (to the number of 8,000) and ammunition without which the king could scarcely create a new army were lost.

NASH, PAUL (1889–1946), British painter, was born in London on May 11, 1889, and educated at St. Paul's school and at the Slade school. His first exhibition was given in 1911, but he was comparatively little known until an exhibition of his western front war pictures (1918), the fruit of his work as an official artist 1917–18; several of these are in the Imperial War museum, London. He then attracted attention as a landscape painter of individuality and charm, a somewhat mannered technique giving way gradually to a freer expression; he gave an important exhibition in London in 1924. He also produced some interesting woodcuts and book illustrations, such as the wood engravings, "Genesis" (1924). He was instructor of design at the Royal College of Art, South Kensington, 1924–25. He was also an official artist during World War II. He died on July 11, 1946.

NASH, RICHARD (1674–1762), English dandy, better known as "Beau Nash," was born at Swansea on Oct. 18, 1674. He was educated at Carmarthen grammar school and at Jesus college, Oxford. He obtained a commission in the army, which however, he soon exchanged for the study of law at the Temple. Here among "wits and men of pleasure" he came to be accepted as an authority in regard to dress, manners and style. When the members of the Inns of Court entertained William III. after his accession, Nash conducted the pageant at the Middle Temple. He was offered knighthood, but he declined the honour, unless accompanied by a pension. The pension was not given and Nash turned gamester. In 1705 he succeeded Captain Webster as master of the ceremonies at Bath. Under his régime Bath became the leading fashionable watering-place. He drew up a new code of rules for the regulation of balls and assemblies, abolished the habit of wearing swords in places of public amusement and brought duelling into disrepute, induced gentlemen to adopt shoes and stockings in parades and assemblies instead of boots, reduced refractory chairmen to submission and civility, and introduced a tariff for lodgings. Through his exertions a handsome assembly-room was also erected, and the streets and public buildings were greatly improved. Nash adopted an outward state corresponding to his nominal dignity. He wore an immense white hat as a sign of office, and a dress adorned with rich embroidery, and drove in a chariot with six greys, laced lackeys and French horns. When the act of parliament against gambling was passed in 1745, he was deprived of an easy though uncertain means of subsistence, but the corporation afterwards granted him a pension of six score guineas a year, which, with the sale of his snuff-boxes and other trinkets, enabled him to support a certain faded splendour till his death on Feb. 3, 1762. He was honoured with a public funeral at the expense of the town. He was a man of strong personality, and considerably more able than Beau Brummell, whose prototype he was.

See Oliver Goldsmith, *Life of Richard Nash* (1762); Lewis Melville, *Bath under Beau Nash* (1908), with full list of authorities.

NASHE (or NASH), **THOMAS** (1567–1601), English poet, playwright and pamphleteer, was born at Lowestoft in 1567. His father belonged to a Herefordshire family, and is vaguely described as a "minister." Nashe spent 6 years, 1582–1588, at St. John's College, Cambridge, taking his B.A. degree in 1586. On leaving the university he tried, like Greene and Marlowe, to make his living in London by literature. It is probable that his first effort was *The Anatomie of Absurditie* (1588) which was perhaps written at Cambridge, although he refers to it as a forthcoming publication in his preface to Greene's *Menaphon* (1589). In this preface, addressed to the gentlemen students of both universities, he makes boisterous ridicule of the bombast of Thomas Kyd and the English hexameters of Richard Stanihurst, but does not forget the praise of many good books. Nashe was really a journalist born out of due time; he boasts of writing "as fast as his hand could trot"; he had a brilliant and picturesque style which, he was careful to explain, was entirely original; and in addition to his keen sense of the ridiculous he had an abundance of miscellaneous learning.

As there was no market for his gifts he fared no better than the other university wits who were trying to live by letters. But he found an opening for his ready wit and keen sarcasm in the famous Martin Marprelate controversy. His share in this war of pamphlets cannot now be accurately determined, but he has been credited, on doubtful evidence, with the following: *A Countercuffe given to Martin Junior* (1589), *Martins Months Minde* (1589), *The Returne of the renowned Cavaliero Pasquill and his Meeting with Marforius* (1589), *The First Parte of Pasquils Apologie* (1590), and *An Almond for a Parrat* (1590). He edited an unauthorized edition of Sidney's poems in 1591, and *A Wonderfull Astrologicall Prognostication,* in ridicule of the almanacmakers, by "Adam Fouleweather," which appeared in the same year, has been attributed to him. *Pierce Penilesse, His Supplication to the Divell,* published in 1592, shows us his power as a humorous critic of national manners, and tells incidentally how hard he found it to live by the pen. It seems to Pierce a monstrous thing that brainless drudges wax fat while "the seven liberal sciences and a good leg will scarce get a scholar bread and cheese."

In this pamphlet, too, Nashe began his attacks upon the Harveys by assailing Richard, who had written contemptuously of his preface to Greene's *Menaphon.* Greene died in September 1592, and Richard's brother, Gabriel Harvey, at once attacked his memory in his *Foure Letters,* at the same time adversely criticizing *Pierce Penilesse.* Nashe replied, both for Greene and for himself, in *Strange Newes of the intercepting certaine Letters,* better known, from the running title, as *Foure Letters Confuted* (1592), in which all the Harveys are violently attacked. The autumn of 1592 Nashe seems to have spent at or near Croydon, where he wrote his satirical masque of *Summers Last Will and Testament* at a safe distance from London and the plague. He afterwards lived for some months in the Isle of Wight under the patronage of Sir George Carey, the governor. In 1593 he wrote *Christs Teares over Jerusalem,* in the first edition of which he made friendly overtures to Gabriel Harvey. These were, however, in a second edition, published in the following year, replaced by a new attack, and two years later appeared the most violent of his tracts against Harvey, *Have with you to Saffron-walden, or, Gabriell Harveys Hunt is up* (1596). In 1599 the controversy was suppressed by the archbishop of Canterbury.

After Marlowe's death Nashe prepared his friend's unfinished tragedy of *Dido* (1596) for the stage. In the next year he was in trouble for a play, now lost, called *The Isle of Dogs,* for only part of which, however, he seems to have been responsible. The "seditious and slanderous matter" contained in this play induced the authorities to close for a time the theatre at which it had been performed, and Ben Jonson (*q.v.*) and others were imprisoned. Apparently Nashe escaped. Besides his pamphlets and his play-writing, Nashe turned his energies to novel-writing. He may be regarded as the pioneer in the English novel of adventure. He published in 1594 *The Unfortunate Traveller, Or the Life of Jack Wilton,* the history of an ingenious page who was present at the siege of Térouenne, and afterwards travelled in Italy with the earl of Surrey. It tells the story of the earl and Fair Geraldine, describes a tournament held by Surrey at Florence, and relates the adventures of Wilton and his mistress Diamante at Rome after the earl's return to England. The detailed, realistic manner in which Nashe relates his improbable fiction resembles that of Defoe.

His last work is entitled *Lenten Stuffe* (1599) and is nominally "in praise of the red herring," but really a description of Yarmouth, to which place he had retired after the trouble over *The Isle of Dogs.* Nashe's death is referred to in Thomas Dekker's *Knight's Conjuring* (1607), a kind of sequel to *Pierce Penilesse.* He is there represented as joining his boon companions in the Elysian fields "still haunted with the sharp and satirical spirit that followed him here upon earth." Had his patrons understood their duty, he would not, he said, have shortened his days by keeping company with pickled herrings. The date of his death is fixed by an elegy on him printed in Fitzgeffrey's *Affaniae* (1601).

The works of Thomas Nashe were edited by Dr. A. B. Grosart in 1883–85, and by Ronald B. McKerrow (1904–1910). *See* also *English Novel in the Time of Shakespeare,* by J. J. Jusserand (Eng. trans., 1890); and F. G. Harman, *Gabriel Harvey and Thomas Nashe* (Ouseley, 1923).

NASHUA, a city of southern New Hampshire, U.S.A., on the Merrimack river at the mouth of the Nashua, 15 mi. S. of Manchester and 40 mi. N.W. of Boston; one of the county seats of Hillsboro county. It is on federal highway 3, and is served by several divisions of the Boston and Maine railroad. Pop. (1950) 34,666; (1940) 32,927 by the federal census.

Nashua is beautifully situated in an amphitheatre of hills and mountains. There is abundant water power, and the city has extensive manufactures (notably of cotton goods, paper, asbestos, shingles, shoes, machinery and refrigerators). A U.S. fish hatchery is near by.

A settlement known as Indian Head was established there in 1665. In 1803 it was incorporated as the village of Nashua, and in 1836 the town of Dunstable (in which it was situated) took the same name. The town of Nashville was set off from the town of Nashua in 1842, but the two were reunited in 1853 under a city charter.

NASHVILLE, the capital city of Tennessee, U.S., a port of entry, and the county seat of Davidson county; on the Cumberland river in the north central part of the state. It is on federal highways 31, 41 and 70; has two municipal airports; and is served by the Louisville and Nashville, the Nashville, Chattanooga and St. Louis and the Tennessee Central railways, by American and Eastern air lines, motorbus lines and river barges. Pop. (1950) 173,359; it was 167,402 in 1940 (28.3% Negroes and 99.1% native-born).

The city covers 22.327 sq.mi., on hills and bluffs averaging 500 ft. above sea level, in a vast undulating elliptical valley of 5,450 sq.mi. The surrounding country is a blue-grass region of great fertility. Within 25 mi. of the city practically everything is raised that is needed for food and clothing and most of the necessities of life are manufactured. Seven bridges cross the river. On the highest hill stands the state capitol, a fine example of pure Greek architecture, with a cupola 205 ft. high.

The tomb of Pres. James K. Polk is on the capitol grounds, and 11 mi. east of the city is "The Hermitage," the beautiful plantation home of Pres. Andrew Jackson. In Centennial park, where the Tennessee Centennial exposition was held in 1897, is a reconstruction of the Parthenon. Mt. Olivet cemetery contains a beautiful monument to the Confederate soldiers, surrounded by 2,000 of their graves, and north of the city is a national cemetery where 16,862 Federal soldiers are buried. A memorial to the soldiers and sailors of World War I (covering two blocks and containing a large auditorium) was erected by the city, the county and the state, at a cost of $2,600,000. The Tennessee state fair is held at Nashville annually.

Many of the state institutions are situated in Nashville, including the Tennessee Industrial school, the Tennessee School for the Blind, the Central State Hospital for the Insane, the penitentiary, and the Training and Agricultural school for boys.

The public parks cover 3,618 ac.; the hotels have 2,000 guest-rooms; there are 366 churches, including a Roman Catholic cathedral, 49 public schools and 50 under private auspices. The city's assessed valuation for 1949 was $232,513,451. It operates under a councilmanic form of government with a mayor as administrative head.

Nashville is one of the foremost educational centres in the south. Vanderbilt university (founded in 1873 by Commodore Vanderbilt) has grounds and buildings valued at $9,772,685, endowment of $31,255,787 and an enrolment (1949–50) of 3,397. Its medical school was housed in 1925 in a well equipped and comprehensive plant, built with grants from the General Education board and the Carnegie corporation and earlier gifts from Andrew Carnegie.

The George Peabody College for Teachers (opened as a normal school in 1875) has an endowment of $4,607,261 and an enrolment (1949–50) of more than 3,000.

Fisk university (for Negroes), started in 1865 by the American Missionary association and the Western Freedmen's Aid commission, has buildings and grounds valued at $1,770,561, endowment funds of $4,486,947, and an annual enrolment of about 900. The Fisk Jubilee Singers, sent out first in 1871 to raise money for a dormitory for women, have sung in most of the large cities of America and Europe.

Nashville is also the seat of the Tennessee Agricultural and Industrial State college and the Meharry Medical college (both for Negroes).

The Nashville industrial area manufactures a variety of products. Ranking first is the manufacture of chemicals for industrial, commercial and agricultural use, including production of rayon and cellophane. Of major importance is the printing and publishing industry, especially the production of religious periodicals and books.

Other manufactures are food, clothing, shoes, textile products, lumber and building materials, heating and cooking equipment, furniture and transportation equipment.

History.—In Nov. 1779, James Robertson and a party of companions, who had set out in February from the Watauga settlements in eastern Tennessee to establish an "advance guard of civilization" in the rich central basin, arrived at the spot where Nashville now stands, and decided to make it the site of the new settlement. They were joined a few months later by their wives and children and other pioneers, under Col. John Donelson. The town (called Nashborough until its incorporation in 1784) was named for Francis Nash of North Carolina, a Revolutionary general, killed at Germantown.

In 1806 Nashville was chartered as a city. From 1812 (except from 1815 to 1826) the legislature met there, and in 1843 it was made the State capital.

On June 3, 1850, it was the scene of the Southern, or Nashville, convention, attended by 100 delegates from nine states, which denounced the Wilmot Proviso and (at an adjourned meeting in November) expressed disapproval of the Compromise Measures and asserted the right of the south to secede. For the battle of Nashville (1864) *see* below. During World War I the government established the Old Hickory Powder plant across the river, constructing large factory buildings and a village to accommodate 30,000 persons. (X.)

BATTLE OF NASHVILLE

During the Civil War Nashville was captured by the Federals (Feb. '62) after the fall of Fort Donelson and remained in their hands till the end. The battle of Nashville was fought (Dec. 15–16, '64) between a Federal army under G. H. Thomas and *Hood's* Army of Tennessee, and resulted in the complete overthrow of the Confederates. *Hood* had reached the Tennessee at Tuscumbia at the end of October, but waited there three weeks to accumulate a stock of supplies and enable *Forrest's* cavalry to join him. This delay proved fatal to his chance of capturing Nashville, before Thomas, whom Sherman had left to meet *Hood's* invasion whilst he himself "marched to sea," could concentrate sufficient forces for its defence. Thomas had under his command two corps and about 5,000 cavalry under Wilson, in addition to the local garrisons dispersed along the lines of communication from Chattanooga to the Ohio. Until a third corps under A. J. Smith reached him from Missouri (Nov. 30), he can hardly be said to have had a field army at all. *Hood* intended, after capturing Nashville, to invade Kentucky and carry the war to the Ohio. He even contemplated the possibility of marching through the Cumberland mountains to *Lee's* help and attacking Grant. He advanced from the Tennessee (Nov. 21) and endeavoured to outflank Schofield, whom Thomas had placed at Pulaski, 80 m. from Nashville, with the IV. Corps and one division of the XXIII., and about 4,000 cavalry to retard *Hood's* advance, and cut him off from Columbia, where the Nashville railway crossed the Duck river. But Cox's division, by a forced march, saved Columbia from capture by *Forrest*. Wishing to preserve the railway bridge for use when the Federals should take the offensive, Schofield, who had been reinforced by two more infantry brigades, tried to hold on to the south bank, but *Forrest* crossed with his cavalry above the town (Nov. 28), and driving Wilson's mounted troops away from the Franklin road, opened the way for *Hood's* infantry to cut off Schofield's retreat. Next day seven Confederate divisions crossed the river and advanced towards Spring Hill, 11 m. in Schofield's rear, where only a single division was covering the movement of the Federal trains. *Hood* here lost the greatest opportunity offered to any general in the war. He allowed Schofield to escape and make good his retreat to Franklin, on the Harpeth. Schofield was obliged to make another stand there to get his trains across the river. *Hood* made a furious and ill-prepared assault on the strong Federal position late in the afternoon (Nov. 30). The battle raged till 9 P.M., when *Hood* called off his troops, which had suffered terrible losses, and Schofield reached Nashville next day. *Hood's* last chance of conducting a successful offensive was gone, but he continued to follow Schofield and appeared before Nashville (Dec. 2). He believed that retreat would be more demoralizing to his troops than an honourable defeat, and the trans-Mississippi reinforcements promised by the President might yet arrive. Thomas was almost ready to take the offensive. Besides Smith's corps he had just received Steedman's "provisional division" from Chattanooga. He could now put into the field a force probably double the size of *Hood's*. But he needed a few more days in order to remount his large cavalry force, which was intended to play a decisive part in *Hood's* annihilation. Grant grew impatient at the delay. He had expected Thomas to stop *Hood* south of the Duck river, but *Hood* had reached the Cumberland. He bombarded Thomas with telegrams, demanding an immediate attack. Just as Thomas was ready, a storm of freezing rain came on, which covered the ground with a sheet of ice and prevented military operations till a thaw came. Grant ordered (Dec. 9) that Thomas should be superseded by Schofield; suspended the order the same day; ordered (Dec. 13) Logan to Nashville to take command, unless Thomas had moved in the meantime; finally, set out himself to Washington (Dec. 15), intending to go on to Nashville. But the thaw came (Dec. 14) and Thomas attacked next day.

Hood's line ran from the Chattanooga railway on the right across the Franklin and Granny White turnpikes to the Hillsboro' road. His left was sharply refused, extending 1,000 yards behind a stone wall alongside that road. He had thrown up some redoubts on detached hills beyond his left, and established a strong skirmish line along his front, terminating on Montgomery hill, close to the Hillsboro' road. But the line was too long to be held by his attenuated force, and his left was very much "in the air." Having detached *Forrest* with two cavalry divisions to raid the Chattanooga railway, he had but one division left to watch the wide gap between his left and the river. Thomas's plan of battle was to make a grand left wheel with his right wing, consisting of Wilson's 12,000 cavalry, fighting dismounted, and Smith's corps, which should outflank and crush the enemy left, whilst Steedman's division held their right fast by a vigorous demonstration. The IV. Corps under Wood was to storm Montgomery hill and press in upon the Confederate salient on the Hillsboro' road. Schofield's corps was at first held in reserve,

but was finally thrown in between Wilson's and Smith's corps. Had not the Federal advance been delayed by fog in the early morning, *Hood* would probably have been completely defeated on the 15th. His whole left wing was driven back in great confusion to the Granny White turnpike. Darkness stopped the pursuit, but *Hood,* who dared not retreat because *Forrest* could not rejoin for at least 24 hours, during the night formed a fresh and much shorter line 2 m. further back, each flank resting upon a hill. *Cheatham's* corps was shifted from the right to the left, which again was sharply bent back just beyond the Granny White turnpike, and extended to the Brentwood hills along a line of lesser heights. *S. D. Lee's,* which had scarcely fired a shot the previous day, held the right, and *A. P. Stewart's,* after its heavy defeat, was placed in the centre. But again Wilson's dismounted troopers, fighting their way through the smaller hills, turned the Confederate left, and getting into its rear attacked from behind, whilst Schofield and Smith assaulted its front. Under this double pressure *Cheatham's* corps broke and with its flight *Hood's* resistance collapsed, although earlier in the day an attack by Wood and Steedman on the right had been handsomely repulsed. His army fled down the Franklin turnpike, the only line of retreat left. But two brigades, which retained their organization, and *Chalmers's* cavalry division held the Brentwood hill's passes long enough to enable the larger part of *Hood's* army to escape. The Federals took up the pursuit next day, hoping to intercept the flying enemy on the Duck river, but *Forrest,* who rejoined *Hood* at Columbia, organized a rearguard with his cavalry and eight infantry brigades under *Walthall,* and covered the retreat to the Tennessee, which was recrossed (Dec. 27). Thomas's fighting force at Nashville numbered between 50,000 and 55,000 men; his casualties were just over 3,000. *Hood* estimated his own force at 23,000, but this is almost certainly an understatement; some authorities put it as high as 39,000. He made no return of his casualties, but stated that they were "very small." But Thomas captured nearly 4,500 prisoners in the battle itself, and many more were taken during the ten days' pursuit.

(W. B. Wo.)

NASI, JOSEPH (16th century), Jewish statesman and financier, was born in Portugal of a Jewish (Marano) family. Emigrating from his native land, he founded a banking house in Antwerp. Despite his financial and social prosperity there, he felt it irksome to be compelled to wear the guise of Catholicism, and determined to settle in a Mohammedan land. After two troubled years in Venice, Nasi betook himself to Constantinople. Here he proclaimed his Judaism, and married his beautiful cousin Reyna. He rapidly rose to favour, the sultans Suleiman and Selim promoting him to high office. He founded a Jewish colony at Tiberias which was to be an asylum for the Jews of the Roman Campagna. In 1566 when Selim ascended the throne, Nasi was made duke of Naxos. He had deserved well of Turkey, for he had conquered Cyprus for the sultan. Nasi's influence was so great that foreign powers often negotiated through him for concessions which they sought from the sultan. Thus the emperor of Germany, Maximilian II., entered into direct correspondence with Nasi; William of Orange, Sigismund August II., king of Poland, also conferred with him on political questions of moment. On the death of Selim in 1574, Nasi receded from his political position, but retained his wealth and offices, and passed the rest of his life at Belvedere (Constantinople). He died in 1579.

See Graetz, *History of the Jews* (Eng. trans.), vol. iv. chs. xvi.–xvii.; *Jewish Encyclopedia,* ix. 172. (I. A.)

NASIK, a town and district of British India, in the Central division of Bombay. The town is on the Godavari river, connected by a tramway (6 mi.) with Nasik Road railway station, 107 mi. N.E. of Bombay. Pop. (1941) 52,386. It is a very holy place of Hindu pilgrimage, being 18 mi. from the source of the Godavari, and a large number of Brahman priests live here. Shrines and temples line the river banks, and in the vicinity there are a number of sacred caves, among which those of Pandu Lena are the most noteworthy. They are ancient Buddhist caves dating from the 3rd century before Christ to the 6th century after, with numerous inscriptions of the highest historical value. Nasik has manufactures of brass and copper ware, and there is a government distillery at Nasik Road.

The District of Nasik has an area of 5,922 sq.mi. With the exception of a few villages in the west, the whole district is situated on a tableland from 1,300 to 2,000 ft. above sea-level. The western portion is hilly, and intersected by ravines. The eastern tract is open, fertile and well cultivated. The Sahyadri range stretches from north to south; the watershed is formed by the Chander range, which runs east and west. All the streams to the south of that range are tributaries of the Godavari. To the north of the watershed, the Girna and its tributary the Mosam flow through fertile valleys into the Tapti. The Girna Left Bank Canal, irrigating some 4,000 acres, was opened in 1909. It contains several old hill forts, the scenes of many engagements during the Mahratta wars. Nasik district became British territory in 1818 on the overthrow of the peshwa. The population in 1941 was 1,113,901. The principal crops are millet, wheat, pulse, oil-seeds and cotton and fine grapes and vegetables are grown. There is a trade in copper and brass ware, and sugar cane. There are railway workshops at Igatpuri. At Sharanpur is a Christian village, with an orphanage of the Church Missionary Society. The district is crossed by the main line of the Great Indian Peninsula railway.

NASMYTH, ALEXANDER (1758–1840), Scottish portrait and landscape painter, was born in Edinburgh on Sept. 9, 1758. He studied at the Trustees' Academy under Runciman, and became apprenticed as heraldic painter to a coach-builder. At the age of 16 he attracted the attention of Allan Ramsay, who took him to London, and employed him upon the subordinate portions of his works. Nasmyth returned to Edinburgh in 1778, and was soon largely patronized as a portrait painter. He also assisted Mr. Miller of Dalswinton, as draughtsman, in his mechanical researches and experiments; and through his generosity was able to go to Italy, where he remained two years. On his return he painted the portrait of Burns, now in the Scottish National Gallery and well known through Walker's engraving. Nasmyth's pronounced Liberal opinions gave offence to many of his aristocratic patrons, and led to the diminution of his practice as a portraitist. In his later years, accordingly, he worked mainly at landscapes, and occasionally at scene-painting. He has been styled the "father of Scottish landscape art." His subjects are carefully finished and coloured, but are wanting in boldness and freedom.

Nasmyth was also largely employed by noblemen throughout the country in the improving and beautifying of their estates, in which his fine taste rendered him especially skilful. As an architect, he is known for his designs for the Dean Bridge, Edinburgh, and the graceful circular temple covering St. Bernard's Well. Nasmyth died in Edinburgh on April 10, 1840. His youngest son, James, was the well-known inventor of the steam-hammer. His eldest son, Patrick (1787–1831), became a clever landscapist.

For an account of the Nasmyth family *see* James Nasmyth's *Autobiography* (1883).

NASMYTH, JAMES (1808–1890), Scottish engineer, inventor of the steam-hammer, was born in Edinburgh on Aug. 19, 1808, and was the youngest son of Alexander Nasmyth, the "father of Scottish landscape art." He started business in Manchester on his own account in 1834, and in a few years he was at the head of the prosperous Bridgewater foundry at Patricroft, from which he was able to retire in 1856 with a fortune. The invention of the steam-hammer, with which his name is associated, was actually made in 1839, a drawing of the device appearing in his note-book, or "scheme-book," as he called it, with the date Nov. 24 of that year. It was designed to meet the difficulty experienced by the builders of the "Great Britain" steamship in finding a firm that would undertake to forge the large paddle-wheel shaft required for that vessel, but no machine of the kind was constructed till 1842. In that year Nasmyth discovered one in Schneiders' Creuzot works, and he found that the design was his own and had been copied from his "scheme-book." Apparently, however, he was anticipated in the idea by James Watt. Nasmyth did much for the improvement of machine-tools, and his inventive genius devised many new appliances—a planing-machine ("Nasmyth steam-arm"), a nut-shaping machine, steam pile-driver, hydraulic machinery for various purposes, etc. On his retirement

he lived at Penshurst in Kent, and amused himself with the study of astronomy, and especially of the moon, on which he published a work, *The Moon considered as a Planet, a World and a Satellite,* in conjunction with James Carpenter in 1874. He died in London on May 7, 1890.

His *Autobiography* (edit. Samuel Smiles) was published in 1883.

NASR-ED-DIN [NĀṢIRU'D-DIN] (1829–1896), shah of Persia, was born on April 4, 1829. His mother, a capable princess of the Kajar family, persuaded Shah Mohammed, his father, to appoint him heir apparent, in preference to his elder brothers; and he was accordingly made governor of Azerbaijan. His succession to the throne, Oct. 13, 1848, was vigorously disputed, especially by the followers of the reformer El Bab, upon whom he wreaked terrible vengeance. In 1855 he reestablished friendly relations with France, and coming under the influence of Russia, signed a treaty of amity on Dec. 17 with that power, but remained neutral during the Crimean War. In 1856 he seized Herat, but a British army under Outram landed in the Persian gulf, defeated his forces and compelled him to evacuate the territory. The treaty of peace was signed at Paris, on March 4, 1857, and to the end of his reign he treated Great Britain and Russia with equal friendship. In 1866 the shah authorized the passage of the telegraph to India through his dominions and reminted his currency in the European fashion. In 1873, and again in 1889, he visited England in the course of his three sumptuous journeys to Europe, 1873, 1878, 1889.

The only results of his contact with Western civilization appear to have been the proclamation of religious toleration, the institution of a postal service, accession to the postal union and the establishment of a bank. He gave the monopoly of tobacco to a private company, but was soon compelled to withdraw it in deference to the resistance of his subjects. Abstemious in habits, and devoted to music and poetry, he was a cultured, able and well-meaning ruler, and his reign, already unusually long for an Eastern potentate, might have lasted still longer had it not been for the unpopular sale of the tobacco monopoly, which was probably a factor in his assassination at Teheran on May 1, 1896, by a member of the Babi faction. He was succeeded by his son Muzaffar-ed-din.

NASRIDES, THE, of Granada, were the last of the Mohammedan dynasties in Spain. They ruled from 1232 to 1492. The dynasty was of remote Arabic origin, but its immediate source was the mountain range of the Alpujarra, and the founder was Yusuf (or Yahīa) l'Nasr, a chief who was engaged in conflict with the family of Beni-Hud, once kings at Saragossa, who held the fortress of Granada. Yusuf's nephew (or son) Mohammed completed the defeat of the Beni-Hud largely by the help of the king of Castile, to whom he did homage and paid tribute. From Mohammed I., called el Ghalib, *i.e.,* the Conqueror (1238–73), to Mohammed XI., called Boabdil, and also the little king "El Rey Chico" by the Christians, who lost Granada in 1492, there are counted 29 reigns of the Nasrides, giving an average of nine years. But there was not the same number of sultans, for several of them were expelled and restored two or three times. There were also contemporary reigns in different parts, and tribal or local rivalries between plain and hill, and the chief towns, Granada, Malaga and Guadix. The dissensions of the Nasrides reached their greatest pitch of fury during the very years in which the Catholic sovereigns were conquering their territory piecemeal, 1482–92.

See M. Lafuente Alcantara, *Historia de Granada* (Granada, 1884); S. Lane-Poole, *The Mohammedan Dynasties* (1894).

NASSAU, a territory of Germany, now forming the bulk of the government district of Wiesbaden, in the Prussian province of Hesse-Nassau, but until 1866 an independent and sovereign duchy of Germany. It consists of a territory, 1,830 sq.m. in area, divided into two nearly equal parts by the river Lahn and bounded on the south and west by the Main and Rhine, on the north by Westphalia and on the east by Hesse. The southern half is almost entirely occupied by the Taunus mts., while to the north of the Lahn is the barren Westerwald. The valleys and low-lying districts, especially the Rheingau, are very fertile, producing abundance of grain, flax, hemp and fruit; but by far the most valuable product of the soil is its wine. Nassau is one of the most thickly wooded regions in Germany, and its forests yield good timber and harbour large quantities of game while the rivers abound in fish. There are upwards of a hundred mineral springs in the district; the best known are those of Wiesbaden and Ems. Other mineral wealth of Nassau includes iron, lead, copper, building stone, coals, slate, a little silver and a bed of malachite. Manufactures are unimportant, but brisk trade is carried on by rail and river in wine, timber, grain and fruit. There are few places of importance besides the above-named spas; Höchst is the only manufacturing town. Wiesbaden is the capital. The population of Hesse-Nassau in 1939 was 2,688,922.

History.—During the Roman period the whole of the district of Nassau was occupied by the Mattiaci and later by the Alamanni. The latter were subdued by the Franks under Clovis at the end of the 5th century, and at the partition of Verdun in 843 the country became part of the East Frankish or German kingdom. Christianity seems to have been introduced in the 4th century. The founder of the house of Nassau is usually regarded as a certain Drutwin (d. 1076), who built a castle on a hill overlooking the Lahn, near the present town of Nassau. Drutwin's descendant Walram (d. 1198) took the title of count of Nassau, and placed his lands under the immediate suzerainty of the German king; previously he had been a vassal of the archbishop of Trier. Then in 1255 Walram's grandsons, Walram and Otto, divided between them their paternal inheritance, which had been steadily increasing in size. Walram took the part of Nassau lying on the left bank of the Lahn and made Weisbaden his residence; Otto took the part on the right bank of the river and his capital was Siegen. The brothers thus founded the two branches of the house of Nassau.

The fortunes of the Ottonian, or younger line, belong mainly to the history of the Netherlands. William the Silent, the best known of this line, and his descendants were called princes of Orange-Nassau, and this line became extinct when the English king William III. died in 1702. The descendants of Count John, his brother, remained rulers of Nassau until 1806, when the reigning prince, William VI., was deprived of his lands because he refused to join the Confederation of the Rhine. Some of them were given in 1815 to the other main line of the family, the one descended from Count Walram. In 1815 William VI. became king of the Netherlands as William I., and was compensated for this loss by the grant of parts of Luxemburg and the title of grand-duke. When in 1890 William's male line died out Luxemburg, like Nassau, passed to the descendants of Count Walram. In the female line he is now represented by the queen of the Netherlands.

The territories possessed by the other branch of the house of Nassau were partitioned several times, and only in 1816 was the whole of Nassau united under the rule of Frederick William of Nassau-Weilburg as duke of Nassau. In 1866 Duke Adolph espoused the cause of Austria, sent his troops into the field, and asked the landtag for money. This was refused; Adolph was soon a fugitive before the Prussian troops, and on Oct. 3, 1866, Nassau was formally incorporated with the kingdom of Prussia.

For the history of Nassau *see* Hennes, *Geschichte der Grafen von Nassau bis 1255* (Cologne, 1843); von Schütz, *Geschichte des Herzogtums Nassau* (Wiesbaden, 1853); von Witzleben, *Genealogie und Geschichte der Fürstenhauses Nassau* (Stuttgart, 1855); F. W. T. Schliephake and K. Menzel, *Geschichte von Nassau* (Wiesbaden, 1865–89); the *Codex diplomaticus nassoicus,* ed. K. Menzel and W. Sauer (1885–87); and the *Annalen des Vereins für nassauische Altertumskunde und Geschichtsforschung* (1827 f.).

NAST, THOMAS (1840–1902), American caricaturist, was born on Sept. 27, 1840, in Landau, Germany. His mother took him to New York in 1846. He studied art there with Theodore Kaufmann and at the school of the National Academy of Design. At the age of 15 he became a draughtsman for *Frank Leslie's Illustrated Newspaper;* three years later for *Harper's Weekly.* In 1860 he went to England for the *New York Illustrated News* and soon afterwards joined Garibaldi in Italy as artist for *The Illustrated London News.* His first serious work was the cartoon "Peace" in 1862, directed against those in the North who opposed the prosecution of the Civil War. This and his other car-

toons during the Civil War and Reconstruction days were published in *Harper's Weekly;* they attracted great attention, and Nast was called by President Lincoln "our best recruiting sergeant." Even more able were Nast's cartoons against the Tweed Ring conspiracy in New York city, his caricature of Tweed being the means of the latter's identification and arrest at Vigo. He had been an ardent Republican in his earlier years; but his advocacy of civil service reform and his distrust of Blaine forced him to become a Mugwump and in 1884 an open supporter of the Democratic Party, from which in 1892 he returned to the Republican Party. He had lost practically all of his earnings by the failure of Grant and Ward, and in May, 1902, was appointed consul general at Guayaquil, Ecuador, where he died on Dec. 7, in the same year. He did some painting in oil and some book illustrations, but his fame rests on his caricatures and political cartoons. Nast introduced the donkey to typify the Democratic Party, the elephant to typify the Republican Party, and the tiger to typify Tammany Hall.

See A. B. Paine, *Thomas Nast, his Period and his Pictures* (1904).

NASTURTIUM or **INDIAN CRESS,** *Tropaeolum majus,* a perennial climber, native of Peru, but in cultivation treated as a hardy annual. It climbs by means of the long stalk of the peltate leaf which is sensitive to contact like a tendril. The irregular flowers have five sepals united at the base, the dorsal one produced into a spur; of the five petals the two upper are slightly different and stand rather apart from the lower three; the eight stamens are unequal and the pistil consists of three carpels which form a fleshy fruit. The flowers are sometimes eaten in salads, and the leaves and young green fruits are pickled in vinegar as a substitute for capers.

The dwarf form known as Tom Thumb (*T. m. nanum*), is an excellent bedding or border flower, growing about a foot high. Other fine annual tropaeolums are *T. peltophorum* with long spurred orange flowers and numerous varieties; and *T. minus;* a kind of miniature *T. majus* with yellow, scarlet and crimson varieties.

The genus *Tropaeolum* (family Tropaeolaceae), native to South America and Mexico, includes about 50 species of generally climbing annual and perennial herbs with orange, yellow, rarely purple or blue, irregular flowers; *A. peregrinum* is the well-known canary-bird flower. A fine nasturtium with brilliant scarlet blossoms is *T. speciosum* from Chile; it has tuberous roots, as have also such well-known perennials as *T. polyphyllum* and *T. pentaphyllum.* The *Nasturtium* of botanists is a genus of plants of the family Cruciferae; *N. officinale* is the water-cress.

NATAL, a province of the Union of South Africa, is bounded by the Indian ocean, by the Umtamvuna and Umzimkulu rivers, which divide it from the Griqualand East division of Cape Colony, by the Drakensberg, which separates it from Basutoland, the Orange Free State, and part of the Transvaal, and by the Pongola river, the Lebombo range, and, for a short distance, a line of latitude, which mark it off from the Transvaal, Swaziland and Portuguese East Africa. Natal, in this extended and official sense, includes Zululand and Amatongaland. The northern boundary of Natal proper for part of the way is the Tugela. The sea board from the mouth of the Umtamvuna to the mouth of the Tugela is 166 m., and from the Tugela to the Portuguese border near Ore Point, 210 miles. Its total area is 35,284 sq.m., or 7·47% of the Union, while it carries a little over 20% of the Union's population. The area of Natal proper is 24,857 sq.mi.

Geologically, the country consists of a monoclinal fold affecting Karroo rocks. Along the axis, which runs more or less north and south, these have been eroded and the underlying rocks of the Swaziland system (granite, schists, etc.) have been exposed along a fairly continuous belt, which can be followed from a point, 5 or 6 m. inland from Port Shipstone, through Inchanga, the Valley of a Thousand Hills, and on into Zululand, where their area broadens out. A great part of the country is formed of horizontal, or gently inclined shales and sandstones, among which numerous sills of dolerite are intercalated. Erosion, attacking these beds, has produced a distinctly terraced topography. The hills are often steep-sided and flat-topped.

Conventially, three zones are distinguished: (*a*) the Coast belt below 1,000 ft., which is about 20 m. wide behind Durban, and which narrows southward, and widens considerably when followed northward and into Zululand. (*b*) The Midlands, between 2,000 and 4,000 feet. (*c*) The Highlands from 4,000 ft. to the foot of the Drakensberg. This classification is over simplified, but may serve as a rough indication of the build of the country. The rivers, owing to rejuvenation, have cut deep valleys in their lower courses, with the result that the topography of the coast belt and part of the midlands is very broken. In their middle, and in part of their upper courses, the rivers flow in broad, open valleys. Owing to their high average gradient, and the numerous waterfalls, due to the outcropping of hard beds of sandstone and dolerite, and also to their low winter level, they are all unnavigable, except for stretches of 3 or 4 m. at the mouths of the Umkomaas and Umzimkulu. The dominant topographical feature is the great barrier of the Drakensberg (*q.v.*), which rises to over 10,000 ft., and from which several secondary ranges run out toward the coast. The Lebombo range, in the north runs from north to south, and is caused by the outcrop of resistant lavas. Rivers, such as the Usutu and the Pongola cut across this escarpment in great "poorts."

Climate and Vegetation.—These are described under UNION OF SOUTH AFRICA. Owing to the range of altitude from sea-level to 5,000 or 6,000 ft. at the foot of the Drakensberg, there is a wide range of climate, which is further complicated by the varied topography. Always, however, the sub-tropical coast belt stands out as a distinct natural region, with its humid heat, small temperature ranges and its sub-tropical vegetation and production. Inland, the winter drought becomes more clearly marked and frosts more frequent and severe during the winter nights. The chief rain-bearing wind is from the south-west. A very characteristic feature of the Natal climate is the "hot winds," which are usually most frequent in spring and summer. They appear to be due to the flow of air being drawn toward depressions passing southward along the coast. They blow from the north-west and are heated by compression as they descend the escarpments. The temperature often rises above 90° and the relative humidity may fall to 30. A hot wind may blow for a few hours, or for two or three days. It causes great clouds of dust, and all doors and windows in the houses have to be closed. Usually these winds change suddenly, or are replaced by a cool, moist wind from the south-west, which often brings greatly appreciated rain, or sometimes, in the higher districts, snow.

In addition to the trees, shrubs and grasses, described elsewhere, mention may be made of the flowers, which are often beautiful. Some of these, like the red bush lily, grow in the shade of the patches of bush. Others are more tolerant of light, and are to be found in the open. Among these are the fire lily, which blooms in the early spring before the grasses have grown beyond a few inches, the agapanthus, the arum lily along the streams, the gladioli, etc. A very common grassland flower, and one that blooms late, when the grasses are tall, is the leonotis, which attains a height of 5 or 6 ft., and has terra-cotta to orange-coloured flowers. Many a hillside in early spring is enlivened by the flowers of the aloes, in various shades of red. The delightfully rich crimson of the Kafir boom blossoms is peculiarly characteristic of much of Natal

Fauna.—(*See* also SOUTH AFRICA, UNION OF.) Some of the smaller buck have increased of late years, owing to the cover afforded them by the large wattle plantations. Jackals are undesirably numerous in some of the upland districts, and they often destroy many lambs. Otters occur in some of the rivers. Snakes are common. The chief sporting birds are the quail, partridge and guinea fowl. About 450 sq.m. of country have been set aside as game reserves, in which no animals may be killed at any time. There are several such reserves, one near Giants' Castle, to protect the surviving eland, and one on the Mkusi, in Zululand, where the inyala (buck) still survives, as well as impala, the Zululand suni, etc. Reserves have been established in the Klip River and the Umgeni districts. In addition, several animals and birds have been declared royal game, and cannot be shot

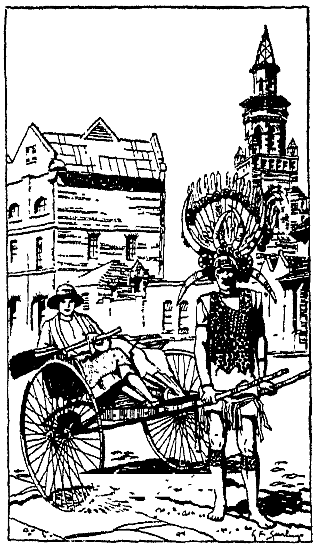
or captured. They include the white, or square-lipped, rhinoceros, which is still found in Zululand, the elephant, female eland, the impala, inyala, roan antelope, springbok, sassaby; crested crane, Stanley crane, etc.

Population.—The total population of Natal in 1936 was 1,946,468. The natives (*see* ZULULAND, CAPE PROVINCE) numbered in 1936 approximately 1,553,629, or nearly 80% of the total population. About half of them live under tribal conditions on locations, which are saturated with population, under 20th-century conditions of skill and methods of exploitation. The other half live on farms owned by Europeans, on crown lands, or in the towns. In 1936 the Asiatics were numbered at 183,661. They were largely concentrated in the coastal belt. Originally imported as indentured labourers for the sugar plantations, many of these Indians have become small market gardeners, or have taken employment in hotels and domestic service or industry, where they supply much of the unskilled and semi-skilled labour. The British elements constitute the majority of the white population of 190,549 (1936). The "northern districts," Utrecht and Vryheid, however, are chiefly inhabited by Afrikaans-speaking people of Dutch origin. In recent years the percentage of Europeans of non-British origin in the total population has probably increased, owing to the considerable numbers employed in the government services. In 1936 the "home language" of the Natal European population was reported as follows: English 141,550, Afrikaans 38,301, English and Afrikaans 3,727, German 4,792, other languages 2,179. The German group is centred about New Hanover. Scandinavian settlers about the Umzimkulu, and in Durban, especially connected with the whaling industry, contribute a very valuable element to the population. There is also an appreciable French element, which originally migrated to Natal, largely from Mauritius, in connection with the sugar industry, though it is no longer confined to that industry. The number of "coloured" people in Natal is quite small, the "mixed and others" in 1936 numbering about 18,629.

Towns.—Apart from Pietermaritzburg, the capital, and Durban (*qq.v.*), the only port and the largest centre, the towns of Natal are quite small. Only two, in addition to the two just mentioned, had a white population of over 2,000, according to the 1936 census: Ladysmith (whites 3,660, total 9,702), which is now a railway centre of some importance; and Vryheid (whites 3,127, total 6,436). Other towns, with 1936 populations, are: Glencoe (whites 1,256, total 3,339), a railway junction, and near the coal fields; Newcastle (whites 1,908, total 4,945). Vryheid and Newcastle are also near coal mines, and Newcastle is developing an iron and steel industry.

Communications.—Railway construction has been greatly handicapped by the varied topography. The main line from Durban to the Transvaal climbs to 1,808 ft. at Krautzkloof (23 mi.), 3,006 ft. at Thornville Junction (61 mi.), drops to 2,218 at Pietermaritzburg (73 mi.), rises to 3,702 at Hilton Road (84 mi.), to 4,807 at Nottingham Road (116 mi.), drops to 3,280 ft. at Colenso (185 mi.), and rises again to 5,429 ft. at Volksrust, just over the Transvaal border, and to 5,520 ft. at Van Reenens, just within the Orange Free State. Electrification of the whole Natal main line from Durban to Volksrust (323 mi.), begun in 1922, was completed in 1937. From the main system a line runs from Durban along the coast southward to Port Shepstone, and northward as far as the Pongola in Zululand to serve the sugar cane area. From Pietermaritzburg a line with two short branches was constructed to Krantzkop through the wattle belt. Another runs southwestward across the grain of the country to open up East Griqualand; from Glencoe Junction a line running through Dundee and Vryheid carries large quantities of coal. There are a few other smaller lines, which can be seen on a map. As in other parts of the world, the railways are feeling the effect of motor competition along some stretches. The journey by road from Pietermaritzburg to Durban is shorter and quicker than by rail.

Agriculture.—The coast belt is sharply marked off from the rest of the country. It produces sugar, bananas, pineapples, citrus fruit, etc. Formerly, practically all the cane grown was of the Uba variety, but extensive research was undertaken with a view to the development of new Mosaic-free varieties superior to Uba. In 1940 there were 340,396 ac. under cane, and the production of sugar for the year 1938–39 was 522,732 short tons. The industry now satisfies the requirements of the South African market, and has a surplus for export. Among the by-products are molasses, used for cattle feeding and also exported, motor spirit produced from the molasses, methylated spirits, ether and wax. Approximately 2,000 ac. in the Kearsney-Stanger area are devoted to tea growing. In 1938–39 the production of green leaf was 3,438,532 lb., of manufactured tea, 814,015 lb. The industry shows little sign of growing. The rest of Natal is devoted to mixed farming, with increasing stress being laid on dairying. Maize thrives particularly well in the midlands, but little of this grain is exported because it is often sold by the white farmers to the natives, whose own food production is insufficient. Between 2,000 and 6,000 ft. above sea level the Australian black wattle is grown, especially in the mist belts along the escarpments. From the bark an extract is made which is used in tanning. The poles supply the mines with pit props, and the towns with much of their domestic fuel. There is a wattle belt, fairly well defined in the midlands of Natal, through the middle of which runs the Richmond-Pietermaritzburg-Greytown-Krantzkop railway. The wattle plantations cover 365,000 ac., and in 1939 the quantity of bark exported from the country was over 90,000 tons, Great Britain, Belgium, Germany and Japan being the chief customers. Wattle extract is also exported. Cotton growing appears to have passed the experimental stage. It is being grown in some of the northern and eastern districts of Natal and in Zululand. In 1938–39, 533,588 lb. unginned cotton seed were grown. The growing of tobacco was stimulated by the introduction of a preferential tariff for empire tobacco in Great Britain in 1925.



BY COURTESY OF E. G. MORSE
'RICKSHA "BOY" OF DURBAN, NATAL

The chief mineral produced in the country is coal. The chief coal field is in the Klip river and Newcastle districts, centring about Dundee. Mines are also active in the Vryheid and Utrecht districts. The expense of the long railway journey to the coast, on the average about 240 mi., is partially counterbalanced by the nearness of the coal to the surface. In 1940 the output was over 4,000,000 short tons. At Waschbank the following by-products are being produced: tar, sulphate of ammonia, light creosote oil and naphtha. Tar is also being made.

Education.—For higher education *see* SOUTH AFRICA, UNION OF. The direction of public education, other than higher education, rests with the Provincial Education department, subject to the control of the provincial administration. At its head is the superintendent of education. The department has direct management of primary and of some secondary schools, and makes grants to various private schools, which maintain the same standard as the government schools. Fees are charged for pupils in the secondary schools. Special schools are provided for native, coloured and Indian children. Attendance is compulsory for European children between 7 and 15 who live within three miles of a school. A government training college for teachers is situated in Pietermaritzburg in conjunction with Natal University college. There are in Natal five training colleges for natives, Sastri college and four training classes for Indians, and one training centre for coloured teachers. In addition to the government schools, there are several good schools in the province, both for boys and girls, which are modelled on the English public school. An agricultural college, connected with a government experimental farm, was opened in 1906 at Cedara, 14 mi. from Pietermaritzburg. To

meet some of the requirements of the non-European population, there were, in 1939, 739 public primary and 55 secondary schools for natives, and 141 primary and 5 secondary for other non-Europeans (chiefly Asiatics). There were 86,345 native pupils, and 29,097 other non-Europeans in the primary, secondary and industrial schools of Natal in 1939. (*See* also SOUTH AFRICA, UNION OF.) (R. U. S.)

HISTORY

Vasco da Gama on his voyage to India sighted the bluff at the entrance to the bay now forming the harbour of Durban on Christmas day 1497 and named the country Terra Natalis. Da Gama made no landing there and, like the rest of South Africa, Natal was neglected by the Portuguese, whose nearest settlement was at Delagoa bay. The first detailed accounts of the country were received from mariners. In 1684 an English ship put into Port Natal (as the bay came to be known) and purchased ivory from the natives, who, however, refused to deal in slaves. In May 1685 another English ship the "Good Hope" was wrecked in crossing the bar at Port Natal and in Feb. 1686 the "Stavenisse," a Dutch East Indiaman, was wrecked a little farther south. Survivors of both vessels lived for nearly a year at Port Natal and there built a boat in which they made the voyage to Capetown in 12 days. They brought with them three tons of ivory. This fact, and their reports of the immense herds of elephants which roamed the bush, led Simon van der Stell, then governor at Capetown to dispatch (1689) the ship "Noord" to Port Natal, with instructions to her commander to open up a trade in ivory and to acquire possession of the bay. The bay was "purchased" from the chief of the Amatuli tribe, for about £50 worth of goods. No settlement was then made, and in 1705 the son of the chief repudiated the bargain. In 1721 the Cape government did form a settlement at the bay, but it was soon afterward abandoned. Thereafter for nearly 100 years Natal was again neglected by white men.

From the records of the 17th and 18th centuries it is apparent that the people then inhabiting Natal were Bantu Negroes of the Kafir (Ama Xosa) branch. The most numerous and most powerful tribe appeared to be the Abambo, while the Amatuli occupied a considerable part of the coastland. These Kafirs seem to have been more given to agriculture and more peaceful than their neighbours in Kaffraria and Cape Colony. But the quiet of the country was destroyed by the inroads of Chaka, the chief of the Zulus (*see* ZULULAND). Chaka between 1818 and 1820 ravaged the whole of what is now known as Natal, and after beating his foes in battle, butchered the women, children and old men, incorporating the young men in his impis. The population was greatly reduced and large areas left without a single inhabitant. By right of conquest Chaka became undisputed master of the country.

First British Settlement.—Such was the situation when the first British settlement was made in Natal, Cape Colony having passed meanwhile from Dutch to British possession. In 1823 Francis George Farewell, formerly a lieutenant in the British navy, with other merchants of Capetown, formed a company to trade with the natives of the southeast coast. In the brig "Salisbury," commanded by James S. King, who had been a midshipman in the navy, Farewell visited Port Natal, St. Lucia and Delagoa bays. He was so impressed with the possibilities of Natal both for trade and colonization that he resolved to establish himself at the port. He went there with ten companions, among them Henry Francis Fynn. All the rest save Farewell and Fynn speedily repented of their adventure and returned to the Cape, but the two who remained were joined by three sailors, John Cane, Henry Ogle and Thomas Holstead, a lad. Farewell, Fynn and others went to the royal kraal of Chaka and, having cured him of a wound and made him various presents, obtained a document, dated Aug. 7, 1824, ceding to "F. G. Farewell and company entire and full possession in perpetuity" of a tract of land including "the port or harbour of Natal." On the 27th of the same month Farewell hoisted the Union Jack at the port and declared the territory he had acquired a British possession. In 1825 he was joined by King, who had meantime visited England and had obtained from the government a letter of recommendation to Lord Charles Somerset, governor of the Cape, granting King permission to settle at Natal. Farewell, King and Fynn made independent settlements at various parts of the bay, where a few Amatuli still lingered. They lived, practically, as Kafir chiefs, trading with Chaka and gathering round them many refugees from that monarch's tyranny. Early in 1828 King, accompanied by two of Chaka's indunas, voyaged in the "Elizabeth and Susan," a small schooner built by the settlers, to Port Elizabeth. He appears to have been coldly received by the authorities. Soon after his return to Natal, King died, and in the same month (Sept. 1828) Chaka was murdered by his brother Dingaan. In Dec. 1828 Farewell went in the "Elizabeth and Susan" to Port Elizabeth. On this occasion the authorities confiscated the schooner on the ground that it was unregistered and that it came from a foreign port. Farewell was not daunted, and in Sept. 1829 set out to return overland to Port Natal. He was, however, murdered in Pondoland by a chief who was at enmity with the Zulus. Fynn thus became leader of the whites at the port, Dingaan declaring him to be his representative and "great chief of the Natal Kafirs." In 1834, however, Fynn accepted a post under the Cape government and did not return to Natal for many years. It was in this year that a petition from Capetown merchants asking for the creation of a British colony at Natal was met by the statement that the Cape finances would not permit the establishment of a new dependency.

The next step was taken by the settlers at the port, who in 1835 resolved to lay out a town, which they named Durban, after Sir Benjamin d'Urban, then governor of Cape Colony. The settlers, who numbered about 50, sent a memorial to the governor calling attention to the fact that they were acknowledged rulers over a large tract of territory south of the Tugela, and asking that this territory should be proclaimed a British colony under the name of Victoria and that a governor and council be appointed. To all these requests no official answer was returned. The settlers had been joined in the year named (1835) by Captain A. F. Gardiner, a naval officer, whose chief object was the evangelization of the natives. With the support of the traders he founded a mission station in the hills (which he named Berea) overlooking the bay. In 1837 Gardiner was given authority by the British government to exercise jurisdiction over the traders. They, however, refused to acknowledge Gardiner's authority, and from the Cape government he received no support.[1] It was not until their hand was forced by the occupation of the interior by Boer farmers that the Cape authorities at length intervened.

The Dutch and Dingaan.—The British settlers had, characteristically, reached Natal mainly by way of the sea; the new tide of immigration was by land—the *voortrekkers* streamed through the passes of the Drakenberg, bringing with them their wives and children and vast herds of cattle. The reasons which caused the exodus from the Cape are discussed elsewhere (*see* SOUTH AFRICA, UNION OF and CAPE PROVINCE); here it is only necessary to point out that those emigrants who entered Natal shared with those who settled elsewhere an intense desire to be free from British control. The first emigrant Boers to enter the country were led by Pieter Retief (*c.* 1780–1838), a man of Huguenot descent and of marked ability, who had suffered severely in the Kafir wars. Passing through the almost deserted upper regions, Retief arrived at the bay in Oct. 1837. He went from there to Dingaan's kraal with the object of securing a formal cession of territory to the Dutch farmers. Dingaan consented on condition that the Boers recover for him certain cattle stolen by another chief; this task Retief accomplished, and with the help of the Rev. F. Owen, an Anglican missionary then living at Dingaan's kraal, a deed of cession was drawn up in English and signed by Dingaan and Retief on Feb. 4, 1838. Two days after the signature of the deed Retief and all of his party, 66 whites,

[1]Captain Allen Francis Gardiner (1794–1851) left Natal in 1838, subsequently devoting himself to missionary work in South America, being known as the missionary to Patagonia. He died of starvation in Tierra del Fuego.

besides Hottentot servants, were treacherously murdered by Dingaan's orders. The Zulu king then commanded his impis to kill all the Boers who had entered Natal. The Zulu forces crossed the Tugela the same day, and the most advanced parties of the Boers were massacred, many at a spot near where the town of Weenen now stands, its name (meaning wailing or weeping) commemorating the event. In one week after the murder of Retief 600 Boers—men, women and children—had been killed by the Zulus. The English settlers at the bay, with a following of some 700 natives, made an attempt to aid the Boers, but in a fight on April 7 they were overwhelmed, and only four Europeans escaped to the bay.

After the Zulus retired, fewer than a dozen Englishmen returned to live at the port; the missionaries, hunters and other traders went back to the Cape. Meanwhile the Boers, who had repelled the Zulu attacks on their laagers, had been joined by others from the Drakenberg, and about 400 men under Hendrik Potgieter and Piet Uys advanced to attack Dingaan. On April 11, however, they fell into a trap and with difficulty cut their way out. Among those slain were Piet Uys and his son Dirk, aged 15, who rode by his side. Toward the end of the year the Boers received reinforcements, and in December 460 men set out under Andries Pretorius to avenge themselves on the Zulus. On Sunday Dec. 16, 1838, while laagered near the Umslatos river, they were attacked by over 10,000 Zulus. The Boers had firearms, the Zulus their assegais only, and after a three hours' fight the Zulus were totally defeated, losing thousands killed, while the farmers' casualties were under a dozen. (This memorable victory is annually commemorated by Afrikaners as Dingaan's day. while the Umslatos, which ran red with the blood of the slain, was renamed Blood river.) Dingaan fled, the victorious Boers entered the royal kraal, gave decent burial to the skeletons of Retief and his party, and regarded themselves as now undisputed masters of Natal.

Returning south, Pretorius and his commando were surprised to learn that Port Natal had been occupied on Dec. 4 by a detachment of the 72nd Highlanders In sanctioning the occupation of the port the British government of the day had no intention of making Natal a British colony, but wished to prevent the Boers establishing an independent republic upon the coast. After remaining at the port just over a year the Highlanders were withdrawn, on Christmas Eve 1839. Meanwhile the Boers had founded Pietermaritzburg and made it the seat of their volksraad. They rendered their power in Natal absolute, for the time, in the following month, when they joined with Panda, Dingaan's brother, in another attack on the Zulu king. Dingaan was utterly defeated and soon afterward perished, Panda becoming king in his stead by favour of the Boers.

This Boer community was not able to establish an enduring state. But their impatience of control, reflected in the form of government adopted, led to disastrous consequences. Legislative power was vested, nominally, in the volksraad (consisting of 24 members), while the president and executive were changed every three months. But whenever any measure of importance was to be decided a meeting was called of *het publiek,* that is, of all who chose to attend, to sanction or reject it—a procedure which led to confusion and indecision. While such was the domestic state of affairs the settlers cherished large territorial views. They had declared themselves an independent state under the title of "the republic of Port Natal and adjacent countries" (commonly called the republic of Natalia or Natal), and sought (Sept. 1840) from Sir George Napier at the Cape an acknowledgment of their independence by Great Britain. Sir George, being without definite instructions from England, could at first give no decisive answer. Having at length received an intimation from London that the queen "could not acknowledge the independence of her own subjects, but that the trade of the emigrant farmers would be placed on the same footing as that of any other British settlement, upon their receiving a military force to exclude the interference with or possession of the country by any other European power," Sir George communicated this decision to the volksraad in Sept. 1841. The Boers, who strongly resented the contention of the British that they could not shake off British nationality though beyond the bounds of any recognized British possession, after very brief consideration firmly rejected Napier's overtures.

An incident which happened at this time greatly encouraged the Boers to persist in their opposition. In March 1842 a Dutch vessel sent out by G. G. Ohrig, an Amsterdam merchant who sympathized warmly with the cause of the emigrant farmers, reached Port Natal, and its supercargo, J. A. Smellekamp (a man who subsequently played a part in the early history of the Transvaal and Orange Free State), without any authority, concluded a treaty with the volksraad assuring them of the protection of Holland. The Natal Boers were firmly persuaded that Holland would aid them in resisting Great Britain.

Dick King's Ride.—On May 4, 1842, Capt. T. C. Smith with a force of 263 men who, at Sir George Napier's orders had marched overland from Cape Colony, reached Durban without opposition, and encamped at the base of the Berea hills. The Boers, cut off from their port, called out a commando of some 300 to 400 men under Andries Pretorius and gathered at Congella at the head of the bay. After repulsing an attack on their camp the Boers captured the harbour and settlement, and on May 31 blockaded the British camp. Meanwhile an old Durban resident, Richard (commonly called Dick) King, had undertaken to convey tidings of the perilous position of the British force to the commandant at Graham's Town. He started on the night of the 25th and, escaping the Boer outposts, rode through the dense bush and across the bridgeless rivers of Kaffraria at peril of his life from hostile natives and wild beasts, and in nine days reached his destination—a distance of nearly 600 mi. by the route to be followed. This remarkable ride was accomplished with one change of mount, obtained from a missionary in Pondoland. A comparatively strong force under Col. A. J. Cloete was at once sent by sea to Port Natal, and on June 26 Capt. Smith was relieved. Within a fortnight Col. Cloete had received the submission of the volksraad at Pietermaritzburg. The burghers represented that they were under the protection of Holland, but this plea was peremptorily rejected by the commander of the British forces.

The British government of the day, the second Peel administration, held that the establishment of a colony in Natal would be attended with little prospect of advantage, but in deference to the strongly urged views of Sir George Napier, Lord Stanley (secretary of state for the colonies), in a dispatch of Dec. 13, received in Capetown on April 23, 1843, consented to its annexation. The institutions adopted were to be as far as possible in accordance with the wishes of the people, but it was a fundamental condition "that there should not be in the eye of the law any distinction or disqualification whatever, founded on mere difference of colour, origin, language or creed"—a condition not kept in later years. Sir George then appointed Henry Cloete (a brother of Col. Cloete) as special commissioner to explain to the Natal volksraad the decision of the government. Cloete, whose task was one of great difficulty and delicacy, behaved with the utmost tact, and on Aug. 8, 1843, the Natal volksraad unanimously agreed to the terms proposed by Lord Stanley. Many of the Boers who would not acknowledge British rule trekked once more over the mountains into what are now the Orange Free State and Transvaal provinces At the end of 1843 there were not more than 500 Boer families left in Natal.

A British Colony.—Although proclaimed a British colony in 1843, and in 1844 declared a part of Cape Colony, it was not until the end of 1845 that an effective administration was installed, with Martin West as lieutenant-governor, and the power of the volksraad finally came to an end.

The new administration found it hard to please the Boer farmers, who among other grievances resented what they considered the undue favour shown to the natives, whose numbers had been greatly augmented by the flight of refugees from Panda. The natives were settled in 1846 in "locations" and placed under the general supervision of Sir Theophilus Shepstone (*q.v.*). Sir Harry Smith, newly appointed governor of the Cape, met, on the banks of the upper Tugela, a body of farmers preparing to

recross the Drakensberg—which had been fixed as the northern frontier—and by remedying their grievances induced many of them to remain in Natal. By the migration of the others the whites were again considerably reduced, but the Boers who remained were contented and loyal, and through the arrival of 4,500 emigrants from England in the years 1848–1851 and by subsequent immigration from overseas the colony became overwhelmingly British in character.

From these years dates the development of trade and agriculture in the colony, followed somewhat later by the exploitation of the mineral resources of the country. At the same time schools were established and various churches began or increased their work in the colony. Dr. Colenso, appointed bishop of Natal, arrived in 1854. In 1856 the dependence of the country on Cape Colony was put to an end and Natal was constituted a distinct colony with a legislative council of 16 members, 12 elected by the inhabitants and 4 nominated by the crown. At the time the white population exceeded 8,000. While dependent on the Cape, ordinances had been passed establishing Roman-Dutch law as the law of Natal and, save where modified by legislation, it remained in force.

Indian Coolies Introduced.—The British settlers soon realized that the coastlands were suited to the cultivation of tropical or semitropical products, and from 1852 onward sugar, coffee, cotton and arrowroot were introduced, tea being afterward substituted for coffee. The sugar industry soon became of importance, and the planters were compelled to seek for large numbers of labourers. The natives, at ease in their locations, did not volunteer in sufficient numbers, and recourse was had to coolie labour from India. The first coolies reached Natal in 1860. They came under indentures, but at the expiration of their contract were allowed to settle in the colony. Up to 1869 some 5,000 Indians had come to Natal. Immigration then ceased but was resumed in 1874. This bringing in of Indians proved one of the most momentous steps taken in the history of South Africa, for the Indian population rapidly increased, the "free" Indians becoming market gardeners, farmers, hawkers, traders, and in time serious competitors of the whites. But in 1860 and for many years afterward these consequences were not foreseen, and alone among the South African states Natal offered a welcome to Asiatics.

In 1867 R. W. Keate (1814–73) became lieutenant-governor, a post which he filled until 1872. His administration was notable because he twice acted as arbitrator in disputes in which the Boer states were involved. In a dispute between the Transvaal and the Orange Free State he decided (Feb. 1870) that the Klip river and not the upper Vaal was the frontier stream. A more famous decision, that known as the Keate award, was given in Oct. 1871. It concerned the southwestern frontiers of the Transvaal, and the award, which was against the Transvaal pretensions, had important effects on the history of South Africa (*see* GRIQUALAND EAST AND GRIQUALAND WEST; TRANSVAAL).

During all this time little was done to alter the condition of the natives. There was scarcely an attempt to copy the policy, then followed in Cape Colony, of encouraging the education and civilization of the black man. Neither was Natal faced with the Cape problem of a large half-caste population. While the opportunity of educating and training a docile people was in the main neglected, savage abuse of power by their chiefs was prevented. Under the superintendence of Shepstone the original refugees were quiet and contented. This ideal lot, from the native point of view, drew such numbers of immigrants from disturbed districts that, with the natural increase of population, in 30 years the native inhabitants increased from about 100,000 to fully 350,000. The first serious collision between the natives and the government occurred in 1873. The Amahlubi, one of the highest in rank of the Bantu tribes of South Africa, fleeing from the cruelties of Panda, had been located by the Natal government under their chief Langalibalele (*i.e.*, the great sun which shines and burns) in 1848 at the foot of the Drakensberg with the object of preventing the Bushmen who dwelt in the mountains from plundering the upland farmers. There the Amahlubi prospered, and after the diamond fields had been discovered many of the young men who had been to Kimberley brought back firearms. These Langalibalele refused to register, and entered into negotiations with several tribes with the object of organizing a general revolt. Prompt action by Sir Benjamin Pine, the lieutenant-governor of the colony, together with help from the Cape and Basutoland, prevented the success of Langalibalele's plan, and his own tribe, numbering some 10,000 persons, was the only one which rebelled. The chief was captured, and exiled to Cape Colony (Aug. 1874). Permitted to return to Natal in 1886, he died in 1889.

The Colenso Affair.—Meantime the colony had weathered a severe commercial crisis brought on in 1865 through over-speculation and the neglect of agriculture, save along the coast belt. But the trade over the mountains largely developed on the discovery of the Kimberley diamond mines, and the progress of the country was greatly promoted by the substitution of the railway for the ox wagon as a means of transport. On Jan. 1, 1876, Sir Henry Bulwer, who had succeeded Wolseley as governor, turned the first sod of a new state-owned railway which was completed as far as Maritzburg in 1880. At this date the white inhabitants numbered about 20,000. But besides a commercial crisis, the colony had been the scene of an ecclesiastical dispute which attracted widespread attention. Bishop Colenso (*q.v.*), condemned in 1863 on a charge of heresy, ignored the authority of the court of South African bishops and was maintained in his position by decision of the privy council in England. This led to a division among the Anglican community in the colony and the consecration in 1869 of a rival bishop, who took the title of bishop of Maritzburg. (Reunion of the Anglican body in Natal was effected in 1910.) Colenso's bold advocacy of the cause of the natives attracted almost equal attention. His native name was Usobantu (*father of the people*).

For some years Natal, in common with the other countries of South Africa, had been influenced by disturbed conditions in the Transvaal. The annexation of the Transvaal to Great Britain, effected by Sir Theophilus Shepstone in April 1877, would, it was hoped, put a period to the disorders in that country. But the new administration at Pretoria inherited many disputes with the Zulus, disputes which were in large measure the cause of the war of 1879. For years the Zulus had lived in amity with the Natalians, from whom they received substantial favours, and in 1872 Cetywayo (*q.v.*), on succeeding his father Panda, had given assurances of good behaviour. These promises were not kept for long, and by 1878 his attitude had become so hostile toward both the Natal and Transvaal governments that Sir Bartle Frere, then high commissioner for South Africa, determined on his reduction. During the war (*see* ZULULAND) Natal was used as the British base, and the Natal volunteers rendered valuable service in the campaign which, after opening with disasters to the British forces, ended in the breaking of the Zulu power.

Majuba.—Scarcely had the colony recovered from the shock of the Zulu War than it was involved in the uprising of the Transvaal Boers (1880–81). The Natalians were intensely British in sentiment, and resented deeply the policy adopted by the Gladstone administration. At Ingogo, Majuba and Laing's Nek, all of them situated within the colony, British forces had been defeated by the Boers; and the treaty of retrocession was regarded in Natal as an unworthy surrender of British rights. The Natalians nevertheless made up their minds to shape their policy in conformity with that settlement. It was not long before their patience was once more severely taxed. Transvaal Boers, taking advantage of the disputes among the petty Zulu chiefs set up by Sir Garnet Wolseley after the war of 1878–79, intervened (in 1883), and as a reward for the assistance they had rendered to one of the combatants, demanded and annexed 8,000 sq.mi. of country, which they styled the "New Republic." This interference by the Transvaal in Zululand affairs gave great offense in Natal. The "New Republic," reduced in area, however, to fewer than 2,000 sq.mi., was nevertheless recognized by the British government in 1886, and in 1888 its consent was given to the territory (the Vryheid district) being incorporated with the Transvaal. Meanwhile, in 1887, the remainder of Zululand had been annexed to Great Britain (*see* ZULULAND).

Effect of Discovery of Gold.—In 1884 the discovery of gold in De Kaap valley, and on Moodie's farm in the Transvaal, caused a considerable rush of colonists from Natal to that country. Natal not only sent its own colonists to the new fields, but also offered the nearest route for prospectors from Cape Colony or from Europe. Two years later the Rand gold fields were proclaimed, and the tide of trade which had already set in with the Transvaal steadily increased. In that year (1886) the railway reached Ladysmith, and in 1891 it was completed to the Transvaal frontier at Charlestown, the section from Ladysmith northward opening up the Dundee and Newcastle coal fields. Thus a new industry was added to the resources of the colony.

The demand which the growing trade made upon the one port of Natal, Durban, encouraged the colonists to redouble their efforts to improve their harbour.

Harbour works had been begun in 1857, but it was chiefly due to the energy of one of Natal's most distinguished sons, Harry Escombe, that Durban was transformed into a modern port. From 1881 to 1893 Escombe was chairman of the harbour board.

Self-Government.—For many years there had been an agitation among the colonists for self-government. In 1882 the colony was offered self-government coupled with the obligations of self-defense. The offer was declined, but in 1883 the legislative council was remodelled so as to consist of 23 elected and 7 nominated members. In 1890 the elections to the council led to the return of a majority in favour of accepting self-government, and in 1893 a bill in favour of the proposed change was passed and received the sanction of the imperial government. At the time the white inhabitants numbered about 50,000. The electoral law was framed to prevent more than a very few Indians and natives obtaining the franchise. Sir John Robinson (1839–1903), who had gone to Natal in 1850, was a leading journalist in the colony and had been a member of the legislative council after 1863, became the first premier and colonial secretary, with Harry Escombe as attorney-general. The year that witnessed this change in the constitution was also notable for the death of Sir Theophilus Shepstone, Natal's most prominent citizen. Sir John Robinson remained premier until 1897, a year marked by the annexation of Zululand to Natal. In the following year Natal entered the customs union already existing between Cape Colony and the Orange Free State.

The Anglo-Boer War.—Natal watched with anxiety the increasing tension between the Transvaal and Cape Colony, and its citizens suffered, equally with other *Uitlanders,* the disabilities imposed by the Pretoria government. As early as May 1899 the Natal ministry officially intimated its belief that the Transvaal would go to war and, while promising every support possible to the imperial government, expressed anxiety for the defense of the frontier. On Oct. 11, 1899, war broke out, and Natal was invaded by the Boers. The story of the war is told elsewhere (*see* SOUTH AFRICAN WAR; SOUTH AFRICA, UNION OF). A small number of the Boer colonists joined the enemy but there was no general rebellion among them, and the promise that Natal would assist the imperial government was amply redeemed.

One result of the war was an addition to the territory of Natal of a small part of the Transvaal, namely the district of Vryheid, the district of Utrecht, and a portion of the district of Wakkerstroom. As to Vryheid, "in handing over this district to the administration which controls the rest of Zululand, his majesty's government," wrote Joseph Chamberlain (then secretary of state for the colonies), under date March 1902, "feel that they are reuniting what ought never to have been separated." A claim by Natal to annex portions of the Harrismith and Vrede districts of the Free State was, however, disallowed. The districts which were added to Natal contained about 6,000 white inhabitants (mostly Dutch), and some 92,000 natives, and had an area of nearly 7,000 sq.mi., so that this annexation meant an addition to the white population of Natal of about one-tenth, to its native population of about one-tenth also, and to its territory of about one-fourth. The territories were formally transferred to Natal in Jan. 1903.

Native Affairs: The 1906 Revolt.—The period following the war was succeeded by commercial depression. The government met the crisis by renewed energy in harbour works, railway constructions, and the development of the natural resources of the country. A railway to the Zululand coal fields was completed in 1903, and in the same year a line was opened to Vryheid in the newly annexed territories. In Aug. 1903 Sir Alfred Hime, who had been premier after June 1899, resigned and was succeeded by George Sutton, the founder of the wattle industry in Natal and one of the pioneers in the coal-mining industry. In May 1905, the Sutton cabinet was replaced by a coalition ministry under C. J. Smythe, while in 1906 Sir F. R. Moor became premier. These changes of ministry reflected, chiefly, differences concerning the treatment of commercial questions and the policy to be adopted toward the natives. Toward those Boer colonists who had joined the enemy during the war leniency was shown, all rebels being pardoned. The attitude of the natives both in Natal proper and in Zululand caused much disquiet. The chief concern of the Natal government was to remodel its native policy where it proved inadequate. During 1903–04 a Native Affairs' commission, representative of all the South African states, had obtained much evidence on the status and conditions of the natives. Among its recommendations was the direct political representation of natives in the colonial legislatures on the New Zealand model, and the imposition of direct taxation upon natives. Carrying out this last recommendation Natal passed in 1905 an act imposing a poll tax of £1 on all males over 18 in the colony, except indentured Indians and natives paying hut tax (which was 14s. a year). Every European was bound to pay the tax. In 1906 a serious rebellion broke out in the colony, attributable ostensibly to the poll tax, and spread to Zululand. An incident which marked the beginning of this rebellion brought the Natal ministry into sharp conflict with the imperial government (the Campbell-Bannerman administration). Twelve natives were to be shot by order of a court martial for killing, at Byrnetown, two Europeans, who had been sent to enforce the collection of the poll tax. On the day before that fixed for the execution Lord Elgin, then secretary of state for the colonies, intervened and directed the governor to postpone the execution of the sentence Thereupon the Natal ministry resigned, giving as its reason the importance of maintaining the authority of the colonial administration at a critical period and the constitutional question involved in the interference by the imperial authorities in the domestic affairs of a self-governing colony. After a day's delay, during which the governor of Natal, Sir Henry McCallum, reiterated his concurrence, already made known in London, in the justice of the sentence passed on the natives, Lord Elgin gave way (March 30). The Natal ministry thereupon remained in office. The guilty natives were shot on April 2. It was at this time that Bambaata, a chief in the Greytown district who had been deposed for misconduct, kidnapped the regent appointed in his stead. He was pursued and escaped to Zululand, where he received considerable help. He was killed in battle in June, and by the close of July 1906 the rebellion was at an end. As has been stated, it was ostensibly attributable to the poll tax, but the causes were more deep-seated. Though somewhat obscure they could be found in the growing sense of power and solidarity among all the Bantu tribes of South Africa. There were, moreover, special local causes, such as undoubted defects in the Natal administration. (*See* governor's dispatch, June 21, 1906, printed in the Blue Book, Cd. 3247). Many Natalians regarded Dinizulu, the son of Cetewayo, as the inciter of the rebellion and, after a series of murders of whites in Zululand in 1907 and evidences of continued unrest among the natives, the Natal government itself became convinced that Dinizulu was implicated in a rebellious movement. A force under Sir Duncan McKenzie (who had suppressed the 1906 revolt) entered Zululand. Thereupon Dinizulu surrendered (Dec. 1907) without opposition, and was removed to Maritzburg. He was in 1909 found guilty only on the minor charge of harbouring rebels.

The intercolonial commission had dealt with the native question as it affected South Africa as a whole; it was felt that a more local investigation was needed, and in Aug. 1906 a strong commission was appointed to inquire into the condition of the

Natal natives. The commission, whose report was published in Aug. 1907, declared that the chasm between the native and white races had been broadening for years and that the efforts of the administration to reconcile the Bantus to the changed conditions and to convert them into an element of strength had been ineffective. Among other proposals for a more liberal and sympathetic native policy the commission urged the creation of a native advisory board entrusted with very wide powers. "Personal rule," they declared, "supplies the keynote of successful native control"—a statement amply borne out by the influence over the natives exercised by Sir T. Shepstone. The unrest in Zululand delayed action being taken on the commission's report. But in 1909 an act was passed which placed native affairs in the hands of four district commissioners, gave to the minister for native affairs direct executive authority, and created an advisory council for native affairs on which nonofficial members had seats.

Concurrently with the efforts to reorganize its native policy the colony also endeavoured to deal with the Asiatic question. The rapid growth of the Indian population from about 1890 caused much disquiet among the majority of the white inhabitants, who viewed with especial anxiety the activities of the "free," *i.e.*, unindentured, Indians. Several acts had already been passed imposing restrictions upon Indians, and in 1908 a strong commission was appointed to inquire into the whole subject. This commission reported in 1909, its general conclusion being that in the interests of Natal the importation of indentured Indian labour should not be discontinued. For sugar, tea and wattle growing, farming, coal-mining and other industries, indentured Indian labour appeared to be essential. Nothing further was done in Natal up to the establishment of the Union of South Africa, when all questions specially or differentially affecting Asiatics were withdrawn from the competence of the provincial authorities.

Union and After.—Not long after the conclusion of the war of 1899–1902 the close commercial relations between the Transvaal and Natal led to suggestions for a union of the two colonies, but these suggestions were not seriously entertained. The federation or union of all the colonies was a different and more reasonable measure; and this matter was formally reopened by the Cape ministry in 1906. The movement for union rapidly gained strength, and a national convention to consider the matter met in Durban in Oct. 1908. In Natal, especially among the older colonists, who feared that in a united South Africa Natal interests would be overborne, the proposals for union were met with suspicion and opposition, and the Natal ministry felt bound to submit the question to the people. A referendum act was passed in April 1909, and in June 1910 the electors by 11,121 votes to 3,701 decided to join the Union. (*See* South Africa, Union of.) Meanwhile it was agreed by the Cape, Transvaal and Natal governments that, subject to Natal entering the Union, its share of the Rand import trade should be 25% before and 30% after the establishment of the Union. Previously Natal had only 22½% of the traffic, and this agreement led to a revival in trade. The closing months of Natal's existence as a separate colony thus found it peaceful and prosperous. On the establishment of the Union on May 31, 1910, Natal entered it as an original province, Sir F. R. Moor, the premier, becoming a member of the first Union cabinet. The change from the status of a self-governing colony to a province of the Union affected Natal politically more closely than any other province, since in it alone were the great majority of the white inhabitants of British descent. The firm attachment of Natalians to the British connection continued an unchanging factor in the South African situation. Provincial administration was, however, largely carried on upon non-party lines. An exception occurred in 1927 when not a single candidate opposed to the inclusion of the Union Jack in the national flag of the Union was returned to the provincial council. About 70% of the total expenditure of the council is on education. Sir George Plowman, who had filled the office of administrator with great ability after 1918, was succeeded as administrator in 1928 by H. Gordon Watson.

The Indian Problem.—Of the 219,691 Asiatics in the Union in 1936, no fewer than 183,661 lived in Natal. Besides labourers, there were many Indians engaged in professions and commerce. White South Africans in general opposed the further increase of Asiatics in the Union; while, in 1911, the Indian government, long dissatisfied with the attitude of Natal to Indians, prohibited the recruitment of indentured coolies. The Indians both in Natal and the Transvaal complained of many grievances, and their cause was championed by M. K. Gandhi, then resident in South Africa. Arising out of the agitation, riots and disturbances occurred in Natal in 1913. In 1914 the Union government passed legislation intended to prevent Indian immigration into South Africa and to prevent Asiatics already in the Union leaving the province in which they lived. The Smuts-Gandhi agreement of that year was designed to guard the vested interests of Indians already in the Union. The attitude of the white inhabitants of Natal was shown by the borough ordinance passed by the provincial council in Jan. 1924, debarring Indians in future from acquiring the municipal franchise. This ordinance was held up by the Union government for consideration, but in Dec. 1924 assent to its operation was given. The parliamentary franchise was, with few exceptions, already confined to whites. In 1925 there were 38,547 parliamentary electors, of whom only 24 were Indian. In 1927 an agreement on the Indian question was reached by the Union government and the government of India, which led to an amelioration of the condition of Indians in Natal. In accordance with this agreement, the government of India appointed an agent-general in the Union in order to secure effective co-operation between the two governments on this problem. The rank of this official was raised to that of high commissioner on Jan. 1, 1941. During World War II the Indian problem in Natal again became acute. The passage of the so-called "Pegging act" in 1943, intended to deal with the question of Indian penetration of formerly European areas, especially in Durban, was the occasion for the reopening of controversy on this issue.

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NATAL, a city and port of Brazil and capital of the state of Rio Grande do Norte, on the right bank of the Rio Potengí, or Rio Grande do Norte, about 2 mi. above its mouth. The population in 1950 was 97,736. Natal is the starting-point of the railway which extends on down the coast to Pernambuco and Maceió, and is a port of call for coastwise steamers, which usually anchor outside the bar. The harbour has been improved and the Brazilian government uses the port as a naval depot. A large airport for transatlantic planes lies a short distance from the city. The only industry of note is the manufacture of cotton, but the exports (chiefly sugar and cotton) are large. Natal was founded in 1597 as a military post to check an illicit trade in Brazil wood. It became the capital of a province in 1820.

NATCHEZ, a noted tribe of lower Mississippi river, near the present city of Natchez, Miss., who, after massacring the French in their territory in 1729, were defeated by them, the remnants taking refuge with the Chickasaw, and later with the Creek and Cherokee. Allied in general culture to the Muskogian tribes (*q.v.*), they had developed a sun worship with a perpetual fire in a temple, and a caste division into "suns," nobles, honoured men and commoners or "stinkards." This system was matrilineal and exogamic, "suns" marrying "stinkard" wives and having honoured children, whereas "sun" women married "stinkard" husbands and had "sun" children. The head "sun" had power of life and death over all others, and was followed in death by his spouses, attendants and voluntary victims. The origin of these anomalous customs is not clear. *See* J. R. Swanton, *Bur. Am. Ethn. Bull.* 43 (1911).

NATCHEZ, a city of Mississippi, U.S.A., on the Mississippi river, near the southern boundary of the state; county seat of

Adams county. It is on federal highways 61, 65 and 84 and is served by the Illinois Central, the Mississippi Central and the Missouri Pacific railways. A $4,000,000 Mississippi river bridge connects Natchez with Vidalia, La. The population in 1950 was 22,740; and 15,296 in 1940 by federal census. The city, centre of romantic life during steamboat days, is on bluffs more than 200 ft. high above the river. There are three small parks overlooking the river; in the heart of the city is the Confederate Memorial park. Duncan park, city-owned park, contains 200 ac., with golf course and tennis courts. Jefferson Military college (chartered 1802), one of the oldest schools in the southwest, is 6 mi. from the city.

Natchez annually attracts thousands of visitors who enjoy the deeply shaded avenues and the old ante bellum homes of this section. The Natchez Garden club and the Pilgrimage Garden club, organized to preserve the historic and architectural beauty of Natchez, hold annual pilgrimages each spring. Forty or more outstanding historic homes are thrown open to the public each year.

Natchez is a trading centre and an important shipping point for industrial and agricultural products. Manufactures include woodworking, tires and other rubber products, rayon, pulp, boxes, candy, clothing and roasted coffee. The total industrial output at mid-20th century was valued at more than $10,000,000 annually. Natural gas is piped from the Louisiana fields and a high-powered transmission line from Natchez to Amite, La., gives to Natchez two-way electric transmission service.

The Natchez Indians were living there when Robert de la Salle and Henri de Tonti visited them in 1662, and when Le Moyne de Bienville in 1716 built a fort, which he named Rosalie, for the duchess of Pontchartrain. In 1764 Fort Rosalie passed from the French to the English and was renamed Panmure; in 1779 it was turned over to the Spaniards; in 1798 it was occupied by U.S. troops. The city was chartered in 1803. It was the capital of Mississippi from 1798 to 1802 and from 1817 to 1821.

NATHAN, ISAAC (1791?–1864), British author and composer, born at Canterbury, Kent, of Hebrew parentage, studied Hebrew at Cambridge university, preparing to enter the Hebrew priesthood. He wrote a number of songs and in 1815 published the first edition of *Hebrew Melodies,* with words by Lord Byron, whom he had met about three years previously. One of Nathan's most popular songs, "Why Are You Wandering Here?," was included in the comedy *Sweethearts and Wives,* produced in 1823, with words by James Kenney. In 1841 Nathan went to Australia, where he was killed in a traffic accident on Jan. 15, 1864.

NATHANAEL, THE APOSTLE: *see* APOSTLE.

NATICK, a town of Middlesex county, Mass., U.S., 18 mi. W.S.W. of Boston, at the southeast end of Cochituate lake. It is served by the Boston and Albany railroad. Pop. (1950) 19,838; (1940) 13,851. Natick is the Indian name ("our land" or "hilly land") of the tract (originally part of Dedham) granted to John Eliot in 1650 for the "praying" Indians. Until 1719 the Indians held the land in common, and for several years the community was governed (in accordance with Exodus xviii) by "rulers of tens," "rulers of fifties" and "rulers of hundreds." The town owns a copy of Eliot's Indian Bible. An Eliot monument was erected in 1847 near the site of the Indian church. Natick was incorporated as a town in 1781.

NATION, CARRY (1846–1911), U.S. temperance advocate, was born in Garrard Co., Ky., Nov. 25, 1846. Her father, George Moore, moved his family about so often that she had little schooling. In 1867 she married a drunkard; their brief unhappy life together prompted her later career of saloon-smashing in Kansas. With a few hymn-singing women, or alone, she would march into a saloon, sing, pray, hurl vituperations at all "rummies" present and smash the fixtures and the stock with hatchets. This crusade, most violent in the 1890s, led to scattered temporary efforts at law enforcement. After this period of "hatchetation" of "joints" —her words—she lectured in many states, in Canada and Great Britain, usually under no management but her own. For a while she made her speeches between acts of carnivals and burlesque shows.

The fact that her husband had been a Mason as well as a drunkard led her to fight fraternal orders along with saloons, and she added to her list of things to be destroyed tobacco, foreign foods, corsets, skirts of improper length, and paintings of the sort often found in barrooms. She was an advocate of women's suffrage, but neither the national movement for suffrage nor that for temperance gave her much support. Her second husband, David Nation, divorced her in 1901 on grounds of desertion after a marriage of 23 years. She died June 2, 1911.

Her autobiography, *The Use and Need of the Life of Carry A. Nation* (1904) is a hodgepodge of disorder.

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(G. BN.)

NATIONAL ANTHEMS. The official patriotic songs of some countries, used on various national and other festive occasions and as greetings to the sovereign in countries under a crowned head, are known as national anthems, although the word anthem has a special ecclesiastical connotation that is not strictly suited to such songs, which would be better called national hymns. The following are or have been the national anthems of various countries:

Abyssinia: "Etiopia hoy, des yibalish," tune by M. K. Nalbadian (1925), words by a group of Ethiopian scholars (1930). *Argentina:* "Oid, mortales, el grito sagrado Libertad," words by V. Lopez y Planes, tune by J. Blas Parera (1813). *Australia:* "God Save the Queen" (see *Great Britain,* below); also used unofficially: "Advance, Australia Fair," words and tune by P. Dodd McCormick, and "Australia Will Be There," words and tune by W. W. Francis. *Austria:* After World War II: "Land der Berge, Land am Strome," tune by Mozart ("Brüder, reicht die Hand zum Bunde," from the Masonic cantata, K. 623, 1791), words by Paula Preradovic (1946). Under the empire: "Gott erhalte, Gott beschütze, unsern Kaiser, unser Land," words by L. L. Haschka, tune by Haydn (1797). After World War I: "Deutsch-Oesterreich, du herrliches Land," words by Karl Renner, tune by Wilhelm Kienzl (1920). After 1933: "Oesterreichische Bundeshymne" ("Sei gesegnet ohne Ende"), words by Ottokar Kernstock, to Haydn's tune. *Belgium:* "La Brabançonne" ("Après des siècles d'esclavage"), original words by H. L. A. Dechet (Jenneval), tune by F. van Campenhout (1830). In 1951 the tune was revised by a specially appointed commission and a fourth verse was added. A Flemish version was also prepared, with words by M. Herreman, which replaced "De Vlaamsche Leeuw," words by H. van Peene, tune by K. Miry (1845). *Brazil:* "Ouviram do Ypiranga as margens plácidas," words by J. O. Duque Estrada, tune by F. M. da Silva. *Bulgaria:* From 1950: "Bulgario mila, zemya na gheroi," words by Nikola Furnadzhiev, M. Isaev and Elisaveta Bagriana, tune by G. Dimitrov, G. Zlatev-Cherkin and S. Obretenov. Until 1946: "Shumi Maritsa," words by Marachek, tune by Gabriel Shebek; later version of words by N. Zhivkov. *Canada:* "God Save the Queen" (see *Great Britain,* below); also used unofficially: "The Maple Leaf Forever," words and tune by A. Muir (1867); French-Canadians, "O Canada! terre de nos aïeux," words by Sir A. B. Routhier, tune by C. Lavallée (*c.* 1880). *Chile:* "Dulce patria, recibe los votos," original words by B. de Vera y Pintado (1819), modified by E. Lillo (1847), tune by R. Carnicer (1828). *China:* Under the people's republic: interim anthem, tune by Niel Eel. After the 1912 revolution: "Tsung Kuoh hiung," words and tune anonymous (*c.* 1912). Later Kuomintang party song: "The Song of the Kuomintang," words from an address by Sun Yat-sen, tune by Ch'eng Mao-yün (1928). *Colombia:* "Oh! gloria inmarcesible," words by R. Núñez, tune by O. Sindici (*c.* 1905). *Cuba:* "Himno Bayamés" ("Al combate corred Bayameses"), words and tune by P. Figueredo (1868). *Czechoslovakia:* Czech, "Kde domov můj," words by J. K. Tyl, tune by F. Škroup (1834); Slovak, "Nad Tatru sa blyska," words by J. Matuška (1844), tune traditional. (These were combined in 1919.) *Denmark:* Danish royal anthem: "Kong Kristian stod ved højen mast," words by J. Ewald, tune probably adapted by J. E. Hartmann from D. L. Rogert (1779). Danish national anthem: "Der er et yndigt Land," words by A. Oehlenschläger, tune by H. E. Krøyer (*c.* 1819). Also used unofficially, "Den gang jeg

drog afsted," words by F. Faber, tune by J. O. E. Horneman. *Dominican Republic:* "Quisqueyanos valientes, alcemos," words by E. Prud'homme, tune by R. Reyes (1883, adopted 1900). Two others before that, including "Himno de Capotillo," tune by I. M. Caldéron (1865). *Ecuador:* "Salve! O patria!" words by J. L. Mera, tune by A. Neumann (1866). *Egypt:* Instrumental march by Verdi (*c.* 1872), words added by Arabic Music institution (1940s). *Estonia:* "Mu isamaa, mu õnn ja rõõm," words by J. Jannsen (1865, adopted *c.* 1917), tune by F. Pacius (1848, Finnish national anthem). *Finland:* "Maamme laulu" ("Oi maamme Suomi synnyinmaa"), words by J. L. Runeberg (1846), tune by F. Pacius (1848). *France:* "La Marseillaise" (*q.v.*), words and tune by Rouget de Lisle (1792). During the reign of Napoleon III: "Partant pour la Syrie," words by A. de La Borde, tune attributed to Queen Hortense of Holland, but probably by L. Drouet. *Germany:* German Federal Republic: "Einigkeit und Recht und Freiheit" (verse three of "Deutschland, Deutschland über alles"), tune by Haydn (*see* below) (adopted 1950). German Democratic Republic: "Auferstanden aus Ruinen und der Zukunft zugewandt," words by J. R. Becher, tune by H. Eisler (adopted 1949). The first German national anthem was "Heil dir im Siegerkranz," words by H. Harries (1790), modified by B. G. Schumacher (1793), tune "God Save the Queen" (see *Great Britain*, below) (adopted 1796). After World War I: "Deutschland, Deutschland über alles," tune by Haydn ("Gott erhalte," see *Austria*), words by A. H. Hoffmann von Fallersleben (1841, adopted 1922). *Great Britain:* "God Save the Queen," words and tune anonymous, first sung semiofficially at Drury Lane and Covent Garden theatres in London, arranged by T. A. Arne and Charles Burney respectively, after Sept. 28, 1745, when the defeat of the Jacobite rebellion was announced. It was then merely an expression of party loyalty to George II, and the words (*e.g.*, "confound their politics") referred to the Jacobites, not to some enemy of the country as a whole. The tune has been traced back, unconvincingly, as far as John Bull (1619) and its opening phrase, to the words "God save the King," appears in a catch by Henry Purcell (1685) as though quoted from a song already familiar, which may, however, be a coincidence. The later claims made for Henry Carey and James Oswald rest on no solid foundations. The words became slightly altered when the song came into use as the British national anthem and "Queen" was first substituted for "King" in Queen Victoria's reign. *Greece:* "Se gnorizo apo tin kopsi," words by D. Solomos (1823), tune by N. Mantzaros (adopted 1863). *Hungary:* "Isten áldd még a magyart," words by F. Kölcsey (1823), tune by F. Erkel (1845). *Iceland:* "O Gud vors land," words by M. Jochumsson, tune by S. Sveinbjørnsson (1874). *India:* "Jana Gana Mana," words by R. Tagore, tune attributed to him but probably traditional (adopted 1950). *Ireland, Republic of:* "The Soldier's Song" ("We'll sing a song"), words by P. Kearney, tune by P. Heaney (*c.* 1917, adopted 1937). *Israel:* "Hatikvah," words in Hebrew by N. H. Imber, English by Nina Salaman, tune based on traditional Hebrew melodies (adopted by the Zionist movement in 1907, by Israel in 1948). *Italy:* "Inno di Mameli" ("Fratelli d'Italia"), words by G. Mameli, tune by M. Novaro (1847, adopted 1946). From the foundation of the kingdom of Italy (1861): "Marcia Reale." *Japan:* "Kimi ga yo," words 9th century, tune by H. Hirokami, revised by F. Eckert (1880). *Latvia:* "Dievs, sveti Latviju," words and tune by K. Baumanis. *Lithuania:* "Lietuva, tévyné mūsu," words and music by V. Kudirka (1918). *Mexico:* "Mexicanos, al grito de guerra," words by F. Gonzalez Bocanegra, tune by J. Nunó (1854). *Netherlands:* "Wilhelmus van Nassouwe," words attributed to Philip van Marnix heer van St. Aldegonde (*c.* 1590), tune anonymous (first published, 1626). *New Zealand:* "God Defend New Zealand," words by T. Bracken, tune by R. A. Horne (adopted 1940); but "God Save the Queen" continues to be used. *Nicaragua, Republic of:* "Salve a te Nicaragua," words by Sálomon Ibarra Mayorga (written 1917), tune anonymous. *Norway:* "Ja, vi elsker dette landet," words by B. Bjørnson (1869), tune by R. Nordraak (1863–64). *Pakistan:* No official anthem had been chosen in 1953; "East Bengal" was sung as a national song. *Paraguay:* "Paraguayos, República ó muerte," words by F. Acuna de Figueroa, tune by F. Dupuy. *Persia:* "Shāhanshāh i mā Zandah bādā," words by S. Afsar, tune by N. Moghaddam (adopted *c.* 1934). *Peru:* "Somos libres, seámos lo siempre," words by J. de la Torre Ugarte, tune by J. B. Alzedo (1821), tune rewritten by C. Rebagliati (1912). *Poland:* "Jeszcze Polska nie zginęła," words by J. Wybicki (1797), tune traditional (*c.* 1795, adopted 1927, altered 1948, harmonized by K. Sikorski). *Portugal:* "Herois do mar," words by L. de Mendonça, tune by A. Keil (1890, adopted 1910). Before the republic: "O patria, O rei, O povo," words and tune by Pedro IV (Pedro I of Brazil). *Rumania:* "Te slăvim, România, pământ părintesc," adopted on Aug. 23, 1953, words by E. Frunza and D. Deşir, tune by M. Socor. Before 1947: "Trăească Regele in pace si onor," words by B. Alexandri, tune by E. A. Hübsch (1861). *South Africa:* "Die Stem van Suid-Afrika," words by C. J. Langehoven (1936), tune by M. L. de Villiers (adopted 1938), official English translation, 1952. *Spain:* "Marcha de Granaderos." Under the republic: "Himno de Riego." *Sweden:* "Du gamla, du fria, du fjällhöga Nord," words by R. Dybeck, tune traditional (adopted 1844). *Switzerland:* "Rufst du, mein Vaterland," words by J. H. Wyss (1811), tune, "God Save the Queen" (see *Great Britain*, above). *Syria:* "Humatal diyári 'alaikum salám," words by Khalil Mardam Bey, tune by the brothers Fulayfel (adopted 1939). *Thailand:* "Taurasben Barami," words and tune anonymous. *Turkey:* "Istiklal marsi," words by Mehmed Akif Ersoy, tune by Osman Zeki Ungor (adopted 1921). *United States of America:* "The Star-Spangled Banner," words by F. S. Key (1814), to the tune of J. Stafford Smith's song "To Anacreon in Heaven" (adopted 1931). Earlier, "My Country, 'Tis of Thee," words by S. F. Smith, tune "God Save the Queen" (see *Great Britain*, above) (1832); "Hail Columbia!" words by J. Hopkinson (1798), tune by P. Fyls (*c.* 1800). *U.S.S.R.:* "Gimn Sovietskogo Soyuza" (or "Song of Stalin"), original words by B. Lebedev-Kumakh (1942), rewritten by S. Mikhalkov and I. Registan (1944), tune by A. V. Alexandrov (1942). Used earlier by the U.S.S.R.: "L'Internationale," words (originally French) by E. Pottier (1871), tune by P. Degeyter. Tsarist Russia: "Bozhe Tsarya khrani," words by V. A. Zhukovsky, tune by A. Lvov (1833). *Uruguay:* "Orientales, la patria ó la tumba," words and tune by J. Coppetti. *Venezuela:* "Gloria al bravo pueblo," words by V. Salias, tune by J. Landaeta (*c.* 1810). *Yugoslavia:* Since 1945: "Hej Slaveni," words anonymous, tune traditional (the Polish national tune). Earlier: A composite of three songs: "Bože pravde ti što spase" (Serbian), words by J. Djordje, tune by D. Jenko (1872), "Lijepa naša domovino" (Croatian), words by A. Mihanović, tune by J. Runjanin (1846) and "Naprej zastava slave" (Slovene), words by S. Jenko, tune by D. Jenko. (E. W. Bm.)

NATIONAL ARCHIVES, U.S. The national archives and records service is a part of the General Services administration. It consists of the national archives, the records management division, the Federal Register division and the Franklin D. Roosevelt library in Hyde Park, N.Y. It is headed by the archivist of the United States, who is also chairman of the National Historical Publications commission.

Its functions are to promote efficient management of records throughout the government; to facilitate orderly destruction of federal records no longer needed and economical storage of those needed for a short time only; to preserve, describe and service those selected for permanent preservation; to publish the *Federal Register*, the *Code of Federal Regulations*, the statutes at large and the *United States Government Organization Manual;* and to supervise collections in the Franklin D. Roosevelt library. By the 1950s there were about 800,000 cu.ft. of records in the national archives dating from the Revolutionary War through World War II and including more than 250,000 sound recordings, 900,000 maps and charts, 2,000,000 pictures and about 75,000 reels of motion-picture film.

The Declaration of Independence, the constitution of the United States, the Bill of Rights and many other famous documents relating to United States history were placed on display in the National Archives Exhibition hall.

Reproductions of the three great documents are available in an inexpensive publication, Charters of Freedom, and facsimiles

of such documents as the Emancipation proclamation are also on sale. Certain records of high research value are also available on microfilm at low cost. (W. C. G.)

NATIONAL ASSOCIATION FOR THE ADVANCEMENT OF COLORED PEOPLE. In Jan. 1909 Mary White Ovington, William English Walling and Henry Moskowitz met in New York, N.Y., to discuss problems of discrimination against the Negroes in the United States. A campaign was begun Feb. 12, Abraham Lincoln's birthday, to call a national conference "for the discussion of present evils, the voicing of protests, and the renewal of the struggle for civil and political liberty."

The conference was held on May 30, 1909, at the Charity Organization hall, New York city, and a committee of 40 was formed to begin the national work. At the second conference held in New York in May 1910, the N.A.A.C.P. was organized as a permanent body. W. E. B. DuBois became an executive in the association, and publication of the *Crisis* magazine was begun in Nov. 1910 with DuBois as editor and Mary Dunlop MacLean as managing editor. In the early 1950s there were approximately 250,000 members.

NATIONAL BETTER BUSINESS BUREAU: *see* BETTER BUSINESS BUREAUS.

NATIONAL CITY, a city of San Diego county, southwest California, U.S., in the San Diego metropolitan area, about 10 mi. N. of the Mexican border. Pop. (1950) 21,199. National City is situated on federal highway 101 and is served by the Atchison, Topeka & Santa Fe and the San Diego and Arizona Eastern railroads. Several airports are near by. The city's products are largely agricultural.

NATIONAL CONVENTION, THE. In the United States the national convention is the representative organ of the political parties which nominates candidates for president and vice-president, adopts the platform and performs other party functions. National nominating conventions were held by the Federalist party in 1808 and 1812. These gatherings of party leaders were held privately and no proceedings were published. They were not in form representative assemblies of the party, and they had no influence on the displacement of the congressional nominating caucus by the national convention. The Anti-Masonic party met in national convention at Baltimore, Md., in Sept. 1831. This convention was composed of 112 delegates for 13 states and adopted "An Address to the People of the United States." The National Republican or Whig party followed with a convention at Baltimore in Dec. 1831, with each state entitled to a delegation the size of the electoral vote of the state. A system of state and local correspondence committees was authorized. The Democratic party held its first national convention in Baltimore in May 1832, for the purpose of nominating Martin Van Buren for vice-president, as the running mate to Pres. Andrew Jackson. Since then the national convention has been the recognized method of selecting presidential and vice-presidential candidates.

While the number of delegates in the early conventions fluctuated, ordinarily each state was limited to a vote equal to its electoral-college strength. Eventually twice as many delegates were sent as there were electors, and finally each delegate was given an entire vote. The Democratic party adhered to these rules through the convention of 1940, which decided that thenceforth each state casting its vote for the Democratic presidential candidate should be allowed a bonus of two votes in the succeeding national convention. The national committee increased the bonus to four votes in 1947.

The Republicans formerly allowed each state twice as many delegates as its electoral vote, but the rule was altered in 1913, 1923 and 1940 to lessen the number of delegates from the normally Democratic states of the south. The 1940 rule allotted to each state two delegates for each senator and representative at large. Three additional delegates were allowed if the state cast a majority of its electoral vote for the Republican nominee at the preceding presidential election or elected a Republican senator at the preceding congressional election. One delegate was allotted to each congressional district casting 1,000 Republican votes at the preceding presidential or congressional election. Another delegate could be chosen from a district if its Republican vote exceeded 10,000 at either of such elections. With delegates from the territories, dependencies and District of Columbia, in 1948 the Republicans had 1,094 delegates, the Democrats 1,234. For each delegate, an alternate is chosen to act in the absence of the delegate. The Democrats permit states to send more than the allotted number of delegates and give to each a fractional vote.

In the December or January preceding the convention, the national committee of each party meets in Washington, D.C., and issues the call for the next convention. At this time the allotment of delegates is made and the state committees are instructed as to how they are to be chosen. A convention city also is selected, giving consideration to auditorium facilities, hotel accommodations, financial donations and political benefits. The convention delegates are elected by state and district conventions, by state party committees, or by the voters acting through presidential primaries in about one-fourth of the states. They are either instructed as to presidential preference or are sent uninstructed; some are instructed as to vice-president. Prior to the convening of the convention, usually in June or July, the national committee meets to make final arrangements for the convention. A temporary roll of convention delegates is made and a temporary organization is suggested for the convention.

The chairman of the national committee calls the convention together and the first question is on temporary organization. After temporary organization has been effected, the temporary chairman makes a keynote speech sounding the campaign issues. Then the committees on rules and procedure, credentials, permanent organization and platform and resolutions are appointed, the members being nominated by the state delegations.

After the adoption of rules and the report on credentials, a permanent organization is effected. The permanent chairman also speaks in outline of the campaign issues. The convention then proceeds to nominate candidates and adopt a platform. Nominations for president are made by calling the roll of delegations. Seconding speeches often are made. A majority vote is necessary to nominate; until 1936, however, the Democrats required two-thirds to nominate. After the candidate for president is nominated, a choice for vice-president is made along the same procedure. A platform is adopted either before, during or after the nominations. Committees on notification of the two candidates are named and the convention adjourns after authorizing the national committee to fill any vacancies on the ticket.

The national committee, composed of a man and woman from each state and territory, assumes office upon adjournment of the convention, the members being selected by the delegations or by state conventions or primaries if so authorized by state statutes or party rules or by state conventions.

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(S. LE.; V. O. K.)

NATIONAL COUNCIL OF EVANGELICAL FREE CHURCHES, a voluntary association of British Nonconformist churches for co-operation in religious, social and civil work. It was the outcome of a unifying tendency displayed during the latter part of the 19th century. About 1890 the proposal that there should be a Nonconformist Church congress analogous to the Anglican Church congress was seriously considered, and the first was held in Manchester on the 7th of November 1892. In the following year it was resolved that the basis of representation should be neither personal (as in the Anglican Church congress) nor denominational, but territorial; and the name of the organization was changed from congress to national council as soon as the assembly ceased to be a fortuitous concourse of atoms, and consisted of duly appointed representatives from the local councils of every part of England. The local councils consist of representatives of the Congregational and Baptist Churches, the Methodist Churches, the Presbyterian Church of England, the Free Episcopal Churches, the Society of Friends and such other Evan-

gelical Churches as the National Council may at any time admit. The constitution states the following as the objects of the National Council: To facilitate fraternal intercourse and co-operation among the Evangelical Free Churches; to assist in the organization of local councils; to encourage devotional fellowship and mutual counsel concerning the spiritual life and religious activities of the Churches; to advocate the New Testament doctrine of the Church, and to defend the rights of the associated Churches; to promote the application of the law of Christ in every relation of human life. Although the objects of the Free Church councils are thus in their nature and spirit religious rather than political, there are occasions on which action is taken on great national affairs. The movement differs essentially from the Evangelical Alliance, inasmuch as its unit is not an individual, private Christian, but a definitely organized and visible Church. The essential doctrine of the movement is a particular doctrine of churchmanship which regards the Lord Jesus Christ as the sole and Divine Head of every branch of the Holy Catholic Church throughout the world.

The report of the National Free Church Council is published at the headquarters of the organization, the Memorial hall, Farringdon street, London E. C. The Report for 1927–28 shows that England, Wales and the Channel Islands have been covered with a network of councils, each of which elects its representatives to the annual gathering. The movement has spread to Australia, New Zealand, South Africa, Jamaica, the United States of America and India.

NATIONAL DEBT. A public debt is any obligation for the preservation or extinction of which a state is willing to devote its resources. "National debt" refers to the indebtedness of a central government, as distinct from that of a state, provincial, or subordinate political unit. Like any other debt it is a recognized obligation to pay a definite sum of money, either on demand or after specified notice, or on a definite date, or in instalments coming due on a series of dates. A national debt is both a contractual and moral obligation. Gaston Jèze, the eminent French jurist, limits public debts to those originating in "an act of borrowing"—that is, in a voluntary transaction between the state and the lender. But a forced loan, under which a state uses legal compulsion to secure capital, is no less a part of the national debt, if, or so long as, the obligation of repayment is recognized.

National debts are the debts of a political entity. They are not the aggregate debts of its citizens. Nor is private property, save through taxation, subject to seizure for payment of public debts. The state, moreover, fixes the rules under which it can be sued both for its torts and violation of contracts. Without its consent claims against it are not enforceable. Its debts are only those claims the state recognizes as such.

Because of the fact that resources of citizens are taken by taxation to pay interest or to retire the principal of national debts, these obligations are sometimes called "mortgages on the wealth and income of the people of a country," or "a lien on the income of taxpayers." Jèze called public loans "a financial device whereby receipts of imposts and taxes are anticipated." Lord Stamp was of the opinion that "apart from their psychology, borrowing and taxation are interchangeable; there is no external difference between the intermediate effect of borrowing and taxation. They both mean that there are fewer tickets, and so fewer goods for the taxed person or for the lender to consume."

What Is Included and Excluded.—Public debts of various nations are not strictly comparable. They differ in inclusiveness because of variations in political structures (as in unitary or federated governments), in functions performed, and in accounting procedures employed. The gross public debt of the U.S., for example, is composed of the direct obligations of the federal government including obligations carried over from the Civil War, World Wars I and II, building the Panama canal and financing the relief-recovery program of the 1930s. The debt includes interfund borrowings, such as from the old age and survivors' insurance trust fund, the railroad retirement account and the postal savings system. It includes obligations on which interest has ceased, as where issues have been called for payment but not presented; it includes also noninterest-bearing debts such as savings stamps, demand notes and fractional currency issued at the time of the Civil War and not retired, legal tender notes and national bank notes. The U.S. gross debt does not include the contingent liabilities of the government, unless specifically stated as "the gross debt and guaranteed obligations of the U.S."

The contingent liabilities of the U.S. are authorized obligations issued by certain government corporations and agencies guaranteed as to payment of principal or interest by the U.S., or issued on the credit of the U.S. Among the issues *guaranteed* by the U.S. were obligations of the Commodity Credit corporation, Federal Housing administration, Reconstruction Finance corporation and the Tennessee Valley authority. Deposits in the U.S. postal savings system are issued "on the credit of the United States." On Oct. 16, 1941, the treasury announced that thereafter it would provide funds needed by government corporations and agencies, and that the sale of obligations by these agencies would be discontinued. Maturities and redemptions of such outstanding issues were thereafter handled by the treasury. The distinction between direct and guaranteed debt in the U.S. will disappear in the course of time. The contingent liabilities of the U.S. for financing of corporations and agencies decreased from $6,360,000,000 on June 30, 1941, to $27,000,000 on June 30, 1949. Loans for these public authorities were now included in the direct debt. A saving in interest costs was a result of the new arrangement.

Many other countries follow the practice of excluding contingent liabilities from the gross debt. The primary exclusion is for issues of central banks, (*e.g.,* federal reserve notes are listed as "other obligations" rather than as "guaranteed by" or "on the credit of the U.S.," in tabulations of contingent liabilities, but are not included in statistical totals for guaranteed debts. On June 30, 1949, federal reserve notes outstanding amounted to $23,209,000,000.) In Italy, on the other hand, paper money and bank advances are considered as part of the national debt. Among the liabilities also generally excluded from public debt statements in the U.S. and United Kingdom are unpaid wages and salaries, unpaid rents, interest accrued but unpaid, open book accounts payable, liabilities under pension systems, judgments and adjudicated claims. Occasionally such liabilities are funded and hence are embraced within the national debt. For example, certain obligations to war veterans in the U.S were met by the issuance of 3% Adjusted Service bonds in 1936. It may be argued, however, that this was in satisfaction of a moral claim rather than the funding of a current liability. Indemnities imposed by foreign states usually are excluded from debt statements.

Political loans have at times been concealed. Practices have also varied as to foreign debts. France, for example, carried the Morgan loan in its statement from 1871 until 1875, when it was repaid. Its foreign debts from World War I were included from 1916 to 1932, when payments were suspended under the Hoover moratorium (1931) and the Lausanne conference (July 1, 1932). After Dec. 31, 1934, no foreign debts appeared in the French statements of public debts. Italy traditionally separated foreign indebtedness from its domestic public debt statements. The U.S.S.R. excluded all foreign loans contracted under the tsarist regime.

Debt statements often reflect the various undertakings or industries owned and operated by governments. Railroad debts have been included among the debts of Frence, Germany, Switzerland, Canada and Japan. Capital expenditures for canals, telephone and telegraph systems, harbours, hydroelectric plants, housing, highways, armaments, etc., have been financed by public borrowing. In some cases the issues have been for designated purposes, in other cases they have been covered by general loans.

Types of Public Credit.—Public debts may be classified and identified by types. The use of the classification depends upon the purpose at hand. There are geographical as well as chronological variations in terms and usages. The following classification will cover most common usages. The groups shown are not mutually exclusive.

Gross debt refers to the total amount of debt outstanding. It ordinarily includes the sum of all obligations, funded and floating,

except contingent liabilities.

Net or dead-weight debt is the gross debt less sinking fund or other assets dedicated to the retirement of such debt. "Dead weight" is in more general usage in England than in the United States.

External or foreign debt is a debt owed to a nonresident national, or to a foreign creditor or state. The payment of interest or principal on an external debt involves the transfer of goods or services to another country. At the time of the loan, however, the debtor received goods, services or capital from abroad. Indemnities and reparations debts, by their nature, belong in this group. At the time of imposing the obligation, usually by force of arms or by treaty concluding a war, no *quid pro quo* was involved. Payments, however, represent transfers from the debtor to the creditor country.

Internal debts include loans within a state to the government thereof; or loans held within the debtor country and payable therein. Internal loans involve transfers within the debtor country. At the time of the loan, capital goods or services are placed at the disposal of the government. At the time of payment of interest or principal, taxpayers are deprived of resources for transfer to domestic holders of the debt (less costs of administration) In view of the transfer aspects of internal debts, the country as a whole is neither richer nor poorer as a result of the loan or its repayment, unless deleterious effects are produced by taxation for debt service or the loans cause a decrease in the efficiency of the use of capital.

Funded debt is a term of English origin derived from the fact that the interest due was originally paid from the proceeds of certain taxes or funds. Gradually the meaning was extended to cover debts due at some distant date, or to refer to formal obligations, like consols, redeemable at the pleasure of the government but not repayable at any definite time. The term "funding system" referred to the process of creating the funded debt, although most writers devoted their attention to the evils of the system. Early English works on borrowing made general use of the term "funding." See for example David Ricardo's "Essay on the Funding System" in Supplement to *Encyclopædia Britannica,* 1824, or J. R. McCulloch, *Treatise on the Principles and Practical Influence of Taxation and the Funding System* (1845). Sir Robert Palgrave (*Dictionary of Pol. Econ.*) says that it was customary to associate the term "funding" with an agreement to repay a greater sum than was received, as happens when bonds are sold at a discount.

Floating or unfunded debt.—It is usual to define the floating debt as being unfunded. In essence it is a temporary or short-term indebtedness. It may be incurred as a result of an emergency, a temporary shortage of revenues, a lack of synchronization between the receipt of revenues and due dates of obligations, or even by reason of repeated failures to levy sufficient taxes to meet current expenditure requirements. In Britain and the U.S. floating debt generally refers to debts payable within one year. The League of Nations so classified debts payable within two years. In early usage the term referred to all except funded debts, specifically including accounts, warrants, commissary certificates, obligations issued for commandeered military supplies, unliquidated claims for services or supplies and even fiat money. It is now generally limited to liabilities in recognition of which the government has issued some type of paper (obligation). Therefore, it does not ordinarily include open accounts, unpaid wages, rent accruals or similar liabilities. The obligations given vary widely as to form. Often they are carried over from year to year and end by being funded into longer term debts. The conventional attitude is that floating debts should be kept at a minimum and, instead of being funded, should be paid as soon as practicable.

Long-term debt refers to obligations having a maturity date ten or more years after issue. It includes "perpetuities," or perpetual debts, which are loans having no fixed date for repayment but nevertheless are redeemable. British consols are of this type. When debts are classified into two groups, long- and short-term, the dividing line is usually placed at five years. This dual classification is not as satisfactory, particularly for purposes of analysis, as the threefold grouping into long-term, intermediate and short-term issues.

Intermediate debt refers to obligations having maturities of from five to ten years after issue. Many U.S. treasury notes fall in this category.

Short-term debt refers to obligations with maturities of less than five years. In the U.S. they have been used mainly in time of war or monetary crisis, and have been an outstanding feature of federal finance since World War I. In England, except for a few exchequer bonds introduced by William Ewart Gladstone, they were also the creation of World War I and have been widely utilized ever since. The role of short-terms has thus changed from an emergency expedient to that of a permanent feature of regular borrowing programs. Treasury bills and certificates of indebtedness are typical short-terms issued by the U.S.; treasury bills and ways and means advances are English examples. Notes, certificates, etc., sold in anticipation of the receipt of funds from subsequent bond issues also belong in this group. In France, short-term debt appeared in statistics after 1816, but took on great importance only during and after World War I, as was also the case in Germany and Italy.

Marketable debt is composed of securities which may be sold by owners on the open market. Among the marketable issues of the U.S. are consols of 1930, Panama canal loan bonds, Liberty bonds, treasury bonds, treasury notes, certificates of indebtedness and treasury bills. The term is synonymous with "negotiable." British, as well as most European, securities also are typically of the marketable variety. Such for example, were the Victory bonds of 1919, the conversion loan of 1924, and the national war bonds (1941 *et seq.*) issued by the U.K.

Nonmarketable debt is composed of securities which cannot be freely sold by holders. When owners desire to convert them into cash, or other government securities, they must be presented to the treasury, or designated agents, for redemption at values usually declared at time of issue. Redemption at stated figures removes the risk of fluctuations in market prices. Lack of negotiability is ordinarily compensated by the rate of interest paid. These securities are designed primarily for low-income groups who can ill afford to risk capital losses from price fluctuations. Nonmarketable issues of the U.S. include savings bonds, depositary bonds and treasury tax savings notes. The U.K. national savings certificates issued during World War II are of this type.

Special issues are interest-bearing securities issued (specially) by the treasury for the investment of trust and other funds deposited in the treasury. They are obligations arising from inter-fund borrowing. They are not publicly issued, nor are they marketable. Interest paid is typically controlled by statute. Among U.S. special issues outstanding at mid-20th century were: (1) treasury notes given to the federal old-age and survivors insurance trust fund, or to the civil service retirement fund; (2) certificates of indebtedness, issued to the unemployment trust fund.

The relative importance of marketable, nonmarketable and special issues in the U.S. government public debt shows some variation over time depending on treasury policies and economic conditions, as may be seen from the following table (amounts in millions):

	Dec. 31, 1944	Sept. 30, 1949
Total U.S. debt outstanding (direct and guaranteed obligations)	$232,144	$256,709
Marketable issues	161,648	155,647
Nonmarketable issues	50,917	65,195
Special issues	16,326	33,914
Matured debt and debt bearing no interest	1,783	1,923
Guaranteed obligations	1,470	29

Interest-bearing debt includes all issues on which a government promises to pay interest, whether directly or by way of accumulations added to the issue price. Liberty bonds were of the coupon variety, interest being paid through banks upon presentation of coupons on their due date. Series E savings bonds issued by the U.S. during and after World War II were sold on a discount basis ($25 bonds issued at $18.75), interest being added to issue price at

rate of 2.9% if held to maturity. (Maturity value at end of ten years, $25.)

Noninterest-bearing debt denotes public securities issued without promise of payment of interest. Fiat or paper money is the typical illustration. As governments exhaust taxing power and voluntary borrowing they have tended to turn to such issues. The relative importance of noninterest-bearing issues tends to increase at such times. Some temporary issues, such as savings stamps, carry no interest because these debts are expected to be exchanged into more permanent form, because individual investments in them are nominal, and because of administrative difficulties in arranging to pay interest. At mid-century the most important debt of this type was the special notes of the U.S. to the International Monetary fund. Matured debt on which interest has ceased is not included in this category.

Redeemable debt includes issues as to which the government is under obligation to pay cash, usually at stated values, upon presentation prior to maturity.

Nonredeemable debt includes issues which the government has not promised to exchange for cash prior to maturity. Holders desiring to receive cash prior to maturity are usually free to sell in open market. Frequently issues are nonredeemable until after the lapse of a specified period. Redemption is sometimes determined by lot.

Callable debt consists of obligations which the issuing government is free to redeem at its convenience, or after the lapse of a specified time subsequent to issue, depending upon the agreement. The privilege of calling bonds for redemption prior to maturity enables the government to convert the debt so as to secure savings from lowered interest rates. Insertion of call privilege in contract is supposed to require payment of a slight extra premium over loans sold without such provisions, so as to cover uncertainty as to the life of the investment. This extra premium is not always exacted by lenders.

Noncallable debt consists of public obligations which do not contain the contractual right of redemption prior to maturity.

Government obligations are debts of issuing governments backed by the faith and credit of such governments. They are sometimes called direct debts.

Government guaranteed debts are obligations for the ultimate repayment of principal and interest of which a government has pledged its credit and resources.

Voluntary loans result from borrowing involving no element of coercion, direct or indirect, or conditional exercise of taxing power or implied use of administrative or regulatory authority. They refer to loans made in a free market by willing lenders. Only in exceptional cases are loans otherwise than voluntary. That a free market can be relied upon for public borrowing is an indication of the maturity of governments as institutions, of the stability of credit and of the high state to which economic and financial institutions, including an organized money market open to all, have evolved in the modern world

Compulsory or forced loans are transfers of goods, services or capital to the use of a government brought about by the exercise of force, or the threatened use thereof upon failure to effect transfers of capital, but accompanied by a promise of repayment, or indemnification, with interest. The earliest loans seem to have been of this type, reflecting either the lack of a basis for voluntary credits, or the power of absolutist sovereigns to wrench capital from unwilling subjects or easy victims of political power. In England forced loans were originally raised from foreigners, especially Jews and Italian bankers. In the 15th century native lenders were common. Charles I employed a forced loan to finance an unpopular war with France and its failure led the third parliament in 1628 to draw up a Petition of Right outlawing forced loans without the consent of parliament. Forced loans were employed in the city republics of Italy as early as 1171, but their precise origin is unknown. Their record of repayments was, on the whole, fairly good, and in due course Italy pioneered the development of voluntary credit institutions and techniques, and transplanted them into northern Europe. France made some use of forced loans after the Revolution. Prussia utilized treasures during the 18th century to finance wars but these were exhausted by 1794. Among the expedients subsequently utilized were coinage debasement, lottery loans and, in 1809, the delivery of all articles of gold and silver in return for certificates payable in coin. There was another forced loan in 1810. Out of exhausted credit and the ruthlessness of kings came the early antipathy to forced loans. From 1815 to 1914 there were few forced loans throughout the world.

During World War I and its aftermath, forced loans again appeared to reinforce weak taxation, or to drive through voluntary loans. In France, Britain and the U.S. it was argued that forced loans were appropriate if men were drafted for military service. Such loans were employed (1914–22) in Australia, Czechoslovakia, Germany, Greece, the Netherlands, Italy, New Zealand, Norway and Poland without conspicuous success. In the U.S. during the war, many local committees adopted coercive methods to secure subscriptions to war bonds.

In the financing of World War II, forced loans, or forced saving plans, were employed in Great Britain, New Zealand, Japan, Germany and Italy. In Canada (1942–43), they were euphemistically termed "refundable taxes." The victory tax in the U.S. and the excess profits tax in England with their postwar credits bore close resemblance to forced loans. Japan imposed forced loans in some of the occupied areas of southeast Asia, as well as at home, during World War II. The degree of compulsion exerted in some places in the U.S. to secure subscriptions to Series E war bonds should not be ignored. Many economists in Britain and the U.S. (especially J. M. Keynes) favoured compulsory loans during the war not only to aid in financing that undertaking, but as a means of mopping up purchasing power to help prevent inflation. This, in part, accounts for the forced saving incorporated in the British wartime personal income tax. This use of forced loans was in marked contrast to early usage. At first it was an instrument directed at the wealthy few, by a state with imperfect credit standing. During the 1940s it was aimed at the masses, the holders of the bulk of purchasing power. In its modern use it is really a form of universal saving or a refundable tax and, when popularly sanctioned, may be used increasingly in the future by governments fully able to borrow by other means, which also will be utilized.

Among the practices which, from time to time, have been denominated forced loans are: military requisitions, fiat money, currency debasement, withdrawal of conversion privilege from legal tender notes (as in the U.S. in 1863), the unilateral alternation of terms of loan contracts by the issuing government, and the appropriation of bank deposits, or portions thereof, by the government.

Bond anticipation borrowing is a form of short-term credit issued prior to the floating of a large bond issue from the proceeds of which the temporary anticipatory borrowings are to be retired. The use of interim short-terms makes possible the timing of long-term issues to coincide with better market opportunities.

Tax anticipation borrowing refers to short-term borrowing by the government in advance of the receipt of taxes soon to be in process of collection. The U.S. direct-tax loan of 1815 was of this type. This form of borrowing is more frequent in state and local governments than in national units. Such loans are usually secured only by the tax receipts anticipated and are in reality borrowings of "funds" rather than of governmental units. Such loans are to be distinguished from securities sold to taxpayers to permit them to prepay taxes or to save via government security purchases sums needed to meet tax liabilities. The tax anticipation warrants issued by the city of Chicago are examples of true tax anticipation borrowing, while the U.S. treasury tax notes issued subsequent to 1943 are illustrative of plans devised to help the individual accrue (save for) his tax liabilities. In both cases, however, the government secures use of capital prior to tax-payment dates

Differences Between Public and Private Credit.—Many of the differences between public and private credit are due to differences between the state and the individual. The state has jurisdiction over all individuals in the social group; it is responsible for their welfare. It controls their actions, determines what they may do, establishes rules of conduct, provides opportunities for

earning a living, regulates the ownership of property and provides the means through which wrongs may be redressed and breaches of contract indemnified. The state is the creator of credit and the agency which delegates this function to others, when it is lodged in private hands. Since the state makes the rules concerning credit creation it must be careful not to discriminate in its own favour, if a system of voluntary borrowing in a free market is to develop. Lack of such discrimination can be interpreted as one sign of the fiscal maturity of governments. Similarly the state must respect the financial institutions it creates. The state, too, has a permanence—a length of life—not possessed by the individual. The stability of government is reflected in its credit, and vice versa. This stability affects the risks investors must assume. The earning power of the individual is cut short by death; that

TABLE I—*Growth of National Debt in United Kingdom, United States, France, Germany, Japan and Canada*
(in millions of currency units shown)

Year*	United Kingdom of Great Britain and Northern Ireland† (Pound Sterling)	United States‡ (Dollar)	France§ (Franc)	Germany‖ (Mark)	Japan¶ (Yen)	Canada♀ (Dollar)
1697	14	—	—	—	—	—
1757	77	—	—	—	—	—
1781	187	—	—	—	—	—
1791	—	75	—	—	—	—
1795	(1793) 245	81	—	—	—	—
1800	—	83	—	—	—	—
1802	523	81	—	—	—	—
1805	—	82	—	—	—	—
1810	—	53	—	—	—	—
1815	834	100 (1816) 127	1,272	—	—	—
1820		91	3,590	—	—	—
1825	(1828) 800	84	4,123	—	—	—
1830	—	49	4,890	—	—	—
1835	(1836) 832	δ	4,557	—	—	—
1840	827	4	4,682	—	—	—
1845	818	16	5,810	—	—	—
1850	804	63	5,426	—	—	—
1855	789	36	6,965	—	—	—
1860	799	65	10,262	—	—	—
1865	790	2,678	13,865	—	—	—
1867	—	2,650	—	—	—	75
1870	768	2,436	12,310	487	5	78
1875	742	2,156	21,185	120	56	116
1880	730	2,091	21,597	388	247	152
1885	703	1,579	24,943	587	240	196
1890	678	1,122	26,152	1,242	255	237
1895	627	1,097	27,258	2,205	299	253
1900	610	1,263	30,080	2,421	506	265
1905	756	1,132	30,610	3,327	1,292	266
1910	720	1,147	32,750	5,014	2,605	336
1915	1,104	1,191	39,023	16,955	2,506	449
1920	7,828	24,299	240,242	184,864	3,278	2,248
1925	7,597	20,516	418,075	2,413	4,901	2,417
1930	7,469	16,185	480,173	10,375	6,003	2,177
1935	7,687	28,701	324,043	14,253	9,613	2,846
1940	9,083	42,968	708,715	52,060	23,481	4,027
1945	21,366	258,682	1,831,859	(Sept. 30, 1944) 323,615	150,795	15,713
1947	25,631	258,286	2,499,073		265,851	17,698
1949	25,168	252,770	3,568,200		524,448	16,950

*Fiscal years as of which data are reported vary as between countries and over the period covered for the same country, as a rule. Data for 1940 on, unless especially noted, taken from *Public Debt, 1914–1946*, United Nations, Department of Economic Affairs (1948).

†The data from 1697–1828 inclusive are gross national debt figures from *The National Debt* by E. L. Hargreaves, p 291 (London, 1930). The data from 1836–1935 inclusive are "net national debt" figures compiled from British official "Accounts and Papers" by subtracting exchequer balances from total debt.

‡Data from 1791 to 1850 taken from *Annual Report of the Secretary of the Treasury on the State of the Finances for the Fiscal Year Ended June 30, 1903*, p. 63; from 1855 to 1935 from *ibid.*, pp. 562–63 (1943). Recent years taken from *Treasury Bulletin*, p 16 (Nov. 1949).

§Data at the end of the calendar year, 1949. Source: Ministère des Finances: *Statistiques et Etudes Financières, Supplement Statistiques*, nos. 1–2, p 237 (1949). Data for 1940 and subsequent years taken from *Public Debt; 1914-1946* (United Nations Department of Economic Affairs, 1948); *Public Finance Data 1938–49* (United Nations Document E/C.N. 8/31 and Annexes, mimeographed); *United Nations Statistical Yearbook 1948;* and recent issues from the *Treasury Bulletin*. All data up to 1935 are computed from the *Annuaire Statistique de la France*.

‖From the *Statistische Jahrbuch für das Deutsche Reich* except for 1940 and 1943 which are from *Bank for International Settlements, Thirteenth Annual Report*, (*May 1944*).

¶These data were computed from Japanese government sources, especially the *Financial and Economic Annual of Japan*, Department of Finance.

♀Data taken from *The Canada Yearbook* prior to 1940.

δThe total gross debt of U. S. on January 1, 1835 was $33,733.05.

of the state runs on. Its life may not be permanent, but ordinarily it is not fleeting. Its greater resources, lodged in the power to tax all individual wealth and income as well as to utilize its own public domain, give greater certainty of payment to obligations than the individual can provide. The state can compel the individual to pay his debts; only the combined wills (the mores) of the citizens, or external force, can compel the state to pay its debts. But the moral force for observance of public contracts is part of the heritage of modern states.

There was a time when it was said that the loans of the state were unproductive, going to pay for the wastes of past wars, or to finance useless undertakings, whereas private loans were investments, providing employment and raising the standards of living for citizens. Such notions hark back to the time when governments were regarded as unproductive and when tax payments were believed akin to losses. Modern students recognize that governments supply valuable utilities and that they make real contributions to economic and social welfare. Even the preservation of liberty, which has occasioned war debts, may be regarded as productive. What is regarded as unproductive, and there are ample illustrations in public and private spheres, is often determined by the political beliefs or ideologies of the critics, rather than by the economics of the case.

The purposes of public and private borrowing are numerous. Both the state and the individual may borrow to acquire goods. Both cause transfers from those who previously have saved wealth, or who create it for the purpose at hand. Both may borrow to add to the wealth under their control, although the state scarcely needs to borrow to acquire such control. The state, on the other hand, may borrow to avoid present taxation, to supply individuals with a safe place for investment of funds or to provide a basis for a monetary or banking system. The individual can borrow only to the extent of his own resources; the state can borrow on the resources of all and can create credit of its own in addition, so long as it possesses the power to reinforce its promises with an ability to pay interest, or can maintain the confidence necessary to keep its credit instruments circulating at or near par. When a state exhausts its taxing power its credit sags. The extent to which a state can tax the resources of its citizens depends upon the public services provided and upon the emergencies at hand. The degree to which private wealth may be taken by the state is conditioned by the time, place and circumstances surrounding the event. Actually, though not legally, expropriation by the state, for debts or current services, is subject to limits. Even docile citizens may rebel or vote a debt-creating government out of power.

Evolution of National Debts.—Public debts are a product of political and commercial evolution. They do not arise until there is a political differentiation between the ruler and the state. The borrowings of the sovereign, secured by his jewels or domainal revenues, were personal rather than governmental obligations. The debts of one ruler were seldom assumed by his successors. If public debts were to have permanence or stability, governments had to develop a continuity apart from that of the sovereigns. They had to secure regular and compulsory sources of income independent of privileges and feudal dues. Likewise, negotiation and voluntary subscription had to replace force, grants of privileges or confiscatory exactions as alternatives to voluntary loans. On the commercial side, credit institutions had to replace the wealthy subject who could be prodded into surrendering capital, or the ecclesiastical orders who could be persecuted and alienated from their domains. A monetary system of reasonable stability had to develop. These came with the rise of commerce and industry. The appearance of exchanges not only aided in financing new developments but made liquid the bulk of public and private debt instruments. Rising incomes and the diffusion of wealth and income in society made possible the ownership of public securities by the masses and their financial institutions. The public debt frequently became a coveted type of investment.

The stages in the development of public debts seem to run from public treasures for emergency use to forced loans, from loans to the sovereign to loans to the state, from loans anticipat-

TABLE II —*Gross National Debt in Millions*

Country	Currency	Date	Amount of debt in domestic currency
Argentina	Peso	Dec. 31, 1947	14,462.9
Australia*	£ Australian	June 30, 1948	2,790 2
Belgium†	Franc	Dec 31, 1948	251,932 0
Bolivia	Boliviano	Dec 31, 1947	6,669 9
Brazil‡	Milreis	Dec 31, 1946	39,090 4
Bulgaria	Lev	Dec. 31, 1946	162,049 1
Canada	$ Canadian	Mar. 31, 1949	16,950 4
Chile	Peso	Dec. 31, 1947	7,661 0
China§	$ Chinese	Dec 31, 1947	12,701.0
Colombia	Peso	Nov. 30, 1948	514.1
Costa Rica	Colón	Dec 31, 1947	259 4
Cuba‖	Peso	Dec. 31, 1946	97.1
Czechoslovakia¶	Koruna	June 30, 1947	121,500 0
Denmark	Krone	Mar 31, 1948	10,712.5
Dominican Republic	Peso	Dec 31, 1948	25.3
Ecuador	Sucre	Dec 31, 1947	635.6
Egypt	£ Egyptian	Nov 30, 1948	130 3
El Salvador	Colón	Dec 31, 1947	38.3
Finland	Markka	June 30, 1949	114,996 0
France	Franc	June 30, 1949	3,568,200 0
Germany	Mark	Sept 30, 1944	323,614 9
Greece	Drachma	Oct. 31, 1939	52,425 5
Guatemala	Quetzal	June 30, 1948	15 8
Haiti	Gourde	Sept 30, 1948	45 4
Honduras	Lempira	June 30, 1946	13.5
Hungary♀	Pengó	Dec 31, 1943	6,501 0
Iceland♁	Króna	Dec 31, 1948	198.0
India	Rupee	Mar. 31, 1949	24,442.7
Indonesia□	Guilder	Dec 31, 1946	2,900 0
Iran◇	Rial	Mar 20, 1948	5,364 2
Ireland	£	Mar 31, 1948	91 0
Israel	£ Palestine	Mar 31, 1947	9 4
Italy▲	Lira	June 30, 1949	2,108,166 0
Japan	Yen	Mar. 31, 1949	524,448 0
Liberia	Dollar	Dec 31, 1947	0 7
Luxembourg	Franc	Dec 31, 1948	6,473 7
Mexico✦	Peso	Dec 31, 1948	6,129 4
Netherlands	Guilder	Jan. 1, 1948	21,586 0
New Zealand	£ New Zealand	Mar. 31, 1949	615 0
Nicaragua	Córdoba	June 30, 1948	47.3
Norway	Krone	June 30, 1948	6,347 7
Panamá	Balboa	June 30, 1948	24 6
Paraguay	Peso	Dec 31, 1947	99.9
Peru	Sol	Dec. 31, 1947	1,749 7
Philippines, Rep. of	Peso	June 30, 1947	63 0
Poland	Zloty	Sept. 30, 1947	29,380 0
Portugal	Escudo	Dec 31, 1947	10,237 5
Rumania	Leu	April 1, 1945	98,937.0
South Africa	£ South African	Mar 31, 1949	662 1
Spain	Peseta	Jan. 1, 1948	52,078 0
Sweden	Krona	June 30, 1949	11,861.1
Switzerland	Franc	Dec. 31, 1948	10,780 0
Thailand	Baht	June 30, 1949	915 9
Turkey	£ Turkish	May 31, 1948	1,478 0
United Kingdom	£ sterling	Mar. 31, 1949	25,168.0
United States	Dollar	June 30, 1949	252,770 0
Uruguay	Peso	Aug. 31, 1948	741 5
Venezuela	Bolívar	Dec. 31, 1948	22 8
Yugoslavia	Dinar	July 22, 1942	30,533 0

*Includes states' debt taken over by the commonwealth.
†Includes monetary stabilization loan.
‡Including money in circulation; not including bonds held by amortization fund; not including guarantees (1,700,000,000).
§Domestic debt only.
‖Excluding floating debt estimated at about 70,000,000.
¶Approximate figures. In 1949 central government took over all local authorities debt.
♀Provisional figures.
♁Excluding state enterprises debt.
□Approximate figures.
◇Government liabilities to Bank Belli Iran only; end of 1947 debt to U.S. $7,500,000, to U.K. £700,000.
▲Domestic debt only (not including Morgan loan)—amount outstanding May 31, 1949, $66,000,000.
✦Including states' bonded debt (52,800,000).
●Bonded debt only.
Sources. *Public Debt, 1914–1946* (U.N. Department of Economic Affairs, 1948); *Public Finance Data 1938–49* (United Nations Doc. E/C N 8/31 and Annexes, mimeographed); and *United Nations Statistical Yearbook 1948; The Statesman's Year-Book 1949;* Czechoslovakia, Budget Speech (Oct. 30, 1947); India, *Report on Currency and Finance 1948/49;* Indonesia, ECAFE Memo (Dec 9, 1949); Bank of Mexico, *Annual Report 1949;* Bank of Thailand, *Current Statistics* (Aug 1949); *Revenu National et Dépenses Nationales de la Turquie en 1947 et 1948, Office Central de Statistique, Juin 1949.*

ing taxes (or other revenues) to permanent obligations based upon the promise of the state to apply its resources to interest and the eventual repayment or refunding of the debt. In the evolution of the state from absolute to democratic rule, forced loans of the original type were virtually outlawed; and taxes as well as loans and expenditures required the sanction of legislative assemblies or of the electorate. As governmental functions increased, the needs for borrowing also rose. These steps were complete by the time modern governments appeared. To them public credit was a full-blown instrument of fiscal policy.

No histories of public debts, comparable with the notable histories of taxation, have yet been written. Hence, the development of this institution can be sketched only in fragmentary fashion. The public credit institutions seem to stem from the Italian city banks: the Bank of Venice (1156), the Bank of St. George (1407) of Genoa and the Bardi of Florence. The Italians helped school the Dutch in financial methods. It was from the Netherlands that public borrowing from private bankers and financial institutions spread to German cities and to England and France. Transplantation to the new world followed as a matter of course. Jèze says that public credit is essentially a product of modern times, developing after the end of the 18th century. H. C. Adams thought that conditions requisite for public borrowing were not realized until the latter part of that century. C. F. Bastable added the observation that the last 50 years of the 19th century were even more important for the development of public credit than the two preceding centuries. All writers agree that the evolution of public credit coincides with the development of the state as an institution and with the development of an industrial commercial civilization with its attendant economic and financial institutions, especially banks and security exchanges with their ancillary agencies, to facilitate transfers and to provide an open market for the purchase and sale of debt instruments. A legal system for the enforcement of contracts, and social mores which require performance of contractual obligations assumed, particularly for the payment of interest and principal, are important. The development of a system of private credits, accounts and records, as well as surplus incomes available for investment, have done much to carry public borrowing as an institution to modern levels.

Growth of National Debts.—The growth of national debts in the U.K., U.S., France, Germany, Japan and Canada is presented in Table I. The series begins with 1697, the earliest date for which U.K. data are available, and picks up the series for the U.S. in 1791. French data begin with 1815 because regular financial statistics were introduced after the end of the Napoleonic regime. The Canadian series starts at the beginning of confederation; German data start with the first year of the modern *Reichsschuld;* the Japanese series begins with the first public loan after the Meiji restoration, floated in London in 1870.

Outstanding Debts of Principal Countries of the World.—The gross national debts outstanding in the principal countries of the world are shown in Table II.

Relation between Public and Private Debts.—The claims of creditors upon the income of debtors are in the nature of a lien to be discharged before debtors are free to spend or enjoy the resources remaining. In the case of private debts payments are voluntary but are made so that credit standing (the opportunity for future loans) may be maintained. Public creditors have their claims satisfied by revenues received from taxes; the state also fulfils its contractual obligations so that it may borrow again. Both types of debt service represent drains on current income for resources made available in the past. The productive use of the sums borrowed may, however, create the means of payment, yet with fluctuating incomes the burden of debt charges also fluctuates. What the individual borrows, and the charges on his income, he is generally in position to control. What the state borrows will, through taxes, affect the size of the personal income remaining. Individuals per se are seldom able to control the volume of public debts or the resulting debt charges. The claims of the state are superior to those of individual creditors, but the claims of both not only affect individual welfare but also the formation of capital and the volume of consumer spending. Taxes and public borrowing tend to reduce current income, or capital, available for investment or consumption. Public expenditures and payment of interest or principal reverse the process and tend to augment the flow of income or capital. Payments by individual debtors to their creditors are like payments of external debts—they tend to drain the individual's economy for the benefit of "foreign creditors." Payments to and by the state, because of internal loans, which predominate in the affairs of major nations,

involve transfers within the economy. Debts, public and private, must be evaluated therefore on the basis of the transfers (benefits) at the time of the loan as well as on the basis of the transfers (costs) at time of payments. The essence of loans is the transfer of purchasing power from the creditor to the debtor at the time of the loan and the return of purchasing power (but not necessarily of the same real value because of fluctuations in the value of money) upon repayment.

TABLE III.—*Net Public and Private Debt, End of Calendar Year, 1916–48**

Year	Public and private, total	Public			Private						
		Total	Federal government and federal agency	State and local government	Total	Corporate	Individual and noncorporate				
						Total	Total	Farm: Mortgage	Farm: Nonmortgage†	Nonfarm: Mortgage‡	Nonfarm: Nonmortgage§
	Amount (billions of dollars)										
1916	82 1	5 6	1.2	4.4	76.5	40.2	36.3	5.8	2.0	8.5	20 0
1917	94 4	12 0	7.3	4.7	82.4	43.7	38.7	6.5	2.5	9.4	20.3
1918	117 4	25.9	20 9	5.0	91.5	47.0	44 5	7.1	2.7	9.8	24.9
1919	128.0	30.8	25.6	5.2	97.2	53.3	43 9	8 4	3.5	10.3	21.7
1920	135.4	29 6	23 7	5.9	105 8	57.7	48.1	10.2	3.9	11.9	22.1
1925	162 7	30.3	20 3	10.0	132.4	72 7	59 7	9 7	2.8	21.6	25 6
1930	191.4	30 6	16 5	14.1	160.8	89 3	71 6	9 4	2.4	32.7	27 1
1935	175 9	50 5	34.4	16 0	125.4	74 8	50 6	7 4	1.5	26.1	15.6
1940	190.9	61.3	44.8	16 5	129 6	75.6	54.0	6 5	2.6	27.2	17.7
1945	407 2	266 5	252 7	13.7	140 7	85.3	55.4	4.7	2.5	27.8	20.5
1947	415 1	237.7	223 3	14.4	177.4	104.7	72 7	4 9	3.6	39.9	24.4
1948	429 4	232.7	216 5	16.2	196.7	112.1	84.6	5 1	5 4	46.4	27.7

*Data for state and local governments are for June 30 of each year.
†Comprises nonreal-estate farm debt contracted for productive purposes and owed to institutional lenders.
‡Data are for noncorporate borrowers only.
§Comprises debt incurred for commercial (nonfarm), financial and consumer purposes, including debt owed by farmers for financial and consumer purposes.
From Elwyn T. Bonnell, "Public and Private Debt in 1948," *Survey of Current Business*, p. 8 (Oct. 1949).

In the U.S. (and in many other countries) private debt was the dominant factor in the economy, until World War II lifted the volume of public loans to unprecedented peaks. From 1916 to 1943 the relative importance of private debt instruments declined but it was not until 1943 that federal securities approximated 50% of the total debt. This was caused not alone by war borrowing but by the correlative policy of minimizing the production of civilian goods and the use of capital for financing such activities. The wartime capital requirements were supplied primarily by the government itself and augmented its borrowings. The relative importance of public and private debts in the U.S. from 1916 to 1948 is shown in Table III.

Ratio between Debt and National Income.—The burden of debt is relative to national income from which interest and amortization are eventually paid. The volume of debt can be more appropriately related to national income than to national wealth or population. Per capita comparisons are of little significance because debts are not retired by poll taxes. Ratios of debts to wealth would be significant but estimates of national wealth are imperfect and cover only selected years. On the other hand, estimates of national income in the U.S. (and certain other countries) are reliable and are available for many years, especially since World War I. The ratio of the national debt and interest charges to the U.S. national income are shown in Table IV.

TABLE IV.—*Relationship of United States Public Debt and Interest Thereon to National Income: 1919–49*

Year	National income* (in millions)	Gross public debt† (in millions)	Ratio of public debt to national income*	Interest on public debt†	Ratio of interest on public debt to national income*	Computed interest charge†
1914	$33,900	$ 1,188	3.50%	$ 22.8	0 07%	—
1916	45,400	1,225	2.70	22.9	0 05	2.376%
1918	60,400	12,244	20 27	189 7	0.31	3.910
1920	69,700	24,299	34.86	1,020.2	1.46	4.225
1922	60,400	22,963	38 02	991.0	1.64	4.240
1924	70,000	21,251	30.36	940 6	1.34	4.180
1926	76,800	19,643	25.58	831.9	1.08	4 093
1928	80,100	17,604	21.98	731 7	0.91	3.877
1930	75,003	16,185	21.58	659.3	0 88	3.807
1932	41,690	19,487	46.74	599.3	1.44	3.505
1934	48,613	27,053	55.65	746.6	1.54	3.181
1936	64,719	33,778	52.19	749.4	1.16	2.559
1938	67,375	37.165	55 16	926.3	1.37	2.589
1940	81,347	42,968	52.82	1,040.9	1.28	2.583
1942	137,119	72,422	52.82	1,260.1	0.92	2.285
1944	183,838	201,003	109.34	2,609.0	1.42	1.929
1946	179,562	269,422	150.04	4,722.0	2.63	1.996
1948	226,204	252,292	111.53	5,211.0	2.30	2 182
1949	—	252,785	—	5,339.0	—	2.236

*Estimates for 1914–18 are by Kuznets. Taken from *Income in the United States: Its Amount and Distribution 1909–19* (National Bureau of Economic Research, 1921), p. 13. Estimates 1920 to 1948 are from United States Department of Commerce. See *Survey of Current Business*, pp. 8-10 (July 1949).
†*Annual Report* and *Bulletins* of the Treasury Department.

Relation of National to State and Local Debts.—The form of political organization affects the size of national debts and their relationship to total public debts of a country. The greater the number of independent units with power to contract debts within a given country the more necessary it may be to add the debts of these units to the debt of the central government to secure a true picture of the debt situation within the country. In England local debts need only to be added to the debt of the central government. In the United States the aggregate of public indebtedness includes obligations of the federal, state, county, township, city, village and *ad hoc* units. The situation in Canada resembles that of the U.S. From Table III, above, it can be seen that for the U.S. in 1916 the amount of state-local borrowing exceeded that of the federal government. This was true throughout many years in U.S. history; but after World War I, federal borrowing became vastly more important than state-local borrowing. In 1949 state-local debts aggregated $20,875,000, of which 45.5% was owed by cities, 19.3% by states, 15.8% by special districts and 10.3% by schools. The changes that took place after 1902 are shown in Table V.

TABLE V.—*Gross Debt of Federal, State and Local Governments: Selected Years, 1902–49*

Year*	Total	Federal†	State and local		
			Total	State	Local
	Amount (millions of dollars)				
1949	273,645	252,770	20,875	4,024	16,851
1946	285,344	269,422	15,922	2,358	13,564
1942	92,112	72,422	19,690	3,211	16,479
1932	39,063	19,487	19,576	2,896	16,680
1922	33,219	22,963	10,256	1,163	9,093
1912	5,692	1,194	4,498	423	4,075
1902	3,373	1,178	2,195	270	1,925
	Per-cent distribution, by level of government				
1949	100.0	92.4	7.6	1.5	6.2
1946	100.0	94.4	5.6	0.8	4.8
1942	100.0	78 6	21.4	3.5	17.9
1932	100 0	49 9	50.1	7.4	42.7
1922	100 0	69.1	30 9	3.5	27.4
1912	100.0	21.0	79.0	7 4	71.6
1902	100.0	34 9	65.1	8.0	57.1

*For years 1940–49, data are as of June 30; data for earlier years are as of fiscal year endings
†Excludes debt of federal agencies incurred outside of the general treasury.
Source: *Governmental Debt in 1949*, Bureau of Census.

Justifiable Occasions for Borrowing.—Classical writers on political economy justified resort to public borrowing on three occasions: (1) to meet fiscal emergencies; (2) to cover the initial cost of public works; and (3) to cover temporary deficits. The primary cause for public indebtedness throughout history has been war. The second major cause has been public works. The reflationary spending of major governments of the world during the depression of the 1930s was largely for public works. In Germany, however, the expenditures were mainly for rearmament and public works, such as roads, for strategic purposes. England, after expanding its public works program, turned in 1937 toward rearmament; the U.S. later followed, in June 1940. Local borrowings throughout the world have been mainly to acquire public works, such as streets, schools, public buildings, utility plants, etc. The fundamental purpose underlying most loans has, therefore, been the avoidance of frequent increases in current taxation. John Stuart Mill, in addition to approving the three occasions for loans enumerated above, did not regard as pernicious the borrowing of capital from abroad, or the borrowing of capital at home "which either would not have been saved at all unless this mode of investment had been open to it, or, after being saved, would have been wasted in unproductive enter-

prises, or sent to seek employment in foreign countries." (*Prin. of Pol. Econ.*, bk. v, ch. vii, §1.)

Scholars must agree with Gustav Cohn that the history of public debts has been characterized "by the progressive development of occasions and inducements to the contraction of public debts." (*The Science of Finance*, p. 682.) Even the needs of lenders were considered. Low-income groups in France needed safe investments for savings; *rentes* were offered. Public credits, often issued to help the government finance emergencies, as in the U.S. Civil War, were made the basis of commercial banking. A government loan provided the capital of the Bank of England, chartered in 1694. Government securities have also provided endowments for charitable trusts and eleemosynary institutions. When national governments, after experimenting with banking and credit mechanisms to prevent recurrent financial crises, accepted direct responsibility for the economic welfare of citizens, public borrowing assumed a new role. Intentionally unbalanced budgets became common as public expenditures to provide relief, or to offset shrinkages in individual spending, or to provide employment via public works, were covered by recurrent borrowing. The problem at such times was largely one of maintaining aggregate purchasing power within the economy. Expenditures financed by borrowing created a smaller volume of counteracting (deflationary) forces than other types of financing. Through borrowing to provide a desired level of public expenditures, the government could directly, and via secondary or multiplier effects, affect the volume of consumer spending, the level of national income and to some degree the volume of investment. Such fiscal policies follow the reasoning of J. M. Keynes in his *General Theory of Employment, Interest and Money*. Experiments in the U.S. from 1933–39 and expenditures for war 1940–45, also financed by borrowing, clearly demonstrated that the volume of production, spending, employment and flow of income can be affected by public spending supported by borrowing. The volume of effects from each dollar spent is still debated, but there is agreement among economists that the effects of initial expenditures decrease with the passage of time after expenditure.

These theories, particularly the multiplier analysis (secondary effects of expenditure), led to the formulation of a pump-priming theory under which it was held that public expenditures, particularly on public works, would generate economic recovery. A deflated economy would thus soon become self-propelling and prosperous, so that injections of purchasing power created by government borrowing would no longer be necessary. Such were not the results, however, of the relatively small U.S. spending program of the 1930 epoch. When government expenditures were reduced the volume of economic activity sagged in 1937–38. Other factors than the reduction of expenditures contributed to this slump but ability to create an economy capable of moving forward, with increased production and employment, when government-induced expenditures are curtailed remains to be demonstrated in fact, if not in theory.

The limitations of the pump-priming theory seemed to lead Alvin Hansen to the advocacy of another use for public debts. He saw in the mature economy of the 20th century declining outlets for new private investments. (See *Full Recovery or Stagnation?* and *Fiscal Policy and Business Cycles*.) This tendency, conducive to an increase in idle resources and unemployment, was to be offset by public investment covered by additions to the public debt. The factual reality of the mature economy hypothesis is doubted by many economists. It represents, however, one of the latest justifications for the expansion of public debts. It may take its place as an alternative to, or as a supplement to, theories of public works expenditures as antidepression measures.

War Borrowing.—The old Roman principle was that every war should maintain itself. The Prussians subscribed to this—witness the war indemnities imposed—but embraced as well the ancient idea of a war chest acquired by taxation, expropriation, coinage debasement or other means. Later, as wars became more costly, the treasure was supposed to be adequate for initial war expenses, to strengthen the public credit and to make possible the orderly increase of revenues. These advances were to be recouped, if possible, from the vanquished. The English and French, by way of contrast, relied heavily on loans, including fiat money, to finance wars. Neither treasures nor loans long sufficed to meet the mounting cost of wars; increased taxes soon had to be added, so that *loans and taxes* came to be the customary means of financing wars.

The first modern interallied loan was made by France to the U.S. during the Revolutionary War, amounting to $6,352,500. It was fully repaid by 1815. Great Britain made loans of £600,000 to Portugal in 1809, and £2,000,000 to Sardinia in 1855. Both were only partially repaid.

The ratio of loans to taxes became a crucial problem for finance ministers in wartime. The economic effects produced by varying the contributions from these two sources had profound effects on the economic life of the country. The greater the portion of war costs paid from taxation the better it was for the future economy of the country. The disastrous effects of financing wars by loans were learned in the U.S. from the Revolutionary War and the War of 1812, to the cost of which taxes made only a negligible contribution. In the Civil War 78% of the costs were met from loans. From 1861 to 1864 the credit of the union fell steadily, fluctuating with the vicissitudes of the army. Prices during the war practically doubled as inflationary borrowing, including the printing of money, was utilized. World War I was more creditably financed in the U.S., loans covering about two-thirds of the costs. In Great Britain 71% of total expenditures 1915–19, excluding loans to allies, were covered by loans, and 75% of war expenditures, also excluding loans to allies, were so covered. In France more than 91% of expenditures (1914–19) were from loans; in Italy 73% came from loans (1915–18); in Germany 90% of expenditures (1914–18) were financed by loans.

For an account of debts contracted by the various belligerent nations in World Wars I and II, *see* War Finance: Cost of World Wars I and II; *see* also Inter-Allied Debts.

Burden of the Debt.—Only superficial analysis leads to the conclusion that the burden of public debt is measured by interest requirements. Interest represents the cost to the government—hire for money borrowed. Interest is the minimum amount finance ministers must insert in governmental budgets to keep public loans afloat. The real burdens lie in the economic effects produced by taxes for debt service, by transfers of payments, and by the gains or losses arising from the comparative alternative uses of public and private capital. There are circumstances under which debts represent no economic burden whatever; there are other instances where society is poorer because capital, if left in private hands, would have been more effectively employed. Moreover, in discussing the burden of public debts, external and internal borrowing must be distinguished.

In the case of external loans the borrowing country receives a net addition to its capital at the time the loan is made. When interest or principal is repaid, the debtor must export gold, goods or services to the creditor country. This deprives the debtor nation of these resources, provided they are not reinvested in the debtor country. These payments may not constitute a real burden, however, for the capital initially borrowed, if put to productive use, may have developed the resources of the debtor country or may have been employed in a specific venture the operation of which yielded the returns from which both principal and interest were paid. Domestic capital was thus free to add to the development of the debtor country. The external loan not only made the debtor country better off than it was before, but the capital borrowed produced interest and its own replacement. If the funds borrowed were not productively employed, the debtor would suffer a real loss.

Instead of looking at goods and services produced or employed in payments abroad, gold was frequently the only object of attention. At the time of the loan, gold was received; at the time of payment, gold was exported. The fact that foreign loans were so often employed in wars and that shipments of gold to repay debts were a visible drain on debtor countries accounted for the early opposition of classical economists to public debts. Taxes em-

ployed in securing funds for the repayment of external loans were often burdensome per se. Their effects on incentives to produce or save were frequently negative, adding to the consequences of transfers abroad.

In the case of internal loans all payments are transfers within the country. The nation as a whole can be neither richer nor poorer. At the time of the loan, capital is either transferred from those who have previously saved it, or from those who have created it, to the use of the debtor. The question of burdens at the time of the loan is whether the transfer to the government will result in a more efficient or less efficient use of capital than if capital were left in private hands. If the use of the proceeds of loans to the government is to increase the productivity of capital, the economy of the country is better off than if capital were left in private hands. This is a question of fact rather than of theory, but unfortunately facts are seldom available for an answer.

At the time of payments, either of principal or interest, resources must be acquired by the government to discharge claims of creditors. Taxes collected to pay debts are transferred to holders of government securities. The country has neither gained nor lost as a whole, but the fortunes or distribution of income among groups within the debtor country have been affected, for seldom are bondholders paid by taxes primarily upon themselves. If bonds are paid by taxes imposed in such a way as to fall on funds which otherwise would have been spent, forced saving results, unless the bondholders, in turn, squander payments made to them. If forced saving results from tax payments and reinvestment of capital by bondholders, the net result of debt payments is an increase in the supply of capital. If taxes are paid from capital and funds are reinvested by bondholders, there is no loss of capital save to the extent that administrative costs represent diversions to consumption; but even administrators may save a portion of their incomes. If bondholders squander payments to them, capital decrements result. It is believed that owners of government bonds are more likely to reinvest than to consume the interest and capital payments received by them. This depends upon the time in the cycle, and the income groups or institutional holders to which payments are made. If payments are made to individuals during depressions, there is greater likelihood that the percentage reinvested will be smaller than during prosperity periods. There may, of course, be shifts in investments made, as from gilt-edged to speculative securities. This, too, is affected by prosperity and depression, as well as by investment fads. If, as a result of these shifts, individuals, who can ill afford to assume losses, do purchase relatively risky investments, actual losses may be accompanied by disastrous consequences to them and even to society. The concentration of such losses among low-income (or middle-income) groups tends to increase the share of wealth held by the well-to-do.

Likewise, if the rich are the primary holders of bonds while taxes to service debts are paid mainly by the less well-to-do, the concentration of wealth in the hands of the rich is increased. If fortunes composed largely of government bonds are handed from one generation to another by inheritance, such estates may be transferred with a larger pecentage intact than fortunes composed of more risky investments. The privilege of tax exemption accorded to income from certain government securities by various units will affect these tendencies. They will also be affected by the levels of progressive income taxation, including provisions for the deduction of capital losses where incentives to save, to assume risks and to hold investments may be involved. However, with advancing industrial civilization the concentration of government securities held by the rich has tended to decrease. The holdings of institutions, such as savings banks and insurance companies, in which are massed the small savings of the many, have steadily grown. This greatly complicates all generalizations as to debt burdens and effects of payments.

If internal loans are made by banks on the basis of credit created by them, a net addition to domestic investment or purchasing power results. This is inflationary unless the borrowing so scares the holders of capital or income that they reduce net investments and consumption. It also tends to free taxpayers from the payment of current taxes (to the extent of loans) if the activity financed by government would have been undertaken in any case. And, the larger the sums needed by government in a world full of wealth inequalities, the higher its tax-rate progressions would have to be. The distributional effects of taxes and debts increase with their size.

The manufacture of credit by banks for government (or private) use tends to create future difficulties both for banks and the economy as a whole. Inflationary financing tends to raise prices and interest rates; as interest rises the price of outstanding government bonds tends to fall, decreasing the value of bond portfolios and increasing the sale of bonds by private holders. This causes further declines until an equilibrium is reached. Such conditions, in the past, have produced bank failures with widespread losses; market maintenance and other countermeasures have been required, but the aftermath of credit creation has been depression, declining prices and an increase in the real burden of debt, for the charges have to be met from smaller national incomes and payments made in money of higher purchasing power.

Present *v.* Future Burdens.—The question frequently is asked as to whether it is possible to pass internal debt burdens from present to future generations. The possibility is envisaged because borrowing precedes the imposition of taxes for the payment of interest and principal. However, at the time of the loan, lenders surrender present goods and services to the borrower. Private capital is surrendered for present economic goods. Lenders, moreover, forego consumption or alternative investment of their funds; those who sell goods part with them. The goods, in turn, may be currently consumed or converted into capital assets to render service until worn out. At the time taxes are imposed to pay interest or principal, goods are transferred by present taxpayers to holders of debt instruments. Taxpayers surrender goods or forgo consumption; bondholders receive them. These are transfers within the group in existence at the time transfers are made. No transfers are made between the generations alive at the time of the loan to those at time of payment. The transfers are effected only within the groups on each separate occasion.

There are, however, circumstances when the burdens created by internal debts can be passed on to future generations: (1) when the proceeds of loans are put to unproductive use, as in a war of aggression ending in defeat, so that future generations are worse off than before; (2) when the present generation consumes its capital; (3) wastefully exploits its resources; (4) undermines the efficiency of its labour for a considerable period of time; (5) retards industrial progress; or (6) fails to maintain or replace depreciating productive plant and equipment. Thus, future generations are made poorer by the profligacy of present generations. On the other hand, wise utilization of resources by the borrowing government should increase national productivity, making it easier for future payments to be made.

The ability to shift the burden of external loans to the future rests upon analysis similar to that above, and depends largely upon the uses to which borrowed funds were put. (*See* also *Burden of the Debt,* above.)

Every loan or tax means that the possessor of resources surrendered gives up the opportunity to consume or invest funds. The real cost of loans is found not in the interest paid but in the net comparative loss, if any, in the use of funds to lenders. Presumably money would not have been loaned if alternative and more productive employment of funds had been available. Nor should government devote its resources to debt repayment if more productive uses of funds are open. The net advantage from public or private use of capital depends on comparative rates of return. The gain from capital so employed must be set against the losses resulting from taxes collected. The use of capital borrowed holds the clue to real debt burdens.

Problems of Issue.—The problems confronting finance ministers at the time of borrowing are also of a technical order. They present a mixture of economic, political and administrative questions. Decisions made at the time of issue determine, for the most part, the problems of managing the public debt, until it is extinguished. Even the time of occurrence, and periodicity, of many

problems is fixed when the terms of borrowing are decided. The problems of issue are, therefore, largely anticipatory management problems.

The main problem of issue is often said to be that of putting the debt in such form as to enable the state to borrow at the lowest effective rate. The way to achieve this is said to be by giving the investor the type of security he wants. This will facilitate sales but what the investor wants, or thinks he wants, may not be what he should have. Nor should the tastes of investors determine decisions as to the form of borrowing. Those decisions should be made in terms of policies calculated to maximize economic well-being—in terms, for example, of production, income flows or incentives to work, save and invest. Such objectives are more important than borrowing at the lowest effective interest rate. There are times when the state should pay high rates rather than the lowest rate at which it can borrow; for example, in order to mop up income or to put securities into proper hands.

Among the primary decisions to be made at the time of the loan is, from whom should the government borrow? From individuals or banks? From hoards, idle balances or from the current-income stream? Is it better to concentrate on past savings or to utilize specially created credit? The economic effects flowing from loans from different sources, tapping unlike types of capital (or credit) are various. Some borrowing is inflationary, some is not. At certain times in the economic cycle, one type will be appropriate while another may not do at all. Those in charge of the state's fiscal policy will have to decide when it is appropriate to use a given type of borrowing, as well as the amount which, under the circumstances, is justified.

Akin to this is the question as to who should own or hold government securities. Should the government try to induce subscribers to hold bonds to maturity, or should it be indifferent to sales by owners? If government bonds become a conspicuous field for speculation, what may happen to the nation's apparent credit standing if securities yielding greater returns provide the inducement to owners of government securities to sell? And, who will the new holders be? Will the government, in order to minimize losses to owners, be forced to go into the market to buy up its own securities? Or, can it rely upon the approach of maturity, or call dates, gradually to bring its issues on the market up to par, as it prepares to pay off holders at maturity should they desire it? Answers to such questions are made when the treasury decides who is to be eligible to subscribe to specific issues, and on what terms. Similar decisions are made when limitations are placed on the amount of given securities any one person may own or purchase within a definite period. When loans are oversubscribed, purchases must be allocated among subscribers. The allocations need not be purely mathematical determinations; they may be selective so as to implement policy decisions.

The usual problems confronting the state at the time of borrowing relate to the form of the loan, the type of securities to be issued, the term of years or days for which money is to be borrowed, the rate of interest, marketability, negotiability and features to promote sales. Among the "lures" or "relishes" to be considered are tax exemption, circulation privileges, prize drawings or lotteries, use of securities at par or fixed values, in payment of taxes, etc. With the development of security markets and citizens' investment habits (along with funds for investment) such features have declined in importance.

The issuance of securities at par is preferable to their sale at discount. Sale at discount is not to be confused with sale on a discount basis. In the latter case, to the issue price is added interest accumulations so that the holder receives his return through additions to principal rather than via current interest payments. (*See* also *Types of Public Debt: Interest-Bearing Debt,* above.) In the early days of public borrowing sale at discount was prevalent because the credit of states was weak and lenders could secure increased profits from loans (in the nature of underwriter's profits) without making conspicuous additions to the interest rate which opposition to usury also condemned. History is replete with examples, as in the U.S. during the Civil War, when treasuries refused to offer securities bearing as much as the market rate of interest, with the result that they could be sold only below par —or at a discount. Nevertheless, such securities had to be redeemed at par. Consequently a higher effective rate of interest was paid over the life of the loan than was called for on the face of the debt instrument. More had to be paid at maturity than was in fact received at issue. Samuel Gale, writing in 1784, said, "If the rate of interest for money should be restrained by legal provisions, or apparently disguised . . . such disguise will be attended with the loss of a *principal* proportionate to the degree in which the rate of interest shall be so disguised." Similarly when bonds are issued at interest rates above the market, a *premium* is received, based roughly on the present value of the excess interest, which is amortized over the life of the loan, the obligation being payable at par. It is hard to justify the payment of excess interest in such cases over the life of the loan. If greater sums are needed by the state, more securities should be issued at par.

With a constantly increasing U.S. public debt interest charges also mounted, in spite of any tendency for rates of interest to fall (*see* Table IV, above). This caused many government officials to be concerned over the budgeting of interest costs. As long as national incomes rise, interest requirements do not seem burdensome; but when depressions bring low-income payments, the relative weight of interest rises. It becomes harder to wring from declining incomes the taxes required to pay interest on past debts. As interest burdens rise, budget officers, too, seek to minimize the payments thus required. From fiscal officers naturally come demands that rates of interest be kept low. This desire, on the part of government, to minimize its own interest payments may be in conflict with the policies of monetary authorities, who at a given time may be increasing interest rates in order to curb inflationary credit expansion. Thus, the policies of the government as a debtor may come into conflict with policies of government to control private credit, or the level of economic activity in the nation. The two policies will not always be in conflict. At times in the cycle, easy-money (low-interest) policies will be appropriate for both the treasury and monetary authorities and for the country as a whole. In other situations advancing interest rates may be desirable.

To an increasing extent in the future, proposals to reduce interest costs on the public debt will be made. For years groups have advocated the substitution of fiat money—often called "interest-free borrowing"—for interest-bearing securities. Likewise, increased borrowing from central banks as a regular policy rather than as a temporary emergency seems to be growing in favour. During World War II the large holdings of treasury bills by the federal reserve banks in the U.S. were tantamount to direct borrowing, as, of course, was the case of advances on ways and means in England. The treasury (U.S.) sold bills to commercial banks which, in turn, sold the bulk of them to the federal reserve banks. Direct borrowing would have had the same effect and perhaps also provided savings in interest costs. Opponents to direct borrowing denominate it as inflationary, but if credit was being created to finance the government at the time, the argument loses much force. Inflation, as a monetary phenomenon, arises from the source and volume of funds rather than from the type of instrument issued as an evidence of indebtedness, although some types of securities can be more easily substituted for money than others. Proposals have also been made to require banks to finance the government *at cost* for creating credit rather than at market rates of interest. Special securities designed only for bank ownership bearing a low rate may tend to lower interest. This was the result of financing via short-term loans in both England and the U.S. after World War I. Speculation in government securities and profits from their appreciation in value tend to increase proposals to monetize public debts and otherwise to socialize public credit. The development of *rentier* classes or corporations tends to produce similar movements. Hence, modern governments desire a wide distribution of securities.

Who Holds the Debt?—During the 17th and 18th centuries when private bankers, such as the Barings, Hopes, Goldsmiths and Rothschilds were financing governments, the concentration in

TABLE VI.—*Ownership of and Interest from United States Tax-Exempt Obligations Reported by Individuals with Net Incomes of $5,000 and More, by Net Income Groups· 1935*
(amounts and net income classes in thousands of dollars)

Net income classes	Net income (including wholly tax-exempt interest)	Tax-exempt interest		Tax-exempt interest as a percentage of net income (including wholly tax-exempt interest)	Tax-exempt obligations owned	
		Amount	Per cent of total reported		Amount	Per cent of total reported
$ 5- 10	$2,316,081	$ 44,430	15.7%	1.9%	$ 694,916	15.0%
10- 25	1,878,468	70,534	24.9	3.8	1,127,219	24.4
25- 50	935,779	60,430	21.3	6.5	899,600	19.4
50-100	575,669	43,267	15.3	7.5	671,338	14.5
100-150	184,322	18,718	6.6	10.2	332,070	7.2
Over 150	450,137	46,063	16.2	10.2	900,043	19.5
Total	$6,340,456	$283,442	100.0%	4.5%	$4,625,186	100.0%

Taken from *Securities Exempt from the Federal Income Tax as of June 30, 1937*, United States Treasury Department, Division of Research and Statistics, p. 102 (Aug. 1938).

debt ownership was evident. Speculation in public securities has been the source of many fortunes. The assumption of the Revolutionary War debt by the U.S. national government was opposed because it tended to enrich speculators. The financing of the Civil War "offered a rich harvest for the money lender" (H. C. Adams, *Public Debts*, p. 40). Not until comparatively modern times, and in only a few countries, are data available as to the distribution of debts. In 1880 in the U.S., when the registered debt was $1,173,749,250, foreign holdings were $27,894,350 (or 2.4%); national banks owned $319,937,800; the residuum of $825,917,100 was owned by 80,802 corporations and private individuals, no allowance being made for duplicate registrations by the same owners. The census bureau counted individual owners by size of holdings for $417,538,850 of bonds, of which 47.8% were held in amounts of more than $50,000, presumptively indicating ownership concentration in the upper-income level. Only 10.1% of the holdings were in amounts of $2,500 or less.

By 1935, although there remained a marked concentration of bond ownership among the rich, the distribution seems a priori to be more equitable than in 1880. Table VI shows the distribution of tax-exempt interest on wholly and partially tax-exempt securities (federal, state and local issues), and the distribution of ownership among income classes for 1935. This is the closest approach that can be made in the U.S. to a personal distribution of bond ownership. Unfortunately, it does not cover the holdings of those with less than $5,000 personal income. In 1935–36, however, the study of *Consumer Expenditure in the United States*, by the National Resources committee, indicated that total savings by families and single persons in income groups less than $5,000 amounted to $1,248,000,000, in comparison with $4,730,000,000 for income classes above the $5,000 level. The great increase in wages and salaries during World War II is believed to have greatly improved the lot, and, hence, the volume of saving, in income groups below $5,000. During World War II this group purchased substantial amounts of war bonds via pay-roll deductions.

In recent years there has been a growing tendency for larger fractions of the public debt to be held by institutional holders, particularly by banks, corporations and insurance companies. This complicates the problems of analysis, particularly as to who is being paid (either interest or principal) and by whom. The banks represent depositors and stockholders; insurance companies invest funds contributed by a legion of policyholders and the relatively small capital subscriptions of stockholders; savings banks invest the small surpluses of people of slender means; government trust funds invest contributions of other large groups but the composition of each group, by income classes, is unknown. That they are far-flung is common knowledge. Security ownership by institutional categories has been tabulated monthly in the U.S. since 1941. Data for selected years from 1939 to 1949, as shown in Table VII, reflect the impact of financing World War II and indicate the degree to which individuals, as well as institutions, helped to underwrite the war, and changes which have since taken place.

Comparable information as to the ownership of national debts is not available for other countries. Harold Seligman, however, worked out a distribution on the basis of the increase in debt, 1940–44, for the U.S., U.K. and Canada, as shown in Table VIII, which indicates the preponderant reliance on individual ("other") subscriptions in the U.K. and Canada and the slightly greater dependence on banks in the U.S. compared with Canada. Ownership distributions by income classes are unavailable in the U.K. and Canada.

TABLE VIII.—*Increase in Interest-Bearing National Debt, Direct and Fully Guaranteed, in the United States, United Kingdom and Canada from 1940 through 1944, by Type of Holder*
(in millions)

Type of holder	United States		United Kingdom		Canada	
	Total amount of increase	Per cent	Total amount of increase	Per cent	Total amount of increase	Per cent
Commercial banks	$52,803	33.9%	£2,000	17.8%	$1,607	22.6%
Central banks*	12,350	7.9	935	8.3	1,186	16.7
Gov't agencies	13,190	8.5	830	7.4	—	—
Other investors†	77,370	49.7	7,457	66.4	5,007	70.4
Repatriation‡	—	—	—	—	−692	−9.7
Total	$155,713	100.0%	£11,222	100.0%	$7,108	100.0%

*Federal Reserve Banks in United States, Bank of England and Bank of Canada.
†Holdings of government agencies in Canada are not available and have been included in "other investors."
‡Securities repatriated from United Kingdom are shown as a negative figure to give a better picture of the share in the increase taken by "other investors" in Canada.
Adapted from Harold L. Seligman, "Patterns of Wartime Borrowing in the United States, United Kingdom and Canada," *Federal Reserve Bulletin*, p 1066 (Nov. 1944).

Problems of Debt Management.—Debt management is concerned with problems arising from the time of issue through the payment of debt obligations, such as, (1) the redemption or funding of nonmarketable issues; (2) the funding or refunding of short-term issues; (3) the discharge or refunding of interfund borrowings; (4) maintaining the market, to promote stability of prices; (5) meeting maturity schedules; (6) covering interest costs or effecting reductions therein; and (7) repayment of the debt. These problems are also of a technical nature. Some arise inevitably as debt matures; others, particularly as complications arise, are created by uncertain economic events in an unpredicta-

TABLE VII.—*Estimated Ownership of Federal Securities by Bank and Nonbank Investors (par values*—in billions of dollars)*

Date	Total federal securities outstanding†	Held by banks			Held by nonbank investors						
		Total	Commercial banks‡	Federal reserve banks	Total	Individuals§	Insurance companies	Mutual savings banks	Other corporations and associations‖,¶	State and local governments♀	U.S. government investment accounts¶
1939, December	47.6	18.4	15.9	2.5	29.3	10.4	6.3	3.1	2.6	.4	6.5
1941, June	55.3	21.8	19.7	2.2	33.5	11.5	7.1	3.4	2.4	.6	8.5
1946, February (peak)	279.8	116.7	93.8	22.9	163.1	64.6	24.8	11.1	27.9	6.7	28.0
1949, June	252.8	82.5	63.2	19.3	170.3	68.8	20.9	11.6	22.5	8.2	38.3

*United States savings bonds, Series A-D, E and F, are included at current redemption values.
†Securities issued or guaranteed by the U.S. government, excluding guaranteed securities held by the treasury.
‡Consists of commercial banks, trust companies and stock savings banks in the United States and in territories and insular possessions. Figures exclude securities held in trust departments.
§Includes partnerships and personal trust accounts.
‖Includes savings and loan associations, dealers and brokers, and investments of foreign balances and international accounts in the U.S. Beginning with Dec. 1946, includes investments by the International Bank for Reconstruction and Development and International Monetary fund in special noninterest-bearing notes issued by the U.S. government.
¶Holdings by federal land banks are included under "other corporations and associations" instead of "U.S. government investment accounts" beginning with June 30, 1947, since the proprietary interest of the United States in these banks ended June 26, 1947.
♀Consists of trust, sinking and investment funds of state and local governments and their agencies, and territories and insular possessions.
Data taken from *Treasury Bulletin, November 1949*, p. 31.

ble future. Competent debt management must meet all conditions and use management policies, like taxation, borrowing and expenditure as an instrument of fiscal policy.

When the government agrees to redeem nonmarketable debt, it must do so when called upon and at prices fixed in the loan contract, if its credit standing is to be maintained. Such securities, when eligible for redemption, become, for practical purposes, demand paper. The government can secure funds for redemption via taxes or by new loans. In the latter case, what is involved is a substitution of creditors. The volume of redemptions is affected both by the credit standing of the borrowing government and the cash requirements of the creditor. At maturity, nonmarketable debts present the same problems as other debts—payment or extension.

Ability to manage short-term debt is both a test of over-all debt policy and of efficiency of debt administration. Instead of being an instrument of emergency finance confined to periods of monetary crisis when even circulation needs can be met, short-terms have become the conspicuous feature of U.S. and U.K. finance. Keeping them afloat involves the almost constant task of renewal; it keeps the government regularly in the money market, in close touch with commercial and central banks. If the credit of the government wanes, or if interest rates change, it becomes quickly visible in the short-term market. The traditional objection to the liberal use of short-terms has been this very dependence on the money market for renewal. In times of crises it was feared that renewals would be difficult or even impossible to obtain or available only at prohibitive rates. Modern governments have met such criticism by increasing the size of working-cash balances, by anticipating borrowing requirements for longer periods, even though slight increases in interest were involved, and by combining short-terms with borrowings on longer maturities. A further traditional objection has been that short-terms were inflationary. However, it is not the form of the security which creates inflation but the source and volume of borrowing. If borrowing is on the basis of manufactured credit, long-terms, short-terms and other issues will be inflationary; if borrowings are from current incomes, the particular security offered cannot *at that time* make the transaction inflationary.

When these objections are not sufficient deterrents, the frequency of renewal is supposed to be conclusive. Such work is one reason, however, why administrators are hired. So long as financial institutions can absorb short-terms they will desire them in cyclically differing volumes; so long as governments can borrow upon them at lower effective rates than other securities they will be offered. Governments can be expected to utilize short-terms in the future in greater relative volume than in years prior to World War II.

On occasions of credit stringency, or at times when the market is propitious, governments may be expected to fund short-terms into longer maturities. Likewise, maturing long-terms may be exchanged for short-terms when such switches facilitate later refunding, or when market conditions justify increases in short-term borrowing. If debt is to be reduced, short-terms may be paid off first since recurrent maturities make this easy for the government to accomplish, as was the case in the U.S. between 1920 and 1930. But what securities, and whose, should be retired at any given time depend on the monetary and economic effects produced by repayment.

Interfund borrowings, to the degree utilized, free the government from recourse to the money market. The loans may, however, carry market rates of interest. If the rates are above market, the borrowing fund subsidizes the creditor fund; if the rates are below market, the debtor fund secures the advantage. One fund cannot loan to another unless it has a temporary surplus of cash. The interfund operations will fail, too, over the long run unless the debtor fund repays the creditor by the time cash is needed to meet current obligations. The management problem of the debtor, fundamentally, is that of meeting the cash requirements of creditor funds. To do this the debtor may need to resort to temporary borrowing in the market or secure revenue receipts by the time required. No fund should be plundered or robbed of cash for the sake of another.

Often a government is called upon to take steps to keep the market price of its securities from falling below par. The practice is more common in the U.S. than in England where temporary fluctuations in price are not regarded as a government responsibility. Not only has the U.S. government, through the open market committee of the federal reserve banks, tended to keep the price of its securities from falling below certain points but the committee has also sold securities to retard their advance in price and to check speculation. Three motives operate to foster price maintenance arrangements: (1) the desire to minimize losses to small investors; (2) the desire to minimize losses to financial institutions, particularly banks; and (3) the desire to implement monetary or fiscal policy. The sales of the open market committee reduce the reserves of member commercial banks; purchases provide reserves to the banking system. Sales help keep down the price of governments; purchases tend to bolster the market. Of course, it may be argued that purchasers of government securities have been paid interest which includes a premium for risks assumed. If purchasers buy short-terms the brief maturity protects them from capital losses caused by fluctuations in price. Consequently, rates are low. Long-terms are exposed to all market forces during their life; therefore, interest rates are higher. Maintaining the market for long-terms tends to make them almost as riskless as short-terms, both being equally liquid in an active, available market. Such a price-pegging policy tends to increase the worth, in the market, of long-terms, rewarding present holders, but not the government, if the policy was settled upon after issue. Hence, apart from considerations urgent in monetary policy, the government may not have an economic interest in decreasing price fluctuations in its outstanding securities. If price changes depreciate the assets of the banking system, for example, its interest may become vital. The forces on each side of the market-maintenance controversy need to be weighed carefully. Answers cannot be categorical.

Meeting of maturity schedules is perhaps the most important task of debt management. At maturity, debts either have to be paid or extended. In case the obligation is renewed, the operation is one of refunding. Such extensions tend to maintain the credit standing of the state because they not only pay off those who want cash but adjust the new offerings to the requirements of the security market. Refunding operations are therefore timed, where possible, to market conditions propitious for renewal. The permanent loans (consols) of the British avoid these renewal problems. They carry no definite date of payment but the exchequer is free to pay them when convenient. From the standpoint of the treasury, consols are superior to term issues. Subscribers may not like them so well, for the government may redeem them at a time when investors find it difficult to reinvest funds, but such preferences are often imaginary.

Frequently, long-term securities are issued with a "call" privilege. That gives the government the right to pay off issues prior to maturity. For example, the $2\frac{7}{8}\%$ bonds issued by the U.S. on March 15, 1935, were made payable on March 15, 1960, but subject to call for redemption on March 15, 1955. Any time between March 15, 1955, and March 15, 1960, these bonds could be paid upon notice to holders, or could be refunded or converted. The refunding operation has been described.

Conversion refers to an extension of debt under an agreement to exchange a security bearing a given rate of interest for one carrying a lower rate. Conversions are designed, therefore, to give the state the advantage of declines in market rates of interest. If holders do not care to accept new securities, they are usually paid off in cash. In the early days some conversions were compulsory; in modern times exchanges have generally been voluntary. The earliest English conversion was engineered by Sir Robert Walpole but carried out by James Stanhope in 1717, other notable conversions were those of Henry Pelham (1750), Nicholas Vansittart (1818 and 1822), F. J. Robinson (1824), Henry Goulburn (1830 and 1844), William Gladstone (1853) and George Goschen (1888). After World War I numerous conversions were effected to take advantage of declines in interest rates,

as, for example, the British conversion of 1932 and U.S. conversions of the First and Fourth Liberty Loans in 1934 and 1935.

The payment of interest without deviation from the terms of the loan contract assures the government a ready market for future issues appropriately priced and is the cardinal feature of excellent credit standing. The meeting of interest payments with fidelity is both a budgetary and a management task. Ordinarily, interest payments will be appropriated from tax receipts. On occasion it may be necessary to cover them by temporary borrowing although a continuation of that practice for long periods inevitably leads to a deterioration of credit as well as a decline in the quality of the financial management of the state itself. Debt administrators naturally desire to keep interest costs at a minimum (see *Problems of Issue,* above), which cannot be done by refusing to pay the market rate for funds. The state, however, should take advantage of opportunities by refunding and conversion to keep its securities in line with market rates of interest; when necessary to adjust interest rates on public securities, it should do so in a forthright manner. Unilateral adjustments—changes in debt contracts promulgated by the state without consent of creditors—are generally opposed. (See *Problems Created by Price Level Changes,* below.)

Repayment of Principal.—The repayment of national debts has long been the central problem of management and a chief concern of scholars. Classical economists looked at national debts as though they were personal obligations, to be repaid at the earliest opportunity. Unless debts were promptly repaid, some future emergency might arise when the borrowing power was exhausted. Furthermore, continuously mounting interest costs could only bring an increase of taxes; there might be also interferences with expenditure programs. Then, too, it was felt that mounting debts would progressively undermine the monetary system, especially if difficulties were encountered in meeting contractual payments. Finally, repayment was regarded as the means through which credit standing was maintained. More recently other aspects of management—fidelity of interest payments, refunding and conversion—are seen to be of equal importance.

Opposition to debt repayment has taken three forms: (1) objection to reduction of principal; (2) postponement of payment in order to discover, or utilize, means whereby burdens of retirement could be reduced; (3) opposition to the imposition of sufficient taxes to reduce debt. Procrastination in repayment, accompanied by the gradual depreciation of the purchasing power of money through rising prices has played into the hands of opponents of debt reduction. It has been argued that if the same efforts devoted to debt payment were turned to increasing production and the development of natural resources, the burden of debt would be reduced and its eventual payment more easily effected. Such a program would also avoid dislocations of industry and the reduction of consumption and investment following heavy taxation for debt retirement. At times it has been pointed out that there are better uses for public and private dollars than the reduction of national debts.

Payment has also been opposed on the ground that certain institutions and individuals need public securities. They have furnished part of the foundation for commercial banking; they have provided socially desirable institutions (charities, schools, hospitals, etc.) with certain income from endowments; they have given low-income groups a safe place to invest savings. Although these uses for government securities would be ended if the national debt were paid off in its entirety, much reduction is possible before the above uses are impinged.

In the case of an internal debt it has been argued that since "we owe it to ourselves," repayment is unimportant. What is taken away in taxes to repay the debt is returned to holders of debt tickets, administrative expenses of taxes and loans being ignored. While the aggregate transfers do not change national income, the distribution of resources among income-groups within the country is affected, for the holders of debt and taxpayers who pay them are not identical. Certainly the realization that payments of internal debts are only transfers should dispose of the argument that debt repayment is desirable *per se.* Internal debts should be retired when beneficial economic effects for the whole group are to be realized. When other uses of funds are more important, a less important use, such as debt retirement, has little claim for attention. The larger the debt the more serious are the economic consequences of transfers. These effects provide the answer to the wisdom or folly of debt retirement.

In the case of external debts, payments to creditors involve the transfer of gold, goods or services abroad. The debtor country loses the use of whatever is shipped outside of its economy. A desire to cut off these losses as promptly as possible argues in favour of speedy retirement of foreign debts. Without bothering to distinguish between internal and external debt, many writers have applied their arguments to debts of all varieties.

F. W. Pethick-Lawrence (*The National Debt* [published by The Labour Publishing Co., Ltd.], p. 26) has pointed out nine ways in which a national debt can be reduced or extinguished:

"(1) The debt may be redeemed. (2) The debtor and the creditor may become the same person. (3) The creditor may cease to exist (4) The debtor may cease to exist. (5) The creditor may forgive the debt. (6) The debtor may refuse to acknowledge the debt, in whole or in part, and compel the creditor to accept the situation. (7) The debtor may become bankrupt. (8) The debtor and creditor may come to a mutual agreement to commute the debt into a different form. (9) The debt, while nominally remaining intact, may in effect be reduced, and even practically extinguished, by altering the standard of value in terms of which it is measured."

The methods by which a nation may pay its debt to an existing creditor may be divided into three general groups: (1) nonrecurrent opportunities for debt reduction, such as the sale of public property or a capital levy; (2) periodic or almost automatic retirements; and (3) retirements made to implement a cyclical fiscal policy. The last two groups are most important, both from the standpoint of use and theory.

The periodic or regular reduction plans include the dedication of yields from designated taxes or other revenues to debt payment, the creation of sinking funds and retirement via the issuance of annuities. The partial repayment of loans of World War I by their allies to the U.S. and U.K. may be included in this category.

The repayment of loans by the use of tax receipts pledged therefore has long been prevalent in international finance. It was an almost certain method by which foreign bankers could extract payments from weak or newly established governments. The familiar dedication of the salt tax revenues of China to the payment of foreign loans is a case in point. Internal loans have been similarly retired. Special property-tax levies have discharged most municipal debts in the U.S. Franchise taxes on federal reserve banks were devoted to the retirement of the U.S. national debt from 1918 to 1933. Gladstone and others have favoured the dedication of death tax receipts to debt reduction. The use of other specific taxes has been championed.

By far the most important method of debt reduction, historically and from the standpoint of the volume of scholarly output, has been from the creation and use of sinking funds. The essence of a sinking fund is the incorporation in the spending program (budget) of a regular appropriation for debt retirement to be covered by available revenues. In early years the miracles of compound interest caused sinking funds to be invested and held pending the maturity of the obligation, at which time the fund would be sufficient mathematically to retire the issue. Richard Price (1771), regarded as the classical progenitor of the sinking fund, believed that it should be set up from revenues; if these were insufficient, it would pay to borrow to make sinking fund payments, for that fund would accumulate at compound interest whereas the debt would draw only simple interest. Robert Hamilton (1813) completely punctured this illusion, establishing the valid point that the only true sinking fund, or effective method of debt reduction, is a surplus of revenues over expenditures.

The experience of English and U.S. governments with sinking funds is long and notable—famous, for the most part, because debt reduction as planned was not achieved. Walpole established the first sinking fund in 1716 but it was violated by diversions to other objects of expenditure. William Pitt based his

experiment of 1786 on Richard Price's theory, even to the extent of borrowing to maintain it. Some modifications were made in it in 1792, 1798 and 1802. In 1813 Vansittart revised it further to discharge the old debt of 1786 and to apply it to new loans. In 1817 the sinking fund of Ireland was consolidated with that of Great Britain. In 1821 David Ricardo criticized the fund; Lord Grenville added an essay of criticism in 1827, with the result that reforms were again instituted in 1828. It appeared that more than twice as much debt had been accumulated as had been retired.

In the U.S. sinking funds have also been the chief means for reducing the national debt. The first sinking fund, sponsored by Alexander Hamilton, was created in 1790. The revenues set up for it were receipts from tonnage dues and the proceeds of a loan. In spite of the failures of this sinking fund, congress created another in 1817 to discharge the debts of the War of 1812. A specific appropriation was made to the fund, and surplus revenues as well were provided. By 1835 the national debt was extinguished. A sinking fund for Civil War debts was established in 1862 but was inoperative until 1866. It was augmented by surpluses and led to the steady reduction of debt until 1893. A sinking fund was also created in 1919 for debts of World War I and became operative in (fiscal) 1921. From (fiscal) 1921 to 1943 debt retirements from this sinking fund amounted to $6,214,685,000 out of aggregate retirements of $11,594,000,000. In 1943 the U.S. sinking fund became inoperative.

An objection to the sinking fund technique is that it tends to provide a minimum of retirement. When debt is being increased, simultaneous retirement only augments total borrowing. When taxes should be increased to provide a maximum of debt retirement, it is often pointed out that the sinking fund will retire the debt within a given period, or that provision has been made so to retire it, with the result that taxes are decreased and debt retirement is thereby minimized. Such was the result of the policies of the U.S. during the boom period 1921–29. The net result, over the course of the trade cycle, is that too little debt is paid off.

The history of attempts to retire debts has vindicated the scholar's assertion that a surplus of revenue is the *sine qua non* of debt reduction. This has caused many writers to advocate debt redemption by the application of surpluses; but unless a surplus is budgeted for debt retirement the reduction achieved is apt to be small. Casual surpluses cannot be depended upon for substantial retirements. The use of surpluses for debt reduction will, however, provide cyclical retirements, for surpluses are seldom achieved during depressions. Those who favour cyclical retirements usually advocate retirements during prosperity and booms, with debt expansion taking place during depressions. It is also possible to achieve a cyclical policy by imposing taxes for debt reduction during prosperity, but with the actual repayments being delayed until subsequent depressions appear. An intentionally realized surplus provides all of the advantages of a fixed provision for redemption with none of the embarrassments or moral hazards of rigid policies or accumulating funds. It gives the government flexibility but makes it squarely responsible for debt retirement.

Problems Created by Price Level Changes.—Changes in the general price level either decrease or make more severe the burden of taxes for the payment of public debts. Decreases in the value of money ease burdens upon debtors but return to creditors less than they transferred to debtors at the inception of the loan. Falling prices may carry with them the tax base so that nations, being unable to meet their contractual obligations, default upon loans. If this condition continues, unilateral adjustments of the loan contract may be the course of relief selected by the state. It may take the form of a compulsory reduction of interest, as in the southern Confederacy in 1862, or in Australia (1931) and Argentina (1933); or a forced conversion, as in Belgium (1926) and New Zealand (1933); or an extension of the term of the loan, even to the extent of changing short- into long-term debt as was done in Italy in 1926; or of a devaluation of currency and the repeal of the "gold clause" relative to payments as in the U.S. in 1933; or the adjustment may take the form of an outright reduction of principal as in Turkey in 1881. Payment in other than stipulated media of exchange also took place in Russia in 1839 and in Germany and France after World War I. The extremities resulting from economic depression, and the alternatives available for avoiding them should be carefully weighed in appraising such actions. In terms of equity the question is whether justice to the debtor is to be preferred to benefits to the creditor. Many actions can be explained by attempts to balance these equities. The shifting of debt burdens is one of the penalties of a fluctuating price level.

Repudiation.—On rare occasions states have decided not to honour debt obligations. Repudiations are unlike defaults. When a nation defaults, it is temporarily unable to pay its debts; when it repudiates, it is unwilling to honour its obligations. Extreme depression may cause a nation in default to repudiate its debts. The usual cause of repudiation, however, is political rather than economic. The state contracting the loan may no longer exist and the new government may not care to assume the debts of the old, as in Spain (1823), Portugal (1832) and Mexico (1867). When revolts are quelled, the debts of rebellious groups are usually outlawed. After the Civil War, the U.S. constitution was amended (1868) to declare void the debts of the Confederacy. The total repudiation, scaling of principal and accrued interest on the scaled debt not paid amounted to $116,308,000 for eight of the southern states. The largest repudiation on record, however, is that of Russia, which in 1918, renounced the $19,000,000,000 debt of the tsarist regime; but the U.S.S.R. later scrupulously observed all of its own obligations. Repudiations frequently are said to cause difficulties in the floating of future loans, or an increase in the rate of interest. On the other hand, instances are numerous where the state has quickly restored its credit standing and its ability to borrow at market rates. That repudiations are rare is testimony to the extent to which the institution of public borrowing has progressed. It is part of the moral code of nations that their debt contracts, internal as well as external, be faithfully observed.

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NATIONAL DEPOSIT FRIENDLY SOCIETY: *see* FRIENDLY SOCIETIES.

NATIONAL FINANCE: *see* FINANCE.

NATIONAL GEOGRAPHIC SOCIETY, a U.S. scientific society founded in Washington, D.C., in 1888, "for the increase and diffusion of geographic knowledge." Its membership in 1951 was approximately 1,965,000.

In the field of research it sent expeditions to many parts of the world, some wholly financed by it, others in collaboration with other institutions and organizations. The expeditions it sent out to study the processes of volcanism and seismology, including studies at Mont Pelée, Messina, Mt. Katmai and the Pavlof area brought new light on these earth processes and resulted in the discovery of the Valley of Ten Thousand Smokes in Alaska, a great pregeyser land which was established as a national monument by proclamation of the U.S. president. In tracing the ancient civilizations of the new world, the society, in conjunction with Yale university, unearthed the ancient Inca retreat, Machu Picchu, in Peru, and in a series of eight expeditions unearthed the even more ancient community of Pueblo Bonito, N.M., and laid the foundations for the co-ordination of the tree-ring calendar with our own and the establishment therefrom of an American chronology antedating the discovery of America by many centuries. In 1949 the society, in co-operation with the Palomar observatory of the California Institute of Technology, began a comprehensive survey of the sky with the 48-in. Schmidt wide-angle phototelescope on Palomar mountain. By 1951, 1,000 new clusters of nebulae—the farthest 350,000,000 light-years distant in space—had been discovered and recorded for the first time.

In the field of spreading geographic knowledge, the society publishes the *National Geographic Magazine*, which every member receives, issues a bulletin service for the daily press of the world, furnishes the schools of the United States with material for current-event geography and pictorial geography text in loose-leaf form. It also issues scientific monographs and publishes a widely distributed series of maps. (G. GR.; X.)

NATIONAL GUARD is the name applied in the United States to a volunteer organization of citizen soldiers who devote part of their time each week to train as members of military units. These units are organized under the same standards of equipment and personnel as are the regular army and air force units and are an integral part of the U.S. military forces. The national guard comprises more than 5,500 federally recognized army and air units established in more than 2,000 communities in the 48 states, Alaska, Hawaii, Puerto Rico and the District of Columbia. Guard units are part of the internal military apparatus of the several states and territories and under command of their chief executives. Simultaneously, all federally recognized guard units are part of the national guard of the United States, a federal force equipped by and trained under the direct supervision of the regular army and air force. The two organizations actually are identical in personnel, organization and equipment. In time of war or national emergency, however, the national guard of the U.S. may be ordered to active military service. Such units lose their state control and are absorbed into the regular active military forces for the period of active service. An outgrowth of the early militia concept, the national guard has the longest continuous history of any military organization in the U.S. The oldest guard unit in continental U.S. is the 182nd infantry of Massachusetts, originally organized as the Middlesex county militia regiment in 1636. Known as the Old North regiment, it responded to the call at Lexington and Concord, where the American tradition of citizen-soldier "Minutemen" was born. The 295th infantry of Puerto Rico traces its ancestry to the militia organized there in 1510 under the command of Juan Ponce de León. Authority for the establishment of the national guard was written into the constitution. The name "national guard" was first used in 1824 by New York units in honour of the Marquis de Lafayette, first commandant of the famed French *garde nationale*. By 1896 most states had adopted this title.

Militias, raised by the several colonies for local and self-protection, were formally organized into the over-all defense force of the country in 1775 by the committee of safety of the Second Continental Congress. They provided approximately 165,000 of the 396,000 troops raised for Gen. George Washington's command. The right and privilege of the early settlers to form these local protective organizations were recognized in the constitution of the new nation. Provision for and recognition of the militia was given in the first and second amendments in the Bill of Rights, and in the Federal Militia act of May 8, 1792. The federal government was to organize and arm "a well-regulated militia," and the states were to provide officers and control.

The constitution gave congress the power to raise and support armies, and President Washington constantly pressed congress to prepare "a uniform and well-digested plan" for the militia. No action was taken, however, and troops were separately formed and trained by each state entirely under state control. Spoken of as the "uniformed" militia, these local volunteer units were not only utilized by the states for local emergencies but also in answer to federal calls on the states to furnish forces for service elsewhere. They furnished the major manpower of the northern response to President Lincoln's first proclamation of April 15, 1861.

Congress (act of Feb. 28, 1795) gave the president authority to call out the militia in cases of invasion and other emergency, but it was dependent upon the individual governor's acceptance or rejection of the president's request.

In 1808, legislation provided for specific federal aid to be paid annually to the states to support their forces which still remained under state control. But throughout the 19th century, the national guard remained a generally unwieldy, sprawling force despite local pride and traditions and increasing federal aid. Then, in 1903, came a sweeping change. Elihu Root, secretary of war after the Spanish-American War, instituted a general program to reorganize the military establishment. A part of his program emerged as the Dick act of Jan. 21, 1903. It provided the national guard with both state and federal support. The states were assigned the responsibility of furnishing personnel and armoury facilities. The federal government became responsible for training, equipping and paying the men. Included were definite training programs, periodic inspections by regular officers detailed by the secretary of war and joint participation with the regular army in manoeuvres. The national guard developed into well-organized and adequately trained regiments.

Under the National Defense act of June 3, 1916, the organized militia was officially re-established as the national guard and made to conform to regular army organization. It became a component part of the organized peace establishment. Although largely federal in method and training, in law it remained local until actually called into federal service. Approximately 100,000 guardsmen were called into federal service in 1916 and served six months on the Mexican border. When war was declared against Germany in April 1917, the guard had a strength of 7,612 officers and 174,008 enlisted men. During 1917–18, it contributed 380,000 men in units to the army. The 11 guard divisions that saw combat made up two-fifths of the divisions in the American Expeditionary force. Of the eight U.S. divisions listed by the German supreme command as superior or excellent, six were guard divisions.

The general disintegration that followed the widespread eagerness for demobilization after World War I made it necessary to rebuild the defense force. The act of June 4, 1920, (amendments to the National Defense act of 1916), created a completely new military policy for the U.S. It established an "army of the United States" with the regular army, the national guard and the organized reserve corps as the three basic components. The national guard remained a state force under command of state authorities, except when in actual federal service. Federal assistance was expanded. When units reached certain minimum standards in strength, equipment and skill, they were recognized for federal support.

The act of June 15, 1933, created a new component of the army, the national guard of the United States. Identical in personnel and organization to the national guard of the several states, it nevertheless was a separate entity. It was a component of the army at all times, while the national guard of the several states were components of the army only when in the active military service of the U.S. The guard's federal mission was formalized and could be ordered into active military service whenever congress declared a national emergency without the necessity of being called through the governors of the several states. During the first four years after World War I, the national guard reorganized in the states at the rate of about 40,000 men a year. For economy, however, it was not allowed to attain its target strength of 435,000, but was held down and stabilized at about 185,000. Then, under the impetus of Adolf Hitler's threat to world peace, the ceiling was raised. New units were created and enlistments increased.

In Aug. 1940, the president ordered the national guard into active military service. Induction began Sept. 16, 1940, and was completed Oct. 6, 1941. About 300,000 men were brought into federal service in 18 combat divisions and numerous separate units, including 29 air observation squadrons. These troops immediately doubled the strength of the army. Guardsmen supplied trained leadership for the expanding army, and 75,000 enlisted guardsmen later became commissioned officers. Nine divisions fought in Europe, nine in the Pacific. Guard units participated in 34 separate campaigns and 7 assault landings, received 88 presidential citations for outstanding performance of duty in action, conspicuous valour or heroism.

When, after World War II, the guard was demobilized and returned directly to civilian life, there actually was no national guard for a short period. Then a joint committee of the war department general staff drew up policies for the postwar national guard, which were approved by the secretary of war on Oct. 14, 1945. The guard, under an entirely new conception, was established as a "Mobilization day" (M-day) force, an integral part and first-line component of the national military establishment. Its expanded mission was to provide a reserve component of the army and the air force capable of immediate expansion, trained and equipped to defend the U.S. at home and abroad against an aggressor. It could be called into federal service when a state of national emergency is declared by the president or congress.

Authorized strength of the national guard was set at 695,000 men (635,000 army and 60,000 air). The first postwar unit—the 120th fighter squadron of Colorado—was federally recognized on June 30, 1946. By 1950 budgets had been provided for an actual strength of approximately 350,000 army and 50,000 air. The guard troop basis included 25 infantry divisions, 2 armoured divisions, 20 infantry regimental combat teams, 97 anti-aircraft battalions, numerous supporting units and 514 air units, including 84 tactical squadrons. Strength within individual states was mainly prorated on a population basis. An annual minimum of 48 armoury drills was required, each including at least 2 hours of training, plus 15 days of full-time field training.

During the Korean emergency, more than 2,000 army and air guard units, including 8 infantry divisions and 66 tactical air squadrons, and about 150,000 men were called to active military service.

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NATIONAL INCOME. National income is the net product of the economic activity of individuals, firms and institutions that comprise a nation. During any year, economic activity yields a huge total of diverse commodities and services, some of which (raw materials, semifabricates, machinery and structures, services rendered by one firm to another) are consumed in the process of production. The net product or national income is the sum of commodities and services produced minus the amounts consumed in the production process. Measurement is ordinarily in terms of money since prices are the only commonly available yardstick for the wide variety of commodities and services.

Unless laboriously constructed part by part, national-income measures are neither reliable nor useful. Only in such a way can large errors in the totals be guarded against. Only in such a way, too, can a useful picture be secured of the origin of income in various industries; the distribution of income flows by type (wages, salaries, dividends and others); the apportionment among various population groups and the division between consumption and investment, or spending and saving. Statistical data needed for detailed estimates were still lacking for many countries at mid-20th century. Even in countries with abundant information (*e.g.*, the United States, the United Kingdom, Sweden) important branches of economic activity could be only crudely approximated, and some types of apportionment could not be made on a continuous annual basis.

International Differences in Income Per Capita.—An attempt to give a picture of national-income levels and distributions must employ rough estimates for many countries with inadequate data. Yet countries can be grouped by the level of their national income per capita, measured in units of comparable purchasing power, for the period intervening between World Wars I and II. In this classification, among the countries with highest income per capita, are the United States, the United Kingdom, Canada, New Zealand, Australia and Switzerland. This group has between 9% and 10% of the world's population and accounts for a little more than 40% of total world income. Countries with lowest income per capita are India and Pakistan; Netherlands Indies; China; the rest of Asia, excluding Japan (prior to World War II) and Asiatic U.S.S.R.; Africa, excepting South Africa; Latin America, excepting Argentina, Uruguay, Chile, Brazil and Mexico; Oceania, excepting Australia and New Zealand. This group has almost 60% of the world's population, and accounts for only 16% of total world income.

The group between the two extremes may be subdivided further into an upper middle group, including all countries of western and central Europe not already in the upper group and the more prosperous countries of Latin America (Argentina, Uruguay, Chile); and a lower middle group including all countries of eastern Europe, the Balkans, South Africa, Brazil, Mexico and Japan. Some of the relatively developed units in Asia and Africa (*e.g.*, Turkey, Syria, Israel, Egypt, Morocco, Tunis) may properly belong to this group. The upper middle group, with roughly 10% of the world's population, accounts for about 22% of world income; the lower middle group, with 22% of the world's population, accounts for about 21% of world income.

These rough quantitative estimates confirm the common impression of the contrasts between various parts of the world in the level of material well-being assured them by their economic activity. What is, perhaps, less widely realized is the limited magnitude of the proportion of the world's population that has succeeded in getting a material return at all approximating that of western Europe and North America—at most about one-fifth, if we combine the upper and upper middle groups.

Industrial Structure.—In general, a high national income per capita is associated with a relatively small share originating in agricultural and other primary industries (fishing, forestry) and a relatively large share originating in service industries (professional, governmental, educational, personal). Conversely, in countries with low national income per capita, the main sources of national income are agriculture and other primary industries; and relatively small shares originate in other activities—manufacturing and construction, transportation and trade and particularly the service industries.

This association is most readily illustrated by the distribution of the working force among industries. But the distribution tends to overstate the share of the primary industries and understate the share of the service industries in national income because income produced per agricultural worker is generally much lower, and income produced per worker in service industries much higher, than the national average. In the United States the proportion of

the working force (employees and entrepreneurs) engaged in agriculture between World Wars I and II was less than 20%; in Great Britain 6%–7%; in Bulgaria 67% and in India 62%. The proportions engaged in the service industries were 25% in the United States and 24% in Great Britain, but only 7% in Bulgaria and 12% in India.

It would be an oversimplification to say that because a large proportion of a country's working force is engaged in agriculture, its national income per capita is low. Certain conditions—poverty of industrial resources, low state of education and technical training, insufficient accumulation of industrial capital, a social system unfavourable to intensive economic activity and the like—make for a low national income per capita and most of the working force must engage in agriculture in order to produce the prime necessities of life. And because under such conditions agricultural productivity is low, only a small proportion of the labour force is free to engage in other industries. Conversely, in the more advanced countries, with high agricultural productivity, sufficient farm products can be produced by such a small working force that most of the working force is free to engage in other pursuits. Likewise, in the industrially advanced countries, the large proportion of the working force engaged in service industries is more an effect than a cause of the higher income per capita: this high level causes a shift in the structure of consumers' demand toward services; at the same time high efficiency in the commodity-producing and -handling industries leaves a substantial proportion of the working force free to engage in service pursuits.

Distribution by Type.—Data on distribution of national income by type are available for only a few countries. They reflect differences in economic organization (relative importance of unincorporated enterprises *v.* corporations) and in the relative abundance of capital, whether invested at home or abroad.

In the United States and the United Kingdom, the shares in national income of compensation of employees are roughly about the same, constituting about two-thirds. The share of individual entrepreneurs, whether farmers or urban business and professional people, is low in the United Kingdom (10%), largely because of the low share of agriculture and hence of farmers, and high in such a country as Germany prior to World War II (25%), mainly because of the large role of individual firms in urban industries. It follows that the share of capital (the total of dividends, interest, rents, undistributed profits of private or public corporations) is greatest in the United Kingdom (23%); smallest in prewar Germany (10%); and between the two in the United States (18%).

From these data one could infer the character of the distributions that might be found in other countries. In general, the greater the role of agriculture and the less developed the corporate organization of urban industries, the greater the proportion of income of individual entrepreneurs and the smaller that of compensation of employees and of returns to capital. In general, the less advanced the economy of the country and consequently the smaller its accumulated capital proportionately to working force, the smaller the shares of returns to capital and the greater the share of returns for personal effort; *i.e.*, to the working population, whether employees or entrepreneurs. However, this latter generalization should be qualified because the high price of capital in the less-advanced and hence capital-scarcity countries may serve to raise the share of returns to capital.

Distribution by Size.—The distribution by type just discussed is important in determining the distribution by size. The large incomes are usually derived either from capital investments alone or from a combination of large capital investments with some returns for personal effort. And returns on capital, particularly dividends, are received mostly by the upper-income groups. The larger the proportion of returns on capital, the greater the numerically measured inequality in the distribution of income by size—the greater the difference between the low incomes received by the many, on one hand, and the large incomes received by the few, on the other.

Available data indicate wide disparities in size of income received by various classes in the population. Thus, in the United States, the top 5% of the population received, during 1919–38, about 30% of total income of all individuals. While the share of upper income groups declined during World War II and the years following, it was still close to 20% in 1947.

Income, if averaged over a few years to eliminate transient changes, tends to be more equally distributed among recipients in agricultural than in urban industries; in rural than in urban areas; in smaller cities than in large urban centres and, as already mentioned, in the distribution of incomes for personal effort than in that of property incomes. It follows that absolute and relative inequality in distribution of income may be greater in the industrially advanced countries of the world than in those with a less-developed economy.

The interpretation of these generalizations is subject to many qualifications and is beset with pitfalls. In the form in which the distributions are ordinarily given, of income among recipients for a given year, some incomes are depressed and others raised by purely transient and accidental characteristics of the single year; and hence the data overestimate inequality in distribution by income status; *i.e.*, by income levels characteristic of fairly long periods. Furthermore, the effect of graduated income taxes on amount of income disposable after taxes is often not measured. On the other hand, with data relating to income recipients, the unemployed are neglected (in some years a large group with zero incomes). Finally, in comparisons among countries, numerical measures of relative inequality neglect the absolute size of income and hence the implicit inequality in welfare and the standard of living. In the less-advanced countries, with their low average income per capita, a difference between an income that is only half the national average and one that is twice the average may mean a difference between starvation and a level of living that while adequate is perhaps lower than that of the lower-income-receiving masses of population in an industrially advanced country. In the latter, a difference between an income only half the national average and one twice the average may be the difference between tolerable subsistence and considerable comfort. Numerically, relative inequality in the two countries is the same; but welfare inequality is obviously much greater for the country with the lower national income per capita. In this light, the distribution of income by size associated with maximum welfare of individuals is that in countries with both high average income per capita and a narrow range in inequality of income among various classes. Notable examples are Australia and New Zealand.

Distribution by Type of Use.—Whatever the national income per capita, most of the annual product is consumed; only a small proportion is saved or accumulated as capital. In countries whose national income per capita is small, the reason is low productivity: the total product is not large enough to permit much diversion for addition to the stock of capital. In countries whose national income per capita is large, the reason is a natural pressure for a high standard of living, for a share on the part of consumers in the great and increasing productivity of the economy.

One would expect that the bigger the national income per capita, the lower the proportion of national product consumed and the higher the percentage saved for addition to capital stock. But the available data show no such association. Rough estimates suggest that in some of the lower-income-per-capita countries, the pressure of demand for capital and the power of the state to keep ultimate consumption down to maximize capital accumulation (usually under state auspices) raise the proportions diverted to capital formation above those realized in richer countries with less pressure for new capital and a more democratic social system.

The distribution of the consumer expenditures component is naturally associated with income level. In countries and among consumer groups with low per capita income, outlays on food and other perishables dominate consumer budgets, leaving only small shares for durable commodities (furniture, household equipment, cars, etc.) and for services (education, recreation, personal). These durable commodities and the services loom much larger in consumer expenditures in countries and among consumer groups with high per capita income.

Problems of Interpretation.—Interest in national income goes back at least to the beginning of national states. Some early estimates are available for a few countries (Great Britain, end of the 17th century; France, end of the 18th century; United States, 1800 and 1801). But periodic measurement of national income and its components did not become widespread until the 20th century. World War I emphasized the need for comprehensive totals in planning the war-production effort; and acute economic problems in the 1920s and the 1930s served to concentrate attention upon nation-wide levels of production and employment. During the decades that intervened between World Wars I and II, adequate national-income estimates became available for many more countries and in a few were carried back several decades. The extension and elaboration of national-income measures continued through World War II. The estimates were widely

employed in the measurement of the economic war effort, in assaying postwar production and employment prospects, in international agreements and plans. Measurement of national income might well become a practice as widespread and its results as commonly employed as estimates of populations and of their composition.

The problems toward whose solution national-income measures were expected to contribute would naturally differ from country to country. Where the economic system was characterized by low productivity, the pressure for accelerated industrial development would mean emphasis upon uses of national-income measures in connection with maximizing capital accumulation and raising the productivity of the labour force. In countries that had reached a high stage of economic development, the problem would not be so much one of using the national product to raise the nation's productive capacity as of maintaining a level at which existing capacity would be used adequately and relatively full employment assured. And in the sphere of international relations, with probable competition among countries characterized by differing political and social structures, comparisons of national income would be made as a test of the comparative efficiency of the economies and hence as a partial measure of comparative viability of political and social systems.

Different uses call for different national totals, some of which diverge from the standard definition of national income given above, but may not always be clearly distinguished by a specific term. Combined with such multiplicity of variants are differences among countries, or within each country between different periods, in the scope of economic activity that can be measured and in the adequacy of the market valuation bases. A national-income estimate reduces diverse economic realities to a single quantity (or series of the latter) by limiting the scope of activities to be covered; measuring them in terms of a common denominator, market prices, and applying a set of rules as to what is to be counted as production cost in calculating net product. Agreement upon scope and basis of measurement is not easy even among investigators who deal with the same country over a short period or a group of countries with similar social and economic structures. It becomes much more difficult when the common denominator is to be applied to an agreed-upon scope of activities and distinctions between gross and net, for a variety of countries differing in social structure, or even for the same country for historical periods characterized by different economic and social conditions.

Such definition of national income and its components, valid for both peace and war, for both the present and the more distant past and for countries differing substantially in their social system is not impossible; but it still remained to be developed at mid-20th century. Meanwhile, the available measures, by commonly omitting certain activities (*e.g.*, housewives' services), failed to reflect the differing importance of these omitted activities as between country and country, or within the same country from period to period. By using market prices as the common denominator, often without any adjustments, the available measures failed to approximate closely the relative weight of various commodities and services as they would be in a valuation system less distorted than existing markets are by monopolies, state interference and group differences in economic power. And by allowing for only the most obvious production costs in passing from gross to net product, the available measures failed to adjust for the greater living expenses of population in industrially advanced countries—higher costs of urban life rather than larger net returns to consumers. These various limitations, of which those cited are merely a few examples, do not arise through the faults of estimators but from defects in the data or compromises adopted for the sake of getting some estimates based upon a common denominator that will find widest acceptance.

The sole practicable means of assuring proper interpretation and legitimate use is full cognizance of how the national-income estimates are derived and of the limitations of scope and character of their coverage. Summaries of diverse and changing economic realities, they become the more useful the more they and their components are studied at the various stages of the flow process of economic activity (production, distribution, consumption). If examined against the background of the complex and changing reality they try to summarize, the measures can serve as useful guides to economic theory and policy, guides that help narrow the area over which the uninhibited, because uninformed, narrow group interests and class theories can hold sway.

In using national-income estimates, caution is especially needed today when the character and contents of the economic systems the world over are changing rapidly; the differences with respect to economic organizations among countries are more pronounced than they were in the 19th and early 20th century. Because of these changes, some of the generalizations noted above may become invalid. Because of these differences much more than the totals and a few components are needed before significant comparisons of national income for various countries can be made. Nevertheless, a body of roughly comparable estimates, in combination with other data, may facilitate understanding of how the various economies functioned in the past and how this past sets the general direction and boundaries of their future. (*See* also WEALTH AND INCOME, DISTRIBUTION OF.)

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NATIONALISM, a state of mind, in which the supreme loyalty of the individual is felt to be due to the nation-state. Though attachment to the native soil, to parental traditions and to established territorial authorities have been known throughout history as prevailing sentiments of varying strength, nationalism began only at the end of the 18th century to become a generally recognized sentiment moulding public and private life and one of the great, if not the greatest, single determining factors of history. Thus nationalism is a modern movement, but in the short span of its existence as a dominant element of societal life and organization, it has shown such a dynamic vitality and such an all-pervading character, that the mistake has been frequently made of regarding nationalism as a permanent or at least very ancient factor of history. In reality, nationalism arose as a dominant force in the 18th century in western Europe and in North America; the American and the French revolutions may be regarded as its first powerful manifestations; from the western world it spread at the beginning of the 19th century to central Europe, thence, towards the middle of the century, to eastern and southeastern Europe, until, at the beginning of the 20th century, it put its stamp on the ancient lands of Asia and Africa, after having penetrated the new countries of Latin America. Thus nationalism has become at present a force dominating everywhere on earth, so much so that the 19th century has been called "the age of nationalism" in Europe, while the 20th century has witnessed the rise and struggle of national movements throughout Asia.

Nationalism implies the identification of the state or nation with the people, or at least the desirability of determining the extent of the state according to ethnographic principles. In the age of nationalism, but only in the age of nationalism, the principle was generally recognized that each nationality should form a state, its state, and that the state should include the whole nationality. Formerly states, or territories under one administration, were not delineated by nationality; men's loyalty was not due to the nation-state, but to different other forms of political aspiration: the city-state, the feudal fief and its lord, the dynastic state, the religious group or the sect. The nation-state not only did not form a reality during the greater part of history, for a very long time it did not appear even as an ideal. In the first 15 centuries of the Christian era the ideal was the universal world-state, not the loyalty to any separate political entity. The Roman empire had set the great example which survived not only in the Holy Roman empire of the middle ages, but also in the *res publica christiana* and in its later secularized form of a united world civilization and world policy as it appeared in the writings of the 17th century

As political allegiance, before the age of nationalism, was not determined by nationality, so was civilization not regarded as nationally determined. During the middle ages civilization was regarded as determined religiously; for all the different nationalities of Christendom as well as for those of Islam there was but one civilization—Christian or Mohammedan, and but one language of culture—Latin (or Greek) or Arabic (or Persian) Later in the periods of renaissance and classicism, it was the ancient Greek and Roman civilizations which became a universal norm, valid for all people and all times. Still later the French civilization was regarded throughout Europe as a valid civilization for all educated people of all nationalities. It was only at the end of the 18th century that for the first time civilization was regarded as determined by nationality and that the principle was put forward that man can be educated only in his own mother tongue, not in languages of other civilizations and other times, be it classical languages or the literary creations of other peoples who had reached a high degree of civilization. From the end of the 18th century on, the nationalization of education and national life went hand in hand with the nationalization of states and political loyalties. In many cases poets and scholars emphasized cultural nationalism first, reformed the national language, elevated it to the rank of a literary language, delved deep into the

national past, so as to prepare the foundations for the political claims for national statehood soon to be raised by a people in which the spirit of nationalism had been kindled by writers and educators.

Though national feeling was evident in certain groups at certain periods, especially periods of stress and conflict before the 18th century, nationalism became only in the 18th century a dominant force. Its rise was prepared by a number of complex events: the creation of large and centralized states by the absolute monarchs, which destroyed the feudal allegiances and thus made the integration of all loyalties in one centre possible; the secularization of life and education which fostered the development of the vernacular languages and weakened the ties of religious or sectarian loyalties; the growing economic interdependence which demanded larger territorial units, which would at the same time give the necessary scope to the dynamic spirit of the rising middle classes and their capitalistic enterprise. All these developments created the large and unified territorial state with its political and economic centralization. This existing form of the nation-state was filled in the 18th century with a new spirit of nationalism. It received from it an emotional fervour, similar to that which in preceding periods characterized religious movements. Under the influence of the new theories of the sovereignty of the people and of the rights of man, the king as centre of the nation was replaced by the people. No longer was he the nation or the state; the state, formerly a royal state, had become the people's state, a national state, a fatherland. The word "patrie" gained a new emotional depth and a new activist fervour. The land was no longer the king's, no longer his, but the nation's, ours, the land of our fathers and of our children, a fatherland. The nation, no longer the king or a ruling oligarchy, felt itself responsible for the country's destiny; nation and state became identified, as civilization became identified with national civilization.

This new thinking of nationalism was opposed to all the conceptions which had dominated thought for the last 2,000 years. During that period man had commonly stressed the general and the universal and seen in unity the desirable goal. Nationalism stressed the peculiar and parochial, the differences and the national individualities. These tendencies have become more pronounced as nationalism developed. In the 17th and 18th centuries the common standards of western civilization, the regard for the universally human, the faith in reason, one and the same everywhere, and in common sense, the survival of the Christian and Stoic traditions: all that was too strong to allow nationalism to develop its full tendencies, and to disrupt the society of man. Thus nationalism in its beginning was thought compatible with cosmopolitan convictions and with the general love of mankind. This was especially true of nationalism in western Europe and North America.

The first full manifestation of modern nationalism occurred in 17th-century England, in the Puritan revolution. That century saw England the leading nation in the scientific spirit, in commercial enterprise, in political thought and activity. Swelled by an immense confidence in the new age and in the immense possibilities opening up, the English people felt upon their shoulders the mission of history, a new sense that they, the common people of England, were builders of destiny at a great turning point from which a new true reformation and a new liberty would start. In the English revolution a new optimistic humanism and Calvinist ethics merged; the influence of the Old Testament formed the new nationalism by identifying the English people with ancient Israel. The new message, carried by the new people not only for England, but for whole mankind, was expressed in the writings of Milton in whose famous vision the idea of liberty was seen spreading from Britain, "celebrated for endless ages as a soil most genial to the growth of liberty" to all the corners of the earth. "Surrounded by congregated multitudes, I now imagine that I behold the nations of the earth recovering that liberty which they so long had lost; and that the people of this island are disseminating the blessings of civilization and freedom among cities, kingdoms and nations."

English nationalism was thus much nearer to its religious matrix than later nationalism which rose in the 18th and 19th centuries after the process of secularization had made much greater progress; the nationalism of the 18th century shared, however, with English nationalism the enthusiasm for liberty, the humanitarian character, the emphasis upon the individual and his rights and upon the human community beyond all national divisions. The rise of English nationalism coincided with the rise of the English trading middle classes; it found its final expression in Locke's political philosophy. It was in that form that English nationalism influenced American and French nationalism in the following century.

The rising nationalism of the 18th century settlers in British North America was influenced partly by the English traditions of the Puritan revolution and of Locke, and partly by the new rational interpretation given to English liberty by the French philosophers of the century. American nationalism became the typical product of the 18th century: the American settlers became a nation in a fight for liberty and individual rights on the basis of the thought of the century as expressed above all by Thomas Jefferson and Thomas Paine. It was a liberal and humanitarian nationalism, regarding America as the vanguard of mankind on its march to greater liberty, equality and happiness for all. The ideas of the 18th century had found their first political realization in the Declaration of Independence and in the birth of the American nation. Their deep influence was felt in the French revolution which enthroned French nationalism as the decisive factor in place of French royalty.

Rousseau had prepared the soil for the growth of nationalism, not only by his stress of popular sovereignty and of the general co-operation of all in forming the national will, but also by his regard for the common people as the true depository of civilization. Under his influence Johann Gottfried Herder gained a new understanding of art and civilization by emphasizing folk lore, folk songs and primitive popular traditions as revealing the true creative forces of a nation. He went beyond Rousseau in his appeal to the past, often to the primitive past. He glorified the instinctive and irrational, and turned the attention from the universally human and general to the peculiarities of each national tradition, regarding them as valuable sources of creative inspiration. Under Herder's influence German romantic nationalism later stressed these factors of irrationalism and of national peculiarities; while the nationalism of the French revolution was the triumphant expression of a rational faith in common humanity and liberal progress. The famous slogan of "liberty, equality, fraternity" and the Declaration of the Rights of Man and of the Citizen were not only thought valid for the French people, but for all peoples. Individual liberty, human equality, fraternity of all peoples: these were the common corner-stones of all liberal and democratic nationalism. In their name the French nation constituted itself, overthrew the monarchy and began soon to spread the new gospel across Europe. Under their inspiration a new ritual was developed which partly took the place of the old religious ritual: festivals and flags, music and poetry, national holidays and patriotic sermons: in the most varied forms nationalism permeated all manifestations of life. Like the rise of American nationalism, the rise of the French produced a deep change in the art of warfare: the nation in arms. These citizen armies, untrained but filled with a new fervour, proved in America and in France superior to the highly trained professional armies of the 18th century who fought however without the incentive of nationalism. The revolutionary French nationalism stressed the element of will, of free individual decision, in the formation of nations. Nations were constituted by an act, in self-determination of their members. The plebiscite became the instrument whereby the will of the nation was expressed. Nationalism meant, in America as well as in revolutionary France, the adherence to an idea, a universal progressive idea, looking towards a common future of freedom and equality, not towards the past which had been characterized by authoritarianism and inequality.

Napoleon's armies spread this nationalism throughout Europe and even into the near east; under the inspiration of the American and French revolutions it aroused the Latin Americans. But Napoleon's yoke turned the newly awakened nationalism of the European peoples against France. In Germany where the struggle was led by writers and intellectuals it turned not only into a rejection of Napoleon's rule but of all the principles upon which the American and the French revolutions were based, and against the liberal and humani-

National Parks, Monuments, etc.	Location	Acres Owned by U.S. June 30, 1951	Outstanding Characteristics
National Parks			
Acadia 1919	Maine	28,619.50	Scenic, rugged coastal area on Mount Desert Island, most prominent elevation on eastern seaboard; also includes picturesque Schoodic point on mainland.
Big Bend 1944	Texas	692,304.70	Spectacular mountain and desert scenery; variety of unusual geological structures; enclosed in the great bend of the Rio Grande.
Bryce Canyon 1928	Utah	36,010.38	Rocks among the most colourful of any of the earth's crust, exposed in a box canyon and shaped by erosior into pinnacles and grotesque forms.
Carlsbad Caverns 1930	New Mexico	45,526.59	Large subterranean labyrinth; a series of connected caverns with a myriad of magnificent and curious formations.
Crater Lake 1902	Oregon	160,290.33	Lake of deepest blue in heart of once active volcano; encircled by multicoloured lava walls 500 to 2,000 ft. high.
Everglades 1947	Florida	1,228,488.00	Largest remaining subtropical wilderness in U.S ; abundant wildlife.
Glacier 1910	Montana	998,797.31	Superb Rocky mountain scenery, with numerous glaciers and lakes nestling among the highest peaks; forms part of the Waterton-Glacier International Peace park, established on May 2, 1932.
Grand Canyon 1919	Arizona	645,295.91	Tremendous mile-deep gorge, 4 to 18 mi wide, 217 mi. long, of which 105 mi. are within the park; contains fantastically eroded and coloured rock masses.
Grand Teton 1929	Wyoming	298,737.85	Series of imposing high peaks which constitute the scenic climax of the majestic Teton range; once a noted landmark of Indians and "Mountain Men "
Great Smoky Mountains 1930	North Carolina; Tennessee	505,166.61	Loftiest range east of the Black hills and one of the oldest land areas on earth. Outstandingly diversified and luxuriant plant life, often of extraordinary size.
Hawaii 1916	Territory of Hawaii	176,456.60	A spectacular volcanic area; includes two volcanoes in frequent eruption, also one of world's largest dormant volcanoes; luxuriant tropical vegetation; fern forests.
Hot Springs 1921	Arkansas	1,019.13	Contains 47 mineral hot springs said to have therapeutic value; known to the Indians and early Spaniards.
Isle Royale 1940	Michigan	133,838.51	Forested island, the largest in Lake Superior, distinguished for its wilderness character; great moose herd; pre-Columbian copper mines
Kings Canyon 1940	California	453,064.82	Sublime mountain wilderness dominated by the two enormous canyons of the Kings river and by the summit peaks of the High Sierra.
Lassen Volcanic 1916	California	103,509.28	Lassen peak, only recently active volcano in United States proper, erupted between 1914 and 1921; spectacular volcanic exhibits
Mammoth Cave 1936	Kentucky	50,695.73	Historic series of underground passages; beautiful limestone formations; river 360 ft. beneath surface; famous for more than a century.
Mesa Verde 1906	Colorado	51,017.87	Most notable and best preserved prehistoric cliff dwellings and other structures in the United States.
Mount McKinley 1917	Alaska	1,939,319 04	Mount McKinley, highest mountain in North America; large glaciers of the Alaska range; caribou and mountain sheep.
Mount Rainier 1899	Washington	241,571.09	Greatest single-peak glacial system in the United States, radiating from the summit and slopes of an ancient volcano; dense forests.
Olympic 1938	Washingtor	841,032 04	Mountain wilderness containing finest remnant of Pacific northwest rain forests; active glaciers; rare Roosevelt elk.
Platt 1906	Oklahoma	911 97	Numerous cold mineral springs with distinctive properties, including several bromide springs.
Rocky Mountain 1915	Colorado	253,919.63	One of the most magnificent and diversified sections of the Rocky mountains, with 65 named peaks in excess of 10,000 ft.
Sequoia 1890	California	385,099 79	Great groves of giant sequoia trees, world's largest and probably oldest living things; magnificent High Sierra scenery, including Mount Whitney, highest mountain in United States proper.
Shenandoah 1935	Virginia	193,472.98	Tree-covered mountains in the heart of the Blue ridge; scenic Skyline drive; panoramic views of historic Virginia.
Wind Cave 1903	South Dakota	27,885.67	Limestone caverns in scenic Black hills, decorated by beautiful "boxwork" formations tipped with white crystals; buffalo herd.
Yellowstone 1872	Wyoming; Montana; Idaho	2,213,206.55	World's greatest geyser area, with about 3,000 geysers and hot springs; spectacular falls and canyon of the Yellowstone river; one of the world's greatest wildlife sanctuaries.
Yosemite 1890	California	757,200 61	Mountainous region of unusual beauty, Yosemite and other inspiring gorges with sheer granite cliffs; spectacular waterfalls; three groves of giant sequoias.
Zion 1919	Utah	94,241.06	Multicoloured gorge in heart of southern Utah's dramatic desert and canyon country; erosional formations of great height and spectacular carving.
National Historical Parks			
Abraham Lincoln 1939	Kentucky	116 50	Log cabin believed to be that in which Abraham Lincoln was born, enclosed in protective memorial building on the site of Lincoln's birthplace.
Chalmette 1939	Louisiana	69.61	Part of the ground on which was fought the battle of New Orleans, a brilliant U S victory of the War of 1812 and one which brought much fame to Andrew Jackson Includes military cemetery
Colonial 1936	Virginia	7,146.66	Most of Jamestown Island, site of first permanent English settlement in U.S ; Yorktown, scene of U.S. victory over Cornwallis, 1781, culminating battle of Revolution.
Morristown 1933	New Jersey	958.37	Sites of military encampments during the Revolution; George Washington's headquarters, 1779–80.
Saratoga 1948	New York	2,113 59	Scene of decisive U S. victory over the British in 1777.
National Monuments			
Ackia Battleground 1938	Mississippi	49.15	Site of a Chickasaw Indian village and a memorial commemorating the battle of Ackia, in which the Chickasaws, aided by British troops, repulsed attack of the French and their Choctaw allies, May 26, 1736.
Andrew Johnson 1942	Tennessee	16.33	Pres Andrew Johnson's home, tailor shop and grave
Appomattox Court House 1940	Virginia	968.25	Scene of the surrender on April 9, 1865, of the Confederate army under Gen Robert E Lee to the Federal army under Gen. Ulysses S. Grant

National Parks, Monuments, etc.	Location	Acres Owned by U.S. June 30, 1951	Outstanding Characteristics
National Monuments—Continued			
Arches 1929	Utah	33,929.94	Extraordinary examples of erosion in the form of giant arches, windows, pinnacles and pedestals.
Aztec Ruins 1923	New Mexico	27.14	Ruins of a great prehistoric American Indian town built of masonry and timber in the 12th century; largely excavated and stabilized.
Badlands 1939	South Dakota	123,492.46	Magnificently eroded layers of sedimentary deposits containing great numbers of prehistoric animal fossils.
Bandelier 1916	New Mexico	27,048.89	Ruins of prehistoric Indian homes of the later Pueblo period, built in the canyon-slashed slopes of the Pajarito plateau.
Big Hole Battlefield 1910	Montana	200.00	Site of important battle along the line of the famous retreat of Chief Joseph and his Nez Perce Indians in 1877.
Black Canyon of the Gunnison 1933	Colorado	13,176.02	Remarkable deep narrow canyon with sheer rocks of great geologic interest so altered through compression and lava intrusion that their origin is in doubt.
Cabrillo 1913	California	.50	Memorial to Juan Rodriguez Cabrillo, who discovered San Diego bay in 1542.
Canyon de Chelly 1931	Arizona	83,840.00	Prehistoric Indian ruins built at the base of sheer red cliffs or in caves in canyon walls; contains modern Navaho Indian homes and farms.
Capitol Reef 1937	Utah	33,068.74	Twenty-mile-long buttressed sandstone cliff of Gothic appearance, with dome-shaped white formations superimposed on lower colourful strata.
Capulin Mountain 1916	New Mexico	680.42	Huge cinder cone, an interesting example of an extinct volcano.
Casa Grande 1918	Arizona	472.50	Ruined adobe tower built by Indians who farmed the Gila valley between A.D. 1300 and 1450; the only prehistoric building of its particular type in the U.S.
Castillo de San Marcos 1924	Florida	18.51	Oldest masonry fort in the United States; construction started in 1672 by the Spanish to protect St. Augustine, first permanent white settlement in the U.S.
Castle Clinton 1950	New York	1.00	Structure, built in 1808–11, which served as harbour defense and later as immigrant depot, 1855–90.
Castle Pinckney 1924	South Carolina	3.50	Part of the early defenses of Charleston harbour.
Cedar Breaks 1933	Utah	6,172.20	Great natural amphitheatre eroded into the vividly coloured Pink Cliffs formation which there has a depth of 2,000 ft.
Chaco Canyon 1907	New Mexico	21,239.95	Thirteen major Indian ruins without equal in the U.S., representing highest point of Pueblo prehistoric civilization; hundreds of smaller ruins.
Channel Islands 1938	California	1,119.98 (land area)	Large rookery of sea lions; unique plants and mammals; and fossils ranging from marine invertebrates to Pleistocene elephants This monument includes Santa Barbara and Anacapa Islands.
Chiricahua 1924	Arizona	10,529.80	Wilderness of unusual rock shapes; rock strata telling story of nearly 1,000,000,000 years of the earth's forces.
Colorado 1911	Colorado	18,120.55	Sheer-walled canyons, towering monoliths and weird formations hewed by erosion in sandstone.
Craters of the Moon 1924	Idaho	47,210.67	Fissure eruptions, volcanic cones, craters, lava flows, caves and other volcanic phenomena.
Custer Battlefield 1946	Montana	765 34	The monument is on the site of the famous battle of the Little Bighorn river, June 25, 1876, in which Lt. Col. George A. Custer and his command of 226 were destroyed to a man by the Sioux Indians.
Death Valley 1933	California; Nevada	1,860,138.31	Vast desert solitude, weird natural phenomena, extensive salt beds and borax formations; includes lowest point in United States, 280 ft. below the sea; famous in history of the west; a great obstacle to the forty-niners in California gold rush.
Devil Postpile 1911	California	798.46	Symmetrical blue-gray columns rising as high as 60 ft., fitting closely together, a remnant of a basaltic lava flow.
Devils Tower 1906	Wyoming	1,193.91	An 865 ft. tower of columnar volcanic rock, the remains of an igneous intrusion; first national monument.
Dinosaur 1915	Utah; Colorado	190,798.49	Nation's richest fossil quarries containing skeletal remains of giant reptiles and other creatures of remote geologic time; deep gorges.
Effigy Mounds 1949	Iowa	1,000.00	Numerous Indian mounds in shapes of birds and animals.
El Morro 1906	New Mexico	240 00	"Inscription Rock," soft sandstone monolith on which are carved hundreds of inscriptions, including those of early Spanish explorers and early U S. emigrants and settlers; also prehistoric petroglyphs
Fort Frederica 1945	Georgia	79.30	Built in 1736–48 by Gen. James Edward Oglethorpe, colonizer of Georgia, as an English outpost against Spain.
Fort Jefferson 1935	Florida	47,125.00	Largest all-masonry fortification in western world, built in 1846 for control of Florida straits Federal military prison during and after the Civil War Outstanding bird refuge. Extraordinary marine life.
Fort Laramie 1938	Wyoming	214.41	Buildings of old fort that served as principal U.S. military post guarding caravans on route of forty-niners and the Oregon trail.
Fort Matanzas 1924	Florida	227.76	Spanish fort built in 1737 to protect back door to St. Augustine. Near this site Pedro Menendez de Avilés massacred two parties of French Huguenots in 1565, thus determining that Florida should remain Spanish rather than French territory.
Fort McHenry 1939	Maryland	47.64	The successful defense of this fort on Sept. 13–14, 1814, inspired the writing of the U.S. national anthem.
Fort Pulaski 1924	Georgia	5,427.39	Massive early 19th-century fortification whose successful bombardment by federal rifled cannon in 1862 first demonstrated total ineffectiveness of old-style masonry fortresses.
Fort Sumter 1948	South Carolina	2.40	Scene of the engagement marking the beginning of the War Between the States.
Fossil Cycad 1922	South Dakota	320.00	Deposits of fossil remains of fernlike plants of Mesozoic period or Age of Dinosaurs

National Parks, Monuments, etc.	Location	Acres Owned by U.S. June 30, 1951	Outstanding Characteristics
National Monuments—Continued			
George Washington Birthplace 1930	Virginia	393.68	Memorial mansion and gardens on the site of Washington's birthplace.
George Washington Carver 1951	Missouri	210.00	Site of birthplace and childhood home of the U.S. Negro chemurgist and agricultural experimenter.
Gila Cliff Dwellings 1907	New Mexico	160.00	Well-preserved cliff dwellings in four natural cavities in the face of an overhanging cliff.
Glacier Bay 1925	Alaska	2,297,734.10	Great tidewater glaciers and exhibit of early stages of postglacial forests.
Grand Canyon 1932	Arizona	196,051.00	Part of the Grand canyon of the Colorado river containing Toroweap point with its unusual view of the inner gorge and recent lava dam.
Gran Quivira 1909	New Mexico	450.94	Site of 17th-century Spanish mission; ruins of two mission buildings and of 18 Indian pueblo house mounds.
Great Sand Dunes 1932	Colorado	35,908.19	Shifting sand dunes entrapped by a great hook in the Sangre de Cristo mountains; they are among the largest and highest dunes in the United States.
Homestead 1939	Nebraska	162.73	Site of the first claim under the Homestead Act of 1862, marking the beginning of homesteading, the U.S. democratic land settlement policy.
Hovenweep 1923	Utah; Colorado	410.32	Four groups of remarkable prehistoric towers, pueblos and cliff dwellings.
Jewel Cave 1908	South Dakota	1,274.56	Cave in limestone formation consisting of series of chambers connected by narrow passages; numerous side galleries; fine calcite crystal encrustations.
Joshua Tree 1936	California	427,096.49	Representative stand of the rare Joshua tree; many other varieties of desert flora.
Katmai 1918	Alaska	2,697,590.00	Dying volcanic region; includes the Valley of Ten Thousand Smokes, scene of a violent eruption in 1912.
Lava Beds 1925	California	46,161.99	Principal theatre of the Modoc Indian War of 1873; unusual exhibits of volcanic activity.
Lehman Caves 1922	Nevada	640.00	Caves of light gray and white limestone honeycombed by tunnels and galleries of stalactite formations.
Meriwether Lewis 1925	Tennessee	300.00	Site on Natchez trace where Meriwether Lewis, leader of the Lewis and Clark expedition, was buried.
Montezuma Castle 1906	Arizona	783.09	One of the best preserved and most interesting cliff dwellings in the United States; built in cavern-pitted limestone cliff; original 5-story, 20-room castle is 90% intact.
Mound City Group 1923	Ohio	57.00	Famous group of prehistoric Indian mounds.
Muir Woods 1908	California	473.96	Virgin stand of coast redwoods, the tallest of living things.
Natural Bridges 1908	Utah	2,649.70	Three natural bridges carved out of sandstone; the highest is 222 ft. above the stream bed, with span of 261 ft.
Navaho (Navajo) 1909	Arizona	360.00	Three of largest and most intricate of known cliff dwellings—Betatakin, Keet Seel and Inscription House.
Ocmulgee 1936	Georgia	683.48	Numerous outstanding and unique remains of mounds and prehistoric towns, representative of the cultural evolution of the southern mound-builder civilization.
Old Kasaan 1916	Alaska	38.00	Site of abandoned Haida Indian village.
Oregon Caves 1909	Oregon	480.00	Caves in limestone formation of great variety and beauty.
Organ Pipe Cactus 1937	Arizona	328,161.73	Examples of organ pipe cactus and other desert plants found nowhere else in United States; traces of the Camino del Diablo, historic Spanish route.
Perry's Victory and International Peace Memorial 1936	Ohio	14.25	At Put-In bay Commodore O. H. Perry won greatest naval battle of War of 1812; commemorates century of peace between the United States and Canada.
Petrified Forest 1906	Arizona	85,303.63	Spectacular display of petrified wood; Indian ruins and petroglyphs; portion of colourful Painted desert.
Pinnacles 1908	California	12,817.77	Spirelike rock formations 500 to 1,200 ft. high, together with numerous caves and a variety of volcanic features.
Pipe Spring 1923	Arizona	40.00	Historic Mormon fort, also structures built by Mormons during 1869–70 and later used by private ranchers and as cattle-buying and shipping point; commemorates significant phase of westward movement by U.S. pioneers.
Pipestone 1937	Minnesota	115.60	Notable for its quarry from which Indians obtained materials for making peace pipes used in ceremonies.
Rainbow Bridge 1910	Utah	160.00	Greatest of world's known natural bridges; a symmetrical arch of salmon pink sandstone, curving in form of a rainbow; rises 309 ft. from bottom of gorge.
Saguaro 1933	Arizona	53,669.24	Cactus forest containing giant saguaro unique to deserts of southern Arizona and northwestern Mexico.
Scotts Bluff 1919	Nebraska	2,196.44	Well-known landmark on Oregon trail associated with mass migration between 1843 and 1869 across treeless plains.
Shoshone Cavern 1909	Wyoming	212.37	A cave of considerable extent decorated with encrustations of crystals.
Sitka 1910	Alaska	57.00	Site of Indian stockade where Kik-Siti tribe made last stand against Russian settlers.
Statue of Liberty 1924	New York	10.38	Colossal copper statue on Bedloe's Island; a gift of the people of France; commemorates alliance of France and U.S. during American Revolution; universal symbol of freedom and democracy.
Sunset Crater 1930	Arizona	3,040.00	Truncated volcanic cone, the upper portion so highly coloured as to give rim appearance of sunset glow; lava flows and ice caves.

National Parks, Monuments, etc.	Location	Acres Owned by U.S. June 30, 1951	Outstanding Characteristics
National Monuments—Continued			
Timpanogos Cave 1922	Utah	250 00	Limestone cavern located on side of Mount Timpanogos, with passageways leading back into the mountain.
Tonto 1907	Arizona	1,120.00	Two large and well-preserved Pueblo cliff dwellings occupied during the early part of the 14th century by Indians who farmed in the Salt River valley.
Tumacacori 1908	Arizona	10 00	Historic Spanish Catholic mission building on site first visited by Father Kino, a Jesuit, in 1691.
Tuzigoot 1939	Arizona	42.67	Excavated ruins of a prehistoric pueblo which flourished between A.D. 1000 and 1400; outstanding example of large late prehistoric pueblos of the Verde valley.
Verendrye 1917	North Dakota	253.04	Commemorates the Verendrye explorations in North Dakota and along the upper Missouri river.
Walnut Canyon 1915	Arizona	1,641 62	Cliff dwellings in shallow caves under ledges of limestone, built by Pueblo Indians about 1,000 years ago.
White Sands 1933	New Mexico	140,247 04	Glistening white gypsum sands, drifting into dunes 10 to 60 ft. high.
Whitman 1940	Washington	45.84	Site where Marcus Whitman and his wife ministered to spiritual and physical needs of Indians until massacred by them in 1847; landmark on Oregon trail.
Wupatki 1924	Arizona	34,853 03	Red sandstone prehistoric pueblos built by group of farming Indians whose descendants are believed to be the picturesque Hopi.
Yucca House 1919	Colorado	9 60	Remnants of once thriving prehistoric Indian village.
Zion 1937	Utah	33,920.75	Colourful Kolob canyon and famous Hurricane Fault, notable examples of geologic phenomena.
National Military Parks Chickamauga and Chattanooga 1890	Georgia; Tennessee	8,127.16	Embraces battlefields of Chickamauga, Orchard Knob, Lookout mountain and Missionary ridge, important in operations around Chattanooga during 1863.
Fort Donelson 1928	Tennessee	102.54	Fortification controlling the upper Cumberland river, captured by Gen. U.S. Grant in 1862.
Fredericksburg and Spotsylvania County Battlefields Memorial 1927	Virginia	2,420 71	Embraces portions of Fredericksburg, Chancellorsville, the Wilderness and Spotsylvania Court House battlefields, where major battles were fought between 1862 and 1864.
Gettysburg 1895	Pennsylvania	2,541.86	Battlefield that is often considered the turning point of the Civil War; portion of battleground dedicated as burial ground by Pres. Abraham Lincoln in his famous Gettysburg address
Guilford Courthouse 1917	North Carolina	148.83	Commemorates battle fought March 15, 1781, between British and U S. forces, which marked the beginning of the end of the Revolutionary struggle
Kings Mountain 1931	South Carolina	4,012.00	Site of an important victory for U.S. frontiersmen at a critical point in the Revolutionary War, Oct. 7, 1780.
Moores Creek 1926	North Carolina	30 00	Scene of a memorable battle in 1776 between North Carolina Whigs and Tories
Petersburg 1926	Virginia	1,501 17	Scene of the "Battle of the Crater" and of the longest siege in the history of the United States, 1864–1865; about 100 mi. of well-preserved earthworks
Shiloh 1894	Tennessee	3,729.26	Natural park embracing the battlefield of Shiloh near Pittsburg Landing (1862) which prepared the way for Gen. U.S. Grant's successful siege of Vicksburg; also well-preserved Indian mounds.
Stone River 1927	Tennessee	323.86	Scene of a stubbornly fought midwinter battle in 1862, which began the great Federal offensive to trisect the Confederacy. Includes part of the battlefield and a portion of Fortress Rosecrans.
Vicksburg 1899	Mississippi	1,323.56	Remarkably preserved fortifications of 47-day siege of Vicksburg (1863), which gave the North control of the Mississippi river and cut the Confederacy in two
National Memorial Park Theodore Roosevelt 1947	North Dakota	59,420.56	Badlands along Little Missouri river and part of Theodore Roosevelt's Elkhorn ranch.
National Battlefield Parks Kennesaw Mountain 1947	Georgia	3,094 21	Historic field on which occurred one of the two heavy assaults made by Gen. William Sherman on Confederate positions during Atlanta campaign (June 27, 1864).
Richmond 1944	Virginia	684.44	Scene of several battles in defense of Richmond during the Civil War; includes portions of battlefields of first and second Cold Harbor and Malvern hill, and massive fortifications along the James river and at Fort Harrison.
National Battlefield Sites Antietam 1890	Maryland	183.33	Scene of the battle which brought to an end Lee's first invasion of the North in 1862; includes avenues and monument plots, and overlooks Burnside bridge and the sunken road or "bloody lane."
Brices Cross Roads 1929	Mississippi	1 00	Scene of the battle of June 10, 1864, in which Confederate cavalry under Gen. Nathan B. Forrest was employed with extraordinary skill.
Cowpens 1929	South Carolina	1.00	Site of Daniel Morgan's victory over the British under Banastre Tarleton on Jan. 17, 1781.
Fort Necessity 1931	Pennsylvania	2.00	Scene of a battle between colonial troops led by George Washingto. and French troops assisted by Indians, July 3, 1754; opening battle of the French and Indian War.
Tupelo 1929	Mississippi	1 00	Commemorates the battle of Tupelo, July 13 and 14, 1864.
White Plains 1926	New York	.00	Memorials showing the positions held by George Washington's army at the battle of White Plains in 1776.
National Historic Sites Adams Mansion 1946	Massachusetts	4.05	Home of Presidents John Adams and John Quincy Adams; Charles Francis Adams, U.S. minister to Great Britain during the Civil War; Henry Adams; and Brooks Adams.
Atlanta Campaign 1944	Georgia	20.96	Marks significant points on the route of Gen. William Sherman's march from Chattanooga to Atlanta, prelude to the "March to the Sea" which finally trisected the Confederacy.
Federal Hall Memorial 1930	New York	.49	On this spot, the site of the modern federal subtreasury building, stood Federal hall, the first seat of the new federal government and the scene of many momentous events in the early days of the republic.

National Parks, Monuments, etc.	Location	Acres Owned by U.S. June 30, 1951	Outstanding Characteristics
National Historic Sites—Continued			
Fort Raleigh 1941	North Carolina	10 70	Place of first attempted English settlement within the confines of the United States, 1585–87. Site of the "Lost Colony" settlement of Sir Walter Raleigh and birthplace of Virginia Dare, first child of English parentage to be born in the new world.
Hampton 1948	Maryland	43.30	One of the great Georgian mansions built in the U.S during the latter part of the 18th century.
Home of Franklin D. Roosevelt 1944	New York	33 23	Fine home in the "Hudson River bracketed" style; birthplace, home and "Summer White House" of Pres. Franklin D. Roosevelt where many distinguished visitors were entertained.
Hopewell Village 1938	Pennsylvania	848 06	One of the finest examples of U S 18th- and early 19th-century iron-making villages; includes the ruins of the old furnace and numerous dependent structures.
Jefferson National Expansion Memorial 1935	Missouri	82.58	Commemorates the territorial expansion of the United States and conspicuous persons and events connected therewith.
Manassas National Battlefield Park 1940	Virginia	1,670.74	Scene of the battles of First and Second Manassas on July 21, 1861, and Aug. 29–30, 1862. The former battle, often called "Bull Run," was the first test of Northern and Southern military prowess. Jackson acquired the nickname "Stonewall" there.
Old Philadelphia Custom House 1939	Pennsylvania	.79	This building, completed in 1824, is one of the finest U.S. examples of Greek revival architecture; famous as the second bank of the United States, which figured so prominently in the historic controversy between Pres. Andrew Jackson and the Whigs over national banking policies.
Salem Maritime 1938	Massachusetts	8 61	Includes Derby wharf, the Richard Derby house, Hawkes house and the Old Customs house in which Nathaniel Hawthorne worked—all of national significance because of their associations with the early New England architectural, maritime and literary history.
San Juan 1949	Puerto Rico	40 00	Massive masonry fortifications begun by the Spanish in the 16th century to protect the harbour.
Vanderbilt Mansion 1940	New York	211.65	Mansion and grounds of Frederick W. Vanderbilt overlooking the Hudson river; fine example of the palatial U S. residence of the period 1880–1900.
National Memorials			
De Soto 1949	Florida	24.18	Commemorates the landing of Ferdinando de Soto in Florida in 1539.
House Where Lincoln Died 1896	District of Columbia	.05	Lincoln died there on April 15, 1865; house was refurnished to give atmosphere of a typical home of the 1860s.
Kill Devil Hill Monument 1927	North Carolina	314.40	Site of the first sustained flight by a heavier-than-air machine, made by Wilbur and Orville Wright.
Lee Mansion 1925	Virginia	2.71	Splendid antebellum home of Robert E. Lee, commander in chief of the Confederate army.
Lincoln Memorial 1922	District of Columbia	.61	Classical structure of great beauty with a seated figure, 20 ft. high, of Abraham Lincoln.
Lincoln Museum 1932	District of Columbia	.18	Located in this building was Ford's theatre in which Lincoln was shot by John Wilkes Booth on the night of April 14, 1865; contains famous collection of Lincolniana.
Mount Rushmore 1929	South Dakota	1,220.32	Colossal figures carved on the face of Mount Rushmore, delineating the features of four great presidents: George Washington, Thomas Jefferson, Abraham Lincoln and Theodore Roosevelt.
New Echota Marker 1930	Georgia	.92	Site of the last capital of the Cherokee Indians in Georgia.
Thomas Jefferson 1943	District of Columbia	1.20	Circular colonnaded structure or rotunda in classic style introduced in the U S. by Thomas Jefferson; on interior walls are four panels with inscriptions based upon writings of Jefferson.
Washington Monument 1885	District of Columbia	.37	Built in commemoration of George Washington, this monument (in the form of an obelisk, 555 ft. high) is one of the dominating features of the U.S. capital.
National Cemeteries			
Antietam 1862	Maryland	11.36	The cemetery is divided into segments, each representing a state. Interments (1951): 4,908 (unidentified 1,836).
Battleground 1864	District of Columbia	1.03	On Georgia Ave., between Van Buren and Whittier Sts. Interments (1951): 44.
Fort Donelson 1867	Tennessee	15.34	Interments (1951): 740 (unidentified, 512).
Fredericksburg 1865	Virginia	12.00	Interments (1951): 15,341 (unidentified, 12,770).
Gettysburg 1863	Pennsylvania	15.55	Interments (1951): 4,155 (unidentified, 1,664).
Poplar Grove 1866	Virginia	8.72	Cemetery is on camping ground of the 50th regiment of New York engineers. Interments (1951): 6,288 (unidentified, 2,163).
Shiloh 1866	Tennessee	10.25	Burial place of men who fell at battle of Shiloh and the surrounding area. Interments (1951): 3,695 (unidentified, 2,417).
Stone River 1865	Tennessee	20.09	Interments (1951): 6,277 (unidentified, 2,560).
Vicksburg 1865	Mississippi	119.76	Two miles north of city on U.S. highway 61. Includes many who died in a radius of 150 mi. from Vicksburg during the Civil War. Interments (1951): 17,682 (unidentified, 12,911).
Yorktown 1866	Virginia	2.91	Interments (1951): 2,204 (unidentified, 1,446).
National Parkways			
Blue Ridge Parkway 1933	Virginia, North Carolina	49,207 42	Scenic parkway averaging 3,000 ft above sea level; follows Blue Ridge mountains and embraces several scenic and recreational areas; 346 mi. of an estimated 477 mi. were completed or under construction in 1951.
George Washington Memorial Parkway 1930	Virginia; Maryland	2,917 33	Embraces many interesting landmarks associated with the life of George Washington; planned as continuous boulevard along the Maryland and Virginia shores of Potomac river. The 15-mi. completed section in 1951 included Mount Vernon Memorial highway between the U.S. capital and Mount Vernon
Natchez Trace Parkway 1934	Mississippi; Tennessee; Alabama	15,806 75	Follows general location of the old Indian trail between Nashville and Natchez, known as the "Natchez Trace," an important route in early travel. In 1951, 156 mi of an estimated 450 mi were completed or under construction.
Suitland Parkway 1949	District of Columbia Maryland	662.87	Four-lane parkway connecting South Capitol St., D.C., with Andrews air base, Md. In 1951 two of the four lanes of the nine-mile road were completed.
National Capital Parks			
National Capital Parks 1790	District of Columbia; Va.; Md.	29,223.71	Park system of the U.S. capital comprising more than 770 units in the District of Columbia and vicinity.

especially of wildlife. All areas of the system are game sanctuaries. The basic wildlife policy is to permit each native species, once established on a normal, healthy basis, to carry on its struggle for existence without artificial aid, in the belief that this is for the ultimate good of the species and conforms to primary national park purposes, provided a proper balance among all species is maintained. Should emergency management of a particular species become necessary, protective measures may be adopted. Careful management of Yellowstone's buffalo herd, including the introduction of new animals from an outstanding private herd, ensured survival of this once-vanishing species.

The forests of the national parks are priceless remnants of the formerly widespread virgin forests of the United States. Held as representative exhibits of the great forests of the past, their protection is a service responsibility of the first magnitude. These forests not only serve to enhance the scenic grandeur of the parks, but they also are important in the protection of watersheds and in the regulation of stream flow. In addition, they provide habitats for many species of wildlife. Their protection involves preventing and combating forest fires and controlling insect infestations and tree diseases. The park meadowlands also must be protected against overgrazing in order to avoid erosion, to preserve the natural cover and to provide forage for the parks' grazing animals that depend upon them for forage.

Nonconforming Uses.—Constantly recurring demands are made by special interests for the use of park features for private gain, to the detriment of the great mass of citizens who own and are entitled to enjoy the national park areas. Attacks are primarily directed at the use of high mountain lakes and rivers for power and irrigation development; at certain park forests, cutting of which would afford a temporary prop to overexpanded and sometimes declining local industries while seriously impairing the beauty of the parks; at minerals; and at mountain meadow lands for domestic cattle grazing. All of these resources are available elsewhere, although possibly at greater cost to the proponents of the projects.

The waters of Yellowstone National park have frequently been the targets of irrigation and power project proponents. Repeated attempts to dam Yellowstone lake were defeated, as were proposals directed at the use of other scenic park lakes. A 1938 project to dam Yellowstone lake for commercial irrigation, which involved construction of a dam and tunnel within the park, brought a protest from the secretary of the Swedish government committee on planning and recreation.

The outstanding example of exploitation and despoliation of a national park feature for private gain was the damming of Hetch Hetchy valley in Yosemite National park to provide a water supply for the city of San Francisco. This occurred before the establishment of the national park service and during a period in U.S. history when exploitation rather than conservation was the watchword.

Since all national park areas are deficient in rangeland, the grazing of livestock constitutes a threat to park wildlife. Experiments in cattle grazing during World Wars I and II proved conclusively that to extend such grazing privileges would ruin park meadows with resultant disastrous effect upon the deer, elk, antelope, buffalo and other wildlife species which are such an important feature in the national park scene. These experiments also demonstrated that livestock grazing in the parks could not appreciably influence the meat situation in the U.S.

Visitors' Facilities.—Foreseeing the demand for accommodations for visitors to national parks, congress provided, in the acts creating the various parks, for the granting of franchises to private capital for the furnishing of public facilities. This franchise policy was reaffirmed in the act establishing the national park service. Operations, prices, plans and types of expansion are subject to approval by the national park service.

Later, however, a beginning was made toward government ownership of the physical plants, wherever possible, with operation on a concession basis. The most significant development in this field came in 1941 with the formation of a nonprofit-distributing private corporation known as National Park Concessions, Inc., to operate hotel and other facilities on lands at Mammoth Cave National park that had been donated to the government.

Interpretive-Services Initiated.—The basis for interpretive programs throughout the national park system is found in the desire of the visitor to develop his understanding and appreciation of characteristic park features, to be stimulated in his thinking, and to be guided in the full use of the park areas. In the scenic and scientific areas he wants to know the genesis of the Grand canyon, the cause of eruptive geysers, and the underlying causative factors of the other geological and the biological features. In the historic areas his desire is to know who did what, when and where.

In the early days of park use, information, frequently based upon folklore and local opinion, was furnished by the picturesque old-time guides. With the influx of visitors that came with the arrival of the motor age, the need was demonstrated for an interpretive service based upon the latest scientific and historical data. Such a service was inaugurated in Yosemite National park in the form of a free nature guide service in 1920. The California State Fish and Game commission, the University of California and certain private interests co-operated in making this experiment possible. The guide service rapidly spread to other parks, both on a federal basis and with private financial assistance. Meanwhile the American Association of Museums secured funds from the Laura Spelman Rockefeller memorial to further the study for and construction of museums in Yosemite and Yellowstone National parks.

Historic Sites Act.—Although national monuments, military parks and other areas had long been established, it was not until 1935 that congress, through passage of the Historic Sites act, provided the implement for undertaking a comprehensive program for investigation, selection and protection of nationally significant historic and prehistoric sites. In the selection and evaluation of proposed sites the advisory board on national parks, historic sites, buildings and monuments passes on and recommends to the secretary those to be considered for national recognition.

In addition to the historic sites established as units of the national park system, the Historic Sites act provides authority for the secretary of the interior to designate outstanding areas in state or local government or private ownership as historic sites and to enter into co-operative agreements with nonfederal agencies for the conservation of national historic sites regardless of title to the property.

The national park service in its historical program endeavours to interpret to the public the broad national aspects of the history of the United States. Beginning with the undocumented history of the American Indian showing the colourful evolution of pre-Columbian peoples, the story carries through the period of documented history.

The national park service seeks to present a well-balanced program of prehistoric and historic sites illustrative of the growth and development of the United States in terms of physical remains. It emphasizes preservation rather than restoration or reconstruction, adhering to the principle that it is better to preserve than to repair, better to repair than to restore and better to restore than to reconstruct. Through the Historic American Buildings survey, photographs and measured drawings have been made of many historic structures.

Recreational Demonstration Areas.—As part of the federal government's plan to acquire and reallocate mistreated and worn-out agricultural lands to better use, the national park service in 1934 undertook acquisition of 46 such areas in 24 states and their development as recreational demonstration areas, designed primarily to provide organized camp and other recreational facilities. Since these areas had never been considered part of the national park system, their development was a contribution of the service in the field of local recreation.

State Parks.—The state park movement, however, grew along with that in the national field, and even antedated national parks. In 1864 Pres. Abraham Lincoln approved an act of congress setting aside Yosemite valley and the Mariposa Grove of Big Trees to be administered as a public trust by the state of California. Following establishment of Yosemite National park, these areas were receded to the federal government for inclusion therein. In 1885 New York's first state parks were established, and other state parks followed in the 1890s. Through the interest of national park service officials and other prominent conservationists, a meeting was called in Iowa in 1921 which resulted in establishment of the National Conference on State Parks to stimulate and give direction to the provision of outdoor recreational opportunities.

(I. F. S.; X.)

NATIONAL PROVINCIAL BANK LIMITED. This British banking institution has branches in London and the provinces. The amalgamation movement wrought great changes in the English banking system, and the National Provincial bank was closely identified with it, particularly during the period from 1918 to 1924. An important amalgamation effected by the bank took place in 1918 when it took over the Union of London and

Smiths Bank, Limited. In the same year, the business of the Bradford District Bank, Limited was acquired. The Sheffield Banking Company, Limited was absorbed in 1919, the Northamptonshire Union Bank, Limited in 1920 and the Guernsey Banking Company, Limited in 1924. A number of private banks also were absorbed.

The parent bank was founded in 1833. At the time of its establishment, the creation of joint stock banks had but recently been legalized, and any such banks conducting business within 65 mi. of London were denied the right of issuing notes, at that time a lucrative privilege. It was decided to confine the banking activities of the new company to the provinces, thereby securing the right of note issue, and to maintain control from an administrative office in London.

The first office was opened at Gloucester on Jan. 1, 1834, and by 1838 there were 60 offices open. After some years the directors decided that the advantages of conducting business in London would outweigh those of retaining their note issue. Accordingly, business commenced in 1866 in Bishopsgate, London. At that time the bank was given a seat in the London Bankers' clearing house, a privilege hitherto withheld owing to the antagonism of the private banks to their joint stock rivals. In 1880 it was registered as a limited liability company.

NATIONAL RECOVERY ACT: *see* UNITED STATES.

NATIONAL SAVINGS. Saving means the setting aside for future use of part of current income—the excess over the amount currently consumed or paid in taxes. Saving may thus be performed by anybody having an income—by an individual, a family or by a business firm.

Because of disagreement as to the sense in which a government body has an income, there is some difference of opinion among economists as to whether or not it is appropriate to say that governments (as distinct from the citizens and businesses under their jurisdiction) carry on saving. But whether or not the *government* is said to save, the *nation* may be said to save the sum of the amounts saved by the individuals and business firms (plus government bodies if they are considered to have savings) which it includes. Since there are always some individuals and businesses whose current expenses and taxes outrun their incomes, and whose savings are therefore negative, national savings must be thought of as a net total with negative savings subtracted out.

Forms Taken by Savings.—Saving is often spoken of loosely as if it were synonymous with the piling up of savings deposits, or of idle cash. This interpretation is misleading. While it is true by definition that savings are not spent on the consumption of the saver, it does not follow that they are not spent at all; what is saved often is spent. It may be spent directly by the saver or indirectly by business firms he helps to finance, on the purchase of new items being added to the community's stock of wealth, such as new houses or machinery. It may be spent indirectly on the consumption of some other person who borrows or sells property to finance his negative savings. It may help to finance a government deficit, thus supporting whatever spending the government is carrying on, whether for battleships, highways, food to feed the hungry or for routine government expenses.

Part of current savings—sometimes a small part, sometimes a large part—appears in the form of increase in savings deposits and other cash assets held by the individuals or business firms doing the saving. The remainder is represented in their accounts by additions to their holdings of physical property, acquisition of government or private securities, reduction of their debts owed to others, etc.

Savings and Investment.—Under the generally accepted use of terms, it will always be found at the end of any accounting period that if the revenues and expenditures of government are equal (the budget balanced) and if all government expenditures are on current account, national savings for the period amount to just as much as investment in new buildings, equipment, etc. This is a matter of definition. Saving means the excess of national income over consumption and taxes. Investment is taken to mean the excess of net national product (which is the same thing as national income) over the parts of the product made up of consumption goods and services and items bought by government expenditures.

Since economic progress depends largely on the increase of wealth through investment, it follows also that economic progress is linked with the achievement of national savings. Some increase in production might be possible without any net national savings, through increasing the labour force, finding new ways to use existing equipment and labour, and replacing old equipment and buildings as they wear out (*see* DEPRECIATION) with more modern types.

But to make full use both of the growing labour force and of new methods of production requires a net increase of plant, equipment, etc.; besides this there is always a backlog of opportunities to increase production, with pre-existing methods and labour force, for which more equipment would have been required.

The need of investment and savings to increase production is of course most acute in countries where modern technology has not yet been put into operation and in devastated areas where houses, workshops, transportation equipment, etc., have been destroyed.

This is the meaning of the much-misunderstood doctrine of "abstinence": if there is to be an increase of productive wealth, somewhere in the economic system somebody must abstain from consuming his entire income. It does not necessarily follow that those who abstain from consuming are suffering. On the contrary, in so far as saving is left to individuals, it is performed chiefly by persons with high incomes who both save heavily and consume considerably more than the average.

But for the community as a whole it is impossible both to consume the whole of current income and to build up productive wealth.

It should be observed that these propositions do not prove that economic progress either will or will not be served by an increased inclination to thrift on the part of individuals and business firms. Progress depends on the achievement of substantial investment and therefore of substantial savings. But as John Maynard Keynes pointed out, decisions to save and decisions to invest are taken by different persons operating under different incentives. A decision by one individual to save more, unaccompanied by a decision by him or anybody else to invest more, cannot be guaranteed to increase the volume of saving and investment actually realized; in fact, many economists argue that the effect would be to decrease that volume. This point will be examined further below.

Effect of Government on Savings-Investment Relation.—If the government's revenues and expenditures are unequal, the relation of savings to investment just described is modified. In a period of depression, for example, the tax base shrinks and reduces revenue, while the addition of relief, etc., to government responsibility increases expenditure. Government is therefore obliged to finance its expenditures in part either by borrowing, by paying out cash on hand or by issuing money. Some savers, consequently, either use their savings to buy government securities, or hold more cash, or have larger balances with banks and other credit institutions while the latter have more cash and government securities. The same is true when a government deficit is incurred for war purposes.

In these circumstances it is no longer true that the net total of savings made by individuals and businesses is equal to the net total invested by individuals and businesses in new productive wealth. Private savings exceed private investment by the amount of the deficit. Whether national savings are said to exceed national investment is a matter of language. Some part of government expenditure (used to pay for productive wealth such as hydroelectric dams, roads, needed buildings, recreation facilities) can reasonably be described as investment. Any excess of the deficit over such government investment can be described as negative saving by government, reducing the net total of national savings. This way of using language has the advantage of stressing the fact that when government savings are positive (*i.e.*, when government has an excess of revenue over current expenses, the excess serving to reduce government's net debt and to finance government investment) there can be an increase of the nation's

productive wealth in the absence of private saving. It has the drawback, however, of inviting dispute as to the scope and measurement of government activity to be classified as investment (particularly in time of war) and leaving statistical measurements of national savings with a much wider range of possible error than measurements of private savings. (*See* also INVESTMENT, ECONOMIC ASPECTS OF; INVESTMENTS: IN BUSINESS).

Ways of Estimating Savings.—For an individual there are two ways to measure his savings for a given accounting period. One is to estimate his income and subtract his current expenditure, the difference being his savings. The alternative is to examine his balance sheet (his property and his debts) at the beginning and end of the period and measure the increase in net worth which reflects his saving. While the figures taken out of the individual's accounts under these two procedures are different, the two are logically equivalent. In either case it is necessary to make sure that we do not include in income (or in the increase of net worth) any items which reflect merely changes in price levels at which pieces of property are valued, or items reflecting events not regarded as linked with income—broadly speaking, to exclude capital gains and losses (whether realized or "paper") from income. For example, losses due to property destruction by enemy action in wartime, or gains due to a rise of prices on the stock market, would be excluded in income determination. If income is measured by the rules generally adopted by national income statisticians, the result is to exclude not merely the effects of price changes but some actual physical changes—chiefly losses —in wealth. The net total of savings estimated in this way tends to exceed the value of additions to the nation's stock of wealth to the extent that war damage, uninsured fire losses and similar events fail to appear in the income account. On the other hand, it tends to fall short to the extent that new wealth is found (for example through mineral discoveries) or that wealth becomes more useful through new techniques (for example, through the development of dry farming techniques which made previously worthless land take on value).

For national totals, estimates based on changes in national wealth would be too unreliable for use because of the inaccuracy of the reports on which wealth statistics are based, the extraordinary difficulty of allowances for price changes, and other drawbacks. But the general principles just described suggest three other ways of estimating national savings: (1) by estimating investment, with adjustments for government; (2) by estimating income of individuals, personal taxes paid, and consumption expenditures to give savings of individuals by subtraction, with separate estimates for savings of business corporations and of government bodies; and (3) by estimating changes in the various asset and liability accounts of individuals which reflect current savings, with separate estimates for the savings of business corporations and of government bodies. All these methods are in practical use.

War Savings.—Savings under war conditions follow different patterns than in peace. Individuals and businesses set aside a larger proportion of their incomes, so that net private savings grow enormously. On the other hand, private investment is restricted because war needs divert labour and materials from making buildings and equipment for private use. Public construction and acquisition of equipment by government expands, but most of the resulting facilities are either used up in the war or are inconvertible to civilian uses thereafter. The consequence is a great growth in the paper wealth of individuals and business firms (corresponding to the growth of the government's debt) with little or no growth in actual productive wealth.

Not much precise information is available about savings during World War I. Interwar studies reveal that individuals and business firms saved in 1919 a much larger proportion of income than in any year in the 1920s, and that savings in 1920, though declining, were still high. For World War II, comparatively reliable studies made at the time show that the proportion of income saved rose well above peacetime levels during 1941 and continued to rise thereafter. At the peak of war activity, individuals were saving nearly one-third of their disposable incomes (*i.e.*, income payments less personal taxes), and corporations well over one-half of theirs.

The total wartime accumulation by individuals amounted to far more than the income of any single year of the interwar period, and the great bulk took the form of additional currency, bank deposits, government securities and claims upon life insurance companies.

It is probable that the savings of the richer groups of the population made up a much smaller proportion of the war savings than of peacetime savings, but the difference must not be exaggerated. About half of the wartime accumulation of individuals and corporations was accounted for by the growth in their holdings of government bonds—more than two-thirds in denominations of $500 and upward—which were not to any great extent small savings. The proportion of the growth in bank deposits, currency and insurance claims representing large savers was probably still higher.

Motives for Saving.—Saving is a very complex phenomenon. Different savers save for different reasons, and a given saver for a mixture of reasons. At any given moment, furthermore, many individuals find themselves spending less or more than their incomes simply because their incomes are more or less than was expected when commitments to spend were made. This is true especially for farmers and self-employed business and professional men whose incomes are subject to unexpected fluctuations.

In so far as saving goes back to decisions to save, the main motives seem to be the following: (1) provision for a future period when income is expected to be less or the need for expenditure greater than at present—for example, provision for retirement, education or vacations; (2) provision against unpredictable decline in income or growth in need—for example, against sickness in the family or loss of earning power by the breadwinner; (3) acquisition of higher income, either by improving the equipment, etc., of a business, or by being housed better or at less expense, or by obtaining interest, dividends, rent or other property income; (4) gain in social status through acquiring property; or (5) direct subjective satisfaction from accumulation ("miser's" instinct). Pulling against these motives, of course, is the desirability of current consumption, and the desirability of having more leisure at the expense of potential income.

This hypothesis about the motives for saving explains the record fairly well. High-income individuals have greater incentives to save than low-income individuals, for example, because the former are: (1) a group many of whose members are enjoying temporary increase of income and must expect a drop later on; (2) have better opportunities to place savings where they will yield income; (3) are more able to gain power and social approbation by saving and (4) are less hard-pressed to maintain what they regard as necessary standards of consumption and of leisure. Rural people are more inclined to save than urban people of like income because: (1) their incomes are more uncertain; (2) their opportunities to gain income from saving are better and the fruits of their savings, in buildings, livestock, equipment, etc., are more visible and thus more conducive to improved social standing and direct enjoyment and (3) their standards of consumption and of leisure are less exacting. War savings are higher than peacetime savings because: (1) incomes are regarded as abnormally high and are above immediately previous levels; (2) ordinary outlets for negative savings (retirement of elderly people, education, prolonged vacations and medical treatments) are reduced; (3) incomes are less secure; (4) social pressures to save are intensified and (5) normal standards of consumption and leisure are suspended. The fact that the rising trend of real per capita income did not bring a rising trend in the proportion saved in the prewar and interwar period is explained by: (1) progressive urbanization; (2) rising standards of consumption and leisure; (3) the trend away from private houses and away from direct ownership by individuals of tangible business property (which reduces both opportunities to gain income and opportunities to gain social status and direct satisfaction by increase of property); (4) the downward drift in interest rates and (5) increased importance

of some sources of negative savings (in particular the increased stress upon higher education and the increased proportion in the population of elderly people who tend to live on past savings). (*See* also CAPITAL AND INTEREST; CONSUMPTION; INCOME: ECONOMIC DEFINITION; NATIONAL DEBT; NATIONAL INCOME; SOCIAL SECURITY.) (A. G. HT.; X.)

NATIONAL SOCIALISM, the name of a movement started as the Nationalsozialistische Deutsche Arbeiterpartei (NSDAP) by Adolf Hitler in Germany in 1919. Its name revealed its emphasis upon nationalism, socialism, Germanism and the working class. Like Benito Mussolini's fascism, it combined an appeal to extreme and exclusive nationalism and chauvinist expansionism with a revolutionary call to the masses. Many traits were from the beginning common to fascism and national socialism, which may be regarded as the German form of fascism. Both proclaimed themselves the implacable enemies of liberalism and democracy, of individual rights and all movements of international co-operation and peace; both stressed the subordination of the individual to the state, the inequality of men and races, the right of the strong to rule the weak, and the necessity of the principle of blind and unswerving obedience to leaders appointed from above. Both praised the military virtues, despised and rejected pacifism, humanitarianism and charity, glorified hatred and conquest, and aimed at the transformation of the whole nation into an armed camp and an instrument of perpetual readiness for warfare.

National socialism, however, had its peculiarly German roots. Some can be traced to the Prussian tradition as it developed under the inspiration of great soldier kings such as Frederick William I and Frederick II and men of blood and iron such as Bismarck. This tradition had always regarded the militant spirit and the discipline of the Prussian army as the model for all individual and civic life. To it was added the tradition of political romanticism with its sharp hostility to rationalism, to the principles underlying the French Revolution, to the "superficiality" of the west, and with its emphasis on instinct, on the past, even on the remote past, and its proclamation of the rights of the exceptional over all universal law and rules. Thus, the exceptional becomes a law unto himself. These two traditions were later enforced by the 19th-century adoration of science and of the laws of nature which with their "iron logic" worked out beyond all concepts of good and evil, and by a biological theory of life which led to the acceptance of that racialism first proclaimed by the Frenchman Joseph Arthur, count de Gobineau, in his *Essai sur l'inégalité des races humaines* (1854 and 1884), and then propounded by Richard Wagner (1813–83), who combined it with a heroic ideal of the Nordic superman, and by his son-in-law, Houston Stewart Chamberlain, whose *Foundations of the Nineteenth Century* (1899) profoundly influenced early Hitlerism. To romanticism, national socialism owed the vague and fluid conceptions of folk as the basis of cultural and political organization, and of *Weltanschauung* or "total world outlook" as opposed in the name of *Kultur* to the more rational civilization of the west.

In addition to these currents in the German tradition, it ought to be pointed out that Hitler's formation was influenced during his youth by specific Austrian movements. National socialism owed much to Karl Lueger (1844–1910), who organized the Catholic lower middle classes of Vienna in an anticapitalistic and anti-Semitic movement called the Christian Socialist party, but who remained loyal to Habsburg conservatism, and to Georg von Schönerer (1842–1921), who combined racial anti-Semitism with a violent anti-Catholicism and pan-Germanic expansionism and a bitter hostility to the Habsburgs. Schönerer's disciple Karl Hermann Wolf founded among the Sudeten Germans in Bohemia a German Workers' party which was later to assume the name of Deutsche National-Sozialistische Arbeiterpartei, a few years before Hitler founded his almost identically named NSDAP in Munich.

Much in Hitler's ferocious nationalism and his contempt of the Slavs can be explained by the experience of his youth amid the bitter nationality struggles of the multiracial Habsburg empire.

When Hitler started his agitation in Munich immediately after World War I he found the intellectual soil well prepared by the writings of the German romanticists, and of the German publicists of the War of Liberation such as Ernst Moritz Arndt (1769–1860) and Friedrich Ludwig Jahn (1778–1852). The last years before World War I were characterized by a renewed interest in romanticism and in the War of Liberation of 1813. In those years a German youth movement with its longing for a true community, a *Gemeinschaft,* the rebirth of the nation, and with its vague mystical enthusiasm for leadership and comradeship, expressed the opposition to rationalism and "bourgeois" liberalism. It had come largely under the influence of Friedrich Nietzsche (1844–1900) and the German poet Stefan George (1868–1933). Oswald Spengler (1880–1936), the author of *Decline of the West* (Eng. trans., new ed., 1939), *Preussentum und Sozialismus* (1920) and *Hour of Decision* (Eng. trans., 1934), and Moeller van den Bruck (1876–1925), the author of *Der preussische Stil* and *Das Dritte Reich,* can be regarded as the immediate forerunners of national socialism in the intellectual field. But the intellectual preparation would in no way have been sufficient for the growth of national socialism in Germany if the defeat in World War I with its ensuing disillusionment and pauperization, especially in the lower middle classes, had not paved the way for Hitler's propaganda. The peace treaty of Versailles gave to Hitler a starting point, but the violent opposition which he evoked was not directed in reality against the peace treaty but against the fact that Germany had been defeated and that its plans had been frustrated. From the beginning Hitler's propaganda appealed to the military circles, who regarded the peace only as a temporary setback in Germany's expansionist program. Hitler added to the pan-Germanic aspirations for world hegemony the almost mystical fanaticism of a faith in the mission of the German race and the fervour of a social revolutionary gospel. In the years of political and economic depression which followed Germany's defeat, Hitler's appeal to the German masses as the bearers of the most exalted racial ideals in the world was eagerly accepted to counteract their inferiority complex.

Though Hitler accepted many elements of the technique of the bolshevist revolution, he found a powerful ally in the widespread fear of bolshevism which he exploited, first in Germany and then on a world-wide scale, posing as the bulwark against bolshevism. Thus, he secured the financial and moral support of many conservative circles who misunderstood the revolutionary and nihilistic character of his movement and its many points of similarity with the appeal and the antiliberalism of bolshevism. On the other hand, he gained the adherence of the masses by vague promises of an anticapitalistic order. The banner of the NSDAP was the red flag of the revolution, but altered to the German imperial colours by the addition of a white circle and a black swastika in the centre. Thus Hitler combined the appeal of social revolution and that of a militant and mystical nationalism; the extraordinary flexibility of his dynamic doctrine enabled him to stress different elements at different times and to adapt his attitude momentarily to changing circumstances, even with complete disregard for previous statements. His most important individual contribution to the theory and practice of national socialism was his deep understanding of mass psychology and mass propaganda in the contemporary world and his perfection of the methods learned from bolshevist technique. His chapter on propaganda in *Mein Kampf* can be regarded as of the most fundamental importance. He stressed the fact that all propaganda must keep its intellectual level to the capacity of the least intelligent of those at whom it is directed, and that its content of truth does not count compared with the only valid criterion, that of success. "The slighter its scientific ballast, and the more exclusively it considers the emotions of the masses, the more complete the success."

Propaganda should say very little, but repeat this very little forever. Hitler understood that, especially with as wide and far-reaching a goal as world domination, it was of the utmost importance to be able to present under one common denominator all potential adversaries who might themselves change according to

the circumstances. "The art of truly great popular leaders in all ages has consisted chiefly in not distracting the attention of the people, but concentrating always on a single adversary. The more unified the object of the people's will to fight, the greater will be the magnetic attraction of the movement and the more tremendous its impact. It is part of a great leader's genius to make even widely separated adversaries appear as if they belonged to but one category, because among weakly and undecided characters the recognition of various enemies all too easily marks the beginning of doubt of one's own rightness." (From Hitler's *Mein Kampf.*) It was a stroke of genius on the part of Hitler to find this common denominator in the Jews and Judaism. This enabled him to discover the "Jew" behind all his changing adversaries, sometimes behind communism or Moscow, at other times behind Great Britain and the United States—in short, behind everybody and everything which at a given moment opposed his wishes or aroused his wrath.

Anti-Judaism served him also for two other purposes. National socialism was fundamentally opposed to all concepts of international co-operation and universal catholicity; it destroyed the framework of a common humanity with common and absolute standards of law, truth and good, applicable to all men. National socialism, therein following Nietzsche, regarded Christianity and prophetic Judaism, with their emphasis on the equality of all men under one common God and upon absolute standards of justice, as alien and inimical to the new hero ideal of the superrace which was interpreted—not by Nietzsche, but by the national socialists—as the true Germanic ideal. Judaism and the ethics of the Bible therefore stood in opposition to national socialism.

National socialism proclaimed the Germanic race as the new *corpus mysticum* on which the salvation of the world depended, as the embodiment of all nobility and creative genius and as the reich which must become the world-controlling reich. This reich necessarily had to have a *Gegenreich,* a counter-race which on a similarly world-wide basis would represent the antithesis of salvation and creative genius. So the Jewish race became the counter-race. National socialism saw its duty not only in the destruction of this counter-race, but in the preparation of the German race for its real task of establishing the new world order. The third reich, ruled by what Hitler called "the highest human species given by the grace of the Almighty to this earth," will have, by suitable education of the youth, in the future a generation mature for the ultimate and greatest decision on this globe. The nation which will first take this road will be victorious," and become "one day the master of the globe."

Working from these principles, Adolf Hitler was able to carry his party from its small beginnings in a beer cellar in Munich to a dominant position in world politics within 20 years. Among his more important collaborators were Alfred Rosenberg, the author of *Der Mythus des 20ten Jahrhunderts,* the most widely read book of the national socialist movement besides Hitler's own *Mein Kampf,* and of *Blut und Ehre;* Rudolf Hess, who helped Hitler write *Mein Kampf* during their internment in the fortress in Landsberg am Lech in 1924; Gregor Strasser, probably the most important of Hitler's collaborators, who separated from him in protest against the leader's opportunist policies and was killed in the blood purge of June 1934; his brother Otto Strasser, who in 1930 founded the Black Front as a more radical wing opposed to Hitler; Gottfried Feder, who drew up the first program of national socialism and was for several years its economic "expert" but thereafter receded into oblivion; Capt. Ernst Röhm, the founder and organizer of the S.A. or *Sturm Abteilungen,* the National Socialist militia, who was purged in June 1934; Julius Streicher, who became famous through his anti-Semitic weekly, *Der Stürmer;* Heinrich Himmler, the organizer and commander of the S.S. or *Schutz Staffel,* Hitler's personal elite guard, and of the gestapo (*Geheime Staats Polizei*), the secret police; Joseph Goebbels, the master of national socialist propaganda; Hermann Goering, the organizer of the German air force and controller of the German industrial mobilization; R. Walther Darré, the author of *Neuadel aus Blut und Boden* and organizer of the national socialist peasant policy; and finally Robert Ley, the leader of the German Workers' front.

It took 14 years for the NSDAP to conquer power in Germany. It had been born at a time when it was only one of many semirevolutionary, reactionary and terrorist organizations springing up as *Freikorps* throughout Germany, composed of former officers and soldiers, students and other elements dissatisfied with the republican democratic and peaceful order which seemed to dawn for Germany in 1919. That it survived and absorbed all others was due to Hitler's leadership and to the fact that Capt. Röhm interested the reichswehr in supporting Hitler. On Feb. 24, 1920, the NSDAP drafted in Munich, the centre of its activities, a program of 25 points, which in 1926 was declared unalterable, but which in reality was very soon surpassed by developments. On Nov. 9, 1923, Hitler, supported by Field Marshal Erich Ludendorff, attempted his first *Putsch* in Munich, but it miscarried. Reaction was so firmly entrenched then in Bavaria, however, that Hitler was let off with only a formal punishment. The ensuing years of political and economic consolidation in Germany did not allow Hitler to make any considerable progress, but the economic crisis at the beginning of the '30s and the lack of energetic measures on the part of the government against the indefatigable propaganda to undermine democracy brought the first great success of the NSDAP in the reichstag elections of Sept. 14, 1930. The reichstag elections of Nov. 6, 1932, marked a temporary setback for Hitler, but an intrigue, started by Franz von Papen, prevailed upon the aged president of the German republic, Marshal Paul von Hindenburg, to name Hitler chancellor on Jan. 30, 1933. He was then only the head of a coalition cabinet of national socialists and members of the conservative and nationalistic right. A fire in the reichstag building on Feb. 27, 1933, gave Hitler the chance to rouse the spectre of a bolshevist revolutionary danger and to hold the elections of March 5, 1933; though they gave the national socialists only 44% of the votes, the antidemocratic totalitarian parties (national socialists and Communists) had a majority following in Germany against the democratic republic, while the democratic forces were weak and without a clear program. Thus, the new reichstag, meeting on March 21, 1933, in the garrison church in Potsdam, the historic receptacle of Prussian military spirit, "enabled" the government to assume dictatorial powers. From that moment on, the relentless process of *Gleichschaltung* began, and within a few months the German reich had become a totalitarian state which was entirely identical with the NSDAP in every concern of public or private life, and that meant with the will of its leader. The death of Hindenburg on Aug. 2, 1934, removed the last conservative obstacle. Hitler became *Reichsfuehrer* and chancellor, the presidency was abolished and all troops and officials were immediately forced to take the oath of fidelity to Hitler personally. The third reich was now to create the "new order" which, according to Hitler, was to last for 1,000 years.

But it was to be not a new order of authoritarianism and of inequality for Germany alone. Its dynamism was bound to expand and to spread. By its own nature it could not recognize any limits of its own volition, only limits set by opposed superior force. The first years were spent in absolute concentration upon forging that instrument which would enable national socialism to establish its military and industrial superiority and thus to fulfil its ambitions. With mounting success, the aims grew in quick progression. The first aim was to unite all Germans within the reich on the basis of "self-determination," which was proclaimed as the right of the German, but denied to other peoples. The next step foresaw the creation of a *Grosswirtschaftsraum,* or a *Lebensraum,* in which the German master race or *Herrenvolk* would rule over a hierarchy of subordinate peoples. The success of that plan widened it into the vision of a hemispheric order which would embrace all of Europe, western Asia and Africa, and finally of a world order which would establish the principles of national socialism, with its emphasis upon the Germans as the leading race, all over the globe. The extreme neomercantilism which received the new name of *Wehrwirtschaft* was accompanied by an extreme cultural autarchy, a resolute hostility against all western thought, a repudiation of all efforts at synthesis between western tradition and Germanism which had been the goal of most of the best Germans in the pre-

ceding centuries. The rejection of the west and its standards of justice, law and reciprocity led also to the proclamation of the official maxim that "Right is whatever profits the German nation; wrong is whatever harms it," which was regarded by Reichsminister Hans Frank, the head of the Academy of German Law, in an address on Dec. 4, 1939, as the "beginning of national socialist justice." The absolute world rule to which national socialism aspired would not only represent, according to national socialist expectations, a military, economic and political domination, but equally an intellectual and moral leadership. Their new world age or *Weltzeitalter* would be German and national socialist at the same time.

National socialist parties existed outside the reich everywhere where there was a population of German descent which national socialist agitation had succeeded in organizing for its own aims. According to national socialist doctrine, loyalty to one's "race" or "blood" took precedence over one's loyalty as a citizen. "Blood," and not a spiritual decision of allegiance, the doctrine taught, was the decisive factor. But this racial basis constituted a weakness of national socialism in its attempt at a world-wide appeal. It helped toward its ultimate defeat.

National socialism, which started a purely German movement, produced by conditions and traditions peculiar to Germany, assumed after 20 years of incessant and successful struggle a world-wide importance and bid to influence and determine the course of history on a world-wide scale. But the attempt at world-wide conquest brought about a coalition of the nations attacked or threatened by Germany to which Germany succumbed in 1945 after almost six years of war. National socialism under Hitler's leadership ended thus in complete failure; the national socialist reich ended in a total catastrophe after 12 years' existence.

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(H. Ko.)

NATIONAL WORKSHOPS (in French, *Ateliers Nationaux*), the term applied to the workshops established to provide work for the unemployed by the French provisional government after the revolution of 1848. (The term is also incorrectly applied to the proposed *ateliers sociaux* of Louis Blanc [*q.v.*], state-supported co-operative productive societies.) The revolution was both preceded and followed by a severe financial and industrial crisis which rendered the problem of unemployment in Paris very acute. The provisional government under the influence of one of its members, Louis Blanc, and on the demand of a deputation of Parisian workers, passed a decree (Feb. 25, 1848) which contained bold promises assuring relief from the extreme conditions then prevailing. Moreover, this relief was to be immediate, effectual and universal. The following is an extract from the decree:

"The provisional government of the French Republic undertakes to guarantee the existence of the workmen by work. It undertakes to guarantee work for every citizen."

For the carrying out of this decree Louis Blanc wanted the formation of a ministry of labour, but this was shelved by his colleagues who, as a compromise, appointed the "Luxembourg" labour commission under the presidency of Louis Blanc and with power of inquiry and consultation only. The carrying out of the decree of Feb. 25 was entrusted to the minister of public works, M. Marie, and various public works were immediately started. These included clearing the trench of Clamart and conveying the earth to Paris for the construction of a railway station on the chemin de fer de l'Ouest; construction of the Paris terminus of the Paris-Chartres railway; improvement of the navigation of the Oise and extension of the Sceaux railway to Orsay.

Those applying for work far exceeded the number of jobs available. There was no effective administrative service and no real desire on the part of the government to make the experiment a success.

The disorder and waste were amazing.

Owing to the increase in the number of those claiming work or relief, disorganization set in, and both the bureaus and the *mairies* became the centres of disturbances, those in charge of the offices being unable to control the crowds. As a consequence M. Marie commissioned Émile Thomas, a chemist, connected with the École Centrale, to reorganize the works. When Thomas took the work in hand on March 5, the number of unemployed had increased to 14,000 in addition to about 4,000 or 5,000 employed on public works, and it was steadily on the increase. On March 16 the daily pay of the workmen who were not working was reduced to one franc; work was guaranteed for at least every other day, in which case the pay was to be two francs for the day.

The national assembly had in the meanwhile been elected, and met on May 4. The executive commission was elected a few days later; Louis Blanc was excluded, but all the other members of the provisional government were on it. Blanc renewed his motion for a ministry of labour; this was rejected. The dispersal of the *emeute* of May 15 freed the assembly from fear of the revolutionary clubs, and on May 15 Thomas received instructions to dismiss all unmarried men under 25 years of age who would not enlist in the army, all men who could not prove six months' residence in Paris and all who refused offers of private employment. Piecework was to be established instead of timework, and men were to be prepared to be drafted into the provinces. The protests of Thomas held this plan up, but he was removed from office on May 26 and on June 20 the proposals were approved, and the sequel was the insurrection of June 23 and following days (*see* FRANCE: *History*).

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NATIONS, LAW OF: *see* INTERNATIONAL LAW, PRIVATE; INTERNATIONAL LAW, PUBLIC.

NATROLITE, a mineral species belonging to the zeolite group. It is a hydrated sodium and aluminum silicate with the formula $Na_2Al_2Si_3O_{10}.2H_2O$, and containing sodium (Na_2O, 16.3%). "Needlestone" or "needle zeolite" are other names, alluding to the common acicular habit of the crystals, which are often very slender and are aggregated in divergent tufts. Larger crystals have the form of a square prism terminated by a low pyramid: the prism angle being nearly a right angle (88° 45½′), the crystals are tetragonal in appearance, though actually orthorhombic. There are perfect cleavages parallel to the faces of the prism. The mineral also often occurs in compact fibrous aggregates, the fibres having a divergent or radial arrangement. Natrolite is usually white or colourless, but sometimes reddish or yellowish. The lustre is vitreous, or in finely fibrous specimens sometimes silky. The spec. grav. is 2.2, and the hardness 5½. The mineral is readily fusible. It is decomposed by hydrochloric acid with separation of gelatinous silica.

NATTIER, JEAN MARC (1685–1766), French painter, was born in Paris in 1685, the son of Marc Nattier, a portrait painter, and of Marie Courtois, a miniaturist. He received his first instruction from his father, and took the first prize at the

Paris academy at the age of 15. He refused to study at the French academy in Rome, and in 1715 went to Amsterdam, where Peter the Great was then staying. There he painted portraits of the tsar and Empress Catherine, but declined an offer to go to Russia. Between 1715 and 1720 he painted the "Battle of Pultawa," for Peter the Great, and the "Petrification of Phineus and of his Companions," which led to his election to the academy. The financial collapse of 1720 all but ruined Nattier, who was obliged to turn to portraiture. He became the painter of the artificial ladies of Louis XV's court. Notable examples of his straightforward portraiture are the "Marie Leszczinska" at the Dijon museum, and a group of the artist surrounded by his family, dated 1730. He died in Paris in 1766.

Among his pictures are the "Magdalen" at the Louvre; "La Camargo" and "A Lady of the Court of Louis XV" at Nantes; the "Head of a Young Girl" at Orléans and "Mme. de Pompadour" at Marseilles. The Versailles museum owns a group of two ladies, and the Dresden gallery a portrait of the "Maréchal de Saxe." In the Wallace collection are "The Comtesse de Dillières," "The Bath (Mdlle. de Clermont)," "Portrait of a Lady in Blue," "Marie Leszczinska" and "A Prince of the House of France." Nattier's works have been engraved by Leroy, Tardieu, Lépicié, Audran and other noted craftsmen.

See Paul Mantz, "J. M. Nattier" in the *Gazette des beaux-arts* (1904); *Life of Nattier* by his daughter, Madame Tocqué; Pierre de Nolhac, *Nattier* (1904, revised 1910); Lady Dilke, *French Painters of the XVIIIth Century* (London, 1899).

NATURAL BRIDGE, a small village of Rockbridge county, Va., in the western part of the state, 145 mi. W. of Richmond, and about 13 mi. S.E. of Lexington, the county seat. It is served by the Chesapeake and Ohio and the Norfolk and Western railways. In the vicinity of the village, which is about 1,200 ft. above sea level, is the great natural curiosity from which it derives its name—a bridge of natural rock 90 ft. long and from 50 to 150 ft. wide, which spans Cedar creek at a height of 215 ft. above that stream. It consists of horizontal limestone strata, and is the remains of the roof of a cave or underground tunnel through which the creek once flowed. It is crossed by U.S. highway 11. In the village are magnesia and lithia springs and a saltpetre cave.

NATURAL GAS is the name given to the inflammable gas which occurs in porous, subsurface, imperviously capped earth formations. Petroleum is found in many instances with the gas. Brine waters are generally present. The occurrence of natural gas is wide-spread both geographically and geologically. Geographically, natural gas is produced in North America, South America, Europe, Asia and Africa. The major producing fields of North America are: Texas, California, Louisiana, Oklahoma, West Virginia and Pennsylvania; in Canada, the provinces of Alberta and Ontario; in Mexico, the states of Vera Cruz, Tamaulipas and Tabasco; in South America, Venezuela, Colombia, Peru, Argentina, Ecuador and Trinidad; in Europe, the U.S.S.R., Rumania and Poland; in Asia, Iraq, Iran, Indonesia, Bahrein Island, the Indian peninsula and Japan; and in Africa, Egypt. Geologically, these deposits of natural gas are variously found in the Carboniferous, Devonian, Silurian, Ordovician, Cambrian, Tertiary, Cretaceous and Jurassic systems.

Chemical Composition.—Natural gas is for the most part composed of the hydrocarbons of the paraffin series. However, its composition varies considerably in the different fields. Carbon dioxide, nitrogen, hydrogen sulphide and helium are sometimes present.

Natural gas of the east American or Appalachian field is almost entirely made up of methane, ethane, propane, the butanes, and the vapours of pentane, hexane, heptane and octane. The gas from some parts of Texas, Oklahoma and Kansas is high in nitrogen content and some of these high nitrogen gases contain helium. The content of nitrogen is so high in some of the gas from the wells of west Texas, that the gas is noncombustible. Practically all the so-called "sour" gas contains hydrogen sulphide and organic sulphur compounds. Some natural gas of California, Colorado, Utah, New Mexico and Washington contains high percentages of carbon dioxide. Natural gas suitable for producing solid carbon dioxide is obtained in several states and natural "dry ice" plants have been built to utilize this gas in all these states except New Mexico. The rated capacity of these plants totals 80 to 100 tons daily.

Natural gas wells are, and have been for the most part, remote from the gas-consuming markets. Fusion-welded and "Dresser-coupling" steel lines are used in the transportation of gas. Many of these lines are more than 100 mi. in length—one line is 1,000 mi. long. The pressure of transportation varies from 200 to more than 400 lb.—one line transports gas at 1,300 lb. pressure. When and where natural well pressures are inadequate to effect delivery, compressing stations are installed. One large gas-transporting company has 72,700 installed horse-power compressing capacity. Many of the transporting lines are 20 to 22 in. in diameter—one is a 36-in. line. During the winter months when consumption is large, temperatures are low, and transporting pressures are high, it has been necessary to install dehydrating plants on the large lines to eliminate stoppage of lines due to the formation of crystalline hydrates. The hydrate of methane contains six molecules of water, while those of ethane, propane, and iso-butane contain seven molecules of water. These hydrates are stable at all temperatures below 66° F. The other hydrocarbons of natural gas do not form hydrates. The wholesale metering of gas in the large transporting lines is effected with orifice meters. The average deviation of natural gas from Boyle's law at 60° F. is approximately 8% at 300 lb. pressure and 20% at 1,300 lb.

Natural gas as distributed is for the most part refined. It has been processed for the elimination of suspended and finely divided solids and water. On practically all the large transporting systems, gasoline and liquefied petroleum gas recovery plants are installed. In some few instances natural gas is processed to remove its content of hydrogen sulphide and organic sulphur compounds. The so-called "dry" natural gas of commerce is mainly made up of the hydrocarbon methane associated with varying quantities of ethane, propane and the butanes. The total heating value per cubic foot, measured at 60° F. and 30 in. mercury pressure, varies from 1,000 to 1,200 British thermal units. The specific gravity (air = 1) varies from .56 to .67. The explosive limits are 4.8 to 15. Since natural gas has no distinctive odour, an odorous substance is usually added to aid in detecting leakages. The liquefied hydrocarbons—whose critical temperatures are above the prevailing atmospheric temperatures—are ethane, propane, normal butane and isobutane. These are recovered in a high state of purity in plants generally associated with natural gasoline recovery plants.

Gasoline Recovery.—Natural gasoline is recovered by three processes: compression and cooling, oil absorption and charcoal adsorption, and is marketed in a variety of grades, generally based upon two factors; the Reid vapour pressure test at 100° F., expressed in pounds per square inch pressure, and the percentage which is distillable and recoverable at 140° F. Both methods are official and standardized by the U.S. bureau of mines. The chemical composition of natural gasoline will vary with its grade of commercial quality. Generally speaking it is composed of normal butane, the pentanes, the hexanes, the heptanes and the octanes. Those gasolines which have Reid vapour pressures in excess of 22 lb. at 100° F. also contain variable quantities of isobutane and may carry some propane. Practically all the marketed natural gasoline is processed to remove hydrogen sulphide and organic sulphur by some one of the following treatments: dilute caustic soda, dilute sodium hypochlorite, cupric sulphate or monoethanolamine.

The deepest natural gas producing well in the U.S. was drilled to a depth of 15,004 ft. at Wasco, Calif., in 1938. There are now more than 54,000 gas wells operating in the U.S. The Candelaria Well No. 1 in Harris county, near Houston, Texas, has a "shut-in" pressure of 4,800 lb. gauge pressure. The depth of this well is 8,101 ft.

Major Uses of Natural Gas.—The following are statistical data for the United States in 1937:

(1) As fuel—(domestic, commercial and industrial), 2,370,000,000,000 cu.ft.

(2) As source of carbon black manufacture—510,606,000 lb. produced.

(3) As source of natural gasoline recovery—2,039,100,000 gal.
(4) As source of liquefied petroleum gas recovery—141,505,000 gal.
(5) As source of helium recovery—4,809,230 cu.ft.
(6) As source of carbon dioxide (dry ice)—20,000,000 lb.

Minor Uses of Natural Gas.—The following are data for the United States in 1937:

(1) Pentane in the production of 50 synthetic chemicals of greater or less commercial importance.

(2) Mixtures of ethane, propane and the butanes in the mass production of 100 synthetic chemicals—alcohols, alcohol ethers, ketones, esters, acids, acid anhydrides, aldehydes, oxides, amines, ethers and chlorinated derivatives.

(3) Mixtures of ethane, propane and the butanes in the mass production of "poly" gasoline—a motor fuel of high octane rating.

(4) Butane in the production of butadiene, synthetic rubber, and as a solvent for the extraction of oils, fats, resins, nicotine and perfumes.

(5) Propane as fuel in isolated districts and as selective solvent in mass production of motor oils of low cold test, high viscosity index, better colour and bloom and high resistance to oxidation and the formation of carbon and sludge.

(6) Ethane in the production of ethylene—useful in citrus fruit ripening, as an anaesthetic, as a refrigerant and in the manufacture of mustard gas and ethylene bromide. Large quantities of the latter chemical are used in connection with tetraethyl lead to yield high octane (antiknock) motor fuels. (J. B. G.)

NATURALISM, in philosophy, is the view which maintains that all explanation should keep within the realm of what is natural, and avoid all recourse to the supernatural. Thinkers may be agreed about this even if they differ on many other points. Thus, for example, materialism, pantheism and positivism are all naturalistic; but it is absurd to equate them for that reason.

NATURALIZATION: *see* NATIONALITY; NATURALIZATION LAWS.

NATURALIZATION LAWS. Naturalization is the act of investing an alien with the status of a national in a given state. It takes place wherever a new nationality is acquired by a person after his birth. It may be accomplished as the result of voluntary application, special legislative direction, marriage, parental action or annexation of territory. The conditions under which the privilege of naturalization will be granted are fixed by the laws of each nation. International law, however, imposes some limits on the power of a state to naturalize persons, especially nonresidents.

UNITED STATES

The constitution of the United States, article 1, section 8, clause 4, authorized congress to "establish an uniform Rule of Naturalization." Congress fulfilled that mandate by enacting naturalization statutes, commencing in 1790, to establish the conditions under which aliens may be admitted to citizenship. The requirements have never been exacting, and the consistent national policy has been to encourage the naturalization of all qualified aliens. That policy aided in developing the strength and homogeneity of a nation whose growth resulted largely from the contributions of millions of immigrants and their descendants.

Naturalization by Court Process.—The principal method of acquiring a new nationality is through voluntary application in the manner provided by law. Most countries authorize the grant of citizenship by an administrative official. In the United States, however, naturalization from the first became a function of the courts. Congress conferred power to grant naturalization upon all federal district courts and upon state courts of unlimited jurisdiction which have a seal and a clerk. An applicant may appeal to the higher courts from a decision rejecting his petition. The government also is a party in every naturalization case, and it too may appeal when it deems that naturalization was improperly awarded.

The principal disqualification for naturalization was directed against some racial groups. Originally the statutes permitted the naturalization only of "free white persons." In 1870, following the Civil War, Negroes were granted the privilege of naturalization. The next modification was made by the Nationality Act of 1940, which permitted the naturalization of races indigenous to the western hemisphere, chiefly North American Indians and Eskimos. Further modifications were made in 1943, when Chinese were declared eligible; in 1946, when Filipinos and East Indians were permitted to apply; and in 1950, when naturalization benefits were extended to noncitizens of Guamanian ancestry. Except for these specifically designated racial groups, Asiatics were not eligible at mid-century for naturalization as United States citizens. Also disqualified from naturalization were: (1) aliens identified with certain proscribed organizations, activities or beliefs at any time during the period of ten years immediately preceding the petition for naturalization; (2) certain aliens who claimed exemption from military service because of their alienage; and (3) deserters from the armed forces during time of war.

Several basic qualifications always have been prescribed, virtually without change, in the statutes relating to naturalization. It is important to bear in mind that these are general requirements which often have been modified with respect to special groups whom congress desired to favour.

First, the applicant for naturalization must have resided in the United States for at least five years following a lawful admission for permanent residence. Lesser periods of residence, and in some cases no fixed residence requirements, were prescribed for naturalization applications by wives and children of U.S. citizens, persons who serve in the armed forces or the merchant marine and other special categories.

Second, the applicant must establish that he is, and was during the requisite period of residence, a person of good moral character. Persons who have committed serious crimes during that period generally are barred.

Third, the applicant must establish that he is, and was during the requisite period of residence, attached to the principles of the constitution of the United States and well disposed to the good order and happiness of the United States. The latter requirement was designed to exclude from citizenship aliens hostile to the United States and its institutions. For many years the courts also interpreted this requirement as forbidding the naturalization of conscientious objectors to military service. In 1946, however, the supreme court, reversing its earlier holdings, determined that conscientious objectors might be naturalized (*Girouard* v. *United States,* 328 U.S. 61 [1946]).

Finally, the applicant generally must meet several educational requirements. He must demonstrate an understanding of the English language, including an ability to read, write and speak words in ordinary usage. He must sign the petition for naturalization in his own handwriting if he is physically able to write, and must demonstrate some understanding of the constitution and form of government of the United States.

While the ultimate power to grant or deny naturalization was conferred upon the courts, the law vested in the immigration and naturalization service of the department of justice administrative supervision over the naturalization process. The service, headed by a commissioner of immigration and naturalization, was placed under direction of the attorney general and was organized into 16 district offices as well as numerous suboffices throughout the United States. Under the act of June 29, 1906, the immigration and naturalization service was given broad legal authority to receive applications, issue certificates of legal entry, interrogate the applicants and their witnesses and make recommendations to the naturalization courts. This administrative function was designed to aid the courts in discharging their responsibilities in granting or denying naturalization.

The naturalization process commences with the filing of a declaration of intention to become a U.S. citizen. Prerequisites to the filing of such a declaration are lawful entry into the United States for permanent residence and the procurement of an official certificate establishing such entry. The requirement that a declaration of intention be filed is waived in the cases of spouses of U.S. citizens, persons with specified service in the armed forces or the merchant marine and other special groups.

The next step is the filing of a petition for naturalization. If

a declaration of intention is required, the petition may not be filed sooner than two years nor later than seven years after the date of the declaration of intention. An applicant who desires to file his petition for naturalization is notified to appear with two citizen witnesses in court, where they are interrogated under oath in the office of the clerk of court by an examiner of the immigration and naturalization service. Then the applicant files the petition for naturalization, which is signed and sworn to by the petitioner and his two witnesses. Further investigation is conducted and the petitioner is then notified to appear before a judge for final hearing. At the final hearing a representative of the immigration and naturalization service appears and recommends that the petition be granted or that it be denied.

If the court grants the petition, the petitioner takes an oath in open court forswearing all foreign allegiance and pledging allegiance to the United States; the judge then signs an order admitting him to citizenship. Thereafter the newly invested citizen receives an official certificate of naturalization. The fees established by law were as follows in 1951: $3 to the clerk of court at the time of filing the declaration of intention and $8 to the clerk of court at the time of filing the petition for naturalization. The latter fee included all charges through completion of the hearing before the naturalization court; no further fee was prescribed for the final hearing or for issuance of the certificate of naturalization.

A naturalized citizen acquires status equal to the native-born, except that he is not eligible to become president of the United States. However, even after naturalization is finally granted, it may be revoked through a judicial proceeding. The statute authorizes such revocation only if the naturalization was induced by fraudulent misstatements or was illegally granted (*e.g.*, misstatements relating to entry into the United States or to criminal record). The supreme court insisted upon strong evidence of irregularity before any naturalization might be cancelled and declared that such revocations would be sanctioned only if there was clear, unequivocal and convincing proof that the naturalization was improperly awarded (*Schneiderman* v. *United States*, 320 U.S. 118 [1943]).

Other Forms of Naturalization.—Another method of acquiring citizenship is by derivation through a husband or parent. Prior to Sept. 22, 1922, marriage to a U.S. citizen or the husband's naturalization conferred U.S. citizenship upon an alien wife. The Cable act of Sept. 22, 1922, abolished the joint citizenship of husband and wife and enabled a wife to choose her own nationality. Citizenship status previously acquired, however, was not affected.

Prior to the Nationality Act of 1940 a child under 21 years of age acquired U.S. citizenship through the naturalization of either parent while he resided in the United States or if he subsequently commenced to reside in the United States prior to his 21st birthday. After Jan. 13, 1941, the effective date of the Nationality Act of 1940, such transmission of citizenship could not occur after the child had attained the age of 18 years. In addition, derivation was to take place only if both parents became citizens, unless one parent was dead or there had been a divorce or legal separation, in which event the naturalization of the parent having legal custody would suffice.

A person who has acquired U.S. citizenship by derivation may apply to the commissioner of immigration and naturalization for a certificate recognizing that status. The fee for this application in 1951 was $5. Upon presentation of proof establishing a valid claim to U.S. citizenship, the commissioner issues a certificate of citizenship to the applicant.

Congress also may grant citizenship by special legislation. In some instances, so-called private bills have been enacted conferring citizenship rights upon named individuals. Much more common has been the award of collective naturalization to large groups of noncitizens, particularly the inhabitants of U.S. territories and possessions.

The nationality status of the inhabitants of certain acquired territories was fixed by the treaty-making power of congress. Statutes have from time to time effected collective naturalization either prior to or upon the admission of territories to statehood. Such action was taken in territory acquired under treaties concluded with Great Britain (territory of Michigan, 1794, 8 Stat. 116), France (Louisiana, 1803, 8 Stat. 200), Spain (Florida, 1819, 8 Stat. 252), Mexico (Guadalupe-Hidalgo, 1848, 9 Stat. 922; Gadsden, 1853, 10 Stat. 1031), Russia (Alaska, 1867, 15 Stat. 542) and Denmark (Virgin Islands, 1916, 39 Stat. 1706).

In the absence of definite treaty stipulations, citizenship has been conferred upon inhabitants of acquired territory by legislative enactments. In this category were the Hawaiians (act of April 30, 1900, 31 Stat. 141), Puerto Ricans (sections 5 and 5[a], act of March 2, 1917, as amended; section 202, Nationality Act of 1940), Virgin Islanders (act of Feb. 25, 1927) and Guamanians (act of Aug. 1, 1950, 64 Stat. 385). Finally, United States citizenship was conferred collectively through the political incorporation of the original states into the United States; in the case of the state of Texas, upon its annexation and direct admission into the union; and upon American Indians born in the United States through special legislation on June 2, 1924.

Full status as U.S. citizens, however, was not conferred on all the inhabitants of U.S. territorial possessions. Complete citizenship rights were extended to inhabitants of Alaska, Hawaii, Puerto Rico, the Virgin Islands and Guam; but the natives of other possessions such as American Samoa were regarded as noncitizen nationals of the United States, entitled to U.S. protection but not to full citizenship status.

COMMONWEALTH OF NATIONS

United Kingdom.—In 1844 Great Britain adopted legislation which authorized for the first time the naturalization of aliens as British subjects. Previously aliens could acquire British allegiance only through a private act of parliament or through the grant of letters of denization by the crown. After 1844 the latter processes were invoked only in rare cases. One such instance occurred when Lord Reay succeeded to a Scottish peerage in 1877 and was naturalized by an act of parliament. The process of denization fell into disuse because denizens were not granted full rights as British subjects.

The British Nationality act, 1948, which became effective Jan. 1, 1949, drastically revised earlier concepts of British nationality. It abolished the previously recognized status of common British nationality throughout the empire and recognized separate citizenship status for the United Kingdom and colonies and for each of the commonwealth nations; namely, Canada, Australia, New Zealand, the Union of South Africa, Newfoundland, India, Pakistan, Southern Rhodesia and Ceylon. Every citizen of the United Kingdom and colonies and of each of the other constituent nations of the commonwealth consequently acquired the status of a British subject, and was also referred to as a commonwealth citizen. Following enactment of the British Nationality act, 1948, Newfoundland became a province of Canada and was governed by the Canadian Citizenship Act of 1946. Citizens of the Republic of Ireland were no longer regarded as British subjects.

Under the British Nationality act, 1948, a noncitizen of the United Kingdom and colonies generally could acquire such status either through registration or naturalization. Both processes are entirely administrative and are entrusted to the discretion and control of the secretary of state, whose discretion in passing upon applications generally is absolute and unqualified. He may, with or without assigning any reason, grant or withhold any such registration or naturalization for any reason he deems conducive to the public good. His decision on any such application is not subject to appeal or review in any court.

Persons in the following groups may be registered as citizens of the United Kingdom and colonies upon application made in the prescribed manner to the secretary of state: (1) citizens of the Commonwealth of Nations or Ireland ordinarily resident or in crown service in the United Kingdom; (2) noncitizen women who marry citizens of the United Kingdom and colonies and who take an oath of allegiance to the British crown; (3) minor children of any citizen of the United Kingdom and colonies, upon application filed by the parent or guardian; (4) in such special circumstances as the secretary of state thinks fit, any other minor may be registered as a citizen of the United Kingdom and colonies.

The second major process for acquiring status as a citizen of the United Kingdom and colonies is through naturalization, which also is accomplished ordinarily upon application to the secretary of state in the prescribed manner. The naturalization application may be made by an alien or by a British protected person (a citizen or resident of a protectorate, protected state, mandated territory or trust territory). Upon satisfying the secretary of state that he meets the established requirements such applicant is granted a certificate of naturalization and, on taking an oath of allegiance to the British crown, he becomes a citizen of the United Kingdom and colonies by naturalization from the date on which the certificate was granted.

The following qualifications must be met by an applicant for naturalization: (1) he must have resided or been in crown service in the United Kingdom for at least 12 months immediately preceding the date of the application; (2) he must, in addition, have resided for specified periods aggregating at least four years in the United Kingdom or its colonies; (3) he must be of good character; (4) he must have sufficient knowledge of the English language; (5) he must intend to reside in the United Kingdom or its colonies or to perform crown or other specified service in the United Kingdom or its colonies. In special cases the secretary of state may waive or modify the residence requirements. Any person whose status as a citizen of the United Kingdom and colonies is in doubt may be granted a special certificate of naturalization by the secretary of state, and such certificate may declare that it is issued for the purpose of quieting such doubts. A certificate of naturalization granted for this purpose is conclusive evidence that the recipient was a citizen on the date of its issuance, but does not preclude his establishing that he was a citizen at an earlier date. A certificate of naturalization does not become effective until the applicant takes an oath of allegiance.

A person who becomes a citizen of the United Kingdom and colonies by registration or naturalization is entitled to all the rights, powers and privileges and is subject to all obligations, duties and liabilities of a natural-born citizen of the United Kingdom and colonies and to all intents and purposes enjoys the status of a natural-born citizen. However, such a person may be deprived of his citizenship, through order of the secretary of state, for fraud, false representation or material concealment in procuring registration or naturalization. In addition, a naturalized citizen may be deprived of his citizenship through order of the secretary of state on any one of the following grounds: (1) disloyalty, before or after the naturalization; (2) unlawful communication with or assistance to an enemy in time of war; (3) conviction and sentence in any court of certain serious crimes within five years of the naturalization; (4) continuous residence in foreign countries, except under certain specified conditions, for seven years after the granting of the certificate. The secretary of state may also revoke the naturalization of a citizen of the United Kingdom and colonies who is deprived of his citizenship in any of the commonwealth nations or in Ireland on grounds that are substantially similar to those mentioned above.

In no case does the secretary of state deprive any person of citizenship, even under the enumerated conditions, unless he is satisfied that it is not conducive to the public good that the person should continue to be a citizen of the United Kingdom and colonies. Before making an order revoking citizenship the secretary of state is required to give to the person affected written notice specifying the cause for the proposed action; in addition, such persons generally may demand a hearing before a committee of inquiry before any final action is taken.

The citizenship status of alien women married to British subjects has been treated differently at different times. The original common-law doctrine regarded a woman's citizenship as independent from that of her husband, and an alien woman did not gain British nationality or lose her native citizenship upon her marriage. The act of 1884 provided for the first time that an alien woman acquired British nationality upon marriage to a British subject. Thereafter, and until 1933, the statutes directed that the wife of a British subject should be deemed a British subject. This was modified by the act of 1933, which provided that when a certificate of naturalization was granted to an alien, his wife did not become a British subject unless she elected to accept British nationality. The original common-law concept was fully reinstated by the British Nationality act, 1948, so that after Jan. 1, 1949, an alien woman married to a citizen of the United Kingdom and colonies did not automatically acquire her husband's citizenship. She could become a citizen of the United Kingdom and colonies, if she desired such citizenship, only by applying for registration, in the manner previously described. The minor children of naturalized citizens likewise might become citizens of the United Kingdom and colonies through registration, upon application made by a parent or guardian.

British Colonies.—As previously indicated, the British colonial possessions were joined with the United Kingdom for the purpose of determining a common citizenship status in the United Kingdom and colonies. The authority of the secretary of state in granting registration or naturalization as a citizen of the United Kingdom and colonies and in revoking such citizenship status is reposed in the governor of any colony, protectorate or United Kingdom trust territory, whose actions generally are subject to the approval of the secretary of state.

Commonwealth Nations.—Completing a process inaugurated on a limited basis in 1914, the British Nationality act, 1948, recognized separate citizenship privileges for each of the countries in the Commonwealth of Nations and confirmed in addition the authority, without any limitation, of each of such countries to enact laws defining its own citizenry. As previously stated, the citizens of each such nation—Canada, Australia, New Zealand, the Union of South Africa, Newfoundland, India, Pakistan, Southern Rhodesia and Ceylon—were designated as British subjects or as commonwealth citizens. It has already been noted that Newfoundland became a province of Canada after enactment of the British Nationality act, 1948, and thereby became subject to Canadian laws.

The nationality laws adopted in each of the commonwealth countries must be consulted in order to determine citizenship status in those countries. Typical of such laws was the Canadian Citizenship act, 1946, which became effective Jan. 1, 1947. Indeed, the enactment of the Canadian law doubtless was an important factor in the subsequent revision of the British statute, which ultimately was enacted as the British Nationality act, 1948.

Under the Canadian statute, naturalization became essentially a judicial function. An executive officer, the secretary of state, was entrusted with broad administrative responsibilities in relation to that process. This division of responsibility thus resembled the system prevailing in the United States.

An applicant for naturalization must meet the following qualifications: (1) he must have filed a declaration of intention in the office of the clerk of court not less than one year nor more than five years prior to the date of final application; British subjects and spouses of Canadian citizens are exempt from this requirement; (2) he must have been lawfully admitted to Canada for permanent residence; (3) he must have resided continuously in Canada for one year immediately prior to the application and generally must also establish residence in Canada for a further specified period of not less than four years; applicants with specified military service and wives of Canadian citizens are exempt from this latter residence requirement; (4) he must be of good moral character; (5) he generally must have an adequate knowledge of either the English or the French language; (6) he must have an adequate knowledge of the responsibilities and privileges of Canadian citizenship; (7) he must intend to reside permanently or to enter public service in Canada.

Naturalization applications are filed and posted in the office of the clerk of court. After a three-month waiting period, during which any person may file objections, the applicant must personally appear before the court for an examination and must produce such evidence as the court may require. The court determines whether the applicant has satisfied the prescribed requirements. If the court orders that naturalization shall be granted, its decision is transmitted to the secretary of state together with the application and other relevant documents.

The certificate of citizenship is issued by the secretary of state to any person whose application has been granted by the court. However, if the secretary of state questions whether such application was properly approved he may refer it to the court for a rehearing, but the court's decision on such rehearing is final and conclusive.

The marriage of an alien woman to a Canadian citizen does not change her nationality status. The law recognizes her right to control her own nationality status. She may acquire Canadian citizenship through naturalization upon her own application, but provision is made for some relaxation of the normal requirements on her behalf. A certificate of citizenship may be issued to a minor child of a naturalized citizen upon application made by his parent.

The secretary of state may grant a certificate of citizenship to any person whose status as a Canadian citizen is in doubt, and the certificate may specify that it is granted for the purpose of quieting such doubts. No certificate of citizenship can become effective, except in the case of a minor under the age of 14 years, until the applicant has taken the prescribed oath of allegiance.

Naturalization may be revoked upon order of the secretary of state for any of the following reasons: (1) unlawful communication with or assistance to an enemy in time of war; (2) fraud, false representation or material concealment in procuring naturalization; (3) residing outside Canada for a period of six years following the naturalization; (4) disloyal acts or speech outside Canada, or, if in Canada, conviction of treason or sedition.

The secretary of state must give advance notice to the naturalized person concerning the proposed revocation and must afford him an opportunity to request that the case be referred for a hearing. If such hearing is requested it is held before a commission of inquiry or, in specially designated cases, before a court. Revocation of a naturalized person's citizenship generally does not terminate the Canadian citizenship derived through him by his wife and minor children unless specially directed or unless the wife of such person files a declaration renouncing her Canadian citizenship or her status as a British subject.

The Canadian Citizenship act also provided specifically that a Canadian citizen is a British subject; that a naturalized citizen shall have full equality with a natural-born Canadian citizen; and that a citizen of any country of the British Commonwealth other than Canada shall be recognized in Canada as a British subject.

OTHER COUNTRIES

Virtually every nation has some provision for the naturalization of aliens. Most countries entrust the authority to grant naturalization to executive officers. In this group in 1951 were: Afghanistan, Albania, Algeria, Australia, Austria, Belgian Congo, Belgium, Bolivia, Brazil, Bulgaria, Chile, Costa Rica, Dominican Republic, Ecuador, Egypt, Finland, France, Germany, Greece, Guatemala, Haiti, Honduras, Hong Kong, Hungary, Iceland, Iraq, Italy, Japan, Madagascar, Monaco, Morocco, the Netherlands, New Zealand, Nicaragua, Norway, Palestine, Panamá, Paraguay, Poland, Portuguese East Africa, Rumania, Salvador, Siam, Spain, Sweden, Switzerland, Syria, Tunisia, Turkey, the Union of South Africa, the U.S.S.R., Uruguay, Venezuela and Yugoslavia.

In still other countries naturalization is granted by the legislature, although in some of these executive officers perform coordinate or auxiliary functions. In 1951 these included Belgium, Bolivia, Paraguay, Rumania, Salvador and Uruguay.

In Belgium and Uruguay the legislature, the executive branch and the judiciary each might award naturalization. Other nations in which naturalization remained a judicial function in 1951 included Algeria, Argentina, Bulgaria, Liberia, Mexico and Spain.

Naturalization laws of the various countries vary as to the requirements for age, residence, eligible classes and other basic qualifications and procedures. A collection of the naturalization laws of each country is found in R. W. Flournoy, Jr., and M. O. Hudson (eds.), *Collection of Nationality Laws of Various Countries, as Contained in Constitutions, Statutes and Treaties* (1929). Some of the important requirements of such laws were summarized in *Research in International Law* (1929), published as special supplement to *American Journal of International Law*, 23:83–100.

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NATURALIZATION OF PLANTS AND ANIMALS,

in the broad sense, is a term applied to the fact that plants or animals may be introduced, artificially or naturally, into a country with a climate the same as or different from that of their original habitat, and may successfully propagate there. What would come to the same thing is the successful persistence and propagation of plants and animals in a country whose climate has undergone some notable change, such as would be involved in the setting in of an ice age or a period of aridity. In this broad usage the term naturalization is practically synonymous with acclimatization (*q.v.*).

But in its narrow usage naturalization means a process by which organisms are changed in the course of generations in adaptation to new climatic conditions in the same or in another country. This usage implies the theoretical postulate of racial adaptation to withstand climatic influences which were at first more or less unfavourable. The establishment of the adaptation might be interpreted by some along Lamarckian and by others along Darwinian lines, and this raises additional theoretical questions.

Thus some investigators, *e.g.*, G. M. Thomson, who find little evidence of acclimatization in the strict sense, prefer to keep the term naturalization, which expresses an indisputable fact that organisms may thrive well when taken to another and in some respects different country.

Effects of Naturalization.—When plants and animals get a footing in a new and different country, what changes may be looked for? (1) There is often a marked increase in the number of individuals in a given area, as is illustrated by the multiplication of the rabbits in Australia, or of greenfinches and skylarks in New Zealand. The reason is twofold: favourable conditions, such as abundant food, may increase the rate of multiplication, and there may be an absence of the enemies and other checks which kept the numbers down in the old country. There have been some costly verifications of the numerical increase that is apt to follow naturalization, as in the familiar case of rabbits in Australia and New Zealand.

(2) Another consequence that has been repeatedly noted is increase in individual size and perhaps vigour. The new conditions prove unusually stimulating. Speaking of plants introduced into New Zealand, G. M. Thomson writes: "Water-cress—a plant of two to four feet in length in European waters—grew in some streams to a length of from 12 to 14 ft., and with stems as thick as one's wrist." This riotous exuberance is due positively to the stimulating conditions of the new territory, and negatively to the absence of the previous checks.

The popular interpretation of the rapid spread of introduced plants, *e.g.*, "weeds," in new countries, is that they come from places where the struggle for existence is keener and where they have therefore become particularly efficient. According to John Christopher Willis, "the real explanation, in all but a very few doubtful cases, is that their spread is due to change of conditions. This has usually been effected by man, who has often altered, or even destroyed, the conditions under which many societies of plants formerly flourished, thus giving a fair field to those newcomers that were suited to the new circumstances."

(3) Many naturalists have concluded that the lessening of the stringency of natural selection after transport to a new country allows an increase in the number of varieties, and the survival of peculiar forms, which would be speedily eliminated in the original environment. Thus, if there are few enemies, one might expect more numerous conspicuous variants, such as albinos. Here the careful work of G. M. Thomson is of great value. In 1891, he concluded that conspicuous colour variations were on the increase

among the rabbits introduced into New Zealand, and also among introduced birds like sparrows, thrushes, blackbirds, skylarks and starlings. Thirty years later he definitely withdrew this conclusion, the fallacy being that he was at first so busy looking for anomalous characters that he met with many, and unconsciously exaggerated the ratio of their occurrence. But inquiry must be made in other fields to see whether there is nothing to be said for the old view.

(4) So many naturalizations have been effected in different parts of the world that one would expect to find it easy to collect instances of change of habit; but there seems to be a strong conservative tendency among animals introduced into new haunts. When domesticated animals are transported to a wilder country there is sometimes an interesting individual rehabilitation of a long lost ancestral trait. Thus cows taken from Scotland to wilder conditions in California have been known to hide their calves in the thicket when they went to graze in the open. Sometimes, however, something novel occurs. Thus, sheep in New Zealand have shown in some places the novel habit of stripping off long pieces of bark from the gaya trees. On the whole it seems that change of habit in consequence of naturalization is infrequent and very gradual.

(5) Some types are quickly at home in a new country, but do not show external change. Horses, rabbits, rats, sparrows and fowls are usually somewhat indifferent to change of climate, while a tough animal like the yak of the Tibetan mountains refuses to thrive below a certain altitude.

Many facts confirm the suggestion that the success or failure of attempted naturalization may depend on inconspicuous constitutional peculiarities. Thus G. M. Thomson notes for New Zealand that the greenfinch and the chaffinch have thriven remarkably, while the allied linnet has failed. "The reasons for these failures are often so obscure that no plausible explanation has yet been given."

A hint of the frequent subtlety of conditions may be found in cases where the attempted naturalization of a plant fails, as of heather in Ceylon, because the associated root-fungus or mycorrhiza will not grow.

(6) When an organismal change directly induced by some change in environment, nutrition or habit, takes such a grip that it persists after the inducing conditions have ceased to operate, it is called a modification, or less conveniently, an individually acquired character. There seem to be some climatic modifications, and the following may be mentioned: (*a*) An Englishman who works half his lifetime under a tropical sun may become so tanned that the deposit of melanin pigment in the skin does not disappear during all the years in which he enjoys his pension at home. Of course it must not be inferred that the blackness of the Negro's skin was directly produced in this way by the tropical sun. (*b*) Karl Naegeli brought some Alpine plants to the Botanical garden at Munich, and there many of them became in the first year so much modified that they were hardly recognizable as the same species. Their descendants in the garden were also quite different from the Alpine originals. Thus the small hawkweeds (*Hieracium*) became large and thickly branched with abundant blossoms. The modifications were very striking, and in some cases many generations were observed—even for 13 years. The reappearance was probably due to the fact that the original modifications were directly reimpressed on each successive crop, for when the plants were removed from the rich garden to poor, gravelly soil, the acquired characters gradually disappeared, and the plants exhibited once more the original Alpine characters. There was no convincing evidence of hereditary entailment.

It is important not to think of these matters too simply. Thus, as Richard B. Goldschmidt points out, the normal development of particular characters, such as general growth and pigment formation, has been "harmonized" for a definite environment. But they have different temperature coefficients, and novel conditions may throw them out of harmony. Moreover, modifications resulting from climatic change must not be thought of as necessarily beneficial. Thus some Lepidoptera tend to melanism in the cold, and others at high temperatures, without there being any demonstrable advantage in either case.

(7) If evidence could be obtained of the hereditary entailment of climatic modifications, this would serve as a basis for a Lamarckian theory of acclimatization. It is necessary to inquire afresh whether there are any facts supporting the Lamarckian interpretation. Bordage records some observations on peach trees (*Prunus persica*) grown from seed of European origin sown in Reunion. For ten years or so the trees shed their leaves as in Europe. Later on, after 20 years, a considerable degree of evergreenness was exhibited. There was no bare period. When seeds of these partial evergreens were sown in the lowlands they grew into trees verdant throughout the year, but the same was true of seeds sown in certain mountainous districts with a considerable degree of frost. They also grew up into young peach trees which were also evergreen. But European seeds sown in similar situations developed into ordinary deciduous trees. This is a peculiar case and may be interpreted as follows: The original imports underwent a gradual constitutional change—some modification of their metabolism; this might affect the constitution of the seed during the period when it was still part and parcel of the parent's body. The change in the metabolism might result in the affected seeds developing into evergreens, though the direct environmental influence would work in the opposite direction. It is unfortunate that the observations were not carried further.

A famous case, often referred to, is that of the feral horses of the Falkland Islands, which Charles Darwin studied on his "Beagle" voyage (1833). He says that the horses and also the cattle were introduced by the French in 1764. Whereas the cattle are large, the horses are small, and Darwin speaks of them as "having degenerated." "They have lost so much strength that they are unfit to be used in taking wild cattle with the lazo: in consequence, it is necessary to go to the great expense of importing fresh horses from the Plata. At some future period the southern hemisphere probably will have its breed of Falkland ponies, as the northern has its Shetland breed." Darwin regarded the degeneration of the Falkland Islands horse as due to the humid climate and the lack of suitable food, but it is difficult to believe that marked changes were effected between 1764 and 1833. It would be necessary to know more about the horses originally imported.

Various statements have been made in regard to changes brought about in the hair of sheep, goats, cattle, sheep dogs and even cats, when these animals are taken to a more rigorous climate. It is said that the fur becomes longer and thicker, which would be a useful adaptation. But there is a lack of precision in these statements, and a regrettable absence of measurements. It would be useful to know what additions were made to the coat after the climatic change; whether the offspring, exposed to the cold from birth, showed further additions; and the character of the fur in the grand-offspring. As regards modifications, no inference can be drawn from the occurrence of adaptive peculiarities, unless the history is known.

On the whole we are forced to the conclusion that the evidence of the heritability of climatic modifications is unsatisfactory.

Naturalization in the Past.—All the world over there are instances of related species flourishing under different climatic conditions, and few evolutionists have any hesitation in regarding these as the outcome of divergent evolution. It may be recalled that while Darwin did not think much of man's achievements in naturalization, he had no doubt as to nature's powers in this direction.

Three saving-clauses should be kept in mind: (*a*) when two nearly related species are thriving in climatically different surroundings, it should not be taken for granted, as it usually is, that all their differences are now part and parcel of the inheritance. Some of the differences may be modificational, hammered on each successive generation in the course of development. There is need for more experimental study of species. (*b*) There has been a tendency to strain the interpretation of specific characters as adaptive to particular conditions of life, such as those implied in climate. Many characteristics separating related species in different localities may be reasonably interpreted as climatic

adaptations, but each case should be carefully judged on its merits. (*c*) When a species is extending its range in consequence perhaps of increasing numbers, the factor of isolation may come into operation, say in the form of a river or a watershed, and variations may be separated off which have no particular relation to the new territory or climate in which the leaders of the advance find themselves. Thus new species may arise by the physical segregation of diversely varying contingents of an advancing army, till the climatic difference itself may become an isolating factor.

Accepting, with these saving-clauses, the idea of naturalization, we must now ask how it may have been effected. The Lamarckian answer involves the postulate of the transmissibility of modifications, especially of functional modifications; and the evidence of this, summed up by Paul P. R. Kammerer (1924) and by Ernest William MacBride (1924), appears inconclusive. The interpretation which seems to involve fewest assumptions is that of Darwin. In discussing naturalization (1868), Darwin laid most emphasis on the natural selection of spontaneous variations. As to these variations he expressly says "there is no evidence that a change in the constitution of the offspring necessarily stands in any direct relation with the nature of the climate inhabited by the parents." In regard to selection he lays emphasis on two points: (*a*) the organism's power of resistance to difficult conditions in the new climate, and (*b*) some useful change in the period of reproduction, such as earlier flowering and fruiting.

To Darwin's interpretation an addition may be suggested. It is conceivable that the climatic peculiarities may affect the metabolism of the organism through and through, and may thus serve as stimuli to the variability of the germ cells. If the climatic peculiarity should induce (*a*) an adaptive modification in the body of the organism and (*b*), at the same time, a variation in the germ cells which finds expression as a similar new character in the offspring, the phenomenon is called "parallel induction." It must be distinguished theoretically from the transmission of a somatic modification; it is a change induced in the germ cells along with, but not through, the bodily modification (*see* EVOLUTION, ORGANIC).

But it is possible that climatic peculiarities may penetrate into the germ cells and affect them without producing any modification in the body. Thus W. L. Tower subjected full-grown potato beetles (*Leptinotarsa*) to peculiar conditions of temperature and humidity during the time when the eggs were maturing, and found that "mutations" occurred in a certain proportion of the offspring. The parents were not affected, having passed the plastic stage; and some of the eggs were not affected at all. Moreover, the same environmental peculiarity, analogous to a climatic change, did not always evoke the same mutation. Some of the mutations in colour and markings were very striking; others affected minute details of structure. In subsequent generations there was no reversion. This case is of particular interest in connection with naturalization, for the artificial environmental conditions, effected in large steel and glass cages, were comparable to different climatic conditions in which different species of potato beetle live.

By Hermann J. Muller in particular it has been shown that an exposure of the germ cells of the fruit-fly (*Drosophila melanogaster*) to appropriate doses of X-rays is followed by numerous mutations, which often breed true. This experimental irradiation illustrates the possible action of the environment as a variational stimulus. A mutation following a climatic change might have this origin. As August Weismann said many years ago (1904): "It does not seem impossible that the climate may have a variational influence upon certain determinants of the germ-plasm, for we have already seen that the influence of cultivation may incite plants and animals to hereditary variations, and that slowly increasing disturbances in the equilibrium of the determinant system may thereby be produced, which may suddenly find marked expression as 'mutations.' But there is little probability that *adaptations*, that is, transformations corresponding to the altered climate, can arise in this way!" The meaning of this last sentence is that Weismann believed these adaptations were the outcome of the prolonged natural selection of fluctuating variations in the germ-plasm.

The Darwinian theory, as applied to naturalization may be briefly resumed in more technical terms. In any species in any given environment there will be an observable percentage of variations from type in a given number of births, and these variations yield a curve of frequency or probable error. The steepness of the curve is a measure of the variability of the species. The aberrants on all sides are pruned off by selection. If the environment is changed, selection may no longer operate on the same axis as before, but may tend to prune off variations on one side of the mean more than on another. In the course of time, the apex of the curve, representing the type form, will shift to suit the new conditions, since more of the aberrants on the favoured side will live to reproduce.

Quite a separate question is this: that the new environment may increase the variability of the species, flattening the curve of probable error. The effect of this is that selection has more material to work with, and therefore attains its end more rapidly, although of the variations appearing as many will be unfavourable as favourable. A species in which there is little variation presents a greater inertia to the shifting effect of altered climatic conditions than a variable species. In the less variable species there will be relatively fewer favourable variations to mate with the type.

William Bateson's Silliman Lectures contain a valuable criticism of the somewhat facilely accepted views (*a*) that local and climatic varieties are adaptational, (*b*) that the influences of environment have directly led either to the production of these varieties or to their selective stabilization, and (*c*) that there is gradual transition—or mass transformation—from one species to another in response to climatic influences. Bateson lays much emphasis on the role of isolation and on the intrinsic character, *e.g.*, Mendelian dominance of the sporadic variations that are of frequent occurrence.

Of importance in connection with naturalization is Erwin Baur's study of cultivated snapdragons, especially *Antirrhinum majus*. He finds a frequent occurrence of small mutations, transmissible in Mendelian fashion, often showing themselves in "pure lines," and sometimes suggesting an enhancement of vigour, as when a mutant appears with deeper green in its leaves. According to Baur wild species of snapdragon, like garden races, have often arisen by the summation of small mutations (*see* EVOLUTION, ORGANIC; GENETICS OF POPULATIONS).

Change of Climate.—So far we have considered what may happen when organisms are naturalized, perhaps acclimatized, in a new and different environment. But similar biological problems are raised when we think of the changes that occur or have occurred in the fauna and flora of a country after some drastic alteration of the climate—toward aridity or humidity, toward markedly higher or lower temperature. To what extent have changes of climate functioned as factors in organic evolution?

(1) In extreme cases, as when a country is covered with glaciers, there may be an almost complete elimination of life, as happened over the greater part of Britain during the quaternary glacial periods.

(2) In less severe conditions the gradual setting in of unfavourable climatic conditions would exert a selective influence. Thus xerophytic plants would tend to survive when arid conditions encroached; quickly flowering and fruiting plants, entrenched below ground in winter, with reserves in rhizome and bulb, would tend to survive when the snow began to cover the ground for many months of the year. In a country becoming warmer there might be survival value in aestivation; in a country becoming colder the advantage might be with the hibernators. In scores of ways a gradual change of climate would sift the fauna and flora.

(3) Some animals able to move about for considerable distances and not too slowly would be prompted by climatic changes to shift their quarters. As the severity of the ice ages spread southward in Europe, many northern mammals came with it; thus remains of reindeer, lemming and arctic fox are found in deposits far to the south. As milder climates set in and the glaciers melted, the descendants of some of the arctic types, like reindeer and white fox, were able to trek for the north. Some, however, remained as refugees on the mountains, like the snow vole (*Microtus nivalis*) of the high Alps. Some of the true bird migrations may owe their origin in part to distant climatic changes such as those of the quaternary ice ages (*see* BIRDS, MIGRATION OF; MIGRATION OF ANIMALS).

(4) It is reasonable to suppose, though difficult to prove, that change of climate in a country induced important changes of habit. Thus Barrell and Richard Swann Lull have suggested that continental elevation and consequent aridity, especially in the Himalayan region, led in the Miocene or early Pliocene ages to a dwindling of the forested area where man's ancestors were at home. The alternatives

were to find other forests in warmer countries, as the present-day anthropoid apes did, or to be eliminated, or to come to earth and begin afresh on a new line of life. The last solution may have been of critical moment in the evolution of Hominoids.

(5) Climatic changes in a country may also have played an important part in punctuating the life history. A kind of variation which has not received adequate attention may be called "temporal." It includes alterations in the tempo, or rate, or rhythm of metabolic processes, or in the duration of particular phases in the life history. In vertebrate animals, at least, this might be brought about by variations (also, of course, requiring to be accounted for somehow) in the secretory activity of the ductless or endocrinal glands, the hormones of which serve now as accelerators and again as brakes. The life histories of many types differ from one another in the shortening or lengthening of particular arcs on the life curve or trajectory. Here is a kind of evolution to which climatic variations may have applied a frequent spur. Thus, when the rate of development was such that the life cycle could not be completed in the first summer, there would be a tendency to favour variations in the direction of interpolating a larval phase, as in insects, suited for an accumulation of reserves, a reduced intensity of life in cold weather, a diminished exposure of vulnerable surface, and so on. Opinions may differ in regard to particular cases, but it is a legitimate and instructive inquiry to associate temporal variations in the life curve with seasonal and with climatic periodicities.

The Arctic tundra is marked by a long dark winter of bitter cold and a short nightless summer of intense illumination, therefore it is reasonable to postulate a prolonged process of elimination as the climate changed—an elimination of those types which did not vary in the direction of quick-flowering and quick-fruiting, dying down in winter, dispensing with all but a little water and accumulating stores in underground parts.

Among the features of the life curve that may be tentatively associated with climatic changes, the following may be suggested—the length of the mammalian gestation and the season for giving birth; the periodicities of migrating birds; the interpolation of periods of winter sleep, rest, coma, lethargy and even de-differentiation. Every trajectory of life should be looked at in the light of the evolution of climates.

Often in the history of the earth a change toward great cold has involved severe elimination. In humid periods there tends to be abundant succulent fodder for browsing animals and extensive forests affording shelter. Diminution of moisture, if it does not go too far, favours the increase of grasses and of grazing animals. Aridity makes the forests shrink and prompts the search for new haunts. The times of quickening, the "expression-points" or "pulsations" of evolution, may often be correlated with climatic changes, chiefly in temperature and humidity, due sometimes to topographic, at others to general atmospheric, conditions. Behind these, again, lie larger factors still, such as shrinkages of the earth's crust.

Interaction of Endemic and Introduced Faunas.—The newcomers may destroy the indigenous or previously naturalized forms. Thus the mongoose, introduced into Jamaica, destroyed the indigenous "cane-rats" and the alien ship-rats. The introduced animals may become so numerous that they make life difficult for their predecessors though they do not actually devour them. They may, for instance, seriously reduce the food supply, but they may be prejudicial with varying degrees of directness. When the brown rat (*Rattus norvegicus*) found its way to Britain in the early 18th century, it proved itself hardier, more plastic and more fecund than the black rat (*Rattus rattus*), with the result that in 50 years the latter was almost exterminated except in places where it was continually being reintroduced by ships.

Sometimes the influence is more subtle. Thus, an extension of squirrels into an area may be followed by the reduction of the number of wood-pigeons. There does not seem at first sight any intersection of the two lives; but squirrels, though largely vegetarian, cannot resist killing and eating the young squabs in the nest; and this is, from the farmer's point of view, a useful check.

The introduction of an animal into a new country may involve the introduction of its parasites; thus rats harbour rat-fleas which disseminate bubonic plague, and it is from rats that pigs, and thence men, become infected with the disease of trichinosis, which is due to *Trichinella spiralis*, a small nematode. Many of these interrelations are very subtle; thus the problem of getting rid of Bilharziasis in Durban is easier than it is in Japan, for in South Africa the only host of the adult parasite is man, whereas in Japan it also occurs in cattle. In both countries the juvenile stages are spent in various water snails, and their abundance or rarity in turn is correlated with the presence of water birds which feed upon them and of water plants on which they feed.

The Case of New Zealand.—The peculiar value of New Zealand in reference to the problems of naturalization is that the introduction of the majority of the nonindigenous larger animals is more or less definitely known; *see* G. M. Thomson's masterly study: *The Naturalization of Animals and Plants in New Zealand* (Cambridge, 1922).

Apart from two species of bats, it is doubtful if there are any indigenous mammals in New Zealand; but 48 species have been introduced, 44 purposely and 4 accidentally. The 4 comprise the mouse and 3 rats, one of which, the Maori rat (*Mus exulans*), disappeared after European settlement began. Twenty-five of the 48 species of mammals are at present well-established and feral in certain districts—wallaby, common opossum, sooty opossum, pig, horse, various deer, cattle, sheep, goats, chamois, cat, ferret, stoat, weasel, black rat, brown rat, mouse, rabbit, hare and hedgehog.

About 130 species of birds have been purposely introduced into New Zealand since the date of Captain James Cook's landing, and 24 have become truly wild, such as mallard, pheasant, pigeon, skylark, thrush, blackbird, hedge sparrow, rook, starling, Indian mynah, house sparrow, chaffinch, goldfinch, greenfinch and yellowhammer.

On the other hand, since 1868, nine species of birds have become either very rare or extinct, such as native crows, huia, native thrushes, the burrowing parrot *Stringops*, the native quail and the white heron. Others, once abundant, have been driven back into areas where there has not been much settlement. As to the causes, Thomson writes: "It must not be supposed that it is the introduced animals alone which have produced this effect, even though rats, cats, rabbits, pigs, cattle, stoats and weasels, as well perhaps as some kinds of introduced birds, have penetrated beyond the settled districts. It is largely the direct disturbance of their haunts and breeding-places, and the interference with their food supply, which has caused this destruction and diminution of the native fauna."

What is true for birds holds also for lower animals, from lizards to insects; but again the reasons are to be found in human intervention rather than in direct competition with newcomers. This is corroborated by the fact that there were some notable cases of increase after about the 1870s. Thus the bellbird has become abundant in the South Island, though scarce in the North Island; and the harrier has greatly increased, perhaps in relation to the abundance of young rabbits. The wax-eye or blight bird (*Zosterops coeruleus*) has apparently increased greatly since first recorded in 1832, perhaps in relation to the supply of animal food about houses and stockyards. The case of the long-tailed cuckoo (*Urodynamis taitensis*) is interesting as an illustration of the complexity of interrelations. It seems to have become increasingly numerous after the 1890s and this is attributed to the increase of small European birds, whose eggs and young it eats, and also to the food afforded in and about trout hatcheries.

Method of Naturalization.—What should man do when he wishes to naturalize a valuable plant or animal in a new and markedly different country? If trial has shown that naturalization is not easy, the transporter should work with those varieties which seem most likely to be suitable. Attention should also be paid to the quality of variability, for some stocks are much more fixed than others. It may be useful to transport individuals of the most promising stocks to some intermediate station, where selection may be made among the variations that continue to arise. Darwin noted that "Merino sheep bred at the Cape of Good Hope have been found far better adapted for India than those imported from England." (*Variation,* p. 305 [1868].) In cases where success in the new country seems to depend on the possession of a particular character, such as thick fur or woolly leaves, the variants selected would be those tending most markedly in that direction, but Mendelian methods might enable the breeder to "graft" on to the tentative imports the desirable character in question if it existed elsewhere in an allied race. By more systematic selection of heritable variations and by Mendelian hybridizing, it seems likely that the process of acclimatization might be greatly extended and hastened.

Willis notes that man has often failed in naturalization by attempting too much abruptly. Learning from failure, he is now trying gradual transitions, "as in the way he has treated Liberian coffee in Java, taking the seed of successive generations a few score yards higher up each time, till he has persuaded the tree to do well at a much higher elevation than that to which it is naturally suited." The attempts to acclimatize the beautiful *Cyperus papyrus* in the Ceylon Botanic garden failed when seed from Europe was used, but seed from Saharanpur in India succeeded at once. The moral is that man must moderate his impatience and take a hint at least from nature's operations by small steps throughout long periods.

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(J. A. TH.)

NATURAL LAW, in science, means the formulation of some uniform characters or connection of things or events; but it is frequently used for the uniformity itself as it exists in natural phenomena. Any such uniformity may be called a natural law; *e.g.*, all the laws formulated in physics and chemistry. On the other hand the term "law of nature" is sometimes restricted to irreducible or ultimate laws (like the law of gravitation), as distinguished from derivative laws (like Johann Kepler's three laws of planetary motion). *See* LAW (in science, etc.); SCIENTIFIC METHOD; J. S. Mill, *System of Logic* (1875, etc.).

NATURAL RESOURCES, CONSERVATION OF: *see* FISH AND WILDLIFE SERVICE; GAME RESERVES; NATIONAL PARK SYSTEM, THE; WILDLIFE RESERVES.

NATURE. In the history of philosophy the term "nature" has been used in various inconsistent senses, corresponding more or less to the different attitudes which thinkers adopted toward the material part of the world in relation to the rest. The early Greek thinkers known as the hylozoists were not conscious of any fundamental difference between mere matter, on the one hand, and life and consciousness on the other. For them, accordingly, "nature" (φύσις) included everything that is, or that ever came into being (Latin *natura* from *nasci*, to be born). Later on the Sophists contrasted the "natural" with the "conventional," or that which anything is originally and what it is as the result of human intervention. In this way they and others described as conventional not only law and custom, but even colours and other secondary qualities in contrast with matter and motion. Thus the "natural" came to be contrasted with the "human" and, of course, the superhuman. Then owing partly to the influence of Plato, and partly to the influence of Christianity, it became customary to set body and mind (to say nothing of Platonic "Ideas," the "Good," and God, etc.) sharply against one another, and to identify "nature," or "the world and the flesh," with the material part of the universe only. This is one of the reasons for the rather common tendency to identify "naturalism" with materialism. With the Renaissance there came a more friendly attitude toward the material world, and the older Greek conception of "nature" was revived. And so in due course we find in Giardano Bruno and Benedictus de Spinoza, among others, the term "nature" used in the all-comprehensive sense of the entire universe—a sense which, of course, excluded the possibility of anything "supernatural." Hence the other meaning of the term "naturalism," merely as the antithesis to "supernaturalism" in science and philosophy. For the conception of nature in recent science *see* A. N. Whitehead, *The Concept of Nature* (1920).

NATURE RESERVES: *see* WILDLIFE RESERVES.

NAUGATUCK, a borough of New Haven county, Connecticut, U.S., land area 16.6 sq.mi. on the Naugatuck river, 15 mi. N.W. of New Haven. It is served by the New York, New Haven and Hartford railroad, and there is an aviation field 6 mi. from the business district. Pop. (1950) 17,455; (1940) federal census, 15,388 (19.1% foreign born white). The principal public buildings, including a fine high school, are grouped around the central green. A mile to the north is the 18th-century Porter tavern, and 2 mi. S. is the Collins tavern (1810), a noted stopping place on the stage-coach route between New Haven and Litchfield. The manufacture of rubber goods (including 100,000 pairs of shoes and boots daily) is the leading industry, and one of the largest rubber-regenerating plants in the world is situated there. Other important products are chemicals, candies, malleable iron castings, copper floats, aircraft instruments, glass, mirrors, plastics, chains, cosmetic containers and drawn metal components. Naugatuck was the home of Charles Goodyear who in 1839 invented the process of vulcanizing rubber. The city's name is an Algonquin word meaning "one tree."

NAUHEIM or **BAD-NAUHEIM,** a watering place of Germany, in the *Land* of Hesse, situated on the northeast slope of the Taunus mountains, 24 mi. by rail N. of Frankfort-on-Main on the main line of railway to Cassel. Pop. (1939) 12,981. Nauheim, which was bestowed by Napoleon upon Marshal Louis Davout, became a town in 1854. From 1815 to 1866 it belonged to the electorate of Hesse-Cassel, but in 1866 it was ceded to the grand-duchy of Hesse-Darmstadt. Its thermal waters (84° to 95° F.), although known for centuries, were, prior to 1835, only employed for the extraction of salt. The waters, which are saline, strongly impregnated with carbonic acid, and to a less extent with iron, are principally used for bathing, and are specific in cases of gout and rheumatism, but especially for heart affections. Three smaller springs, situated outside the Kurpark, supply water for drinking. In 1899–1900 a new spring (saline) was tapped at a depth of 682 ft. Another attraction of the place is the Johannisberg, a hill 773 ft. high, overlooking the town.

NAUKRATIS, an ancient Greek settlement in Egypt. The site was discovered by Prof. W. M. Flinders Petrie in 1884, on the eastern bank of a canal, about 10 mi. W. of the present Rosetta branch of the Nile. In ancient times it was approached by the Canopic mouth, which was farther to the west. The identification of the site is placed beyond doubt by the discovery of inscriptions, with the name of the town, and of great masses of early Greek pottery. The site was excavated in 1884–86 by the Egypt Exploration fund, and a supplementary excavation was made by the British school at Athens in 1899. A list of the temples of Naukratis is given by Herodotus (ii, 178); they were the Hellenion, common to all the colonizing cities, and those dedicated by the Aeginetans to Zeus, by the Samians to Hera and by the Milesians to Apollo. A temple of Aphrodite is also mentioned by Athenaeus. Traces of all these temples, except that of Zeus, or at least dedications coming from them, have been found in the excavations, and another has been added to them, the temple of the Dioscuri. In addition to these temples, there was also found a great fortified enclosure, about 860 ft. by 750 ft., in the southeastern part of the town; within it was a square tower or fort. A portico of entrance and an avenue of rows of sphinxes was added in Ptolemaic times, as is shown by the foundation deposits found at the corners of the portico; these consisted of models of the tools and materials used in the buildings, models of instruments for sacrifice or ceremonies, and cartouches of King Ptolemy Philadelphus. David George Hogarth subsequently found traces of another great walled enclosure to the northeast of the town, together with pottery dedicated *τοῖς τῶν Ἑλλήνων θεοῖς*, and he claims with reason that this enclosure is more likely than the other to be the Hellenion.

Apart from the historic interest of the site, as the only Greek colony in Egypt in early times, the chief importance of the excavations lies in the rich finds of early pottery and in the inscriptions upon them, which throw light on the early history of the alphabet. There are clear traces of a settlement going back to the 7th century, including a scarab factory, and yielding fragments of early Greek pottery. It seems a fair inference that the makers of these were Greeks, and that they probably represent the early Milesian colony, settled here in the time of Psammetichus I.

NAULETTE, a large cavern on the left bank of the Lesse, which joins the Meuse above Dinant, Belgium. Here in 1866 Edouard Dupont discovered an imperfect human lower jaw, now in the Brussels Natural History museum. It is of a very apelike type in its extreme projection and that of the teeth sockets (teeth themselves lost), with canines very strong and large molars increasing in size backward. It was found associated with the remains of mammoth, rhinoceros and reindeer. The Naulette man is now assigned to the Mousterian Epoch.

See G. de Mortillet, *Le Préhistorique* (1900); J. Dechelette, *Archéologie*, vol. i, p. 281 (1912).

NAUMACHIA, the Greek word denoting a naval battle (*ναῦς*, ship, and *μάχη*, battle), used by the Romans as a term for a mimic sea fight. These entertainments took place in the amphitheatre, which was flooded with water, or in specially constructed basins (also called *naumachiae*). The first on record, representing an engagement between a Tyrian and an Egyptian fleet, was given by Julius Caesar (46 B.C.) on a lake which he constructed in the Campus Martius. In 2 B.C. Augustus, at the dedication of the temple of Mars Ultor, exhibited a naumachia between Athenians and Persians, in a basin probably in the *horti Caesaris*, where subsequently Titus gave a representation of a sea fight between Corinth and Corcyra. In that given by Claudius (A.D. 52) on the *lacus Fucinus*, 19,000 men dressed as Rhodians and Sicilians manoeuvred and fought. The crews consisted of

gladiators, condemned criminals, and in later times, volunteers.

See Games, Classical; Panathenaea; Rome: *Ancient City.*

NAUMBURG, a town in the *Land* of Saxony, Germany, the seat of the provincial law courts and court of appeal for the province and the neighbouring districts. It is situated on the Saale, near its junction with the Unstrut, 29 mi. S.W. from Halle, on the railway to Weimar and Erfurt. Pop. (1939) 36,310. In the 10th century Naumburg was a stronghold of the margraves of Meissen, who in 1029 transferred to it the bishopric of Zeitz. In 1564 the last bishop died, and the bishopric fell to the elector of Saxony. In 1631 the town was taken by Tilly, and in 1632 by Gustavus Adolphus. It became Prussian in 1814. The cathedral, a building in the Romanesque Transition style (1207–42), has a Gothic choir at each end, and contains some mediaeval sculptures. It is remarkable for its large crypt and its towers.

NAUNDORFF (or Naündorff), **KARL WILHELM** (d. 1845), French pretender, claimed to be the dauphin, Louis Charles son of Louis XVI and Marie Antoinette, who was announced as having died in the Temple in 1795.

Naundorff, who had arrived from nowhere in Berlin in 1810, with papers giving the name Karl Wilhelm Naundorff, in order to escape the persecutions of which he declared himself the object, settled at Spandau in 1812 as a clockmaker, and married in 1818 Johanna Einert. In 1822 he removed to Brandenburg, and in 1828 to Crossen, near Frankfurt. He was imprisoned from 1825 to 1828 for coining, though apparently on insufficient evidence, and in 1833 came to push his claims in Paris, where he was recognized as the dauphin by many persons formerly connected with the court of Louis XVI. Expelled from France in 1836, the day after bringing a suit against the duchess of Angoulême for the restitution of the dauphin's private property, he lived in exile until his death at Delft on Aug. 10, 1845, and his tomb was inscribed "Louis XVII, roi de France et de Navarre (Charles Louis, duc de Normandie)."

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NAUPLIA, a town in the Peloponnesus, at the head of the Argolic gulf, the seaport of the plain in which Argos and Mycenae are situated, with several tombs of the Mycenaean age. A hero Nauplius took part in the Argonautic expedition; another was king of Euboea. In classical times it was of no importance, and Pausanias, about A.D. 150, found it deserted. The mythic importance of the town revived in the middle ages, when it became chief city of the Morea. It was captured in 1211 by Godfrey Villehardouin with the help of Venetian ships; a French dynasty ruled in it for some time, and established feudalism. In 1388 the Venetians bought Argos and Nauplia. In the wars between Venice and the Turks it often changed masters: given to the Turks in 1540, it was recaptured by Venice in 1686, and the Palamidhi hill overhanging the town was fortified. In 1715 it was taken by the Turks; in 1770 the Russians occupied it for a short time. The Greeks captured it during the War of Independence on Dec. 12, 1822, and it was the seat of the Greek administration till 1833, when Athens became the capital of the country. It is the chief town of the department of Argolis. Population is 7,600.

NAURU: *see* Pacific Islands.

NAUSICAA, in Greek legend, daughter of Alcinous, king of the Phaeacians in the island of Scheria (*Odyssey*, vi, 15–315, viii, 457). When Odysseus (*q.v.*) swam ashore to Scheria, he was found by Nausicaa, who supplied him with clothes and took him to her father's palace, where he was hospitably entertained.

NAUTCH, an Indian ballet dance (Hindostani *nach*). The nautch is performed by nautch girls, who scarcely move their feet, and the dance consists of swaying and posturing with the arms.

NAUTILUS, the name given by the ancient Greeks to a cephalopod mollusc, *Argonauta argo* (the paper nautilus). Carl von Linné, however, applied it as a scientific designation to another cephalopod, the pearly nautilus of eastern seas, and named the "nautilus" of the Greeks, *Argonauta.* The structure and zoological position of the pearly nautilus are discussed in the article Cephalopoda. It is represented at the present time by four species, which are restricted to the area between the Fiji and the Philippine Islands. It usually lives near the sea bottom at considerable depths, though at night it comes into shallow water where it is caught for food by the natives.

The paper nautilus (*Argonauta*) is found in practically all subtropical and tropical seas. Although it has been taken from depths of more than 500 fathoms it is characteristically found at the surface. It is placed along with a few other genera in a separate family of the Octopoda or eight-armed cephalopods. The genus is characterized by several very peculiar features. In the first place the male *Argonauta* is very much smaller than the female, the latter in certain cases being as much as 15 times the size of the male. Like the rest of the Octopoda the male *Argonauta* lacks an external shell, but the two dorsal arms of the female secrete a calcareous shell which is unique in the mollusc phylum. Its origin from the arms is unlike that of the shell of other molluscs which is developed from the mantle. Moreover this shell is used as a receptacle for the eggs and in it they are incubated until the young are hatched out.

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NAUVOO, a city of Hancock county, Ill., U.S.A., on the Mississippi river about 50 mi. above Quincy. Pop. (1950) 1,242.

Nauvoo is the centre of a large grape and wine industry, and has a factory which manufactures blue cheese. An annual "grape festival" features a "wedding of the wine and cheese" similar to that held in Roquefort, France. "Commerce city" was laid out here in 1834 by Connecticut speculators; but the first settlement of importance was made by the Mormons (*q.v.*) in 1839–40; they named it Nauvoo, in obedience to a "revelation" made to Joseph Smith, and secured a city charter in 1840. The Mormons said the name was of Hebrew origin and meant "beautiful place"; Hebrew "naveh" means "pleasant." In 1844 its population was about 15,000, and a large Mormon temple had been built, but internal dissensions arose, "gentile" hostility was aroused, the charter of Nauvoo was revoked in 1845, two of the leaders, Joseph Smith and his brother Hyrum, were killed at Carthage, the county-seat, by a mob, and in 1846 the sect was driven from the state. Traces of Mormonism remain in the many old Mormon homes, including Prophet Joseph Smith's and Brigham Young's. Three years after the expulsion of the Mormons, Nauvoo was occupied by the remnant (about 250) of a colony of French Communists, the Icarians, who had come out under the leadership of Étienne Cabet (*q.v.*). For a few years the colony prospered, and by 1855 its membership had doubled. Each family occupied its own home, but property was held in common, all ate at the common table, and the children were taught in the community school. A proposal to revise the constitution resulted in rending the colony into two irreconcilable factions, and in Oct. 1856 Cabet with the minority (172) withdrew to St. Louis, Mo. Soon after the schism of 1856 those who had rebelled against Cabet began to prepare a permanent home in Adams county, Iowa. There too in 1879 the community split into two factions, the Young Party and the Old Party. Most of the Young Party removed to Sonoma county, Calif., and here early in 1884, formed the Icaria-Speranza community. All branches of the society ceased to exist after 1895. A state park commemorating the role of the Mormons and Icarians in Illinois history was dedicated in 1950.

See Albert Shaw, *Icaria: A Chapter in the History of Communism* (1884); J. Prudhommeaux, *Icaria et son fondateur Étienne Cabet* (1907).

NAVAHO, an Athabascan people in northern Arizona and New Mexico, situated between the various Pueblo Indians. They are first mentioned about 1630; they may have been met by the Spaniards before this without being distinguished from the

Apache. They are probably an Apache division in origin, specialized through contact with the Pueblos. Their territory comprises the heart of the prehistoric Pueblo area about Chaco canyon and other affluents of the San Juan river; but they never adopted the masonry houses, sedentary life, or, except to a limited extent, the agriculture of the Pueblos. For several centuries they raided these people and the Spanish-Mexican colonists, drove off their stock and gradually acquired herds of horses, cattle, goats and especially sheep, from which their living is still largely derived. They are noted for their blankets and silver work. Their great ceremonies last nine days. The Navaho are matrilineal, their 50–60 clans bearing the names of localities but being exogamous. Their houses are of stick and earth covered on a foundation of logs; they make very little pottery and basketry. The original population was probably only a few thousand; it is thought to have reached 9,000 in 1869 and was estimated at approximately 61,000 in 1947 by the bureau of Indian affairs.

NAVAL AND MILITARY SCIENTIFIC SOCIETIES. The *Royal United Service Institution*, first known as the *Naval and Military Library and Museum* (1831), became the *United Service Institution* in 1839, and was incorporated in 1860; its professional museum is housed in the banqueting hall at Whitehall; it publishes a *Journal* (1857 *et seq.*). The *Institution of Naval Architects* (1860) publishes *Transactions*, 4to, (1860 *et seq.*). The *Royal Artillery Institution* (1838), which issues the *Royal Artillery Journal*, is at Woolwich, and the *Institution of Royal Engineers* (1875), which issues the *R. E. Journal*, at Chatham. The *Navy Records Soc.* (1893) publishes works connected with the history of the British navy. CANADA: Toronto, *Military Inst.* INDIA: Simla, *United Service Institution.*

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NAVAL ARTICLES. The subject of navies generally is dealt with in the article NAVY AND NAVIES.

The navies of the various nations are dealt with under the name of each nation, but separate articles have been allotted to the various types of warships; *e.g.*, AIRCRAFT CARRIERS; BATTLESHIP; CRUISER; DESTROYER; FLEET AUXILIARY VESSELS; SUBMARINE.

Historical aspects are under NAVY AND NAVIES; GREAT BRITAIN; UNITED STATES; WORLD WAR I: *Naval;* WORLD WAR II: *The War at Sea;* while important operations or engagements, such as ARMADA; COPENHAGEN; CORONEL; DARDANELLES CAMPAIGN; DOGGER BANK; DUTCH WARS; FALKLAND ISLANDS, BATTLE OF; FIRST OF JUNE; FRENCH REVOLUTIONARY WARS; JUTLAND, BATTLE OF; NAPOLEONIC CAMPAIGNS; NAVARINO; NILE, BATTLE OF THE; QUIBERON; SAINTS, BATTLE OF THE; SEVEN YEARS' WAR; ST. VINCENT, BATTLE OF; TOULON; TRAFALGAR, are found under their appropriate headings. For a more general study of naval warfare, *see* articles on BLOCKADE; COAST DEFENSE; CONVOY; DOCKYARDS AND NAVAL BASES; FUELLING STATIONS; NAVAL STRATEGY AND TACTICS; SEA POWER.

Technical articles in addition to those dealing with each of the various types of ships include ANCHOR; ARMOUR PLATES; BUOY; CABLE; CAMOUFLAGE; CAPSTAN; CHRONOMETER; FIRESHIP; FLEET, NAVAL; FRIGATE; GALLEY; GUNNERY; LOG, MARITIME; MINES (NAVAL); ORDNANCE; PARAVANE; PILOTAGE; PILOTAGE LAWS; RANGE FINDERS; RULE OF THE ROAD AT SEA; SEAMANSHIP; SHIP; SHIPBUILDING; SHIPS' FIGUREHEADS; TORPEDOES; WASHINGTON TREATY.

Administration and personnel will be found dealt with under ADMIRAL; ADMIRALTY; CAPTAIN; COURT-MARTIAL; MARINES; MEDICAL SERVICE, NAVY; MIDSHIPMAN; PRESS GANG; STAFF, NAVAL; UNIFORMS.

NAVAL STORES, a trade name for the products derived from the oleoresin (gum or pitch) of the pine tree. As originally used the term included all raw materials used in building and maintaining sailing vessels, as, for instance, tar, pitch, rosin, flax, cordage, masts and timber. The possibility of obtaining a source of supply for these materials independent of Russia and the Dutch traders had considerable influence upon the British in establishing the colonies in Virginia. Flax, cordage and lumber are no longer classed as naval stores. The term embraces turpentine, rosin, pine oil, pine tar, pine tar oil, pitch and rosin oil. Charcoal from the destructive distillation of "lightwood" and pine needle oil are sometimes included but are not generally considered to be true naval stores products. The former is made from the wood and not from the oleoresin of the tree and the latter is an essential oil usually classed under drugs and chemicals.

Approximately 50% of the world's production of naval stores comes from the United States, 15% from France, 10% each from Russia and Portugal, with smaller amounts from Spain, Greece, Mexico and a few other countries. The United States naval stores crop is all produced in the southern pine belt which includes North and South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and a small part of Texas. U.S. naval stores for years were produced from the long leaf pine (*Pinus palustris* or *Pinus australis*). Now that the virgin forests have been cut, these products are obtained from second growth which is chiefly slash or Cuban pine (*Pinus caribaea*). The French source of naval stores is the maritime pine (*Pinus pinaster*) in the Landes.

There are four distinct methods of manufacture, and the products therefrom vary widely in their characteristics. The largest amount of naval stores is produced by the gum method. The trees are "chipped" and the oleoresin which exudes from the wood in order to heal the wound is caught in cups, collected each week and transported to a still. The historic method of processing the gum, and the method still largely used, is to put it in a copper still heated by direct fire. The volatile material is distilled off with steam (generated from the water in the gum) and condensed as gum turpentine. The residue is gum rosin and is run out of the bottom of the still, strained through cotton batting into troughs and dipped into barrels. An increasing percentage of the oleoresin crop has been transported to centrally located factories and distilled in modern equipment under technical control. The rosin is graded according to colour and freedom from dirt—the pale grades being *X, WW, WG, N, M;* the medium grades being *K, I, H, G* and *F;* the dark grades being *D* and *B.*

DD turpentine, *DD* pine oil, pine tar, pine tar oil and charcoal are produced by the destructive distillation of the dead wood and stumps left on the ground after the lumbering industry has taken off the timber. Long leaf pine wood contains only 5% resinous material, but the dead wood and stumps may contain as high as 40% and wood can be obtained in commercial quantities with more than 20% resinous material. Destructive distillation was originally carried out in the woods by covering a pile of dead wood with sod, clay, etc., and burning the pile with an insufficient amount of air to form complete combustion. The process is now carried out in well-designed retorts where all volatile materials can be recovered.

The third method of manufacture is the so-called steam-distillation, solvent-extraction process, wherein the dead wood and stumps from cutover land are ground up, loaded into steel retorts, steamed with live steam, extracted with solvents, and the pine products recovered. Some of the steam distillation plants represent large investments and have spent much money and effort on research programs. They have improved and diversified their products and made them the foundation of a pine tree chemical industry. The production of steam-distilled wood turpentine, and wood rosin is equal to 60% of America's output of gum turpentine and gum rosin. The fourth method manufactures sulphate wood turpentine, sulphate pine oil and liquid rosin as by-products from the manufacture of paper pulp from pine wood by the sulphate process. Turpentine is used chiefly in the paint and varnish industry, in chemicals and pharmaceuticals, and in shoe polish; rosin, in paper, soap, paint and varnish, foundry and linoleum; pine oil, in mining, textile manufacture, disinfectants and rubber.

See Gamble's *Naval Stores Year Book;* U.S. Dept. of Agriculture, *Annual Naval Stores Report;* A. S. Campbell, *Studies in Forestry Resources in Florida*, 3 vol. (1932). (V. R. C.; X.)

NAVAL STRATEGY AND TACTICS. Naval strategy is the science of employing naval force to further the national aims. It involves the preparation and distribution of naval forces in order to meet the enemy in the most advantageous time, place

and numbers. Naval tactics is the science of employing naval forces when within striking range of the enemy. It involves the use of weapons and manoeuvres in battle. The dividing line between strategy and tactics at sea delineates itself faintly; tactics usually takes up where strategy leaves off and any significant change in one vitally affects the other. Down through the ages the principles of strategy have not changed since the object of every nation engaged in naval warfare has always been to gain control of the sea and deny it to the enemy. However, the evolution of weapons and the increase in mobility have constantly altered tactical precepts.

Naval Strategy.—Naval strategy is of two types (1) *grand strategy* and (2) *campaign strategy.* Grand naval strategy is a component part of national strategy and cannot be developed until national strategy has determined what the nation's objectives are, the degree of co-ordination and participation among army, navy and air force, and what proportion of the military and economic resources will be allocated to each. From this information grand naval strategy determines the size of the navy, types of vessels and aircraft, location of bases and distribution of strength.

Once objectives and means are established grand strategy utilizes the navy to further the international policy of the nation. A nation may use the size or the location of its navy as a threat so as to achieve national aims without war. Britain did just this with its navy in the 19th-century Pax Britannica and the United States in 1941 warned Japan by shifting the bulk of the U.S. fleet to Hawaiian waters. When such threats fail, and neither compromise nor submission accord with the national aims, war ensues and opponents pursue prewar objectives by means of force.

Campaign strategy narrows the objective to one particular phase or theatre of war, concerning itself less with national policies than with naval effort within the particular campaign. An important adjunct of campaign strategy is the dovetailing of naval effort with that of ground forces and land-based air forces. In most respects, campaign strategy is grand strategy on a restricted scale. In World War II Japanese grand strategy dictated that the fleet would assist the army in conquering the East Indies, while campaign strategy determined the distribution of forces and sequence of objectives in that area.

Naval strategy may be a *total offensive* wherein one power seeks not only to deny the seas to the enemy but to destroy every vestige of naval opposition. Accomplishment of this end may be by naval action alone as at Tsushima (1905) when the Japanese annihilated the Russians. Or, it may be by triphibious (land, sea and air) assault on the wellsprings of enemy naval power, as occurred in the last year of World War II, against Japan. On the other hand, a nation may fight a *limited offensive* if its sea power is weak or diverted elsewhere. In 1943 both Japanese and Americans chose just that sort of war, the Americans biding their time until shipyards had turned out the fleets necessary for the cross-ocean sweep, the Japanese husbanding strength and bulwarking the perimeter of the expanded empire. The "fleet in being" strategy is a modification of the limited offensive, exemplified in the stationing of the German fleet idly at Wilhelmshaven in World War I as a constant menace which anchored the much larger British navy to northern Scotland. In this case the British, too, were content with a type of limited offensive, the distant blockade, since no pressing demands for the battle fleet came from other theatres. A strong power may try another form of limited offensive, a close blockade—by ships as in the Civil War, by planes as in the South Atlantic anti-submarine barrier of World War II or by mines as in the offensive mining of Japanese homeland waters. Normally a nation weak in sea power has no alternative but to adopt the limited offensive. When two maritime opponents are evenly matched in naval power the struggle for control, usually a total offensive, results in major clashes as in the Anglo-Dutch wars of the 17th century. When one side outpowers the other, the stronger will at once gain mastery of the sea lanes wherever its navy sails. Then the weaker nation may adopt a limited offensive strategy of attrition against the stronger. The privateers of the American Revolution, the raiders of the Confederacy and the submarines of Germany were instruments of such strategy. To further counter an unfavourable balance of sea power a nation may intensify ground campaigns as did Napoleonic France. Adolf Hitler's Germany tried similar strategic redress with the air blitz. But no nation without control of the ocean lanes, including the air over them, can win an overseas campaign.

The factors which influence the form of strategy are always determined by an estimate of the situation which outlines the nation's own objectives together with the probable and possible objectives of the enemy based on logistic capabilities, intelligence information and psychology of opposing peoples. All these factors are synthesized into a final decision as to the strategic course of action.

Strategic planning on either the grand or campaign scale requires constant application of the science of logistics—procurement, supply and maintenance of all material which goes into a fleet. An examination of fleet cruising ranges in the past emphasizes the strategic importance of logistics. In Greek and Roman days small, fragile ships powered by oarsmen of limited endurance dictated a strategy of short-distance campaigning. When the British, Dutch, Spanish and French built their great sailing navies powered by wind and fed from capacious holds, strategy altered because distance had slight significance. In 1805 Nelson chased Admiral Pierre Villeneuve across the Atlantic and back without replenishing supplies. With the advent of steam the range of navies shrank again, and strategy prohibited campaigns in areas where coal could not be stocked. The trials of the Russian fleet bound from the Baltic to Port Arthur in 1905 carrying extra coal on deck dramatically illustrated the need of bases for the steam warships at the turn of the century. But World War II navies once again acquired self-sufficiency at sea by carrying their train of supplies to war with them. By means of tankers and supply ships great fleets kept the sea for weeks on end, as they had during the sailing-ship era.

Good naval strategy demands a concentration of force so that maximum effort can be employed whenever needed. Such concentration also insures against piecemeal destruction by the enemy. In the Russo-Japanese War the Russians divided their fleet between two oceans and the concentrated Japanese fleet defeated each segment separately. In World War II global conflict compelled an unwanted dispersal of forces on the Allies which kept them on the defensive until each ocean was supplied with the concentrated sea power capable of coping with anything the enemy might employ. Gathering such a concentration was particularly difficult in the Pacific where the Japanese with interior lines of communication could threaten a quick concentration on any part of their perimeter.

Another requisite of successful naval strategy is flexibility. Provision must be made to alleviate sudden setbacks or exploit unforeseen advantages. Defeat at Pearl Harbor compelled instantaneous revision of U.S. strategy in the Pacific. On the other hand, in the autumn of 1944 unexpected erosion of Japan's naval air power invited the Allies to advance the schedule of Pacific offensives. With the tap of a radio key this strategic change occurred smoothly even though it altered logistic requirements, troop routing and fleet dispositions. On the opposing side, one of the major failings of the Japanese was inflexibility of strategic planning, particularly in the Solomons where they dribbled men, planes and ships into destruction. Having refused to strike one huge blow, which might have won, they failed to withdraw soon enough to prevent staggering losses.

Naval Tactics.—When strategic considerations have brought opposing naval forces within striking range of each other, naval warfare enters the realm of tactics and decision is made as to when, where and how to deal the actual blow. As in land warfare, it is always desirable to concentrate superior force at the point of contact.

The two elements of tactics are weapons and manoeuvre. Historically these two elements have varied in relative importance which has accounted for the fact that tactical principles are variable whereas strategic concepts are not. In the Peloponnesian Wars the emphasis was on the weapon, which in this case was the foot soldier who merely transferred his sword to a floating platform, there to fight as he would on land. Manoeuvre was rarely used as an advantage. This type of tactical thinking led the Corinthians at the battle of the Corinthian gulf (Naupactus) (429 B.C.) to form their ships in a circle like a sort of seagoing phalanx as the Athenians approached. The Corinthians

had not allowed room for manoeuvre so that wind and tide tangled ships hopelessly and they were destroyed in detail by the enemy.

Straight through to the middle ages the weapon remained the predominant factor in naval tactics, and that weapon was the seagoing soldier. The Romans adopted a boarding platform, the *corvus,* so as to bring legionnaires into arm's reach of the enemy. Fighting was still hand-to-hand at the battle of Lepanto in 1571. The only manoeuvre of consequence was ramming or shearing off the opponent's oars, and that was not an end but merely a means to stop the enemy long enough to board.

Meanwhile in the Atlantic, the galley gave way to the sailing ship equipped with the "Great Gun" of Henry VIII's time. Now it was possible to destroy ships as well as individuals. In the Anglo-Dutch wars which followed, manoeuvre was more important than weapon. It required superior seamanship to gain and hold the weather gauge (upwind station from the foe) from which one could select the quarter for attack, the range of the fighting and the time to commence or break off action. As for weapons—assuming forces were equally matched—the ship which manoeuvred to bring the most guns to bear won the battle. There was little weapon skill.

However, by 1750 all navies attached too much importance to manoeuvre. Fleets, following the tactical doctrines of the Comte de Tourville, pranced around one another seeking to gain the weather gauge but once achieving it fought in ship-for-ship duels rather than concentrating many ships against few. Not until Lord Nelson came along was the balance between manoeuvre and weapon again restored. Nelson's manoeuvring brought his column head-on against the enemy column at Trafalgar (1805), piercing it so that many of his ships concentrated on a few of the enemy. This manoeuvre, similar in effect to that called *capping* or crossing the "T" embodied the fundamental principle of naval tactics—manoeuvring to bring superior weapon power to bear.

The advent of steam propulsion once again made the weapon more important than the manoeuvre. In the U.S. Civil War the idea was to smash the other fellow with as few preliminaries as possible. Ironclads slugged viciously, and victory went to the craft that could punish the hardest and still survive the most damage at close range. Tactics paid little heed to manoeuvres.

With the beginning of the 20th century, the development of different types of steam warship focused attention once more on manoeuvre. Involved rules for fighting battles were drawn up for all navies. Employment for these rules resulted infrequently in World War I, no doctrines were disproved and little change of tactical concept occurred before World War II. Such vessels as the aircraft carrier and the submarine (its use restricted by international law) were considered subsidiary elements of the fleet to assist the big guns of battleships.

With the outbreak of World War II it became apparent that aircraft successes would require drastic revision of naval weapons and manoeuvres. In Nov. 1940 British carrier aircraft swooped down on Taranto and crippled half the Italian fleet in one blow. Pearl Harbor in December of 1941 demonstrated conclusively that the striking range of fleet weapons had increased from 20 mi. to 200 mi.

Thus the history of naval tactics in World War II is partly the story of the integration of aircraft into the fleet. In the Atlantic, aircraft co-operated with surface vessels in destroying submarines. In the Pacific the carrier aeroplane became a primary weapon, shielding the fleet against attack, dealing heavy blows at enemy air and sea power and spearheading amphibious invasions. At war's end the carrier was the nucleus of the "task force," an organization of carriers, battleships, cruisers, destroyers and other types of combatant craft.

Another tactical innovation in World War II occurred in amphibious warfare. The concept of landing troops on a defended hostile shore had been considered by Napoleon and Hitler and tried unsuccessfully by the British at the Dardanelles (1915-16). It was Allied development of amphibious techniques that made possible the cross-channel landing in Normandy and the 1,000-mi. leaps of whole armies across the Pacific. Sea power with the aid of naval guns and carrier planes extended itself onto a strip of beach until land power and land-based air power had established firm footing. Subsequent to the landings these same naval guns and planes supported troop advances and kept the enemy from breaking ocean supply lines. At Okinawa the fleet came and stayed for weeks.

Throughout the evolution of naval tactics there has existed a constant interaction, a seesaw between offensive and defensive whether it be in weapons or manoeuvre. In the weapons' field passive defense has been armour against bombs and guns, compartmentation of ship hulls against torpedoes and mines, nets and mine fields against submarines. Sometimes weapons are counterbalances. A half century ago the torpedo boat stimulated the building of the torpedo-boat destroyer and the submarine promoted the subchaser. More recently, radar-controlled anti-aircraft fire with proximity-fused shells reduced the aeroplane menace. There were also instances where countermanoeuvres by the defense neutralized offensive tactics. At Jutland (1916) the attempt of the British to cap the German "T" failed because Admiral Reinhard Scheer introduced a new manoeuvre, simultaneous countermarch by ships within a column. In both World Wars I and II U-boat campaigns drove ships to concentrate in convoys rather than steam separately. In World War II it was quickly discovered that column formations were unsatisfactory against air attack, so ships adopted the tight circular formation more easily manoeuvred and defended.

A desirable feature in any naval operation is tactical surprise which may derive from either a weapon or a manoeuvre. "Greek fire," an incendiary weapon, when first used by the ancients came as a surprise to the foe. In the Civil War the ironclad "Merrimac" was another surprise weapon, defeating conventional warships until the "Monitor" appeared and in turn surprised the "Merrimac." The Japanese Kamikaze (suicide plane) came as a dangerous surprise to the Americans in late 1944. The submarine's great tactical advantage is always surprise.

Surprise manoeuvres have often proved invaluable. In 1652 the British admiral Robert Blake surprised his Dutch foe by navigating through an apparently impassable shoal strait to gain the weather gauge and attack suddenly. Admiral Scheer's surprise countermarch at Jutland saved the Germans from destruction. The Japanese assault on Pearl Harbor in 1941, prior to a declaration of war, is the classic example of complete tactical surprise.

The ramifications of modern fleet tactics are bewildering indeed and rely heavily on modern science. In an amphibious operation, carrier task forces lead the advance to the objective. Reconnaissance planes and submarines give advance intelligence on the state of enemy defenses, hydrography and geography. Meteorologists furnish vital data on weather. Enemy submarine attacks are countered and friendly submarines are judiciously employed to cut the enemy's supply lines. When within flying range of the target, carriers launch *strikes* of aircraft to shoot down opposing planes and hit ships and ground installations. Bombardment groups of battleships, cruisers and destroyers soften the enemy and engage ships that may have escaped the carriers. Under cover of the bombardment, minesweepers and demolition squads clear out mines and underwater obstacles. The amphibious force carries the assault troops to the beach, some in boats and amphibian vehicles launched from mother ships, others in large ocean-going craft with bow doors and ramps. Troops pour out against the enemy under the protective fire of gunboats, rocket ships, planes and big naval guns. Following the assault landings transport echelons steam up with additional troops and supplies.

Should the enemy react with his fleet a carrier-against-carrier battle may result followed by action between surface ships. At Midway (June 1942) the destruction of all Japanese carriers by the U.S. carrier planes made it impossible for the Japanese to continue either with a surface engagement or amphibious invasion. At the battle of Leyte gulf (Oct. 1944) near-by friendly air bases encouraged the Japanese to send their fleet forward for a surface engagement.

In carrier battles the tactical objectives are opposing carriers. When the enemy has been located by scout aircraft, a strike is launched which must penetrate the enemy defensive fighters (combat air patrol) and anti-aircraft screen before attacking. Every effort is made to coordinate the attack so that bombers, torpedo planes and strafing fighters converge simultaneously on the enemy from several directions. In these battles relative wind direction is just as vital as it was in John Paul Jones's day. A carrier must head into the wind to launch planes and unless that wind is blowing from the direction of the enemy, the carrier will open range during flight operations. Such adverse winds plagued the Americans notably at the battles of Midway and the Philippine sea.

Battles between carriers are spectacular and decisive when they occur. But in the latter days of World War II the carrier's tremendous contribution was the almost routine support of amphibious operations and the day-in-and-day-out war on enemy submarines.

In surface actions, the primary tactical objectives are the enemy heavy ships. Such actions usually open with destroyer torpedo attacks followed by heavy gun duels in which all ships participate. The crossing of the "T" is as vital today as it was in Nelson's time and won U.S. victories at the battle of Cape Esperance (Oct. 1942) and the battle of Surigao strait (Oct. 1944). Before the invention of radar, night surface actions were likely to degenerate into melees or be decided by chance. Today they can be fought with the same precision as daylight engagements.

Tactics, unlike strategy, rarely permits long-range planning and exact execution. Each situation must be estimated as it occurs and a spot decision rendered. But the decision is still a considered one based on knowledge of intentions and capabilities of both sides. It is particularly important that a tactical decision not jeopardize campaign strategy. Admiral Raymond A. Spruance at the battle of the Philippine sea (June 1944) was faced with the choice of chasing an enemy fleet which he might destroy, or remaining near Saipan to protect the amphibious landings. He correctly chose to remain near Saipan and insure that nothing interfered with his campaign strategy which required conquest of that island.

In general a tactical commander's course of action will be one of the following: concentration, dispersion, deception, interception or a combination of these. Concentration multiplies strength at a given point. The anti-submarine convoy and the submarine wolf pack are examples. Dispersion is a defensive tactic adopted only when it is advisable to risk losing some of a force in order that the rest may attain the objective. North Atlantic convoys dispersed whenever the escorts were outgunned by German surface raiders. Deception comes in many guises—decoy forces, smoke screens, camouflage and false

signals. Interception may be defensive or offensive. An anti-submarine screen of ships, a harbour mine field and a fighter-plane air patrol over a force are all defensive means of intercepting the foe. Air attack on enemy bases and ships, bombardment of his shores and advancing to meet his fleet with guns and torpedoes are offensive interceptions.

There is no factor too small for consideration in tactics—weather, formations, speeds, hydrography, fatigue, psychology and countless others to such a number that Admiral Ernest J. King remarked, "Naval tactics is very much more of an art than it is a science, but unless there is comprehension of the science involved, success in the art is not to be expected."

The use of atomic weapons, guided missiles, high-speed submarines and jet aircraft posed new problems in naval tactics. To cite an instance, dispersion is clearly one defense against atomic bomb attack. But concentration has always been the defense against submarines. These contradictory requirements must be resolved either by weapon or manoeuvre so that protection is afforded against both submarine and bomb.

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NAVAN (An Uaimh), a market town of co. Meath, Ireland, situated at the confluence of the Blackwater with the Boyne. Pop. (1946) 4,102. Here the Clonsilla and Kingscourt branch of the Great Southern railway crosses the Drogheda and Oldcastle branch of the Great Northern. By the former it is 30 mi. N.W. of Dublin. Navan has considerable trade in corn and flour, some manufacture of woollens and of agricultural implements, and a tannery. It was a barony of the palatinate of Meath, was walled and fortified, and was incorporated by charter of Edward IV. It suffered in the civil wars of 1641. It was a favourite centre for rod-fishing.

NAVARINO, BATTLE OF, fought on Oct. 20, 1827. By the treaty signed in London on July 6, 1827 (*see* GREECE: *History*), England, France and Russia agreed to demand an armistice, as preliminary to a settlement. Sir Edward Codrington, then British commander-in-chief in the Mediterranean, received the treaty on the night of Aug. 10 at Smyrna, together with instructions to demand an armistice, and to intercept all supplies coming to the Turkish forces in the Morea. He at once proceeded to Nauplia to communicate with the Greeks, accompanied by his French colleague, Rear-admiral de Rigny. The Greek Government agreed to accept the armistice. Admiral de Rigny left for a cruise in the Levant, and Sir Edward Codrington, hearing that an Egyptian armament was on its way from Alexandria, found it, together with a Turkish squadron, at anchor at Navarino on Sept. 12. The Turkish Government refused to accept the armistice, but on the 25th an interview took place between Codrington, de Rigny, who had just arrived, and Ibrahim Pasha on behalf of the sultan, at which Ibrahim gave a verbal engagement not to act against the Greeks pending further orders. The allies, who were in want of stores, now separated again, Codrington going to Zante and de Rigny to Cervi, frigates being left to watch Navarino. The British admiral had barely anchored at Zante before he was informed that the sultan's forces were putting to sea. From Oct. 3 to 5 Codrington, who had with him only his flagship the "Asia" (84) and some smaller vessels, was engaged in turning back the Egyptian and Turkish vessels, a task in which he was aided by a violent gale. He resumed his watch off Navarino, and on the 13th was joined by de Rigny and the Russian squadron under Rear-admiral Heiden. By agreement among the Powers the command was entrusted to Codrington. The allied force consisted of three British, four French and four Russian sail of the line, and a total of 15 frigates, brigs and schooners. The Egyptians and Turks had three ships of the line and 15 large frigates, together with a swarm of small craft making a total of over 80. Ibrahim Pasha, though unable to operate at sea, considered himself at liberty to carry on the war by land, and his men were employed in burning the Greek villages. On Oct. 17 a joint letter of expostulation was sent to Ibrahim, but was returned with the manifestly false answer that he had left Navarino. The admirals, therefore, decided to stand into the bay. A French officer in the Egyptian service, named Letellier, had anchored the vessels of Ibrahim and the Turkish admiral in a horseshoe formation, of which the points touched the entrance to the bay, and there were forts on the lands at both sides of the entry. The allies entered in two lines and began to anchor in the midst of Ibrahim's fleet. Captain Fellowes, commanding the British frigate "Dartmouth," seeing a Turkish fireship close to windward of him, sent a boat to demand that she should be removed. The Turks opened fire on the boat, and the action at once became general. The result was obtained by heavier broadsides and better gunnery. Three-fourths of the Turkish and Egyptian vessels were sunk or fired by their own crews. The allied casualties were 177 killed and 519 wounded. The loss of the Turks and Egyptians was never accurately reported.

See Lady Jane Bourchier, *Memoir of the Life of Admiral Sir E. Codrington* (1873). (G. A. R. C.; W. C. B. T.)

NAVARRE, a province of northern Spain, and formerly a kingdom which included part of France. The province is bounded on the north by France (Basses Pyrénées) and Guipúzcoa, east by Huesca and Saragossa, south by Saragossa and Logroño and west by Álava. It is traversed from east to west by the Pyrenees and the Cantabrian Mountains. Area 4,056 sq.mi. Pop. (1940) 369,618. From Navarre there are only three practicable roads for carriages into France—by the Puerta de Vera, the Puerta de Maya and Roncesvalles. The highest summit is the Monte Adi (4,931 ft.). The chief river flowing towards the Atlantic is the Bidassoa, which rises near the Puerta de Maya. After flowing southwards through the valley of Baztán it takes a north-easterly course, and for a short distance above its outfall at Fuenterrabia constitutes the frontier between France and Spain (Guipúzcoa); by far the larger portion of Navarre is drained to the Mediterranean through the Ebro, which flows along the western frontier and crosses the extreme south of the province. The hilly districts consist almost entirely of forest and pasture, the most common trees being the pine, beech, oak and chestnut. Much of the lower ground yields grain; the principal fruit is the apple, from which cider is made in some districts; hemp, flax and oil are also produced, and mulberries are cultivated for silkworms. Navarre is one of the richest provinces of Spain in live stock. Game is plentiful.

The Ebro Valley railway traverses southern Navarre and skirts the western frontier. It has several branch lines. Besides Pamplona (*q.v.*), the capital, the only towns with more than 5,000

inhabitants are Baztán (10,326), Corella (5,663), Estella (6,992) Tafalla (6,036) and Tudela (12,873).

HISTORY

The kingdom of Navarre was formed out of a part of the territory occupied by the Vascones (*i.e.,* the Basques and Gascons), who occupied the southern slope of the western Pyrenees and part of the shore of the Bay of Biscay. In the course of the 6th century there was a considerable emigration of Basques to the north of the Pyrenees. The cause is supposed to have been the pressure put upon them by the attacks of the Visigoth kings in Spain. The name of Navarre is derived by etymologists from "nava," a flat valley surrounded by hills, and "erri," a region or country. It began to appear as the name of part of Vasconia toward the end of the Visigoth epoch in Spain in the 7th century. Its early history is more than obscure. The first historic king of Navarre was Sancho Garcia, who ruled at Pamplona in the early years of the 10th century. Under him and his immediate successors Navarre reached the height of its power and its extension (*see* SPAIN: *History,* for the reign of Sancho el Mayor, and the establishment of the Navarrese line as kings of Castile and Leon, and of Aragon). When the kingdom was at its height it included all the modern province of the name; the northern slope of the western Pyrenees called by the Spaniards the "Ultrapuertos" or country beyond the passes, and now known as French Navarre; the Basque provinces; the Bureba, the valley between the Basque mountains and the Montes de Oca to the north of Burgos; the Rioja and Tarazona in the upper valley of the Ebro. In the 12th century the kings of Castile gradually annexed the Rioja and Álava. While Navarre was reunited to Aragon, 1076–1134 (*see* SPAIN: *History*), it was saved from aggression on the east, but did not recover the territory taken by Castile. About the year 1200 Alfonso VIII of Castile annexed the other two Basque provinces, Biscay (Vizcaya) and Guipúzcoa. Tarazona remained in possession of Aragon. After 1234 Navarre, though the crown was claimed by the kings of Aragon, passed by marriage to a succession of French rulers. In 1516 Spanish Navarre was finally annexed by Ferdinand the Catholic. French Navarre survived as an independent kingdom till it was united to France by Henry IV. From 1510 until 1833, when it was incorporated with Spain, Navarre was a viceroyalty. Battles between insurgents and loyalists took place in Navarre during the civil war of 1936–39.

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NAVARRETE, JUAN FERNÁNDEZ DE (*c.* 1526–1579), Spanish painter, called EL MUDO (because he was dumb), was born in Logroño. He is said by José de Sigüenza (*Historia de la Orden de San Jerónimo,* 1605) to have studied in Italy under Titian and others and to have been summoned back to Spain by Philip II. In 1568 he was appointed painter to the king, who chose him to play a major role in the decoration of the Escorial, near Madrid, though he did not live to fulfil it; of the 32 altarpieces commissioned for the church (1576) only 8 were completed at the time of his death in Toledo on March 28, 1579.

El Mudo's eclectic style was based on that of the Italian mannerists working in the Escorial; and he was strongly influenced by Titian, though there is no evidence that he was his pupil. In the "Burial of S. Lawrence" (Escorial), unfinished at his death, naturalism and chiaroscuro foreshadow later developments of the Spanish school.

See J. Zarco Cuevas, *Pintores españoles en San Lorenzo el Real de El Escorial,* (Madrid, 1931). (E. Hs.)

NAVARRO, PEDRO (*c.* 1460–1528), Spanish military engineer and general. Beginning as a sailor, he became *mozo de espuela,* or running footman, to the cardinal Juan de Aragon. Later he enlisted as a mercenary in a war between Florence and Genoa and took part in the warfare between the Genoese corsairs and the Mohammedans of northern Africa. He enlisted under Gonzalo de Córdoba when he sailed to Sicily to take part with the French in the partition of Naples, and in 1500 he laid mines to breach the walls at Cephalonia without much success. He distinguished himself in the campaigns of 1502–03, by the defense of Canosa and of Taranto and by his share in the victory at Cerignola. His mining operation against the castles of Naples, held by French garrisons, in 1503, won him fame as the first military engineer of his age. At the expulsion of the French from Naples, he received from his king a grant of land and the title of count of Olivetto. In 1508 he took Velez de Gomera, largely by means of a species of floating battery which he invented. He did excellent service in the conquest of Oran (1509) and took Bougie and Tripoli in 1510. At Ravenna he covered the orderly retreat of the Spanish foot, was taken prisoner by the French and imprisoned in the castle of Loches. Ferdinand, "the Aragonese skinflint," refused to pay his ransom, and after three years of imprisonment, Navarro entered the service of Francis I in a pique. He distinguished himself in the passage of the Alps, at Marignano, at Milan and in the siege of Brescia. He was at the battle of Pavia and in 1522 was taken prisoner at Genoa by the Spaniards. He was confined at Naples till the peace of 1526 and his Olivetto estate was confiscated. His last service was in the disastrous expedition of Odet de Foix Lautrec to Naples (1527).

See *Documentos inéditos para la Historia de España,* vol. xxv (Madrid, 1854); article *sub nomine* in *Enciclopedia Universal Ilustrada.*

NAVE, ecclesiastically considered, that part of a church appropriated to the laity as distinguished from the chancel, the choir or the presbytery, reserved for the clergy. In a 14th-century letter (quoted in Gasquet's *Parish Life in Medieval England,* p. 45, 1906) from a bishop of Coventry and Lichfield to one of his clergy, the reason for this appropriation is given. "Not only the decrees of the holy fathers but the approved existing customs of the Church order that the place in which the clerks sing and serve God according to their offices be divided by screens from that in which the laity devoutly pray. In this way the nave of the church . . . is alone to be open to lay people, in order that, in the time of divine service, clerics be not mixed up with lay people, and more especially with women, nor have communication with them, for in this way devotion may be easily diminished." The word "nave" has been generally derived from Lat. *navis,* "ship." Salmasius in his commentary on Solinus (1629) finds the origin in the resemblance of the vaulted roof to the keel of a ship. The use of the word *navis* may, however, be due to the early adoption of the "ship" as a symbol of the church (*see* Walter Skeat's note on *Piers Plowman,* xl, 32). The Greek ναός, Attic νεώς (ναίειν, "to dwell"), the inner shrine of a Greek temple, the *cella,* has been suggested as the origin of the word. This derivative must presume a latinized corruption into *navis,* for the early application of the word for ship to this part of a church building is undoubted.

Architecturally considered, the nave is the central and principal part of a church, extending from the main front to the transepts, or to the choir or chancel in the absence of transepts. When the nave is flanked by aisles, light is admitted to the church through clerestory windows. (*See* BYZANTINE AND ROMANESQUE ARCHITECTURE.) At times, a gallery was carried above the side aisles.

NAVEL, in anatomy, the umbilicus, the depression in the abdomen which indicates the point through which the mammalian foetus obtained nourishment from its mother through the blood vessels of the umbilical cord. (*See* ANATOMY: *Superficial and Artistic.*)

NAVIGATION. The science or art of conducting a ship or aircraft from one place to another. Although much of the equipment used and the principles of air and surface navigation are the same, the aspect of the subject dealt with in this article is restricted primarily to shipboard navigation.

Historical.—Before the introduction of the mariners' compass in the 12th or 13th century the only practical means among western nations of navigating ships was to keep within sight of land or to steer for short distances out of sight of land by reference to the sun or stars, more particularly the pole star. In eastern waters, long voyages out of sight of land were possible because of the steadiness in direction of the monsoons, which enabled vessels to keep their course by running directly before the wind.

The act of fixing positions by astronomical methods progressed far more rapidly on shore than at sea. The few rude appliances available to the navigator were limited until the 18th century to finding only the latitude of the ship at sea. No means of finding the longitude was devised, except the very rough method of estimating the run of the ship—known as dead reckoning—until the introduction, for practical purposes, of the lunar problem early in the 18th century. This complicated calculation made the finding of longitude one of considerable difficulty, even after the introduction of the sextant; for the moon passes the stars lying in its course through the heavens at a mean rate of only 33″ in one minute of time. Since its motion in regard to the sun is less than this, it is obvious that a very small error in measuring the distance produces a correspondingly large error in the resulting longitude. The rise of what may be termed modern methods of astronomical navigation may be fairly dated from the invention of the chronometer in 1735, although it was not until about 40 years later that extensive trials of John Harrison's chronometer proved to navigators the value of this instrument. The method of finding the apparent, or sun, time at the ship's position was well-known; but until the chronometer came into use afloat, and enabled the navigator to carry Greenwich mean time with him on board, it was not possible to find the longitude by simple calculation. (*See* CHRONOMETER.)

Rapid strides were made in the 19th century in the improvement of instruments and the publication of textbooks useful to the navigator and also in the production of tables of logarithms compiled to facilitate the solution of trigonometrical problems associated with navigation. The *Nautical Almanac,* first published under authority for the use of seamen in 1767, came into general use. Machines for taking soundings were introduced, and various methods were invented whereby the errors of the magnetic compass, due to the permanent and induced magnetism in the metal of the ship, could be very largely eliminated. Methods were applied whereby that important factor in obtaining an accurate position, the speed of the ship through the water, could be serviceably ascertained. The introduction of steam vessels went far to simplify the problems of navigation as the dead reckoning could be calculated with greater accuracy than was the case with sailing vessels. The progress of the art of navigation was and is, of course, still inseparably connected with chart drawing. The steady and continuous improvement in the number and accuracy of charts resulted from the marine hydrographic and coast survey services conducted by the principal maritime nations. World War II requirements, moreover, accelerated the advancement of several invaluable electronic aids to navigation.

Modern Navigation.—With the above brief summary of the progress of navigation, the modern methods in use will be described, referring the reader for a more detailed and technical description to the textbooks available on the subject. When making a passage from port to port situated at no great distance apart, the navigator ordinarily selects a course on a Rhumb line, which, on a Mercator's chart, the chart normally used, is a straight line. Between ports situated at great distances from one another, and differing widely in longitude, the course followed should be on the great circle, which, on a Mercator's chart is a curve, the shortest distance between any two places on the surface of the earth.

Time at Sea.—To avoid confusion a system of time zones for timekeeping at sea is in force in the navies of most countries. This system has been adopted so that vessels at sea, within certain defined limits of longitude, shall keep the same time as that used on land. The world is longitudinally divided into 24 zones of 15° each, the centre of the system being the meridian of Greenwich. This centre division lies between the meridians of the $7\frac{1}{2}$° E. and $7\frac{1}{2}$° W. and is known as the zero zone, or zone O; the zones lying to the eastward being numbered in sequence with a minus (−) prefix; those to the westward being similarly numbered with a plus (+) prefix. The limits of the zones on land are modified somewhat according to the geographical configuration of the country concerned. By this system the same time is kept whether on land or sea throughout each zone except during the periods of daylight-saving time. The term Greenwich mean time (G.M.T.) is considered to be the standard time of the meridian of Greenwich, commencing at midnight and reckoned throughout the 24 hours.

Since all nautical and air almanacs give the position of the heavenly bodies in Greenwich mean time (G.M.T.), this is the time reckoning which is of the utmost significance to the navigator. In the United States navy, Greenwich mean time was previously called Greenwich civil time (G.C.T.), but in 1953, to avoid misunderstanding and for the sake of uniformity the designation G.M.T. was adopted.

Celestial Navigation.—When considering the various methods of fixing the position of a ship at sea by observations of heavenly bodies, it is assumed that the errors of the chronometers are accurately known. Although chronometers reached a high standard of efficiency they are nevertheless subject to very slight variations in respect to the true Greenwich time. The transmission of radio time signals enables navigators to obtain accurate time checks regularly throughout the world. In 1953 there were 71 stations operating on various radio frequencies and situated in different countries transmitting these signals. It is desirable to refer to the relevant publications for details of the form of transmission and procedure.

Assuming then that the true Greenwich time is known, that the observer is competent and the instrumental errors are known, the accuracy of a sea position, obtained by the observation of heavenly bodies, depends mainly on the accuracy of the sea horizon. On account of abnormal refraction occasioned by special conditions in the atmosphere, the sea horizon, as seen by an observer, is often displaced from the position which the tables of normal dip of the horizon would assign to it. This refraction is most common in localities where the temperature of the air and water differ widely. By combining the results obtained from observation of bodies situated in opposite quarters of the horizon, the errors in finding the true position of the horizon are largely counteracted. The conditions at dawn and twilight, when the horizon is visible and suitably placed stars can be selected, lend themselves to this purpose. And, moreover, it is in these periods that opportunities are present for another important purpose, that is, the selection, for simultaneous observation, of bodies whose relative bearings are such that the lines of position determined from the observations shall afford a well-defined intersection and thus serve to accurately find the latitude and longitude at approximately the same instant.

The only information that is obtained from one observation of a heavenly body is that the ship is somewhere on the circumference of a small circle, on the earth's surface, the centre of which is the geographical position of the body and the radius of which has the same arc measure as the zenith distance at the instant of observation. At this instant the heavenly body observed must be vertically over some one point on the surface of the earth. The latitude of this point is equal to the declination of the body, and the longitude is equal to the hour angle of the body from the meridian of Greenwich.

Because of the size of the globe which would be required, it is, of course, not practicable to plot this small circle on a globe and plotting it on a chart is inconvenient unless the radius is very short and the ship in low latitude. A small circle becomes very greatly distorted when plotted on a Mercator's chart, unless near the equator. The usual method of plotting, on a chart, is to represent a portion of the small circle as a straight line, a tangent to the circumference; that is, a straight line drawn at right angles to the bearing of the body observed. But, as a straight line represents accurately only a very small portion of the circumference of a circle, it is necessary to select some point through which to draw this line, as near the actual position of the ship as possible. This straight line is the "line of position" somewhere on which the ship must be. If another heavenly body, suitably placed, is now observed or, after a reasonable interval, to allow of a change of bearing, a second observation of the same body is made, a second line of position is obtained. The intersection of these two lines of position gives the actual position, provided the first line of position has been moved parallel to itself to allow for any run of the

ship in the interval. The line of position, being a tangent to the small circle, is at right angles to the radius or bearing of the body observed; it follows, therefore, that the angles at which the several lines of position will intersect one another must be the same as the angles at which the bearings intersect. Bodies should, therefore, be selected which will give a good "cut." Each line of position has precisely the same value, provided the altitude has been observed with equal accuracy. An error of 1′ in the observed altitude, and thence in the zenith distance, produces an error of one mile in the line of position.

Now as to the manner of obtaining the point through which to draw the line of position: Whatever method is used, provided the method is a correct one, the point found will be somewhere on the line of position. There can be only one line of position derived from the observation of one body. Different methods of calculation do not give different lines of position, but give different points through which *the* line of position can be drawn. A point can be found by assuming the latitude and calculating the resulting longitude, which is a procedure applicable to observations of heavenly bodies which have a large azimuth; or by assuming the longitude and calculating the resulting latitude, which is applicable to observations of bodies with a small azimuth. The best method, however, is to assume both latitude and longitude and, therefrom, to calculate the zenith distance of the body observed, or in other words, the radius of the circle of position. Having, at the same instant, observed the actual altitude, and thence the zenith distance, it is at once ascertained whether the ship is on a line which is directly nearer to or directly farther from, the geographical position of the body than the assumed or dead reckoning position.

ELECTRONIC AIDS TO NAVIGATION

Radio Direction Finders.—Determining the position of a ship at sea by means of radio bearings is of inestimable value to the navigator in thick weather when approaching the land. The bearing of a shore radio station from a vessel can be found either by means of a directional receiver in the ship, or by the system whereby the bearing of the ship's radio transmission is determined by one or more directional receiving stations on shore, the result being communicated to the ship.

The method of receiving bearings from ashore has the advantage that no additional equipment beyond the regular ship's radio is required. However, it is subject to the disadvantage that the navigator himself cannot take and check the bearings. On the other hand, when using a radio direction finder aboard ship the navigator can repeatedly check and plot his bearings upon the shore direction finding (D/F) station.

The radio direction finder employs a loop antenna which embodies characteristic directional properties. When the antenna, which can be rotated through a complete circle, is directed toward the source of the signal, *i.e.*, the transmitting station, a maximum strength signal is heard at the shipboard receiver; when the antenna is perpendicular to the transmitter a minimum signal is received. Since a definite minimum signal, or "null," is more readily determined, it is preferred for bearing purposes over the maximum signal. The position of the antenna, and consequently the relative bearing from the ship to the shore transmitter, may be read directly from the indicator which is a part of the D/F equipment. Any radio transmission, commercial or otherwise, can be used to obtain a bearing, provided that the exact location of the transmitting antenna is known. Bearings taken on two or more radio stations give a "fix" on the position of the ship.

The accuracy of radio bearings, like all other phases of navigation, are dependent upon properly functioning equipment and skilful operation. In addition radio bearings are subject to certain inherent errors which must be considered and corrected. Clear-cut minimum signals are difficult to distinguish at night; land separating the radio station and the ship may affect the accuracy of the bearing; radio waves travel a great circle, and when plotted on a Mercator's chart a correction may have to be made.

Some stations send out a sound signal at the same time that the radio signal is transmitted. By determining the time difference between receipt of the sound and radio signals, which travel at different rates of speed, the distance from the ship to the transmitter can be computed.

Radar.—This outstanding World War II electronic development is of immeasurable value to the navigator, for it allows him to "see" his surroundings on a cathode ray tube presentation when night, weather, smoke and other adverse circumstances would otherwise make accurate determination of position impossible. It is especially advantageous when a vessel is entering or leaving port, close inshore or travelling in company with other ships. The ship's position relative to possible navigational hazards can be determined rapidly by reception of an echo from a single object because radar gives both bearing and range. (*See* also RADAR.)

Loran.—This is an electronic system for long range navigation which, like radar, was a World War II development (the designation loran is composed of the first letters of *lo*ng *ra*nge *n*avigation; a similar system is called gee). Unlike radar, loran requires no transmission from the ship, but a special purpose radio receiving equipment operating on a relatively low frequency which gives it the capability of receiving signals at great distances. Loran transmitting stations on shore operate in pairs, one designated the master and the other the slave station, and are usually separated by from 200 to 400 mi. A pair of stations transmit pulsed and accurately synchronized radio signals which are received in the loran-equipped ship. The stations from which the signals are received can be identified by their radio frequency and the pulse recurrence rate. The time difference between arrival of signals from the master and slave stations is measured in microseconds at the loran receiving equipment. Once the time difference of signal reception is known, and the station pair identified, a line of position, along which the ship is located, can be found by reference to a loran chart. For every pair of loran stations, lines of constant time, *i.e.*, points on the earth's surface where the time difference for reception of signals from each pair will be constant, have been calculated and laid down on loran charts. If loran charts are not available, a line of position can be plotted on an ordinary navigation chart by using loran tables prepared for that purpose. A loran "fix" is obtained by repeating the process with a different pair of stations and determining where the lines intersect.

Loran has the advantage of accuracy, rapidity and long range (generally 700 mi. by day and 1,400 mi. at night). Stations throughout the world afford extensive loran coverage over the main travel routes. Like the radio direction finder and radar, loran is widely used in air as well as surface navigation.

Sonar.—This term is derived from the initial letters of the words *so*und, *na*vigation and *r*anging and is used to identify a type of equipment designed for underwater detection. Sonar basically consists of transmitting spurts, or "pings," of a high-frequency sound-wave beam through the water, and receiving return echoes from any submerged object struck by the outgoing waves. Sound is known to travel through water at approximately 4,800 ft. per second; therefore, the range or distance to the underwater object struck can be obtained by determining the time interval between the transmission of the sound "ping" and receipt of the echo at the sonar equipment aboard ship. Since the sound projection head can be trained in azimuth, the bearing from which the echo returns is also known. When the projection head is directed straight down, the sonar acts like a fathometer (*q.v.*) and gives the distance to the bottom.

Sonar was born of the necessity for a truly effective World War II antisubmarine device and is a refinement and improvement of World War I echo-ranging equipment. The peacetime value of sonar to safe navigation in unknown or poorly charted waters, in the presence of derelicts, icebergs and other submerged obstacles and in making it possible to know how much water under a ship is clear

Research continues in electronic aids to navigation, and the future possibilities seem almost boundless. However, the navigator must be ever aware that they are not infallible and are subject to material failure and human error; they are "aids" and supplements to but not replacements for the sound principles and practices of celestial navigation. (*See* also AERIAL NAVIGATION.)

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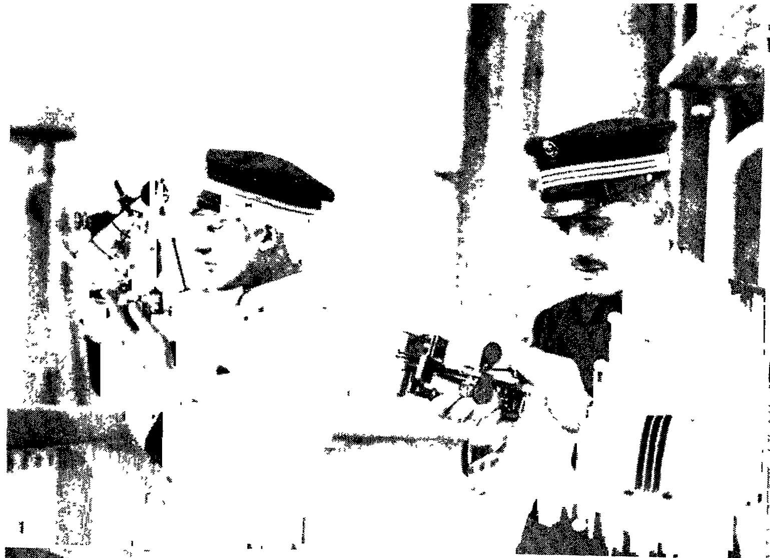

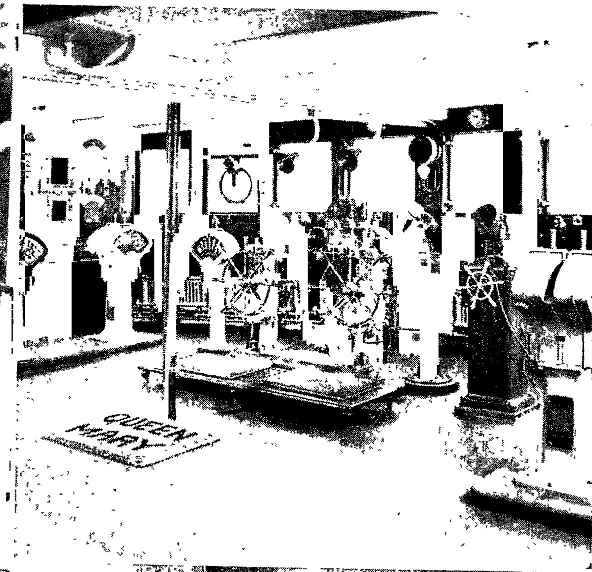

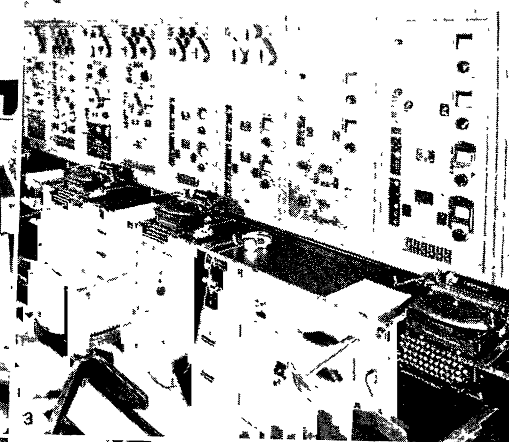

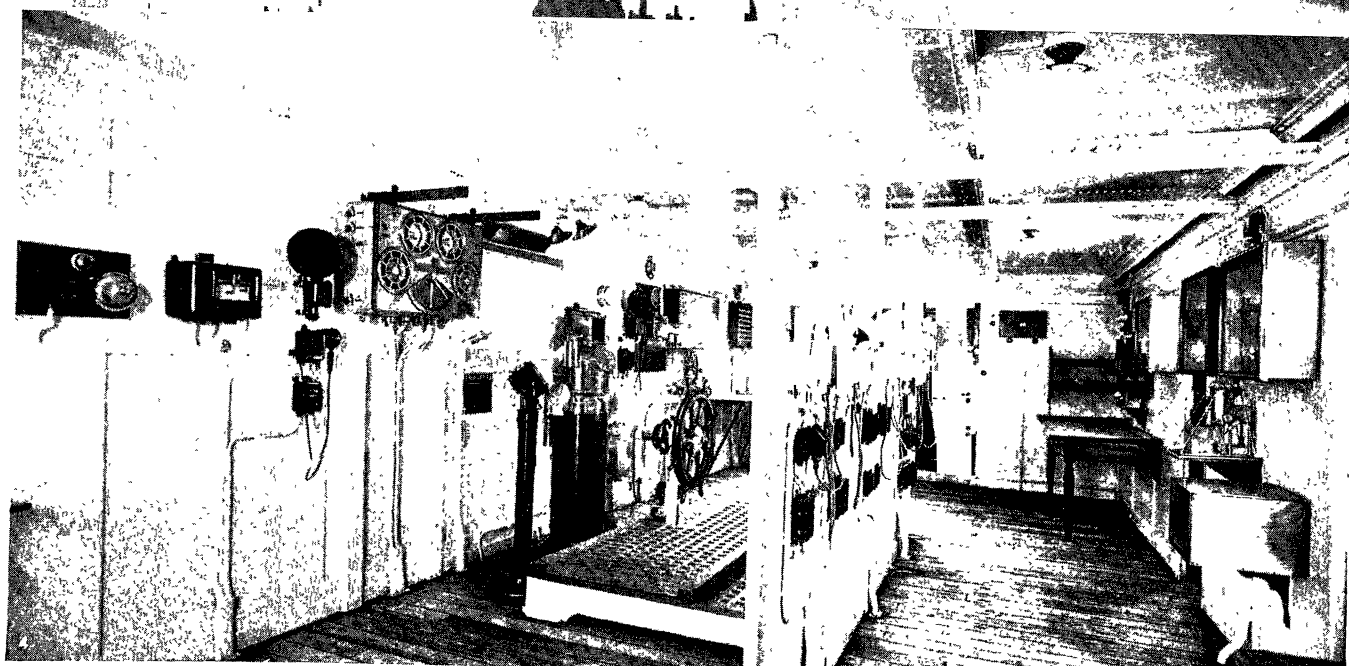

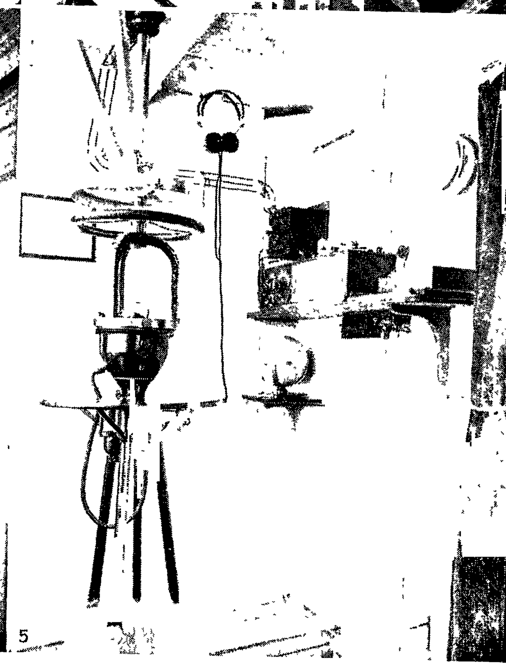

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SCIENTIFIC NAVIGATION AIDS

1. Officers on the bridge of the S.S. "De Grasse," determining the ship's position by means of sextants, through which the sun is sighted. 2. Bridge room of the S.S. "Queen Mary," showing two rudder wheels and magnetic compass between. The gyro-compass, housed below decks, has electrical contact with the gyro-pilot and the steering apparatus in the wheel house. 3. Radio room of the "Queen Mary," with eight operating positions, radio-telephone exchange, and chief accepting office for radiotelegrams of passengers. Control of the entire radio equipment, including transmission on 32 different wave-lengths, is concentrated here. 4. Navigating room of the S.S. "Ile de France." The loud-speakers, on vertical position, are used in establishing rapid communication between the bridge and other portions of the ship, serving as great aids to navigation. The hand-controlled steering wheel, shown in centre, was later supplemented by gyro-pilot control. 5. Radio position finder on the S.S. "Ile de France." The direction from which the land signals are being sent is ascertained by determining from what point of the compass signals are received with maximum intensity

Nautical Almanac (1953 *et seq*); The Nautical Almanac Office of the U.S. Naval Observatory and the British Air Council, *The Air Almanac* (1953 *et seq.*). (J. E. T. H.; J. B. Hn.)

NAVIGATION LAWS. Historically this expression refers to laws passed at various times and places to restrict commerce to ships of a particular nationality. But the expression is used in another sense to denote laws which lay down rules of the road and in other ways regulate the actual navigation of ships. The two classes will here be dealt with separately.

Restriction of Navigation.—In England the first Navigation act was passed in 1381. Policy varied thereafter until in 1651 a Navigation act was passed in order to strike a blow at the maritime supremacy of the Netherlands. The system set up of requiring the national trade by sea to be carried in ships under the national flag was maintained in force (with certain later statutory amendments) for a period of two centuries. By the Navigation acts ships under the national flag were required to be owned by British subjects, and shipmasters and a proportion of the seamen were also required to be British. Moreover, the national register for ships was established by Charles II in 1660 in order to ascertain which ships were to benefit from the acts.

The result of these acts was that by 1847 no produce from Asia, Africa or America could be imported into the United Kingdom from Europe in any ships, the object being that the trade should be direct and in British bottoms. Coastal trading around the United Kingdom could only be carried on by British ships, and colonial trade was prohibited to all foreign ships except where sanctioned by a special order in council. Various restrictions were imposed on imports not carried in British ships, and orders in council laid down differential dues and restrictions on imports carried in ships of any foreign countries imposing similar restrictions on British trade.

In 1849 the Navigation acts were repealed, subject to reservation of the coasting trade and subject to the proviso, intended to secure reciprocity, whereby if prohibitions or restrictions were imposed on British ships by other countries the privileges of the ships of those countries in British ports might be restricted. The reservation as to coasting trade was removed in 1854.

However, despite these relaxations, it is still the law that a ship is not to be deemed a British ship unless it is owned wholly by British subjects, or by a body corporate established in some part of the sovereign's dominions. British ships are still required to be registered as such. Further, no alien can own, nor, subject to certain reservations, may he act as master or as one of the principal officers of a British ship.

In the United States a system of duties discriminating against foreign ships was adopted in 1789. Under various statutes provision was made for relief by way of reciprocity, and consequently, after 1849, British ships were admitted to the United States ports on the same terms as American ships were admitted into British trade. But coastwise trade has continued to be limited to ships of the United States. Similar restrictions are placed on coastwise trade by some other countries, including France and Portugal. But many others, for example the Netherlands, Denmark and Sweden, permit coastwise trade to vessels of all nations which grant reciprocal privileges to ships carrying their flag.

After World War I, and in implementation of the terms of the peace treaty, conferences were convened under the auspices of the League of Nations with the object of facilitating and maintaining freedom of communications and of commerce. Several international conventions were adopted, the most important being the Maritime Ports convention, 1923, under which each of the contracting parties undertook, subject to the principle of reciprocity, to grant the vessels of every other contracting state equality of treatment with its own vessels or those of any other state whatsoever, in the maritime ports situated under its sovereignty or authority, as regards freedom of access to the port, the use of the port and the full enjoyment of the benefits as to navigation and commercial operations which it offers to vessels, their cargoes and passengers. This convention, however, does not apply to maritime coastal trade.

After World War II, the Provisional United Maritime Consultative council, consisting of 18 members, including the United Kingdom, the dominions and the United States, was set up at Washington, D.C., in 1946 for the purpose, *inter alia*, of removing all forms of discriminatory action and considering any shipping problem of international character. In 1948 a conference was held at Geneva at which the great majority of the members of the United Nations, with the notable exception of the U.S.S.R., were present. The conference adopted a convention for the constitution of an intergovernmental consultative organization, whose headquarters were to be in London, and whose objects were to follow the lines of those of the provisional consultative council. Its organs were to be an assembly, a council of 16, a maritime safety committee and a permanent secretariat.

Regulation of Navigation.—The other class of navigation laws laying down rules of the road and in other ways regulating the actual navigation of ships may apply (1) on the high seas, or (2) within territorial waters, ports, harbours, docks and inland navigable waters. (As to territorial jurisdiction in general *see* WATERS, TERRITORIAL.)

Customary rules of seamanship applicable to navigation on the high seas were gradually developed. In England the Trinity masters advised the judges as to the rules by which those in charge of a ship should be guided. In 1846 some Trinity house rules of navigation were made statutory. In 1889 an international maritime conference took place at Washington, D.C., the ultimate outcome of which was the drawing up of the International Regulations for Preventing Collisions at Sea. These have been adopted by all maritime nations and are thus of universal application. They are operative in respect of British ships everywhere and in respect of foreign ships when within British jurisdiction in the following way. The British Merchant Shipping acts empower the sovereign, by order in council to make regulations of this kind. This was done in 1896. Several further orders were made, and in 1910 the regulations were consolidated and reissued. As a result of the international convention for the safety of life at sea which was adopted at London in 1948, new International Regulations for Preventing Collisions at Sea were compiled, to come into operation as regards the United Kingdom at the beginning of 1954 and to supersede the 1910 regulations.

The collision regulations apply in general everywhere but they are subject in certain harbours and inland waters to qualifications introduced by local rules to adapt them to special local circumstances. These were made either in the same way as other national laws or by local authorities under powers given to them by the national legislature having jurisdiction over the place in question. Thus local rules are in force in many British and Irish ports and waterways, in the Danube and port of Sulina, in the Scheldt, at Gibraltar, in the Suez canal, in the United States inland waters and in the Great Lakes, both United States and Canadian.

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NAVY AND NAVIES. Originally the navy of a country meant the whole of its shipping, whether used for war, the carrying of merchandise or fishing. In modern parlance, however, the word is generally taken to mean a nation's warships and craft of every kind maintained for fighting on, under or over the sea and the personnel which mans them, *e.g.,* the royal navy consists of the surface warships—battleships, cruisers, aircraft carriers, destroyers, mine layers, mine sweepers, gunboats and other auxiliary craft; the submarines; and the fleet air arm. Behind the actual fighting units there is, necessarily, a vast organization for their administration and upkeep. *See* the sections *Defense* of the articles UNITED STATES; FRANCE; GERMANY and other countries; also such articles as ADMIRALTY; STAFF, NAVAL; DOCKYARDS AND NAVAL BASES.

History of Navies.—In early history we find navies in the form of the armed men of a tribe or town putting to sea in such large boats or ships as might be available to give battle to enemies similarly equipped or to raid territory from the sea. The craft themselves were for the most part those used for commerce, fishing or, when occasion served, for war or piracy. It was the exception that they were built especially for fighting purposes. But later we see special types of war craft designed as such beginning to assume a recognized place in the armoury of peoples and their sovereigns. Some of the earliest of what we should, today, term sea powers were the Phoenicians, Athenians, Carthaginians, Romans, Norsemen, Venetians, French and early English, but navies

in legendary form are to be found 2,000 years before they materialised in accredited records and the adventures of the Argonauts and of Ulysses would seem poetic forecasts of the age of the Vikings. In regard to the vessels themselves, there are definite indications of long ships built for speed as distinguished from round ships for burden from the time of the ancient Greeks and Romans. The Athenian navy was a state force and in 483 B.C. the threat of Persian attack caused Athens to increase her fleet from 50 to 100 long ships which were paid for out of the proceeds of the mines of Laureium (*see* THEMISTOCLES). The effect of this was to make Athens the predominating partner in the league formed by the Greeks for their common naval defence. By the end of the 5th century B.C. the fleet had increased to 300 long ships and later to as many as 360. In peace these war vessels were kept on slips and under cover in sheds; in war a *strategos* was appointed in command and he chose the trierarchs who were deputed to commission the vessels, partly at their own expense, under the supervision of State Inspectors.

In general the organization of the Athenian navy resembled closely that of the British navy in the 16th and 17th centuries. The trierarch, who was either one of a group of citizens assisting to finance one or more war vessels, or someone paid to discharge the duty, answered to the captain; there was a sailing master; a number of petty officers; seamen and oarsmen; while soldiers or marines formed the fighting personnel. The most ancient warships were many-oared galleys (*q.v.*), each requiring a very large number of rowers. The result was that the personnel provided to man a fleet of those times had to be a considerable one. For instance, the Roman and Carthaginian forces in the first Punic War numbered approximately 150,000 men on each side. These great rowing galleys relied for their offensive powers on boarding or ramming, and we see them in great numbers in the Mediterranean as the war fleets of the succession of Alexander, of Carthage, of Rome, of Byzantium, of the Italian Republics, of the Arabs and of Aragon. (*See* also SHIP.)

In the naval organization of ancient Rome we see the beginning of the idea of an Admiralty in the navy commissioners appointed in 311 B.C. It is interesting to note, too, that the Roman Empire was faced, on a small scale, with maritime problems which have assumed such vast importance to the British Empire of to-day. Not only had Rome to maintain a fleet to neutralize the threat arising from rival sea powers, but sea-borne trade was of such importance as to compel her to provide a navy capable of dealing with prevalent piracy and the needful safeguarding of routes. This organization, which was very complete, included two main fleets which guarded the coasts of Italy at Ravenna and Misenum. These were known as the Praetorian. Other squadrons were allocated to Forum Julii, to the mouth of the Orontes, to Alexandria, to Carpathus (between Crete and Rhodes), to Aquileia (at the head of the Adriatic), to the Black Sea and to Britain. River flotillas were stationed on the Rhine and Danube and, later, on the Euphrates. All these squadrons did not exist at the same time, but there was always a highly organized navy with a body of soldiers, the *classici,* specially assigned for service afloat.

The navy of the Eastern Empire may be said to have originated with the foundation of Constantine's New Rome on the site of Byzantium. The threat of attack from the Vandal kingdom of Carthage (from A.D. 428 to 524) compelled the Emperors to attend to their fleet, but with the fall of that kingdom the navy was neglected until the rise of Mohammedan power at the end of the 7th century produced a new menace. The Byzantine navy reached a high state of efficiency under the sovereigns of the Macedonian dynasty (867–1056). It consisted of an Imperial fleet commanded by the Great Drungarios, the first recorded Lord High Admiral, and of provincial squadrons under their *strategoi.* The Imperial Fleet was essentially a war organization, while the provincial or thematic squadrons were smaller but more permanent forces maintained for police purposes. It is interesting to note that this navy included a corps corresponding to the gunnery experts of a modern fleet. These were the *siphonarioi,* who worked the *siphons* used for discharging the "Greek fire."

After the disorganization of the Eastern Empire by Turkish invasions in the 12th century, the Byzantine navy withered. In the middle ages the Italian republics and monarchial states bordering on the Mediterranean possessed appreciable fleets, and their seamen, especially those of Genoa, were regarded as some of the first in the world, so much so that their services were sought by the powers of Western Europe and even by England. Edward III. and the kings of France employed Genoese to assist them in nautical matters.

The Mediterranean navies made their last great appearance in history at the Battle of Lepanto, 1571 (*q.v.*). From thence onwards the scene of naval activity changed and the ships and fleets took upon themselves a new form, and one to fit them for ocean sailing and fighting. The history of the growth of modern great navies will be found under their respective countries. (E. A.)

BIBLIOGRAPHY.—*Ancient and General.*—Accounts of the naval organizations of the ancient world, and of the sea fighting of the time are to be found in the histories of Greece and Rome: G. Corazzini has written a *Storia della marina militare antica* (Livorno, 1882). Valuable details of the Imperial Roman navy and of the Byzantine navy will be found in Prof. J. B. Bury's appendices to his edition of Gibbon's *Decline and Fall,* vol. i. apx. 5, and vol. vi. apx. 5 (1896–1900). *See* also A. T. Mahan, *Influence of Sea Power on History, 1660–1783* (1890).

For *United States* see UNITED STATES OF AMERICA, *Navy.*

Mediaeval.—As regards the mediaeval navies the first place may be allowed to the Italians. A general bibliography of Italian nautical literature *Saggio de una bibliografia marittima italiana,* occupying fifty-eight pages, drawn up by E. Celani, will be found in the *Revista marittima,* supplement for 1894. The histories of the different Republics of the middle ages record their maritime enterprises. An excellent book, which gives far more than its title promises, is the *Storia della marina pontificia* of A. Guglielmotti, O.P., in 10 volumes published at different times, and in two editions, at Florence 1856, etc. The general maritime history of the Mediterranean in the middle ages is well illustrated in the *Memorias sobre la marina comercio y artes de Barcelona* (1779–1792) by A. Capmany. The naval enterprises of the Norsemen are dealt with in a scholarly fashion by G. B. Depping, *Histoire des expéditions maritimes des Normands* (1826); and with newer knowledge by C. F. Keary, *The Vikings of Western Christendom* (1891).

Great Britain.—*The History of the Royal Navy to the French Revolution,* by Sir N. Harris Nicolas (1847), is unfortunately incomplete. It ends at the year 1422, but is the work of a most laborious and exact antiquary, who had been a naval officer in his youth. The administrative history of the British navy until 1660 is the subject of the *History of the Administration of the Navy and of Merchant Shipping in relation to the Navy* (1896) by M. Oppenheim—a most valuable collection of materials. *The Naval History of England* (1735) by T. Lediard, is copious and useful. The *Naval Chronology, or an Historical Summary of Naval and Maritime Events from the Time of the Romans to the Treaty of Peace 1802,* by Captain I. Schomberg (1802), contains a mass of valuable information, lists of ships, dates of construction, etc., and some administrative details. A good book is *The Naval and Military Memoirs of Great Britain 1727 to 1783* (1804) by R. Beatson, a very careful and well-informed writer who had seen some service as a marine officer. The *Naval History of Great Britain,* from 1793 to the accession of George IV., by W. James (1827), republished with a continuation by Chamier in 1837, is a standard authority. The *History of the British Navy from the Earliest Period to the Present Time* (1863) by C. D. Yonge, contains some original matter for the naval transactions of the 19th century. *The Royal Navy,* 7 vols. (1897–1903), edited and partly written by Sir W. L. Clowes, is a compilation of unequal value. Some of Sir W. L. Clowes's coadjutors, notably Captain Mahan and Sir C. R. Markham, are of high standing and authority. *The Naval Chronicle,* 1799–1818, a magazine, contains useful matter, for the Revolutionary and Napoleonic Wars. *The Naval Biographical Dictionary; life and services of every living officer* (1846), by W. R. O'Bryne, is a solid book of reference. The publications of the Navy Record Society (1894 and subsequent years) contain large and valuable publications of original matter, with some reprints of old authorities, such as Sir W. Monson's *Tracts,* which were difficult of access. *See* also *A Short History of the Royal Navy,* by D. Hannay; *Official History of the War:* "Naval Operations" (1920, etc.); G. Callender, *The Naval Side of British History* (1924); G. F. S. Bowles, *The Strength of England* (1926).

France.—Léon Guérin, *Histoire maritime de la France* (1844). The *Histoire de la marine française* of Le Comte de Bonfils Lablénie (1845), a naval officer, is of value. *La Marine de guerre, ses institutions militaires depuis son origine jusqu'à nos jours,* by Capne Gougeard (1877); the *Essai sur l'histoire de l'administration de la marine française* of Lambert de Sainte Croix (1892); and the excellent little book of M. Loir on *La Marine royale, 1789* (n.d.), may be consulted with pleasure and profit. The three books of A. Jal, *Archéologie navale* (1840), *Glossaire nautique* (1848) and *Abraham du Quesne et la marine de son temps* (1872) are all of high value. *Les Batailles navales de la France* of O. Troude (1867), is a carefully written account of naval actions

The *Histoire de la marine française, pendant la guerre de l'indépendence américaine* (1877); *Sous la première république* (1886); *Sous le consulat et l'empire* (1886); *De 1815 à 1870* (1900); and *La Marine française et la marine allemande, 1870–1871* (1873) of E. Chevalier, are thorough and critical. G. Lacour-Gayet, Professor at L'École supérieure de la Marine, has published two books of serious research, *La Marine militaire de la France sous le règne de Louis XV* (1902), and *La Marine militaire de la France sous le règne de Louis XVI* (1905). The *Recherches sur l'ancien clos des galées de Rouen* (1864) of C. de Robillard de Beaurepaire, and the life of *Jean de Vienne* by the Marquis Terrier de Loray (1878), are valuable monographs on passages of early French naval history. The *Projets et tentatives de débarquement aux Iles britanniques* by E. Desbrière (1900 *et seq.*) is a most valuable authority. A very scholarly *Histoire de la marine française* was begun in 1899 by M. C. de la Roncière.

See also the standard authorities for Spanish naval history, *La Marina de Castilla* (1892), and *La Armada Española desde la union de Castilla y Aragon* (1895–1901), of C. Fernandez Duro. J. C. de Jonghe, *Geschienes van het Nederlandsche Zeewezen* (1858), is an admirable and exhaustive history of the Dutch navy. *The History of the Maritime Wars of the Turks,* by Haji Khalfa (or Hugji Chalifa), tr. J. Mitchell for the Oriental Translation Fund (1831), may be read with curiosity and some profit. There are two general histories of the navy of the United States by Fenimore Cooper (1839) and by E. S. Maclay (1894); the second is the fuller, and the more critical. The monographs by Adm. Jurien de la Gravière, covering the whole field of naval warfare from the Peloponnesian War to his own time, contain much information and sound criticism.

NAVY DEPARTMENT: *see* GOVERNMENT DEPARTMENTS.

NAWABGANJ, the name of three towns of India. (1) The most important is the headquarters of Bara Banki district, central Uttar Pradesh, 17 mi. E. of Lucknow; pop. (1941) 18,207. It has a considerable trade in sugar and cotton goods. It was the scene of a victory by Sir James Hope Grant during the Indian Mutiny of 1857. (2) A town in Gonda district, Uttar Pradesh, pop. (1941) 5,662. (3) A town in Bareilly district, Uttar Pradesh, pop. 4,577.

NAWANAGAR or JAMNAGAR, a native state of the United State of Saurashtra, India, situated on the south of the Gulf of Cutch. Area, 3,791 sq.mi. Pop. (1941) 504,006. Maharaja Jam Shri Digvijayasinhji Saheb became chief in April 1933. Grain, cotton and oilseeds are produced there. Marble and copper are found, and there is a pearl fishery in the Gulf of Cutch. The town of Jamnagar is about 5 mi. from the seaport of Bedi. Pop. (1941) 71,588.

Founded by Jam Rawal in 1540, Nawanagar is built of stone, has manufactures of silk and gold embroidery and locomotive works and is well known for its dyeing. Its water is supplied from a reservoir covering 600 ac. and an aqueduct 8 mi. long.

Nawanagar became one of the jurisdictional states of the United State of Saurashtra, established in April 1948.

NAXOS, the largest of the Cyclades (about 22 mi. by 16 mi.), east of Paros, with which, and adjacent smaller islands, it forms an *eparchia.* In early times it was also called Dia or Strongyle. Rich in vines and famous for its wine, it was a centre of the worship of Bacchus. The god found Ariadne asleep on its shore, when she was deserted by Theseus. The sculptors of Naxos were important in early Greek art; unfinished statues are still to be seen in the quarries, notably the colossal one in Apollona bay, to the northeast. During the 6th century B.C. a tyrant Lygdamis ruled Naxos in alliance with Peisistratus of Athens. In 501 a Persian fleet attacked it unsuccessfully, but in 490 it was captured and treated with severity. Four Naxian ships joined the expedition of Xerxes, but deserted to the Greek side at Salamis in 480. Naxos was a member of the Delian league (*q.v.*); but, revolting in 471, was captured by Athens, and remained in her possession till her fall. In later times after its capture, in A.D. 1207, by the Venetian, Marco Sanudo, the duchy of Naxos flourished till the Turks took the island in 1566. After the War of Independence it belonged to the Greek kingdom. The ancient remains of a temple (*Palati*), supposed to be that of Dionysus, are on an island just off the town. Naxos is rich in fruit trees, and exports corn, wine and oil, but its most important product is emery. The population is about 17,000.

NAXOS, the earliest Greek colony in Sicily, was founded by Theocles from Chalcis in *c.* 734 B.C., on the east coast, south of Tauromenium (modern Taormina), just north of the mouth of the river Alcantara, where the castle of Schiso now stands. As there were already Sicels at Tauromenium, they cannot have offered any opposition. The adoption of the name of Naxos, the island in the Aegean sea, may show that there were Naxians among its founders. It soon founded Leontini and Catana. Naxos was the warmest ally of Athens in the Sicilian expedition. In 403 B.C. it was destroyed by Dionysius and its territory given to the Sicels. Its exiles at last found refuge in 358 at Tauromenium. Scanty traces of its walls are to be seen.

NAYAR (NAIR), the dominant lay caste in Malabar, on the west coast of southern India. The Nairs were originally a militia, the name being a form of Sanskrit *nāyaka,* "leader," as is Tamil *nāyadu, naidu;* but many Nairs now enter civil professions. The caste is split up into numerous groups of varying status, but all are or were curiously submissive to the Nambūtiri Brahmans.

To the Nair, as a soldier or marine, marriage was forbidden, and a Nair woman was therefore ritually married to anyone, even a stranger, merely as a form. After that she could be united to a Nambūtiri or a Nair, not below her in group status, by the *sambandham* ceremony. It would seem that once she was permitted to have several such husbands, not necessarily brothers, at a time. But, strictly speaking, polyandry did not exist, and it is now probably as extinct in fact as in theory. The *sambandham* became monogamous and usually permanent. From the custom, however, descent in the female line naturally ensued, and it involved also inheritance in that line, a man's heir-at-law being his (uterine) sister's son. But a woman's property was managed by the senior male of her own kin. To remedy the evils of this system the Malabar Marriage act of 1896 enabled *sambandhams* to be registered as binding and permanent marriages, but little advantage has been taken of the statute, as it merely legalized the prevailing custom.

E. Thurston, *Castes and Tribes of Southern India,* vol. v (1905), is exhaustive; Moore, *Malabar Law and Custom* (1905).

NAYARIT, a Pacific state of Mexico, until 1917 the territory of Tepic, bounded by Sinaloa, Durango and Jalisco. Area, 10,442 sq.mi. Pop. (1950) 292,343, chiefly mestizos and Indians. The Southern Pacific of Mexico railway and the trunk highway from Nogales to Guadalajara cross Nayarit. Running southeasterly, the Sierra Madre rises steeply from the narrow Pacific littoral and cuts the state into deep gorges and narrow valleys. Its climate is generally wet, frost-free and healthful except on the hot Pacific slope. The main river is the final leg of the Rio Lerma, rising on the main plateau of Mexico; under the name of Santiago it flows westward through Nayarit and empties north of San Blas, chief Pacific port. Its valley is extremely fertile.

Mining is important in the sierras, but Nayarit is primarily agricultural; its products include tobacco, sugar, cotton, beans, coffee, woods and medicinal plants. After its market roads were expanded from 10 mi. to 520 mi. between 1945 and 1950, its output of maize increased from 30,000 tons to 178,000, half of it is shipped to Mexico City; the number of tractors increased from 15 to 450 in the same period.

Tepic (est. pop. 1950, 30,000) is the capital, 26 mi. S.E. of San Blas, with which it is connected by road. It is built on a small plateau 3,000 ft. above sea level, a quiet colonial town surrounded by ranches and small farms. Small villages of Cora and Huichol Indians are scattered through the sierras. (HD. C.)

NAYLER or **NAYLOR, JAMES** (1618–1660), English Puritan, was born at Andersloe or Ardsley, in Yorkshire, in 1618. In 1642 he joined the parliamentary army, and served as quartermaster in John Lambert's horse. In 1651 he became a Quaker. He gradually arrived at the conviction that he was a new incarnation of Christ. He gathered round him a small band of disciples, who followed him from place to place. At Appleby in 1653 and again at Exeter in 1655 he suffered terms of imprisonment. In Oct. 1655, in imitation of Christ's procession into Jerusalem, he entered Bristol on horseback riding single—"a rawboned rude figure, with lank hair reaching below his cheeks"—attended by seven followers, some on horseback, some on foot, he in silence and they singing "Hosanna! Holy, holy! Lord God

of Sabaoth!" At the High Cross he and his followers were arrested. His trial occupied the second parliament of Cromwell for several days, and on Dec. 16, 1656, he was convicted of blasphemy and sentenced to be whipped, to be branded in the forehead with "B" (for blasphemer), to have his tongue bored with a red-hot iron, to be whipped through the streets and to suffer imprisonment for two years. On his release he was readmitted into the communion of the Quakers.

See E. Fogelklou, *James Nayler, The Rebel Saint* (London, 1931).

NAZARENE, CHURCH OF THE, a religious body based on the theological doctrines of holiness and sanctification as expounded by John Wesley in the 18th century. At mid-20th century, it had approximately 3,000 churches in the United States with a membership of more than 200,000.

Earlier this church was known as the Pentecostal Church of the Nazarene, a religious body formed in 1907 when the Association of Pentecostal Churches in America (organized in northeastern United States, 1894–96) merged with the Church of the Nazarene (organized in California in 1895). In 1908 the Holiness Church of Christ, organized in Texas in 1904, joined the union; and in 1915 the Pentecostal Mission, which was first organized in Tennessee in 1898 as the Pentecostal Alliance, also joined. The word "Pentecostal" was dropped from the name of the church in 1919 and it became known as the Church of the Nazarene.

Doctrines of the church emphasize sanctification as a work of grace following regeneration. Members believe that the Bible contains all truth necessary for Christian faith and living. The second coming of Christ, the resurrection of the dead, and the final judgment of the Lord are also precepts of the church. The sacraments of baptism and the Lord's Supper are recognized. (*See* WESLEY, JOHN and WESLEYAN METHODIST CHURCH.)

NAZARENES, an obscure Jewish-Christian sect, existing at the time of Epiphanius (*fl.* A.D. 370) in Coele-Syria, Decapolis, (Pella) and Basanitis (Cocabe). According to him (*Panarion*, xxix, 7) they dated their settlement in Pella from immediately before the siege in A.D. 70; he characterizes them as neither more nor less than Jews pure and simple, but adds that they recognized the new covenant as well as the old, and believed in the resurrection, and in the one God and His Son Jesus Christ. Recent investigation leads to the conclusion that the Nazarenes of the 4th century are to be identified with the Ebionites (*q.v.*).

NAZARETH, a town of Lower Galilee, on the northern border of the plain of Esdraelon, 1,600 ft. above sea level. Population in 1931 was 8,756 (3,226 Moslems, 5,445 Christians); 1939 estimate, 10,100. The industries are lace-knitting, and the manufacture of mementoes for sale to tourists.

Nazareth is not mentioned in the Old Testament. It first became known as the place where Jesus spent his youth. The village was the home of Joseph and Mary, and to it they returned after the flight to Egypt. In its synagogue Jesus preached the sermon that led to his rejection by his fellow-townsmen. A mass of legends and precarious identifications has grown up with the ages. A sample of the soil in which they took root and flourished may be here given. Antoninus Martyr, who visited Palestine in A.D. 570, tells us: "In the synagogue there is still the book from which our Lord was set to learn A.B.C. In the synagogue, too, is the bench upon which our Lord sat with the other children. This bench can be moved and lifted up by Christians; but Jews cannot at all stir it, nor does it permit itself to be carried out of doors." Today visitors are shown the church of the Annunciation, the workshop of Joseph, St. Mary's well, Christ's table, the place of precipitation, etc. Only for the well can authenticity be assured.

The Crusaders captured Nazareth in 1100 and transferred there the bishopric of Scythopolis (Beisān). It was taken by Saladin (1187) and retaken by Frederick II (1229). On its capture by Beibars (1263), the Christian inhabitants were massacred. In 1517 it came into the possession of the Turks. In World War I Nazareth was the headquarters of the Turco-German army. It was captured by British cavalry Sept. 20, 1918. (E. Ro.)

NAZARETH, a borough of Northampton county, Pennsylvania, U.S., 7 mi. N.W. of Easton; served by the Lehigh and New England, D.L. & W. railways. Pop. (1950) 5,830. It has cement works and factories for textiles, musical instruments, paper products, steel, etc. It was founded by the Moravians in 1740.

NAZARITE or, better, NAZIRITE, the name given by the Hebrews to a peculiar kind of devotee. The characteristic marks of a Nazarite were unshorn locks and abstinence from wine (Judges xiii, 5; 1 Sam. i, 11; Amos ii, 11 *et seq.*); but full regulations for the legal observance of the Nazarite vow are given in Num. vi, where every product of the grape-vine is forbidden, and the Nazarite is enjoined not to approach a dead body. The law contemplates the assumption of the vow for a limited period only, and gives particular details as to the atoning ceremonies at the sanctuary by which the vow must be recommenced if broken by accidental defilement. On the expiry of his vow the Nazarite cuts off his hair and burns it on the altar, thus returning to ordinary life. In the earliest historical case, that of Samson, and in the similar case of Samuel (who, however, is not called a Nazarite), the head remains unshorn throughout life, and in these times the ceremonial observances as to uncleanness must have been less precise; *e.g.*, Samson touches the carcass of a lion.

In the cases of Samuel and Samson the unshorn locks are a mark of consecration to God (Judges xiii, 5) for a particular service. Since, moreover, the Hebrew root *n-z-r* is only dialectically different from *n-d-r*, "to vow," both corresponding to the same original Semitic root (Arab. *n-dh-r*), it would seem that the peculiar marks of the Nazarite are primarily no more than the usual sign that a man is under a vow of some kind. To leave the locks unshorn during an arduous undertaking in which the divine was specially implored and to consecrate the hair after success was a practice among various ancient nations, but the closest parallel to the Hebrew custom is found in Arabia. There the vow was generally one of war or revenge, and, till it was accomplished, the man who vowed left his hair unshorn and unkempt, and abstained from wine, women, ointment and perfume. At one time the Nazarites probably had an importance—perhaps even an organization—parallel to that of the prophets, but of a very different religious type from the Canaanite nature-worship. (*See* RECHABITES.)

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NAZARIUS (4th century A.D.), Latin rhetorician and panegyrist, was, according to Ausonius, a professor of rhetoric at Burdigala (Bordeaux). The extant speech of which he is considered the author (in E. Bährens, *Panegyrici Latini*, No. 10) was delivered in 321 to celebrate the 15th anniversary of the accession of Constantine the Great, and the fifth of his son Constantine's admission to the rank of Caesar. The preceding speech (No. 9), celebrating the victory of Constantine over Maxentius, delivered in 313 at Augusta Trevirorum (Trier), has been often attributed to Nazarius, but the differences in style and vocabulary, and the more distinctly Christian colouring of Nazarius' speech, were often cited to refute this theory.

His work is discussed in Teuffel-Schwabe's *History of Roman Literature* (Eng. trans. 1900).

NAZI, a popular abbreviation for a member of Adolf Hitler's National Socialist German Workingmen's party (*Nationalsozialistische Deutsche Arbeiterpartei*, commonly designated by its initials, NSDAP). The nickname originated from the German pronunciation of the first two syllables of "National." (*See* NATIONAL SOCIALISM.)

NEAGH, LOUGH, the largest lake in the British Isles, situated in Northern Ireland. It has an area of 148 sq.mi. and a catchment area of 2,200 sq.mi. The hollow in which it lies was caused by the collapse of a corner of the basalt plateau which covers much of County Antrim. Its waters are divided among the five counties of Antrim, Down, Armagh, Tyrone and Londonderry. Its shape is an irregular oblong, its extreme measurements being 18 mi. from northeast to southwest, 16 mi. from north to south and 11 mi. from east to west.

The Bann river flows through the lake and is its sole outlet

northward to the sea. Under the Drainage act of 1929, the ministry of finance, Northern Ireland, was established as the drainage authority for the Lough Neagh district. A big scheme was begun in 1930 for deepening and widening the Bann river along the 32 mi. from the outlet of Lough Neagh to its tidal reaches. This ensured that 700,000 cu.ft. of water per minute could be discharged and the flood level of the lake kept below 53 ft. 6 in. above sea level. (Hu. S.)

NEALE, EDWARD VANSITTART (1810–1892), English co-operator and Christian Socialist, was born at Bath on April 2, 1810, the son of a Buckinghamshire clergyman. He studied at Oriel college, Oxford, was called to the bar at Lincoln's Inn in 1837, became a member of the Christian Socialists in 1850 and also joined the council of the Society for Promoting Working Men's Associations. He founded the first co-operative store in London, and advanced the capital for two builders' associations, both of which failed. In 1851, though strongly opposed by other members of the promoting "Council," he started on his own initiative the Central Co-operative Agency, similar in many respects to the Co-operative Wholesale Society of a later day. The failure of this scheme, together with that of the operatives' cause in the engineering lock-out of 1852 is said to have cost him £40,000. He was closely associated with the movement which resulted in the Industrial and Provident Societies Act of 1876, and the passing of the Consolidation Act of 1862 was almost entirely due to his efforts. Besides publishing pamphlets on cooperation he served on the executive committee which afterwards developed into the Central Co-operative Board, and took an active part in the formation of the North of England Co-operative Wholesale Society in 1863. One of the founders of the Cobden mills in 1866, and the Agricultural and Horticultural Association in 1867, he also promoted the annual co-operative congress. He was also a director of the Co-operative Insurance Company and a member of the Co-operative Newspaper Society. He visited America in 1875 with a deputation whose object was to open up a direct trade between farmers of the western States and English co-operative stores. He died on Sept. 16, 1892.

NEALE, JOHN MASON (1818–1866), English divine and scholar, was born in London on Jan. 24, 1818, and was educated at Trinity college, Cambridge. He occupies a high place as a hymnologist, but principally as a translator of ancient and mediaeval hymns, the best known being probably "Brief life is here our portion," "To thee, O dear, dear country," and "Jerusalem, the golden," which are included in the poem of Bernard of Cluny, *De Contemptu Mundi,* translated by him in full. He also published *An Introduction to the History of the Holy Eastern Church* (1850, 2 vols.); and other works. His *Collected Hymns* were published in 1914.

See *Letters of John Mason Neale* (1910), selected and edited by his daughter Mrs. C. Towle, who also wrote his *Life* (1907).

NEANDER, JOHANN AUGUST WILHELM (1789–1850), German theologian and Church historian, was born at Göttingen on Jan. 17, 1789, of poor Jewish parents named Mendel. He graecized his name into Neander on his baptism in 1806. Educated under Schleiermacher, he became professor at Heidelberg in 1812 and removed to Berlin in 1813. His learning, sympathies, and personality attracted many students, and he did perhaps more than any other teacher to bring a less formal spirit into Lutheran teaching. He died on July 14, 1850.

NEANDERTHAL MAN. The cave in which the Neanderthal bones were discovered in 1856, is in the valley of the Düssel, a tributary of the Rhine. The bones found, the vault of the skull, upper and lower arm bones, both thigh bones and portions of the shoulder blade, pelvis and ribs, belonged to a separate species —which is represented by remains found in Jersey, in France, Belgium, Spain (Gibraltar), Italy, Croatia, Russia, Czechoslovakia and Palestine. The normal skull of this species was large but low, with retreating forehead and massive brow ridges forming a shelflike ridge. The back part of the skull was somewhat flattened, so that the head must have appeared as set on a thick bull neck. The chin was receding. The teeth and palate were specialized in form and point to a rough diet. The thigh bones had thick curved shafts. Neanderthal man, an aberrant side line in evolution, became extinct about 50,000 years ago. Associated flint implements are known as Mousterian (Middle Palaeolithic).

See Sir A. Keith, *The Antiquity of Man,* 2nd ed. (1929); W. E. Le Gros Clark, *History of the Primates,* British Museum (Natural History), 2nd ed. rev. (London, 1953). (K. P. O.)

NEAP, a word only used of tides in which the high-water mark is at its lowest, as opposed to "spring tides" (*see* TIDES). The word is obscure in origin.

NEARCHUS, one of the officers in the army of Alexander the Great. A native of Crete, he settled at Amphipolis in Macedonia. In 325, when Alexander descended the Indus to the sea, he ordered Nearchus to conduct the fleet to the head of the Persian gulf. Nearchus was then entrusted with the more difficult task of circumnavigating Arabia from the mouth of the Euphrates to the Isthmus of Suez, a project cut short by the death of the king (323). In the troubles that followed, Nearchus attached himself to Antigonus, under whom he held the government of his old provinces of Lycia and Pamphylia.

He wrote a detailed narrative of his expedition, of which a full abstract was embodied by Arrian in his *Indica.*

For the text *see* editions of Arrian by C. Müller in *Geographici Graeci minores,* i (Paris, 1855), and by A. G. Roos, *Arrianus,* ii, in the Teubner series (Leipzig, 1928); on the topography *see* W. Tomaschek, "Topographische Erläuterung der Küstenfahrt Nearchs vom Indus bis zum Euphrat," in *Sitzungsberichte der K. u. K. Acad. der Wissenschaften,* cxxi (Vienna, 1890). *See* also E. H. Bunbury, *History of Ancient Geography,* i, ch. 13 (London, 1879); T. S. Brown, *Onesicritus* (Berkeley, Calif., 1949); and ALEXANDER III, THE GREAT. For ancient authorities *see* F. Jacoby, *Fragmente der griechischen Historiker,* IIB, IID (Berlin, 1923 ff.).

NEATH (Welsh, *Castell-Nêdd*), a municipal borough and market-town of Glamorganshire, South Wales, situated near the mouth of the Neath or Nêdd, on the G.W.R., 7½ mi. E.N.E. of Swansea. Pop. (1951) 32,305. Area, 6.8 sq.mi.

The town perhaps occupies the site of the Roman Nidum on the Julia Maritima from which a vicinal road branched off here for Brecon. At the Norman conquest of Glamorgan, Fitz Hamon gave the district between the Neath and the Tawe to Richard de Granville, who built on the west banks of the Neath first a castle and then in 1129 a Cistercian abbey, to whose monks he later gave all his possessions in the district. All traces of this castle have disappeared. Another castle, built in the same century, on the east bank, was held direct by the lords of Glamorgan, as the westernmost outpost of their lordship. It was frequently attacked by the Welsh, notably in 1231 when it was taken, and the town demolished by Llewelyn ap Iorwerth. The portcullis gate and a tower are all that remain of it; of the abbey there still exist the external walls, with parts of the chapel, vaulted chapter-house, refectory and abbot's house. Neath is a borough by prescription and received its first charter in the 12th century from William, earl of Gloucester, who granted its burgesses the same customs as those of Cardiff. Other charters were granted to it by successive lords of Glamorgan in 1290, 1340, 1359, 1397, 1421 and 1423. By the first of these (1290) the town was granted a fair on St. Margaret's Day (July 20) and as the abbey had extensive sheep walks the trade in wool was considerable. In 1685 James II. granted a further charter. At the Dissolution the abbey and the manor of Cadoxton (part of its possessions) were sold to Sir Richard Williams or Cromwell. Copper smelting has been carried on in or near the town since 1584 when the Mines Royal Society set up works at Neath Abbey; the industry attained huge proportions a century later under Sir Humphrey Mackworth, who from 1695 carried on copper and lead smelting at Melincrythan. With the development of the South Wales coalfield Neath continued its metallurgical associations and concentrated on the by-product industries, thus locally diminishing to some extent the marked depression that characterized this coalfield after the collapse of the post-war boom in 1921–22. Besides the copper works the town possesses tinplate, steel and galvanized sheet works, foundries and engineering works. In the neighbourhood there are numerous collieries. The Neath Canal, from the upper part of the Vale of Neath to Briton Ferry (13 mi.), passes through the town, which is also connected with Swansea by another canal.

One timé independent railway lines now form important branches of the G.W.R. to the Rhondda, Aberdare and Brecon respectively.

NEBO or Nabu ("the proclaimer"), the Accadian translation of various Sumerian ideograms for the god of wisdom and writing, the main seat of whose worship was at Borsippa—southwest of Babylon. It is because of the close association of Borsippa with Babylon after the period when Babylon became the centre of the Babylonian empire that the cult of Nebo retained a prominence only some degrees less than that of Marduk. The amicable relationship between the two was expressed by making Nebo the son of Marduk. In this case the expression of the relationship in this form was intended to symbolize the superiority of Marduk, different, therefore, from the view involved in making Marduk the son of Ea (*q.v.*), which meant that the prerogatives of Ea were transferred to Marduk by the priests of Babylon.

Nebo was the god of wisdom to whom more particularly the introduction of writing was ascribed. He takes his place, therefore, by the side of Ea as a cultural deity. The wisdom associated with him had largely to do with the interpretation of the movements in the heavens, and the priests of Nebo at an early age must have acquired widespread fame as astrologers. Assuming now, for which there is a reasonable amount of confirmatory evidence, that the priestly school of Nebo had acquired a commanding position before Babylon rose to political importance, we can understand why the worshippers of Marduk persisted in paying homage to Nebo, and found a means of doing so without lowering the dignity and standing of their own god. If Assur-bani-pal, the king of Assyria (668–626 B.C.), in the subscripts to the copies of Babylonian literary tablets invokes as he invariably does Nebo and his consort Tashmit as the gods of writing to whom all wisdom is traced, it is fair to assume that in so doing he was following ancient tradition and that the priests of Marduk likewise were dependent upon the school at Borsippa for their knowledge and wisdom.

The temple school at Borsippa continued to flourish until the end of the neo-Babylonian empire, and school texts of various contents, dated in the reigns of Artaxerxes, Cambyses and Darius, furnish the evidence that the school survived even the conquest of Babylonia by Cyrus (539 B.C.). Originally this Sumerian deity seems to have been connected with Dilmun and was often identified with the philosophic principle *mummu;* creative word, form. As such he is the son of the water god Enki (Ea), god of the first principle, water. As the god of writing, Nebo has charge of the tables of fate on which he inscribes the names of men and decides what their lot is to be. If in the systematized religious system, Marduk appears as the arbiter of human fates, the conclusion is warranted that Marduk is here imbued with the authority which originally was in the hands of his son. A reconciliation between the rival claims was effected by continuing Nebo in the role of scribe, but as writing at the dictation of the gods, thus recording what the divine assembly, gathered in the chamber of fates (known as ubshukinna) within the precincts of E-Saggila—Marduk's temple at Babylon—under the presidency of Marduk, had decided.

Nebo also does homage to his father by paying him an annual visit during the new year celebration, when the god was solemnly carried across to Babylon, and in return Marduk accompanied his son part way back to his shrine at Borsippa. Within E-Saggila, Nebo had a sanctuary known, as was his chief temple at Borsippa, as E-Zida, "the legitimate (or 'firm') house." The kings, and more particularly those of the neo-Babylonian dynasty, devote themselves assiduously to the worship and embellishment of both E-Saggila and E-Zida. In their inscriptions Marduk and Nebo are invoked together and the names of the two temples constantly placed side by side. The symbols of the two gods are similarly combined. On boundary stones and cylinders, when Marduk's symbol—the lance—is depicted, Nebo's symbol—the stylus—is generally found adjacent. In astronomy he was identified with the planet Mercury, and with the principal star of Taurus, Aldebaran. In the official reports of astrologers and in official letters, Nebo is even mentioned before Marduk without fear of thereby offending the pride of the priests of Marduk.

His consort, known as Tashmit, plays no independent part, and is rarely invoked except in connection with Nebo.

See also Babylon, Borsippa, Babylonian and Assyrian Religion.

Bibliography.—J. Pinckert, *Hymnen und Gebete an Nebo* (Leipzig, 1920), which given references to earlier monographs on Nebo. He is often mentioned in the Old Testament, for which *see* H. Zimmern, in E. Schrader, *Die Keilschriften und das Alte Testament,* 3rd ed., H. Zimmern and H. Winckler (1903). For prayers, *see* R. Brünnow, vol. iv (1889) and A. Ungnad, vol. xxii (1909) in the *Zeitschrift für Assyriologie* (Strassburg); S. A. Strong, in *Proceedings* of the Society of Biblical Archaeology (1898); S. Langdon, *Babylonian Liturgies* (Paris, 1913) and *Oxford Editions of Cuneiform Texts* (Paris, 1927). On Nebo's relation to the metaphysical concept *mummu, see* S. Langdon, "The Babylonian Conception of the Logos," *Journal of the Royal Asiatic Society,* part ii (1918). (S. L.)

NEBRASKA, styled the "Tree Planter's state" by act of the legislature, 1895, and renamed the "Cornhusker state" by legislative act in 1945, is near the centre of the U.S., lying approximately between 40° and 43° N. lat. and 95° and 104° W. long. It is bounded on the north by South Dakota, on the east by Iowa and a corner of Missouri, on the south by Kansas, on the south and west by a corner of Colorado and on the west by Wyoming. The Missouri river flows along the eastern and northeastern border. The extreme length of the state is about 430 mi. and the extreme breadth about 210 mi. The area is 77,227 sq.mi., of which 564 are water surface. Nebraska was named "Tree Planters' state" because Arbor day was originated by J. Sterling Morton, and forestry was emphasized by its pioneers and their successors. The name "Cornhusker" originally was applied to the University of Nebraska football team.

Physical Features.—The main feature of Nebraska topography is a great undulating plain, sloping gradually from the northwest to the southeast, at an average of ten feet per mile. This plain is broken along its northern and eastern borders by hilly regions of varied character. The highest point, 5,340 ft., is in Banner county. The point of lowest elevation is 825 ft. in Richardson county, at the southeastern corner. The mean elevation is about 2,500 ft.

The United States and state topographical surveys classify Nebraska into four regions: the loess, the sand hills, the high plains, and the Bad Lands, with lowlands along the Missouri and Platte rivers.

The loess region includes about 42,000 sq.mi. of the best farming region in the eastern, central and southern parts of the state. In the loess plains the landscapes flow in a series of long gentle waves toward the southeast. Along the Missouri, the Republican and at some points elsewhere the waves converge into moderate hills. The sand-hill region lies west and northwest of the loess plains, like an open fan with the handle toward the northeast. The main region includes about 18,000 sq.mi., with outlying areas dotting other parts of the state. Scattered through the sand hills are rich valleys, lakes and fertile tablelands. The sand hills themselves are for the most part a series of sloping hills, rising sometimes into pinnacles, at other times stretching in gentle plains. Their general height is from 25 to 100 ft. above the valleys between.

West and northwest of the sand hills lie the high plains, mostly level stretches of tableland, broken occasionally by deep canyons. In this region are about 12,000 sq.mi. Included in this region are two areas of evergreen wooded mountains, the Wild Cat range, in Scotts Bluff and Banner counties and the Pine Ridge in Sheridan, Dawes and Sioux counties. Conspicuous features of these high plains are the buttes, isolated rugged hills, nearly destitute of vegetation, rising hundreds of feet above the surrounding plain. The entire plain region rises to an average height of from 3,000 to 4,000 ft. with large areas of level rich soil. The North Platte river, with its valley, 10 to 12 mi. in width, cuts through the heart of the high plains and is joined near the edge of the sand hills by the South Platte river entering from Colorado. The Pierre Shale region (or Bad Lands) occupies an area of about 1,000 sq.mi., chiefly in Sioux county, with minor sections in Dawes and Sheridan counties. Their weathered slopes and valleys furnish fine grazing and, with water, grow abundant crops. In connection with the Pine Ridge and Wild Cat hills this section

furnishes a region of rare scenic beauty and a sheltered range for stock.

Rivers and Drainage Basins.—All the drainage of the state reaches the Missouri river, a navigable stream which skirts the eastern border for approximately 450 mi. Chief tributaries of the Missouri in Nebraska are the Platte, with its branches; the Niobrara; the Republican; the Big and Little Blue; the Big and Little Nemaha. The Platte river is the dominant and characteristic Nebraska river. Its wide terraced valley, extending across the entire state and leading to mountain passes, made it the chief highway across the continent from the beginning. Its channel varies from one-half to one mile in width, and is filled with islands of varying size and shape. Its waters are shallow with a fall of about six to eight feet per mile. In the spring its depth varies from one to six feet. In the late summer use of water for irrigation leaves its middle course in the state entirely dry. The Loup and Elkhorn rivers, principal tributaries of the Platte, head in the sand hills and are nearly 200 mi. long each, with an abundant flow of water through beautiful valleys. Of Nebraska's 77,227 sq.mi., about 40,000 are in the drainage basin of the Platte and its tributaries. The Niobrara is a swift stream more than 400 mi. in length, running for about half that distance through canyons and hills wooded with pine and cedar. The Republican river is the principal stream along the southern border, as the Niobrara is in the north. The Big Blue and the Little Blue, about 200 mi. in length, with their tributaries, drain the south central part of the state. Their flow is more sluggish, the grade gently sloping back to the surrounding prairie. The Big and Little Nemaha, about 150 mi. long, drain the southeast section.

The lake region in Nebraska is chiefly in the sand hills, on the headwaters of the Elkhorn and Loup, making an area about 200 mi. long and 50 mi. wide. Several hundred lakes in this district furnish ideal fishing and hunting grounds. The lakes vary greatly in size and in water, from fresh spring-fed bodies to strongly alkaline.

Reservoirs resulting from the construction of numerous multiple-purpose dams augment lakes and rivers in the furnishing of recreational facilities. Artesian water exists in at least ten different counties with more than 1,500 flowing wells.

Climate.—The climate of Nebraska is inland or continental. The prevailing wind of the year is northwest, but in the spring, summer and much of the autumn, its predominance is greatly reduced by south and southwest winds from the Gulf of Mexico. Wet and dry years run in irregular cycles with no sufficient data to formulate a rule for them.

A curve covering the years from 1860 to 1950 would show dry cycles in 1860–63, 1890–95, 1910–13, 1933–36.

The normal mean annual temperature varies from 52° in the southeast to 45° in the northwest. The average temperature for January varies from 28° in the southeast to 22° in the northwest, and for July, from 78° to 68°.

The actual growing season between frosts varies from 164 days in the southeast to 122 in the northwest. The normal mean annual precipitation varies from 34 in. in the southeast to 16 in. in certain parts of the west.

Soil.—A soil of remarkable fertility is Nebraska's fundamental asset. Silt is the most common and most fertile physical element in the state soils. The top soils over most of the state are from 1 to 8 ft. in depth, a rich brownish-black vegetable humus. Below this top soil over the largest area is found the loess subsoil, varying from 10 ft. to more than 200 ft. in depth. The soil in the sand-hills regions is largely very fine sand mixed with silt. It never bakes, holds moisture and, under favourable treatment, covers itself with vegetation. Fertile valleys and slopes in the sand hills grow exceptional crops. The soils of the high plains and the butte region are chiefly a mingling of silt and fine sand, rich in lime, derived from the decomposing Arickaree strata. These soils produce splendid crops with a minimum of rainfall under modern culture methods. The Pierre Shale soils contain elements of great fertility.

Flora.—Grasses are the outstanding feature, 200 species growing within the state, a greater variety of native forage species than in any other state. Between 3,000 and 4,000 floral species have been identified within the state, including 64 trees and 77 shrubs growing native. About 1,000,000 ac. out of 49,000,000 are in forest trees.

The vast plains of the western portion of the state, when they were first entered by the white men, were covered with the short perennial grasses that gave the territory its name—"the short grass country."

History.—During approximately two and one-half centuries before 1803 when Louisiana territory, of which Nebraska was a part, was acquired by the United States, Spanish and French explorers and French fur traders occasionally entered the area that is now Nebraska.

Francisco Vásquez de Coronado, the first white man to penetrate the northern plains, probably did not reach Nebraska in his fruitless search for the mythical kingdom of Quivira during the summer of 1541, but the Coronado legend has been incorporated into the literature and pageantry of the state. In 1714, Étienne Venyard de Bourgmont, a French adventurer, ascended the Missouri river to the mouth of the Platte, referring to it as the Nebraska, or flat water. In 1720, a Spanish expedition under Col. Pedro de Villasur was massacred by the Pawnee Indians along the Platte. Peter and Paul Mallet (French) crossed the region from east to west in 1739–40.

The area was claimed by Spain, France and England, but the Spanish claim was recognized by the other two in the peace of Paris, 1763. During the period of Spanish control, fur traders (mostly French) ascended the Missouri river occasionally to trade with the Indians. A small, temporary trading post was erected in 1795 in what is now northeastern Nebraska.

In the half century following the Louisiana Purchase in 1803, exploration by Meriwether Lewis and William Clark (1804–06), Lieut. Z. M. Pike (1806), Maj. Stephen H. Long (1819–20), Col. Henry Dodge (1835), Lieut. John C. Frémont (1842–44), and Lieut. G. K. Warren (1855–57) made known to the public important facts regarding the region. Equally important were U.S. fur traders (notably Manuel Lisa and William H. Ashley) who pioneered travel on the Missouri river and through the Platte valley. Almost all of the early explorers were unfavourably impressed with the region, and their reports (Major Long's, in particular) gave rise to the belief that it was little more than a desert and entirely unfit for agriculture.

Fort Atkinson (1819–27), a military post on the present site of Fort Calhoun, was important in the fur trade and as the site of the earliest organized white activity in the area. Bellevue (1823), the oldest permanent settlement, was important in the fur trade, as a missionary centre and in the administration of Indian affairs.

Fort Kearny was established in 1846 where Nebraska City now stands, and in 1848 it was relocated on the south bank of the Platte about six miles southeast of the present city of Kearney.

The Platte valley, the state's most important topographic feature, developed into an important thoroughfare to the Rocky mountains and the Pacific coast. It was first used by Robert Stuart, returning from Astoria, in 1812–13. In 1824, William H. Ashley led a group of traders and trappers through the Platte valley to the Rocky mountains. Annually thereafter, until the decline of the fur trade in the 1840s, traders followed the Platte river route to and from the trapping grounds of the mountain region. Beginning in 1835, missionaries to the Oregon country followed the same route. In 1841, the first group of Oregon homeseekers went through the Platte valley, to be followed in succeeding years by thousands of emigrants over what came to be known as the Oregon trail. In 1847 the Mormons, led by Brigham Young, went along the north bank of the Platte en route to the valley of the Great Salt lake. They likewise were followed by many thousands in succeeding years. Gold seekers bound for California (1849–50) and Colorado (1859) added to the heavy traffic on the trail.

Concern over winning possession of the Oregon country from Great Britain, followed by agitation for a transcontinental railway, led to interest in the organization of Nebraska territory.

Treaties with the various tribes (1833–54) extinguished Indian titles to the land. The name "Nebraska," long used to designate the Platte river and surrounding territory, was suggested by Lieutenant Frémont in 1843, recommended by Secretary of War William Wilkins in 1844, and adopted by Stephen A. Douglas who introduced bills for the organization of the territory in 1844, 1848 and 1852. The final Kansas-Nebraska bill, providing for two territories, became the centre of an intense struggle in congress between the north and south, involving the extension of slavery, the removal of Indians and rival routes for the proposed Pacific railway. The bill, signed May 30, 1854, by Pres. Franklin Pierce, provided that the new territories should be slave or free as voted by citizens in each, thus reversing the policy regarding the extension of slavery established for the Louisiana territory by the Missouri Compromise of 1820. Controversy resulting from the Kansas-Nebraska act and efforts to organize the territories was an important factor in the formation of the Republican party and the split of the Democratic party, and was prominent in the series of events leading to the Civil War.

Nebraska territory, as organized in 1854, included the vast region from the 40° N. lat. to British America, and from the Missouri and White Earth rivers to the summit of the Rocky mountains. In 1861 and 1863 it was reduced by the creation of other territories to nearly its present boundaries, the only important subsequent change being the annexation in 1890 of what is now Boyd county. White settlers in the territorial period (1854–67) were chiefly in a narrow strip along the Missouri river, with isolated ranches westward along the Platte valley and the Oregon trail. The enactment by congress in 1862 of the Union Pacific Railroad act and the Free Homestead act aided white settlement, the first claim under the Free Homestead act being located in Nebraska on Jan. 1, 1863. In 1861 there were probably 30,000 inhabitants in the territory and 3,300 men from Nebraska were enlisted for the Union army in the Civil War. The great industry in this period was transport by the overland trail. Rival routes from Kansas City, St. Joseph, Leavenworth, Atchison, Nebraska City and Omaha converged at Fort Kearny on the Platte. Freight carried over these trails amounted to 200,000 tons in 1865. Over them ran the overland stagecoaches, carrying passengers, and in 1860–61, the famous "Pony Express," whose services ended with the completion of the overland telegraph in the latter year. This trail transportation business terminated in Nebraska with the construction of the Union Pacific railway in 1865–69.

The legislature first met in Omaha on Jan. 16, 1855, and annually thereafter, during the territorial period. Important early legislation related to land claims, bank charters, schools, prohibition and woman suffrage. A fight for the location of the capital between rival towns on the Missouri river, Bellevue, Brownville, Nebraska City, Plattsmouth, Omaha and Florence, resulted in Omaha's holding the capital, but in the creation of a violent feud between the North and South Platte sections which continued for many years. Speculation in townsites and lands culminated in 1857 in general distress and in the failure of all territorial banks but one, $400,000 of bank notes becoming worthless.

A proposition to form a state in 1860 was defeated at the polls. Congress passed an Enabling act on April 19, 1864, but a convention elected in that year to frame a state constitution adjourned without action. A constitution was adopted by the legislature in 1866, submitted to the voters on June 2, 1866, and carried by a majority of 100 in a total vote of 7,766. The Republicans favoured statehood in order to help the Republican majority in congress in its struggle with Pres. Andrew Johnson; the Democrats opposed it. The constitution, as adopted, limited suffrage to free white males. Congress refused to admit Nebraska until the territorial legislature passed an act pledging that Negroes would not be barred from the ballot. These terms of admission were accepted by Nebraska and carried in spite of President Johnson's veto, and Nebraska was proclaimed the 37th state on March 1, 1867.

The South Platte region had a majority in the first state legislature of 1867 and passed an act providing for the relocation of the capital in that section. Opponents of removal offered an amendment to name the capital "Lincoln," in order to make it distasteful to Democratic members from the South Platte region. The latter accepted the amendment and the capital commission on July 29, 1867, located and named the capital site at the little hamlet of Lancaster, on Salt creek.

The Democratic party was the sole political party in Nebraska from 1854 to 1858. The only political divisions were factions of that party. The Republican party was first organized in the campaign of 1858. Slavery domination of the national administration and especially Pres. James Buchanan's veto of the Free Homestead act changed territorial politics, giving the Republicans control in 1860, which was firmly held by them until 1890. In that year the Farmers' alliance organized the Peoples' Independent or Populist party. A three-cornered fight resulted in the Democrats getting the governor, and the Farmers' movement a majority of the legislature. The Populists elected a governor in 1894 and in 1896, by fusion with the Bryan Democrats and silver Republicans swept the state. The Populist party disintegrated after 1904, and thereafter political control fluctuated between the Democrats and Republicans, although some economic radicalism continued to infuse the local psychology of both parties. Significant in this regard were the career of George W. Norris in the national senate, the election as governor in 1930 and 1932 of C. W. Bryan, brother of W. J. Bryan, and the experiment in unicameral legislation begun in 1937. In 1932 and 1936 the state supported Franklin D. Roosevelt and the Democratic New Deal by overwhelming majorities, but in 1940 all the state offices, the United States senatorship and the state's electoral votes for president were carried by the Republican party. From 1940 to 1950 all offices to which men were elected on a partisan basis were filled by Republicans except in three instances in which Democratic congressmen were elected. The state's electoral votes for president in 1944 and 1948 went to the Republican party.

Government.—A constitution adopted in 1875 and revised by a constitutional convention in 1919–20 is the basis of the government. An amendment approved in 1934 substituted a unicameral legislature for the house and senate.

The general election, state and local, is in even-numbered years on the first Tuesday after the first Monday in November, but municipal and school district elections may be held at other times. In 1909 the state legislature enacted a law providing for the nonpartisan nomination of all judges, of all superintendents of public instruction and of regents of the state university.

The governor is the chief executive officer of the state, and one of the ten executive state officers chosen by direct vote of the people. The other nine executive officers are: lieutenant governor, secretary of state, auditor, treasurer, superintendent of public instruction, attorney general and three railway commissioners. The office of commissioner of public lands was abolished in 1936 by constitutional amendment. All officers are elected for two years, except the superintendent of public instruction, who is elected for four and the railway commissioners for six. The governor appoints, with legislative approval, secretaries of the code departments, members of the board of control and a few other officers. He fills vacanies in state offices arising from death, resignation or removal.

The legislature of Nebraska, beginning in 1937, consists of a single house of 43 nonpartisan legislators representing geographic areas of about equal population. The chamber is presided over by the lieutenant governor. Except at the governor's request or by a committee, no bill or joint resolution may be introduced at a regular session after its 20th day.

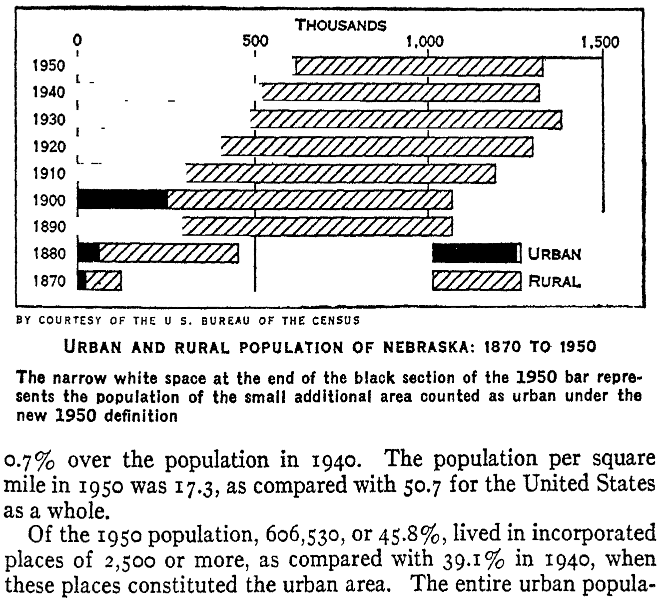
Administration of justice is vested in a supreme court, 18 district courts, county courts, municipal courts and justice courts. The supreme court consists of six associate justices, elected one from each judicial district, and one chief justice elected from the state at large, all being chosen for a six-year term. Each district court consists of from 1 to 9 judges, total number 35, elected for a term of four years. County courts have one judge, elected by the voters of the county. Only Lincoln and Omaha have municipal courts, although any city of 9,000 or more population

may establish them. There is one judge in Lincoln and in Omaha, elected by the voters of the city. There is provision for approximately 2,000 justice courts, each presided over by a justice of the peace elected by popular vote for a two-year term. The district court is the court of general, original, legal and equity jurisdiction. It is a court of record, and its jurisdiction is unlimited in amount and almost unlimited as to subject matter. Its appellate jurisdiction extends to all appeals from inferior courts. The inferior courts—county, municipal and justice—all have a limited jurisdiction, both in amount and in subject matter. The supreme court is the court of last resort. Under the constitution, appeal to this court may not be denied in any case.

Of the 93 counties, 27 are of the township or supervisor type, governed by a board of supervisors of 7 members, and 66 are of the precinct or commissioner type, governed by boards of commissioners of 3 members, except 2 which have boards of 5 members and 1 which has a board of 22 members. There were 117 incorporated cities and 400 incorporated villages in 1948. Three cities are governed by the commission plan, one by a modified commission plan, three by the city manager plan, and all others by the mayor-council form of government. Government of villages is vested in a board of trustees consisting of five members elected by popular vote. Any city with a population of 5,000 or more may adopt a home-rule charter, although only Omaha, Lincoln, and Grand Island have done so.

Other governmental subdivisions include 5 public power districts, 25 rural electrification districts and 477 other units including drainage districts, irrigation districts, reclamation districts, soil conservation districts, metropolitan utilities districts and rural fire prevention districts.

Population.—The population of Nebraska in 1860 was 28,841; in 1880 it was 452,402; in 1910, 1,192,214; in 1940, 1,315,834; and in 1950, 1,325,510. This last figure represented an increase of 0.7% over the population in 1940. The population per square mile in 1950 was 17.3, as compared with 50.7 for the United States as a whole.



BY COURTESY OF THE U S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF NEBRASKA: 1870 TO 1950

The narrow white space at the end of the black section of the 1950 bar represents the population of the small additional area counted as urban under the new 1950 definition

Of the 1950 population, 606,530, or 45.8%, lived in incorporated places of 2,500 or more, as compared with 39.1% in 1940, when these places constituted the urban area. The entire urban population, under a new definition set up for 1950, which included also the thickly settled suburban area, or "urban fringe," adjacent to Omaha and Lincoln, and 1 unincorporated place of 2,500 or more outside this fringe, amounted to 621,905 or 46.9% of the state total.

TABLE I.—*Population of Nebraska and Its Principal Cities*

Area	Population			Per cent of increase	
	1950	1940	1930	1940–50	1930–40
The state	1,325,510	1,315,834	1,377,963	0.7	—4 5
Urban	621,905*	514,148	486,107	21.0	5.8
Rural	703,605*	801,686	891,856	—12 2	—10.1
Per cent urban	46.9	39.1	35.3	..	..
Principal cities					
Omaha	251,117	223,844	214,006	11.7	4.6
Lincoln	98,884	81,984	75,933	20.6	8.0

*Final figures for 1950 based on new definition. *See* comment in text.

The number of households in 1950 was 394,662, compared with 360,744 in 1940.

The average population per household declined from 3.6 in 1940 to 3.4 in 1950.

The population of the state was distributed by colour and nativity in 1950 as follows: 93.9% native white; 4.3% foreign-born white; and 1.8% nonwhite, mainly Negro. Of the foreign-born white population, 23.2% was born in Germany, 11.3% in Czechoslovakia and 9.5% in Sweden.

There were 100.9 males per 100 females in the native white population, and 111.8 in the foreign-born. Of the total population, 9.9% was 65 years old or more; and 52.9% of the population 14 years old and over was in the labour force. Of the total number of employed males, 36.5% was engaged in agriculture, 8.3% in construction, 9.4% in manufacturing, 7.9% in transportation and 16.7% in wholesale and retail trade.

Finance and Taxation.—The general property tax, established in the year 1867, is supplemented by taxes on corporations, gasoline, liquor and cigarettes, by other state licences and fees and special taxes, and by contributions from the United States treasury. The state has no general sales tax and no income tax. For the biennium 1949–51, total appropriations for state government were $152,441,582, including $78,019,590 federal aid. In 1949, state revenues amounted to $46,090,000, and were derived as follows: property tax, 29.6%; motor vehicle fuels and fees, 42.9%; alcohol and tobacco taxes, 14.2%; miscellaneous, 13.3%.

As of June 30, 1948, there were 283 state banks operating in Nebraska, with total resources of $389,682,165; total liabilities of $367,940,632; and total capital accounts of $21,741,533. There were 127 national banks with total resources of $912,954,000; total liabilities of $863,698,000; and total capital accounts of $49,256,000.

Education.—The United States endowment of public education embraced 2,802,756 ac. of land for common schools, 89,140 ac. for the college of agriculture, 45,439 ac. for the University of Nebraska. The endowment of common schools in 1950 included 1,626,230 ac. of land and $12,873,753 in proceeds of former land sales invested in securities; for the university and agricultural college, 10,822 ac. and $1,018,572 invested in securities. In addition, the state endowed Nebraska State Teachers college at Peru with 12,804 ac. of state land. The annual income from these school endowments is about $1,000,000.

In the common-school system in 1949 there were 7,135 schoolhouses with an enrolment of 225,516 and 11,817 teachers. The total investment in school property was $99,598,126 and the annual expenditure $40,437,775.

Four state teachers colleges had a total attendance in 1949–50 of 4,676 students and 245 faculty members; one was at Peru (opened 1867), one at Kearney (1905), one at Wayne (originally private, purchased by the state in 1909) and one at Chadron (established 1911). The University of Nebraska at Lincoln was established in 1869 by an act of the state legislature and was opened in 1871. Connected with it and governed by the same regents are the school of agriculture at Curtis and the agricultural experiment stations at North Platte, Valentine and Alliance. The university in 1950 consisted of ten colleges and three schools, as follows: colleges of agriculture, arts and sciences, business administration, dentistry, engineering, graduate, law, medicine (at Omaha), pharmacy and teachers; and schools of fine arts, journalism and nursing. The total enrolment for the school year 1949–50 was 8,500 students and there were about 700 faculty members. Nearly all educational institutions in the state are coeducational. In 1929 the legislature authorized the establishment of the Municipal University of Omaha. There are junior colleges at Fairbury, McCook, Norfolk and Scottsbluff. Among the private educational institutions are: Nebraska Wesleyan university and Union college at Lincoln; Creighton university, Duchesne college and College of St. Mary at Omaha; Concordia Teachers college at Seward; Dana college at Blair; Doane college at Crete; Hastings college at Hastings; Luther college at Wahoo; Midland

college at Fremont; Nebraska Central college at Central City; and York college at York.

The state board of control and the department of public welfare exercise a general supervision over charitable and penal institutions. The state institutions maintained in 1950 under direction of the board of control included: an institution for feeble-minded, Beatrice; a girls' training school, Geneva; a soldiers' and sailors' home, Grand Island; Hastings State hospital, Hastings; a boys' training school, Kearney; a hospital for tuberculosis, Kearney; Lincoln State hospital, Lincoln; an orthopaedic hospital, Lincoln; a state penitentiary, Lincoln; Nebraska Industrial home, Milford; a school for the blind, Nebraska City; Norfolk State hospital, Norfolk; a school for the deaf, Omaha; a reformatory for women, York; Nebraska Psychiatric unit, Omaha; a home for dependent children, Lincoln; a reformatory for men, Lincoln. These institutions in 1949 had 8,217 inmates and 2,274 employees. The appropriations for board of control institutions for the biennium 1949–51 totalled $8,837,910.

Agriculture and Livestock.—Of a total of 49,057,920 ac. there were, in 1944, 19,596,000 ac. from which crops were harvested, 1,251,000 ac. lying fallow and 23,505,000 ac. used for range and pasture. The total value of crops produced in 1949, exclusive of sugar beets, was $6,519,625,000 compared with a total value, exclusive of fruit, of $142,133,000 in 1940. The total number of farms decreased from 133,616 in 1935 to 111,756 in 1945. The value of farmland and buildings increased from $1,562,813,000 in 1935 to $1,699,210,000 in 1945. The average acreage per farm in 1945 was 427, as compared with 341 in 1935. Of the total number of farms, in 1945, 58,225 were operated by owners or part owners; 432 by managers; and 53,099 by tenants. The percentage of farms operated by tenants in 1945 was 47.5%.

TABLE II.—*Nebraska Field Crops, 1949*

Corn	7,364,000 ac.	239,330,000 bu.	$275,230,000
Wheat	3,761,000 "	54,408,000 "	103,502,000
Oats	2,260,000 "	49,720,000 "	29,832,000
Hay	4,341,000 "	4,786,000 tons	76,576,000
Barley	307,000 "	5,833,000 bu.	5,250,000
Sorghums (grain)	65,000 "	1,592,000 "	1,385,000
Sorghums (forage)	272,000 "	408,000 tons	3,060,000
Rye	189,000 "	1,606,000 bu.	1,847,000
Soybeans	22,000 "	484,000 "	1,016,000
Potatoes	52,000 "	8,840,000 "	11,492,000
Sugar beets	38,000 "	559,000 tons	.
Beans, dry	82,000 "	60,000 "	6,696,000
Alfalfa seed	100,000 "	120,000 "	2,892,000

The value of livestock in Nebraska in 1945 was $375,216,000, compared with $160,396,000 in 1940. The number and value of domestic animals in the state on Jan. 1, 1950, were: 236,000 horses valued at $7,788,000; 9,000 mules valued at $423,000; 3,920,000 cattle valued at $486,080,000; 2,475,000 swine valued at $79,200,000; 588,000 sheep valued at $10,349,000; 14,307,000 chickens valued at $17,168,000.

During the period 1902–50, the steady progress of irrigation and water-power enterprises made possible a tremendous growth of agriculture in Nebraska, and particularly in the central and western portions of the state. Irrigation in western Nebraska developed rapidly following the drought of 1890, and particularly following the passage of the federal Reclamation act of 1902. Principal streams furnishing water for irrigation are the Platte, Loup, Niobrara, Republican and Elkhorn rivers. In 1944 there were 631,762 ac. irrigated in the state. Construction authorized under the Missouri River development program in 1944 would add 989,445 ac. of irrigated land.

Industries, Mining and Transportation.—Manufacturing grew chiefly in the conversion of raw products of agriculture into commodities for market. The United States census of manufactures for 1947 indicated that added value resulting from manufacturing in Nebraska amounted to $260,500,000. Food and kindred products accounted for 60%; printing and publishing, 4%; machinery, except electrical, 4%; electrical machinery, 4%; miscellaneous groups, each less than 4%, 20%.

On Nov. 1, 1939, oil was discovered in Richardson county. By 1950, 130 producing wells had been drilled, and a total of 5,842,000 bbl. of petroleum had been produced in the county. In July 1949 oil was discovered in Cheyenne county. By Oct. 1950 50 wells in the county were producing 2,600 bbl. daily, and six gas wells had been reported.

Missouri river navigation was a leading method of transportation until the construction of the railways in the 1870s. As a result of railway competition it declined to almost nothing, but in the 1940s, as the result of an extensive channel-improvement program carried out on the river, increased in tonnage, if not in relative importance, to a more extensive trade than during the earlier period. Railway mileage amounted to 5,820 mi. in 1947, as compared with 6,174 mi. in 1930. Ten trunk railways radiate from Omaha, five of them with a network of feeders over the state. The Union Pacific was the first railway, beginning construction on July 13, 1865, at Omaha. There were, in 1949, 137 airports in the state, of which 103 were for owners of smaller type aircraft; 18 were for feeder transport aircraft; and 16 were for the largest type of transport aircraft.

The most important transportation development in Nebraska in the years 1920–50 was the great extension of improved highways. An era of road building and road maintenance began in 1917 which was greatly promoted by the rapid increase of motor vehicles. In 1947 a total of 529,930 motor vehicles were registered, including 369,846 passenger cars; 47,230 commercial trucks; 46,201 farm trucks; 299 buses. There were, in 1948, 100,666 mi. of rural roads, of which 9,220 mi. were marked and maintained state highways. Of these, 4,060 mi. were paved. From 1926 to 1948 total highway expenditures were $224,653,062.

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(J. C. O.)

NEBRASKA CITY, a city of southeastern Nebraska, U.S., on the high bank of the Missouri river, 40 mi. below Omaha; the county seat of Otoe county. It is on federal highways 73 and 75, and is served by the Burlington Route and the Missouri Pacific railway systems. Pop. (1950) 6,851; (1940) 7,339. It is the seat of the state Institute for the Blind, and the trading and shipping point for a fine agricultural region; industries include food products, feed and brick. "Arbor Lodge" (formerly the home of J. Sterling Morton, a member of Grover Cleveland's cabinet and the originator of Arbor day) with its fine arboretum, is now a state park. Nebraska City is one of the oldest settlements in the state, and for several years at the height of the migration westward was the largest city. A fort was established on the site in 1847, but was abandoned the following year for a location farther west. In 1858 several settlements in the vicinity were consolidated and incorporated as Nebraska City, and it was made the headquarters of a freighting firm which distributed supplies to the army post between the Missouri and the Rockies (2,782,258 lb. in seven months in 1859).

NEBUCHADREZZAR or NEBUCHADNEZZAR, king of Babylon, the Ναβουκοδρόσορος of the Greeks. The first and last are nearer to the original name as it is found in the cuneiform monuments, viz., Nabu-kudurri-usur, "Nebo, defend the land-

mark." Nebuchadrezzar seems to have been of Chaldean origin. He married Amuhia, daughter of the Median king, according to Abydenus, and in 605 B.C. defeated Necho at Carchemish, driving the Egyptians out of Asia and annexing Syria to the Babylonian empire. In the following year he succeeded his father Nabopolassar on the Babylonian throne, and continued the restoration of Babylon, which he made one of the wonders of the world. His "new palace" there was built in fifteen days; temples were erected to the gods, the great walls of the city were constructed with a moat surrounding them, the Euphrates was lined with brick and a strong fortress erected. Canals were dug throughout the country and a great reservoir excavated near the capital. Only a fragment of his annals has been preserved, recording his campaign against Amasis (Ahmosi) of Egypt in his thirty-seventh year (567 B.C.) when he defeated the soldiers of "Phut of the Ionians." Tyre revolted in the seventh year of his reign, and was besieged for 13 years; a contract-tablet dated in his fortieth year shows that at that time it was under Babylonian officials.

After the investment of Tyre Nebuchadrezzar marched against Jerusalem, put Jehoiakim to death and placed Jehoiachin on the throne. Three months later Jehoiachin was deposed and Zedekiah made king in his place. Zedekiah's revolt in 588 B.C. led to another siege of Jerusalem, which was taken and destroyed in 586 B.C. (*See* JEWS and JERUSALEM.) From his inscriptions we gather that Nebuchadrezzar was a man of peculiarly religious character.

See Josephus, *Cont. Apion*, i, 19; Eusebius, *Praep. Evangel.* x.

NEBULA, in astronomy, the name given to certain luminous, apparently nonstellar patches in the sky. (Latin for mist, Greek νεφέλη.) Dark nebulae are also known. The smaller luminous nebulae resemble distant comets when seen in a telescope of moderate power but can be easily distinguished from them, because comets, being within the confines of the solar system, appear to move among the stars, while the nebulae, being at stellar distances, have no such motion. With the exception of the two Magellanic Clouds in the southern hemisphere, and the two spirals in Andromeda and Triangulum, nebulae are invisible to the unaided eye, and the combined aid of a very large telescope and the photographic plate are required for the adequate study of these faint objects. The two largest and brightest in the northern hemisphere, and the best examples of the two fundamentally different types of nebulae, are the spiral nebula in Andromeda and the diffuse nebula in Orion.

The nebulae are very numerous, those in the Galaxy being counted in the hundreds, those beyond the Milky Way being reckoned up to 100,000,000, with this number limited only by the penetrating power of the largest telescope in operation, the 100-in. reflector on Mount Wilson. Comparatively few of these millions show much structure even on photographs taken with the most powerful instruments. Since the nebulae exhibit luminous *surfaces,* as opposed to the *point-images* of stars, even the largest telescope, though it makes nebulae appear larger, does not make them any brighter than they are to the unaided eye (*see* PHOTOGRAPHY, CELESTIAL). But the photographic plate has the advantage over the human eye of being able to accumulate the effect of exposure to a faint source of light, and thus by means of long exposures, sometimes extending over many hours or even several nights, it is possible to photograph nebular detail far too faint to be observed visually in any telescope.

Historical.—*Earliest Records.* Historical records of luminous patches in the sky are known to go back to Hipparchus (*ca.* 190–125 B.C.), who included in the earliest known star catalogue entries for the double star cluster in Perseus (h and χ Persei) and for the "Beehive" star cluster in Cancer (Praesepe). Nearly 300 years later Ptolemy (*ca.* 138 A.D.) listed five "cloudy stars" in his *Almagest,* but these objects, apparently nebulous to the eye, are in reality star clusters. The earliest known record of a nebula, as distinguished from a star cluster, is the one for the Andromeda nebula given by Al Sûfi (903–986) in his *Book of the Fixed Stars,* epoch 964. The spiral in Andromeda thus shares with the Magellanic Clouds the distinction of being one of the three nebulae discovered before the invention of the telescope. The Clouds of Magellan, which become visible to travellers to the southern hemisphere soon after the Torrid zone is entered, were known to the Portuguese navigators of the 15th century, and although not discovered by Magellan, the clouds are by common consent associated with his name to honour the great circumnavigator. Soon after the first use of the telescope on celestial objects in 1609 by Galileo (1564–1642), the Orion nebula was discovered in 1610 by the famous French patron of science Nicholas Peiresc (1580–1637). The Jesuit priest Cysatus (1588–1657) who began to survey the sky with a telescope in 1611 and who was the first to make a telescopic observation of a comet in 1618, also discovered the same nebula. It was Christiaan Huygens (1629–1695), however, who not knowing of the earlier discoveries by Peiresc and Cysatus, gave in 1656 the first description and sketch of the brightest part of the Orion nebula around the central star of Orion's sword (θ Orionis). In the case of the Andromeda nebula, it too was soon rediscovered after the invention of the telescope, in 1611 by Simon Marius (1570–1624) who described it in the oft-quoted poetical words, "Like a candle seen at night through a horn."

Early Catalogues.—The first attempt to catalogue nebulae seems to have been made in 1715 by Edmund Halley (1656–1742), after whom is named the famous comet that returns to view every 75 years in accordance with his prediction. Halley listed six "luminous spots or patches," among them the globular star cluster in Hercules—the brightest one in the northern hemisphere—which he discovered in 1714. The next list, in this case of 16 "nebulous stars," was given in 1733 by the English divine W. Derham (1657–1735), apparently as a result of some observations he made in 1732, with a reflecting telescope, of such objects included in an earlier (1690) work by J. Hevelius (1611–1687), who has sometimes been called the founder of the scientific study of the moon's surface (selenography). In the first extensive survey of the southern skies made at the Cape of Good Hope in the years 1751–54 by Nicolas Louis de Lacaille (1713–1762), a total of 42 nebulae were observed and then described in another significant list of such objects published in 1755. Shortly thereafter, another Frenchman, Charles Messier (1730–1817), while following the comet of 1758, noticed a nebulous object near the third-magnitude star ζ Tauri. His discovery, later to be called the "Crab" nebula in Taurus, is now known to be the expanding gaseous remnant of the 1054 *supernova* (*see* NOVA) which was observed in China and in Japan, and which represents one of nature's greatest cataclysms, compared with which an atomic bomb explosion is less than a match flame. Messier, although much more interested in comets—Louis XV nicknamed him the "ferret of comets"—found that his searches could be more efficiently prosecuted if he noted the positions of those apparently cometary objects which did not move among the stars. In this way Messier discovered most of the brighter nebulae and clusters visible from northern latitudes, and his final catalogue published in 1781 contained 103 entries.

The Catalogues of William and John Herschel.—The foregoing early catalogues of nebulae almost pale into insignificance, however, when compared with the systematic sweeps of the skies made by William Herschel (1738–1822) and his son John Herschel (1792–1871). With a reflector of his own making, the elder Herschel began his illustrious career as the founder of sidereal astronomy by observing the Orion nebula in 1774. Its appearance so amazed him that he directed his attention to other nebulae, which then became objects for his life-long study and interpretation. Between 1786 and 1802 he discovered and catalogued, in three lists, more than 2,500 nebulae. The younger Herschel, in one of the most striking instances of inherited talent, proved to be his father's ablest successor in the field of nebular observation and discovery. Like his father, he constructed in 1820 his own telescope, an 18-in. speculum metal reflector, and began in 1825 to reobserve many of the nebulae found by his parent. The outcome of this second survey was a catalogue of 2,300 nebulae, of which 525 were new. John Herschel found the field so fascinating that he resolved to extend his search to southern skies, and in 1834 he began on Table mountain near Capetown, South Africa, a four-year survey that marked a new era in the study of celestial

objects visible in the southern hemisphere. The Magellanic Clouds were for the first time subjected to a detailed examination, with the result that the larger one was found to contain more than 900 member star clusters, nebulae and stars associated with nebulosity, while nearly 250 similar objects were counted in the smaller cloud. In addition to these discoveries, admittedly incomplete, the younger Herschel catalogued more than 1,700 other nebulae in southern skies, and for a number of them he made beautiful drawings. Upon his return to England in 1838, he set about systematizing all his own and his father's discoveries of nebulae, and his labours culminated in the "General Catalogue" of some 5,000 entries published in 1864 in the *Philosophical Transactions* of the Royal society. This great work forms the backbone of J. L. E. Dreyer's *New General Catalogue of Nebulae* (N.G.C.) (1888), which augmented by the *First* (1895) and *Second* (1908) *Index Catalogues* (I.C.), with a combined total of more than 13,000 entries, constitutes the standard reference list for nearly all modern observations of nebulae.

Development of Nebular Photography.—With the invention of photography and its application in astronomy, the observation and study of nebulae received an impetus of revolutionary proportions. The first to utilize the technique in this field was a New England physician, Henry Draper (1837–82), who on Sept. 30, 1880 took the first photograph of a nebula, that in Orion. As is usual when a new and powerful means of investigation becomes available, progress is at first very rapid, and widely-separated workers independently and almost simultaneously make the same advances. Thus, while the priority is Draper's, his photography of the Orion nebula quickly found its counterparts in France in 1881 by P. J. Janssen (1824–1907), and in England in 1883 by A. A. Common (1841–1903) and in 1886 by Isaac Roberts (1829–1904), the latter two being pioneers in the use of silver-on-glass reflectors, of apertures of 36 in. and 20 in., respectively. From about 1885 on, nebular photography increased at an accelerated rate, so that only a few of the more important milestones may be mentioned here. The nebulosity around the Pleiades was first recorded photographically by the Henry brothers, Paul and Prosper, in Paris in 1885, though it had been seen visually by W. Tempel in 1859. The faintness of this filmy veil places it near the limit of vision, and even the early photographs showed only the brightest parts around the stars Merope and Maia. The full extent of the nebulosity began to be revealed by an exposure made by Isaac Roberts at Maghull, Lancaster county, England, in 1886, and by later photographs taken in 1888 by the Henrys, but it was not until E. E. Barnard began at the Lick observatory in 1889 to use wide-angle portrait-lens cameras that the Pleiades, and many other Milky Way regions, were shown to be enmeshed in wispy clouds of great complexity and considerable extent. Barnard likewise pioneered in the systematic discovery and listing of the dark nebulae (*see* section below on *Dark Diffuse Nebulae*), and his work did much to direct attention to them as clouds of interstellar dust, with the ultimate result, established by a great deal of modern work, that the astronomical scale of distances for far-away stars needed to be corrected for the dimming of light by obscuring matter concentrated in the galactic plane. Barnard's methods of nebular photography were quickly and widely adopted, notably by H. C. Russell at Sydney in 1890, whose work on the southern Milky Way and on nebulae complemented Barnard's in the north, and by Max Wolf at Heidelberg in 1891, who pioneered in the photographic charting of the small nebulae outside the Galaxy.

Quite a different but highly significant advance in nebular photography was made by J. E. Keeler at the Lick observatory in 1899. Working with a 36-in. reflector donated in 1895 by Edward Crossley, of Halifax, England, Keeler firmly established the advantages, previously suggested by Isaac Roberts' work, of this type of instrument for the detailed investigation of the spiral nebulae. Before the advent of photography, Lord Rosse (1800–67) and his associates at Parsonstown, York, had been able with large speculum metal mirrors (up to six ft. in diameter) to discover visually during the years 1845–50, spiral structure in 14 nebulae, and to resolve into stars a number of hitherto nebulous objects. Keeler's contribution—in a sense a photographic sequel to Rosse's work—was to show that spiral structure was a very common characteristic of nebulae distant from the Galaxy, and that the number of spiral nebulae was at least ten times greater than had formerly been supposed. His conservative estimate made in 1900 placed the number within reach of the Crossley reflector at 120,000 and later work with the same equipment, first by C. D. Perrine, in 1901–03, and then by H. D. Curtis in 1909–19, brought this figure to nearly 1,000,000 nongalactic nebulae.

The manifold possibilities for extensive survey work on nebulae with wide-angle lenses, as exemplified by the pioneer observations of Barnard and Wolf, were soon appreciated by many other astronomers, but perhaps the fullest exploitation of such technique is represented by the modern work in this field initiated by the Harvard college observatory. Beginning approximately in 1900 in the southern hemisphere, originally at Arequipa, Peru, and after 1927 at Bloemfontein, South Africa, Harvard astronomers have used the largest star-camera—the Bruce 24-in. photographic refractor—to investigate nebulae over large areas of the southern skies, while in the north, at Oak Ridge, Mass., the 16-in. Metcalf refractor has been used for similar work. Started about 1930 under the direction of Harlow Shapley, the Harvard surveys of galaxies to nearly the 18th magnitude have recorded many thousands of nebulae, and the program envisions an ultimate census of more than 500,000 objects.

Probably the greatest advances in our knowledge of nebulae have come from the use of reflectors of steadily increasing size. Following Keeler's demonstration that a 36-in. reflector is a powerful means for the study of individual nebulae, G. W. Ritchey at the Mount Wilson observatory constructed and used (1908–17) a 60-in. reflector for the photography of nebulae under the most favourable conditions. Ritchey's pictures, for years unsurpassed in quality, set a new standard in definition, with the result that a number of spirals were partially resolved into stars. This was an achievement of tremendous import, for it pointed the way toward the comparative study of stars in the nebulae with those in the Galaxy, thus leading to a solution of the long-standing problem of the distances of spirals. The promise of still greater advances was foreseen by G. E. Hale, and under his inspiration a 100-in. reflector was installed on Mount Wilson in 1917. With this instrument—the largest in operation in 1946—Edwin Hubble began in 1923 a comprehensive series of researches of nebulae which led to the first firm scale of extragalactic distance and to its extension to distances of the order of hundreds of millions of light-years (1 light-year = 6,000,000,000,000 mi.). With these distances, together with certain spectroscopic observations of his colleague, M. L. Humason, and with those of V. M. Slipher at the Lowell observatory, Hubble in 1929 announced one of the most outstanding results of modern astronomy: the more distant a nebula is, the faster it seems to be receding from the earth. Moreover, the speeds of recession, as indicated by the increased wave lengths of spectrum lines (called "red-shifts") in the light from nebulae, became enormous at great distances, the highest speed measured corresponding to about 25,000 mi. per second, or nearly 1/7 the velocity of light. With astronomy in this manner thrusting into cosmology, by providing the observational basis for W. de Sitter's, A. Einstein's and G. E. Lemaitre's mathematical theories of the "Expanding Universe," Hale in 1928 again realized the possibilities offered by increased aperture, and he was able to initiate construction at the California Institute of Technology, Pasadena, of a 200-in. reflector to be placed on Mount Palomar. Completion of this greatest of telescopes was interrupted by World War II, but by 1946 there was good reason to expect that a few years more work would place it in operation.

Classification of Nebulae.—The nebulae fall naturally into two groups which are designated the *galactic* and the *extragalactic.* Alternate names for the latter group—by far the largest—are *nongalactic, anagalactic,* or merely *galaxies.* Galactic nebulae are found in or near the plane of the Milky Way (the Galaxy), while extragalactic nebulae or galaxies are seen, for the most part, outside the Milky Way. The division is not merely one of apparent distribution over the sky, for the two classes of objects differ fundamentally in every important respect, such as distance, in-

trinsic size and brightness and constitution. In fact, the two categories are so dissimilar that they should logically be separately discussed.

THE GALACTIC NEBULAE

These are of two types: (1) *Diffuse Nebulae* and (2) *Planetary Nebulae.* The first kind includes *bright* and *dark* nebulae, but with no clear-cut division, since the two are often found thoroughly mixed together. The second kind is a relatively unique group of objects, usually of round or of symmetrical structure, and nearly always having a single star near the centre of the sharply-defined outer edges of the nebula.

Diffuse Nebulae.—Modern work on interstellar dust clouds suggests that diffuse nebulae may be regarded from the following very general point of view. Throughout our own stellar system, of which the fundamental plane is the Milky Way, there is a thin layer of nonluminous matter. This material, a mixture of atoms, molecules, dust particles and larger masses, is not uniformly distributed, but is relatively concentrated in some regions, and extremely tenuous or absent in others. In some cases denser clouds are situated in front of a bright, starry background. They are then revealed in silhouette, and photographs such as Barnard's record them as *dark* nebulae. On the other hand, it often happens that single stars, or groups of stars, lie in the denser parts of the stratum. In this case the stars illuminate the surrounding cloud, much like street lights in a fog, and *bright* nebulae may be seen or photographed by the light scattered by the particles composing the cloud. *Mixed bright and dark* nebulae occur in circumstances where a cloud is so large that the light from the involved stars does not penetrate to its boundaries, so that a bright nebula appears to be superposed on a larger dark one; or again, the obscuring matter may be localized in streaks or lanes, which are outlined or contrasted against the brighter and less opaque parts of the cloud.

Bright Diffuse Nebulae.—The true character of these objects became known in 1864–68 when William Huggins (1824–1910) examined several of them with his spectroscope and found their light highly concentrated into a few bright radiations, typical of a rarefied gas excited to luminescence. So many more were subsequently found to have a similar spectrum that for nearly half a century it was generally supposed all diffuse nebulae were incandescent gases. In 1912, however, V. M. Slipher of the Lowell observatory announced that the spectrum of the nebulosity around the Pleiades gave an absorption spectrum, which is a continuous, coloured band of light crossed by dark lines. Furthermore, the nebular spectrum was like that of the stars imbedded in the nebula. These results, which were later obtained for a number of other diffuse nebulae, provided evidence for the view that some nebulae shine by *scattered* or *reflected* light directly received from the stars, rather than by *emitted* light indirectly excited in the nebula by ultra-violet radiation from the stars. The latter mechanism was satisfactorily described by I. S. Bowen in 1927, and is of such great astrophysical importance that it is considered in some detail in the section below entitled, *The Gaseous Spectrum of Nebulae.* Before Bowen explained the origin of the nebular emission spectrum, however, Hubble in a systematic and complete investigation of diffuse nebulae published in 1922 discovered two significant properties of these objects: (1) whether a diffuse nebula shines by emitted light (bright-line spectrum) or by reflected or scattered light (absorption spectrum) depends upon the temperature of the star or stars concerned. Although there is some overlapping, in general it is found that stars hotter than about 20,000° C. (spectral type B1 or earlier) can excite an emission spectrum in the nebula, while cooler stars merely illuminate the nebula by reflection and scattering. (2) The luminous area of the nebula extends outward to a distance proportional to the square root of the brightness of the star.

It is possible to determine with considerable accuracy the velocities in the line of sight (*radial* velocities) of those nebulae which show an emission spectrum, because their light though faint is concentrated in a few bright spectral lines. Observations made at the Lick observatory by W. W. Campbell and J. H. Moore, and published in 1918, show that the average motion is some 6 to 7 mi. per second, which is relatively slow by stellar standards. The determination of velocities across the line of sight (*transverse* velocities), on the other hand, is difficult for two reasons: (1) there is a general absence in diffuse nebulae of sharply-defined points suitable for accurate measurement; (2) the diffuse nebulae are so distant, and their internal motions so slow, that no displacements large enough to measure are shown during the relatively few years that have elapsed since the nebulae were first photographed.

Variable Diffuse Nebulae.—This is a comparatively rare class of objects comprising less than a dozen known members. They are usually fan-shaped, bowed or arched, with a star of irregularly variable light located at or near the point of the fan or centre of the arches. Without exception, they are found in dark lanes of the Milky Way. Only a few of them have been studied, with somewhat inconclusive results. Photographs of J. R. Hind's and Hubble's variable nebulae (N.G.C. 1555 and 2261, respectively), show marked changes in intensity in different parts of the objects, but there is little evidence that the parts have moved. Moreover, no close correspondence between light variation in the stars and nebulae has been established. The few spectra that have been obtained of these nebulae, by Slipher and by Hubble, show their light to be continuous. The spectra of the involved stars, known as T Tauri variables, have been studied by A. H. Joy at Mount Wilson, who reported in 1945 that their light consists of a bright-line spectrum of varying intensity superposed on an absorption spectrum characteristic of dwarf stars like the sun (temperature 6,000° C.). This latter fact, in view of Hubble's relation mentioned above, is consistent with the fragmentary observations of continuous spectra in the nebulae. Although it is clear that much remains to be done before the puzzle of variable nebulae is solved, H. D. Curtis has pointed out that the lack of correlation between stellar and nebular fluctuations in brightness argues against the explanation of light pulses, or bursts from the associated star, producing an unsteady illumination of the nebula. A more plausible hypothesis would be the interruption or dimming of the nebular light by clouds drifting between the star and nebula, and, under certain circumstances, the interposed, passing material could produce shadow effects on the nebula.

Dark Diffuse Nebulae.—There are in the Milky Way a great number of dark patches, some of them almost entirely devoid of stars. A few of these were discovered by the Herschels, who thought them to be holes through which they looked into empty space beyond. Barnard, who catalogued several hundred of them, and whose studies of these dark nebulae finally showed that they were caused by the presence of clouds of nonluminous matter, was at first loath to believe they were other than holes or spaces actually containing no stars. They vary in size from small patches only a minute of arc in diameter to the large lanes in Ophiuchus and Scorpius. Even the huge rift 120° long which divides the Milky Way from Cygnus to Centaurus must be considered to be of a similar nature. An analogous bifurcation is frequently found in spiral nebulae seen edge-on, and comparative studies of them with the Galaxy, carried out by H. D. Curtis, did much to establish the current conception of our own stellar system as one of the giant spiral nebulae.

Although it might be supposed that less could be learned of dark nebulae than of bright ones, because the invaluable spectroscope cannot be directly applied to their investigation, some powerful statistical methods have been devised which lead to the distances of dark nebulae, and to estimates of their absorptive power. At first, distances of these objects were obtained from parallax measurements of the associated stars, but in only a very few instances are the stars close enough to give reliable determinations. A more generally applicable method, first devised by Max Wolf, and later refined and placed on a precise statistical basis by A. Pannekoek of Amsterdam, is one involving star counts in and around a dark nebula. By making counts of stars in two areas of the same size, one in the nebula and the other in a nearby unobscured area, it is found that at first, for the brighter stars, the counts run about the same, but, as the fainter stars are

reached, the numbers in the dark area fall below those outside. The apparent magnitude at which the deficiency becomes noticeable indicates the distance, since as the result of much modern work on stellar statistics, the average distance is known for stars of a given magnitude. Furthermore, the absorptive power is obtained from the percentage deficiency observed for the faintest stars counted. In this way it has been determined that most of the prominent dark nebulae range in distance from a few hundred to a few thousand light-years, which is relatively close on the galactic scale, and that they absorb 30% to 95% of the light.

Considerable information has been obtained about the nature of the obscuring matter in dark nebulae from theoretical investigations of the absorbing and scattering power of finely-divided matter, and from observations of the colours and spectra of the involved stars. In 1901, H. von Seeliger of Münich, as a result of his investigations of the swarm of meteoric bodies composing Saturn's rings, was led to a theoretical consideration of the effects of starlight reflected by small bodies. His work, however, found no immediate application to dark nebulae because it was done so long before Slipher's spectroscopic discovery in 1912 of reflection nebulae in the Pleiades. Ten years after Slipher's significant observations were made, H. N. Russell of Princeton investigated the theory that dark nebulae are composed of extremely fine dust particles. He derived formulae relating the total absorption in such clouds to density and size of the particles, and concluded that the most efficient dimming occurs for particle diameters about $\frac{1}{3}$ the wave length of light, or for sizes of the order of 1/150,000 in. These calculations were very revealing, since they showed that absorptions of several magnitudes could be produced by extensive clouds of matter without the total mass becoming unreasonably large. At approximately the same time as Russell's theoretical work, F. H. Seares and Hubble at Mount Wilson had found numerous cases of reddened stars imbedded in nebulosity. Thus by 1922 it was evident that dark clouds not only dimmed starlight, but that they also absorbed relatively more blue light than red, and this fact constituted additional evidence for the very small size of the material concerned. Russell's absorption theory was extended by Carl Schalén of Upsala, Sweden, who also applied it more powerfully by utilizing the colours and spectra of stars involved in dark nebulae. He found the percentage of reddening to be small, and from the apparently reasonable assumption that the particles are metallic compounds of iron, zinc and copper, concluded that the most effective dimming occurs for a size of 1/300,000 in. Seeliger's reflection theory has also been more fully developed and applied, notably at the Yerkes and McDonald observatories by Otto Struve and his associates L. G. Henyey and J. L. Greenstein. For dust particles large enough to produce more reflection than scattering, Henyey in 1937 developed a theory which allows a determination of the orientation and distance of a reflection nebula from the illuminating star. Application of this theory to some reflection nebulae has indicated separations of several light-years between star and nebula.

If it is true that the process of scattering is more effective than those of absorption or reflection, then a dark nebula might be faintly visible in scattered light. To test this possibility, Struve and C. T. Elvey in 1935 compared the surface brightnesses of dark nebulae with areas between stars in unobscured regions, and from the slight differences detected they concluded that either the reflection was small or the scattering large. The latter explanation was then proved to be the correct one by Elvey and F. E. Roach in 1937 from extensive measures (with the aid of a photoelectric cell) of the radiation from the Milky Way. They found that, after allowing for all the light contributed by the stars, there still remained a considerable amount (50%) which could only have come from scattering by small particles between the stars. Then in 1938, in a notable achievement of spectroscopic observation, Struve and Elvey reported photographs of the spectrum of this extremely faint light, and established the existence of large clouds of dimly-glowing hydrogen and oxygen throughout many regions of the Milky Way. Finally in 1938, in a detailed study of the efficiency of scattering by dust particles, Henyey and Greenstein concluded that the obscuring matter probably does not consist mainly of metallic specks, but that other unknown constituents, perhaps rocklike compounds, are responsible for the appearance of dark nebulae.

Planetary Nebulae.—These are so named because their appearance in a telescope resembles that of planets; *i.e.*, they show fairly well-defined disks having definite edges. But that is the only feature which planets and these nebulae have in common, for the planetary nebulae, being distant members of the stellar system, show no appreciable motion among the stars. In general they are much farther away than the diffuse nebulae, are smaller and have a bright-line spectrum which ordinarily readily distinguishes them from other galactic nebulae.

Numbers and Distribution.—The planetaries form a rather small and unique group which until about 1940 was presumed to include nearly 130 members, but from photographs taken on Mount Wilson with a specially-designed prismatic camera, R. Minkowski by 1945 had increased the total number known to nearly 200. Since practically all these new additions are indistinguishable from stars even on photographs taken with large reflectors, it thus appears that many more remain to be discovered among the fainter stars of the Galaxy.

Like the diffuse nebulae, the planetaries tend to be distributed within the Milky Way, but in much less degree. In galactic concentration they are intermediate between diffuse nebulae and the globular star clusters, and like the latter, the planetaries are most numerous in Sagittarius and Scorpius, which is the direction to the centre of the galactic system.

Size and Structure.—In apparent size the planetary nebulae average less than one minute of arc in diameter, and they range from nonuniform surfaces half the diameter of the moon, down to pointlike stellar images identifiable as planetaries only from their spectra. With few apparent exceptions, and probably with no real exceptions, planetary nebulae have bluish-white central stars whose brightnesses range from the 9th to the 19th magnitude. These central stars are among the hottest objects known, with temperatures in some cases estimated as high as 150,000° C. The high frequency of round or elliptical outlines exhibited by the planetaries means that these nebulae probably are spherical or ellipsoidal in form, and in those numerous cases which show a beautiful arrangement of ring within ring, the true structure may actually be a series of concentric shells.

Distances and Densities.—Unfortunately, the distances of the planetary nebulae are not known with any high accuracy. They are so far away that direct trigonometric methods are untrustworthy, and their transverse motions are so small that they are hardly measurable during the relatively short time that has passed since suitable photographs were first obtained. The most that may be said about distances of the planetaries is that they are large, and that they are uncertainly estimated to range from 3,000 to 30,000 light-years. With these distances, the typical bright planetary has a diameter of the order of 10,000 times the distance between the earth and sun, and, according to L. Goldberg and L. H. Aller of the Harvard observatory, the average total amount of matter in a planetary nebula is less than $\frac{1}{5}$ that in the sun. These figures give some notion of the extreme tenuity of the gases composing these nebulae, since the density indicated, several hundred atoms per cu.in., is far less than the best vacuum obtained on the earth.

Motions.—Because they have bright-line spectra, the radial velocities of planetary nebulae are easily and accurately determined. Spectroscopic observation has shown that their motions are moderately high, averaging 15 mi. per second, a value intermediate between those for the diffuse nebulae and the globular star clusters. In 1937 L. Berman, from an analysis of the radial velocities of 110 planetaries determined prior to 1918 by J. H. Moore and W. W. Campbell at the Lick observatory, showed that these nebulae participate in the rotation of the stars about the galactic centre 30,000 light-years distant in the direction of Sagittarius. Another significant and valuable result from Campbell and Moore's work was the discovery of turbulence in the gases composing the planetary nebulae. From the fact that the spectrum lines were found to be curved, and in some cases doubled, it may

be concluded that the nebular gases are in motion, and in general expanding from the central star. The velocity of expansion, however, is relatively low, being about 10 to 15 mi. per second. Furthermore, from the fact that some of the bright nebular lines were observed to be inclined, it appears that in these cases the nebulae are not only expanding, but are also slowly rotating. However, the complex structure seen in some planetaries finds no such simple explanation, and it must be admitted that in these instances the turbulence of the nebular gases is still a very puzzling phenomenon.

Origin.—The question as to what place, if any, the planetary nebulae take in the scheme of stellar evolution is a difficult one, to which at present there is no certain answer. It has often been suggested that they represent a later stage in the life history of the "new" stars (novae), because: (1) in a number of cases novae have been observed to throw off expanding shells of gaseous matter; and (2) M. L. Humason showed in 1938 for 16 faint, "old" novae that they ultimately tend to become small and extremely hot stars very similar to the central stars in the planetary nebulae. The principal objection to this hypothesis is that the velocities of expansion of the nebular matter usually are of a different order of magnitude, being hundreds of miles per second in novae and only a few miles per second in planetaries. While it can be argued that the nebular shells around novae may slow down in time, there is little evidence that this has occurred in any of the novae observed in modern times; in fact, there seems to be more reason to regard the motion as essentially uniform. On the basis of this assumption, F. L. Whipple of Harvard in 1938 deduced ages for the planetary nebulae of the order of 30,000 years, which is but a fleeting moment in the time-scale of the stars.

The Gaseous Spectrum of the Nebulae.—The spectra of all gaseous nebulae, diffuse and planetary, are very similar in appearance, the differences consisting chiefly in the relative intensities of the bright lines. The lines in the spectra are sharp, a fact which indicates a gas of low density; those of hydrogen are prominent and those of helium are usually present. But for more than 60 years following 1864, when William Huggins first observed the spectrum of a nebula, there were several lines (a wide pair in the green at 5007 and 4959 A, and a close pair in the ultraviolet at 3726 and 3729 A), among the strongest in the spectrum, which remained unidentified. Their origin was one of the most puzzling mysteries in astronomy, and for lack of a better name, they were attributed to a hypothetical element called "Nebulium," although it was generally realized, because of advances in chemistry and physics which left no place in the table of known elements for foreign ones, that the occurrence of the strange lines probably was due to some familiar element existing under conditions peculiar to the nebulae. That this explanation is the correct one was established in 1927 by I. S. Bowen. He showed on the basis of laboratory work and reasonable theoretical considerations that the chief nebular lines are due to singly and doubly ionized oxygen atoms, which radiate light under conditions of low density and high excitation unmatched on the earth.

Forbidden and Permitted Lines.—To understand why certain lines occur in the nebulae and not in terrestrial sources, and vice versa, it is necessary to mention a few of the fundamental principles of modern atomic theory. In this concept, atoms exist in certain definite energy states, depending on their environment. The energy states correspond to orbits in which electrons move about the nucleus, and when an electron jumps from one orbit to another, energy is absorbed, or emitted, depending on whether the jump is from an inner to an outer orbit, or the other way around. The electrons, however, do not remain in the different kinds of orbits for equal times, and it is this property of the atom, together with its environment, which is responsible for the characteristic nebular radiations. The latter represent jumps to orbits in which electrons can move for seconds, minutes and possibly hours, whereas radiations observed in terrestrial light sources correspond to transitions between orbits in which electrons remain for only 1/100,000,000 of a second. Spectral rays from long-lived orbits are called "forbidden" lines, those from the short-lived orbits "permitted" lines, and the reason only the latter are obtained in the laboratory is that collisions between atoms, even with the lowest obtainable densities, are so numerous (millions per second) that electrons are almost always knocked from the long-lived orbits before they have a chance to jump to an inner orbit, with the resultant emission of a forbidden line. In the nebulae, however, the extremely low densities allow sufficient electrons to accumulate in the long-lived orbits (called "metastable states") to yield intense forbidden lines.

Physical Processes and Sources of Energy.—In addition to demonstrating the existence of an almost perfect vacuum in gaseous nebulae, the forbidden lines, being due to ionized atoms (those which have lost one or more electrons), indicate the presence in planetaries of a very high-temperature source of energy. Evidence for this is provided by two apparently unrelated features of the nebular spectrum: (1) the size of a nebula is different in different radiations, and (2) only certain of the permitted lines of neutral oxygen and nitrogen are observed. The first of these properties, originally noted in 1908 by Wolf, and later (1918) extensively studied by W. H. Wright in the most thorough and significant investigation of the spectra of the gaseous nebulae, shows that the smallest nebular diameters correspond to the most highly ionized atoms, and the largest to the least, in just the way to be expected from Bowen's high-temperature theory of the structure of planetary nebulae. The second feature was likewise explained by Bowen as the result of an intense concentration of energy in the far ultraviolet, characteristic of a high-temperature source, which selectively excites the observed lines by a fluorescent mechanism. That the central stars of planetary nebulae are in reality among the hottest objects known was also established by Wright's observations of the spectra of planetary nuclei. Subsequent theoretical investigations by H. Zanstra, A. S. Eddington and D. H. Menzel have fully substantiated Wright's earlier deductions from observations, and Bowen's conclusions from identification of the chief lines, that the dominating physical conditions in gaseous nebulae are extremes of low density in the nebulae and of high temperature in the central stars, which are the ultimate source of all nebular radiations.

Abundances of the Nebular Gases.—Following his explanation of the origin of the nebular lines, and the mechanism of their production, Bowen in 1934 concluded that the gaseous nebulae, like most astronomical bodies, are largely made up of hydrogen, with helium the next most abundant element. Further information on their chemical composition was obtained in 1939 by Bowen and A. B. Wyse at the Lick observatory. By using an especially powerful spectrograph in combination with an "image slicer" (invented by Bowen to overcome certain observational difficulties), and exposures of 12 to 20 hours, they were able to record in two planetary nebulae a number of faint radiations due to the metallic and other elements. Analysis of the intensities of these lines, and comparison of results with similar work by H. N. Russell on the sun, led to the conclusion that the abundances of many elements in the nebulae and sun are not significantly different. Wyse in 1942 extended the program to include 10 additional planetary nebulae and the Orion nebula, and deduced that the chemical compositions in both types of nebulae are similar to that of the sun. In an independent and more elaborate theoretical treatment of the problem, D. H. Menzel and a number of associates at Harvard

Average Composition of a Planetary Nebula Compared with that of the Sun

Chemical Element	Relative Number of Atoms	
	Nebula	Sun
Hydrogen	1000	1000
Helium	100	222
Carbon	0.6	0.04
Nitrogen	0.2	0.12
Oxygen	0.25	0.37
Fluorine	0 0001	....
Neon	0 01	....
Sulphur	0.036	0 037
Chlorine	0.002	..
Argon	0 0015	....

came to the same conclusion in the last of a long series of papers published in 1945. Their final results, which represent the most modern estimates of the cosmical abundances of the lighter elements, are given in the table on page 187B.

THE EXTRAGALACTIC NEBULAE

The extragalactic nebulae are found scattered all over the sky except in the Milky Way itself, which they rigidly avoid. This characteristic is, however, by no means the only thing that differentiates them from the galactic nebulae, and the most casual study soon shows them to be objects of quite a different nature. They vary in apparent size from the great spiral in Andromeda, which has been traced to a diameter of more than 6°, to objects so small that even in the largest telescopes they are barely distinguishable from the faintest stars. The number of such nebulae is enormous and depends upon the limiting brightness to which they are counted. For example, there are approximately 1,000 catalogued to the 13th magnitude, and they increase geometrically by a factor of four for each fainter magnitude reached; thus 4,000 could be counted to the 14th magnitude, 16,000 to the 15th, etc., until at magnitude 21.5, which is the limit of the 100-in. Mount Wilson reflector, some 100,000,000 extragalactic nebulae could be photographed. That each one of these objects is now known to be a stellar system, or "island universe," similar in some cases to our own giant Milky Way, is an achievement of modern astronomy which has immeasurably widened our view of the observable universe. The giant systems among the faintest nebulae counted lie at distances of the order of 500,000,000 light-years. With present resources, therefore, we are able to encompass a vast sphere 1,000,000,000 light-years in diameter. This great volume of space is by no means fully explored, but enough has been learned, especially from large reflectors and powerful spectroscopes, to indicate something of its physical properties and of its stellar systems.

Classification.—The most generally accepted scheme of classification for the extragalactic nebulae is the one proposed by Hubble in 1926. It is represented schematically in fig 1. This

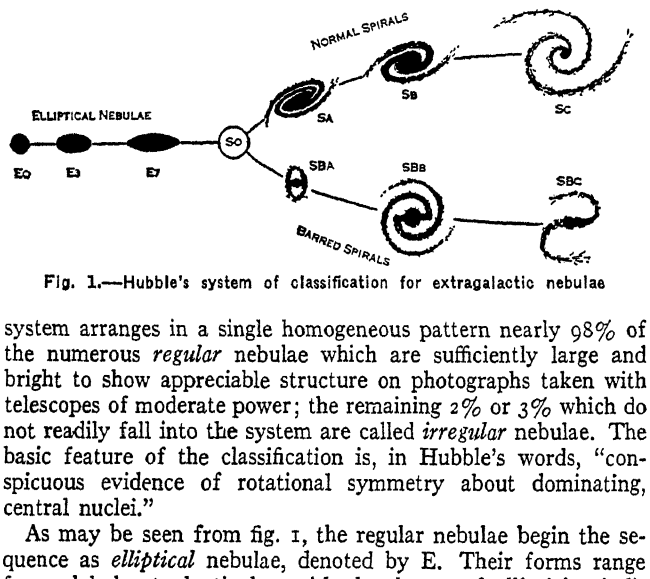


Fig. 1.—Hubble's system of classification for extragalactic nebulae

system arranges in a single homogeneous pattern nearly 98% of the numerous *regular* nebulae which are sufficiently large and bright to show appreciable structure on photographs taken with telescopes of moderate power; the remaining 2% or 3% which do not readily fall into the system are called *irregular* nebulae. The basic feature of the classification is, in Hubble's words, "conspicuous evidence of rotational symmetry about dominating, central nuclei."

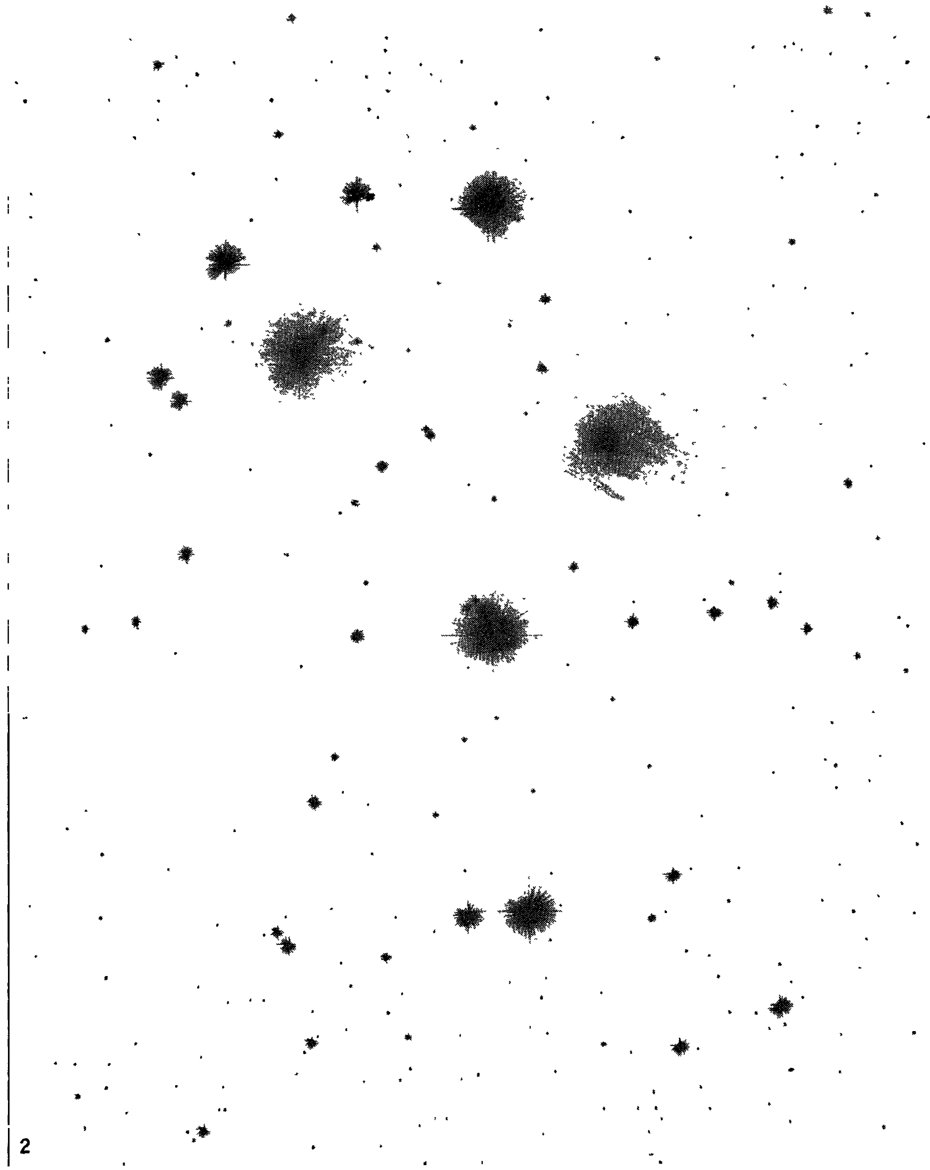
As may be seen from fig. 1, the regular nebulae begin the sequence as *elliptical* nebulae, denoted by E. Their forms range from globular to lenticular, with the degree of ellipticity indicated by numerals from 0 to 7, which are obtained from the relation $10(a-b)/a$, where a and b are the major and minor axes, respectively. Statistical analysis of the frequency of occurrence of the different forms shows that there are actually globular or spherical nebulae, and that not all of the apparently round ones can be accounted for as flattened nebulae with polar axes in the line of sight. The analysis shows, however, that the lenticular objects are much more common, and that there is a definite limiting ellipticity with ratio of axes 3 to 1. When the flattening becomes greater, the nebulae no longer appear as smooth, unresolved objects, and, at a certain stage of the sequence, indicated by *So*, they begin to show structure which in general is of *spiral* character. Two different spiral forms are found, however, so that the spiral nebulae are separated into two groups: the *normal* spirals, designated by *S*, and the barred spirals, symbolized by *SB*. The latter, first noted as a distinct class in 1918 by H. D. Curtis who termed them "phi-type" (ϕ) spirals, are in the minority, for less than 1 spiral in 2 or 3 is barred.

Among the regular nebulae large and bright enough to classify, the spirals outnumber the ellipticals by more than 4 to 1, and this fact stresses the importance of deciding which features in spirals are best suited for further subdivision, such as central concentration, relative size of arms and nucleus, or number and character of condensations. After an examination of hundreds of nebulae on photographs taken with the Mount Wilson reflectors, Hubble concluded that the most significant characteristic for classifying spirals is the *degree of resolution.* Depending upon circumstances, the resolution may be only into spiral structure, into clusters or clouds of stars or, at best, into individual stars. To indicate the degree of resolution the letters *a, b* or *c* are placed after *S* or *SB;* thus, a well-resolved normal spiral would be referred to as *Sc,* a barred one as *SBc.*

Nebular Evolution.—The classification described above arranges the extragalactic nebulae into a consistent pattern in which such important features as linear diameters of the main bodies, spectral types, colours and intrinsic luminosities of the brightest stars all vary uniformly along the sequence. It is tempting to suppose that this sequence gives us a picture of an evolutionary process whereby a spiral nebula develops from a structureless globular system into a galaxy of stars by the continued ejection of matter from the nucleus along the spiral arms. That such a process is mathematically possible was first considered in 1928 by J. H. Jeans, and later in 1933–41 by B. Lindblad. According to theory, a nearly spherical, slowly-rotating nebula spins faster as it contracts, thus becoming more flattened. Tides raised on opposite sides of the equator by some external disturbance form protuberances which are then projected as arms. These wind around the central mass and are disintegrated into groups of condensations which ultimately become stars. The process must be an extremely slow one, involving millions upon millions of years, and we cannot expect to see even during many centuries any changes in the form of a particular nebula. Although such theory is invaluable as a logical synthesis of the available data relating to nebular contents and structure, the factual knowledge is still too meager to permit definite conclusions regarding the course of nebular evolution. Hence, while in practise the terms "early-" and "late-type" spirals (*Sa* and *Sc,* respectively) are often employed, it is done only to indicate relative position in the sequence; there is no implication of an underlying time scale. Observational astronomy, at least, is not yet prepared to assert that the direction of nebular evolution is established by classification.

Distribution.—As the result of extensive counts of extragalactic nebulae on photographs taken chiefly at the Mount Wilson observatory in the northern hemisphere, and at the Harvard college observatory station in the southern hemisphere, it is known that, on the grand scale, the distribution is approximately *uniform* both over the sky and in depth. This result, of great theoretical and practical value for cosmological studies, was obtained only after much modern work which elucidated the effects of galactic obscuration, and of several great clusters of nebulae, upon the true distribution.

Distribution Over the Sky.—Long before the advent of photography it was generally known that the "white" nebulae, now called extragalactic, tended to avoid the Milky Way, and that there was appreciable clustering in high galactic latitudes, especially in Coma and Virgo close to the north pole of the Galaxy. With the development of photography, more and ever more nebulae were counted, and the galactic zone of avoidance and the regions of clustering became more precisely defined. A number of early counts, among them those of J. E. Keeler (1899), E. A. Fath (1914) and H. D. Curtis (1918), suggested the general outlines of the distribution and gave hints as to the total number of nebulae within reach of certain telescopes, but the problem of



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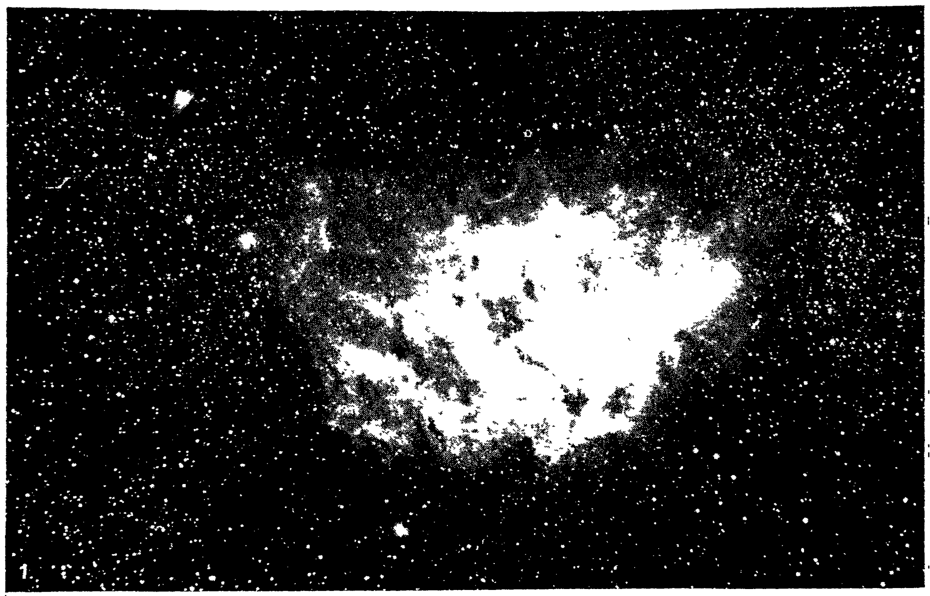
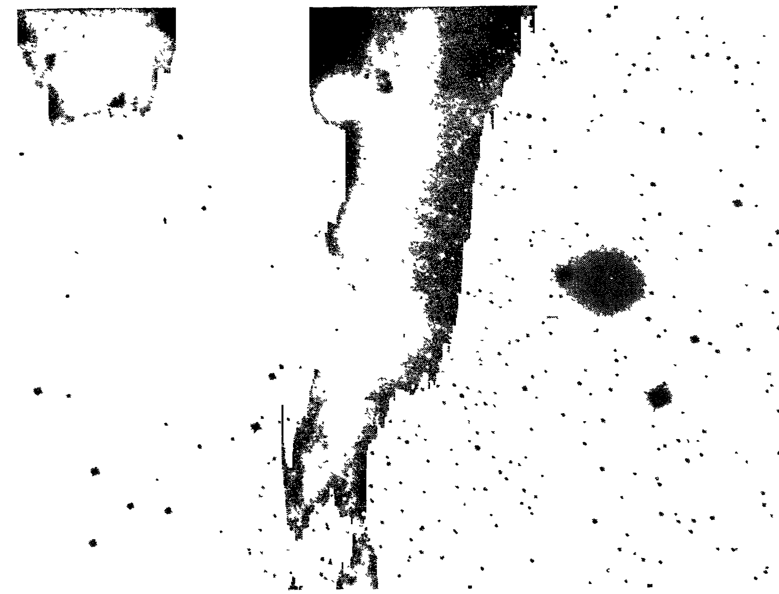
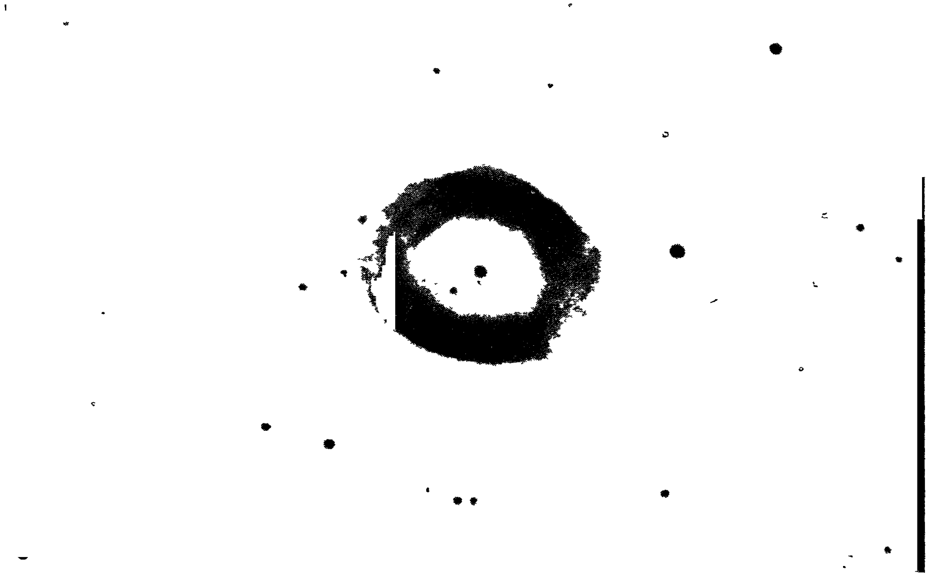
TWO TYPES OF GALACTIC DIFFUSE NEBULAE

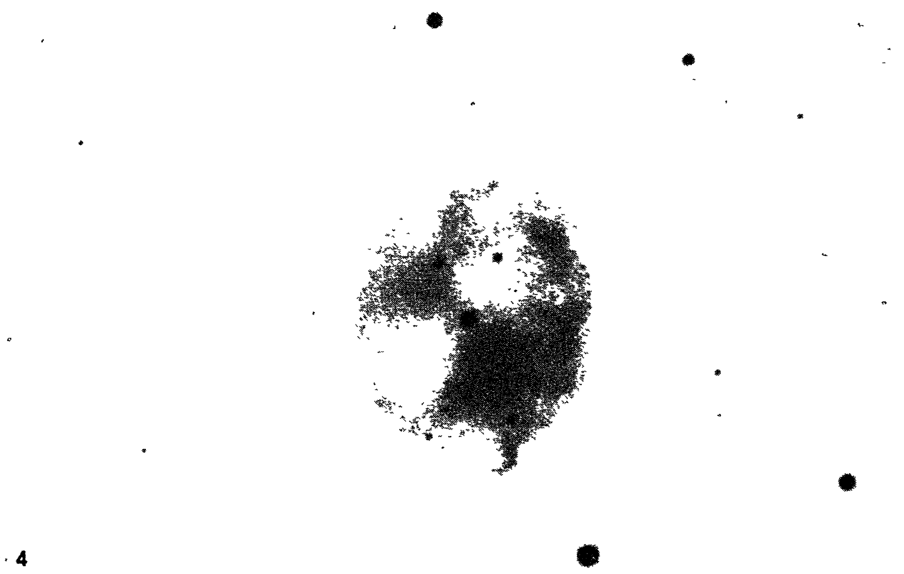
1. Great Nebula in Orion (M42, N.G.C. 1976). The light of this nebula consists of bright rays characteristic of the atoms of hydrogen, helium, oxygen and nitrogen. These gases, highly rarefied, are excited to luminosity by ultra-violet radiation emitted by hot (20,000° C.) stars imbedded in the nebula. Approximate distance and size of nebula, 1,000 and 80 light-years, respectively

2. Pleiades (M45). This nebulosity is reflected and scattered starlight. Stars in the cluster provide the light, and surrounding clouds of finely divided dust particles reflect and scatter the rays from the stars. Distance to cluster, 490 light-years









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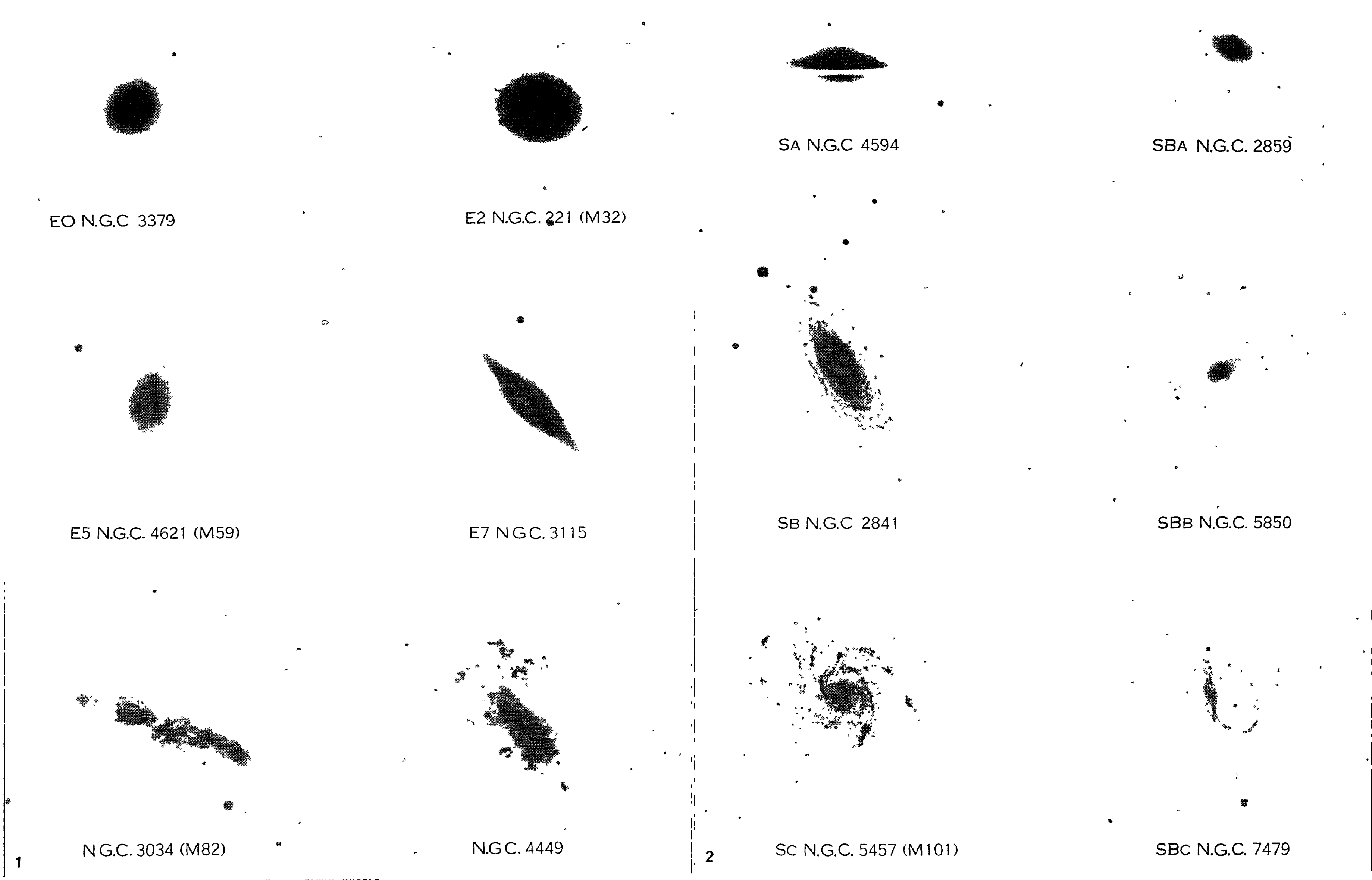
GALACTIC DIFFUSE (MIXED BRIGHT AND DARK), AND PLANETARY NEBULAE

1. Lagoon Nebula (M8, N.G.C. 6523) in Sagittarius; an example of a star cluster with mixed bright and dark nebulosity
2. Horse-head Nebula (N.G.C. 2023) south of star Zeta Orionis; a denser part of a dark cloud in front of several stars
3. Ring Nebula (N.G.C. 6720) in Lyra; a shell of gas made to shine by the central, very hot star
4. Owl Nebula (N.G.C. 3587) in Ursa Major; a nearly spherical volume of gas excited to luminosity by the central, hot star



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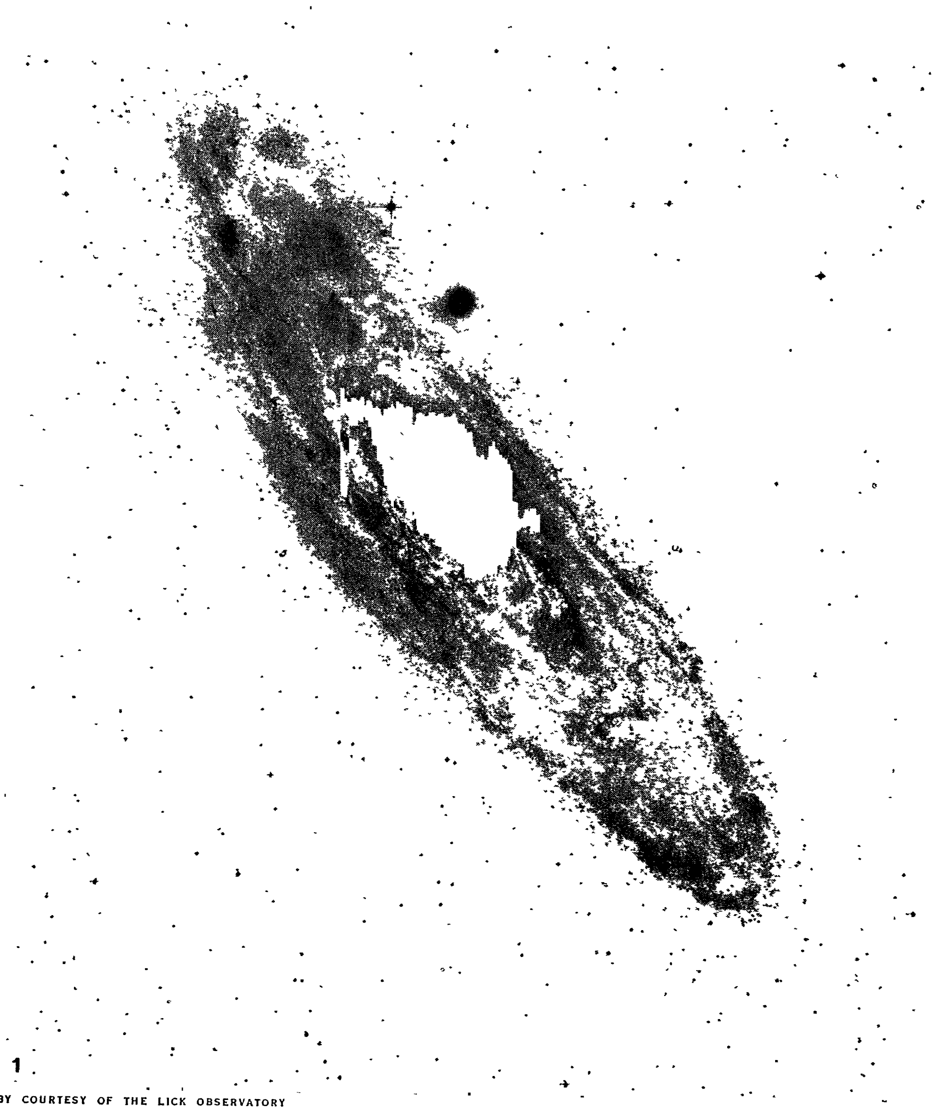
CLASSIFICATION OF THE TYPES OF EXTRAGALACTIC NEBULAE

1. Four typical elliptical (E) nebulae which show the range of flattening (ellipticity) from globular to lenticular, and two irregular (Irr) nebulae which are generally unclassified
2. Six typical spiral nebulae which fall naturally into two groups: the normal spirals (S) and the barred spirals (SB). The small letters a, b, c, indicate the degree of resolution into spiral structure, star clouds or clusters, and individual stars



1

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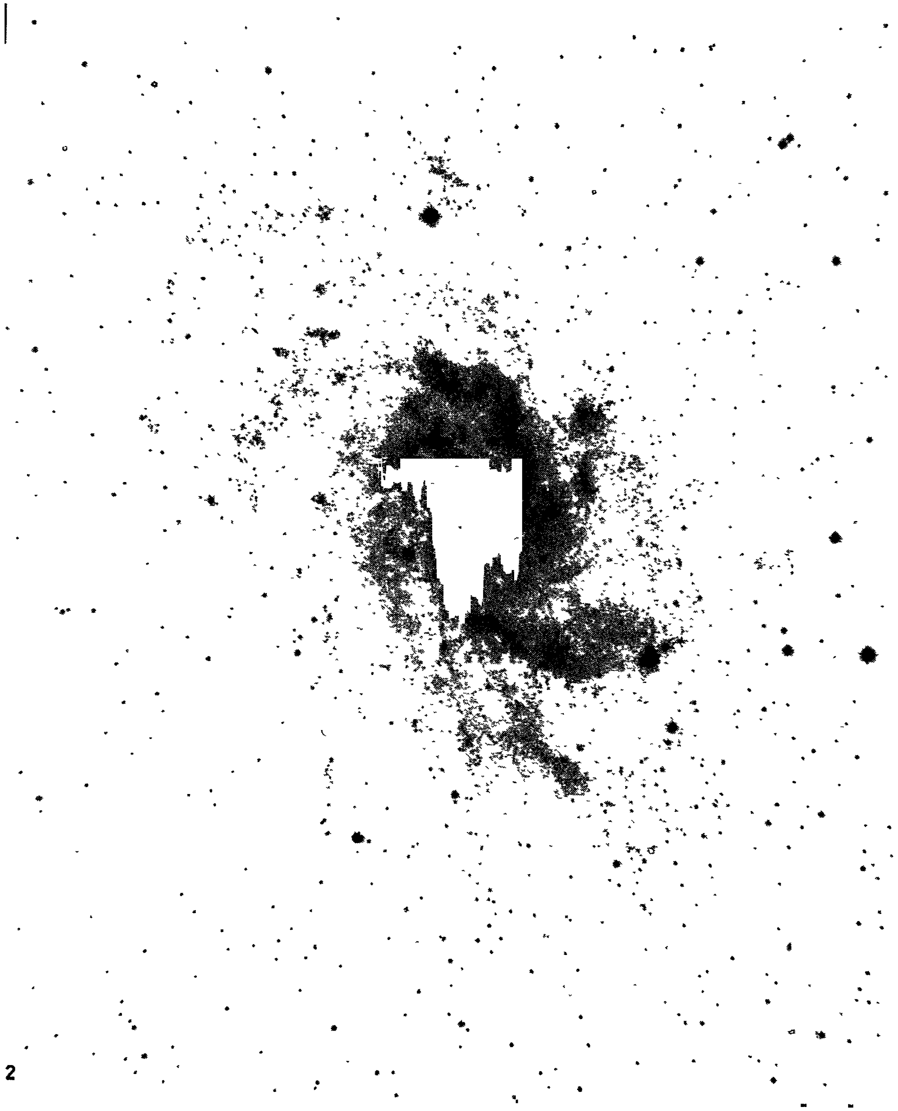
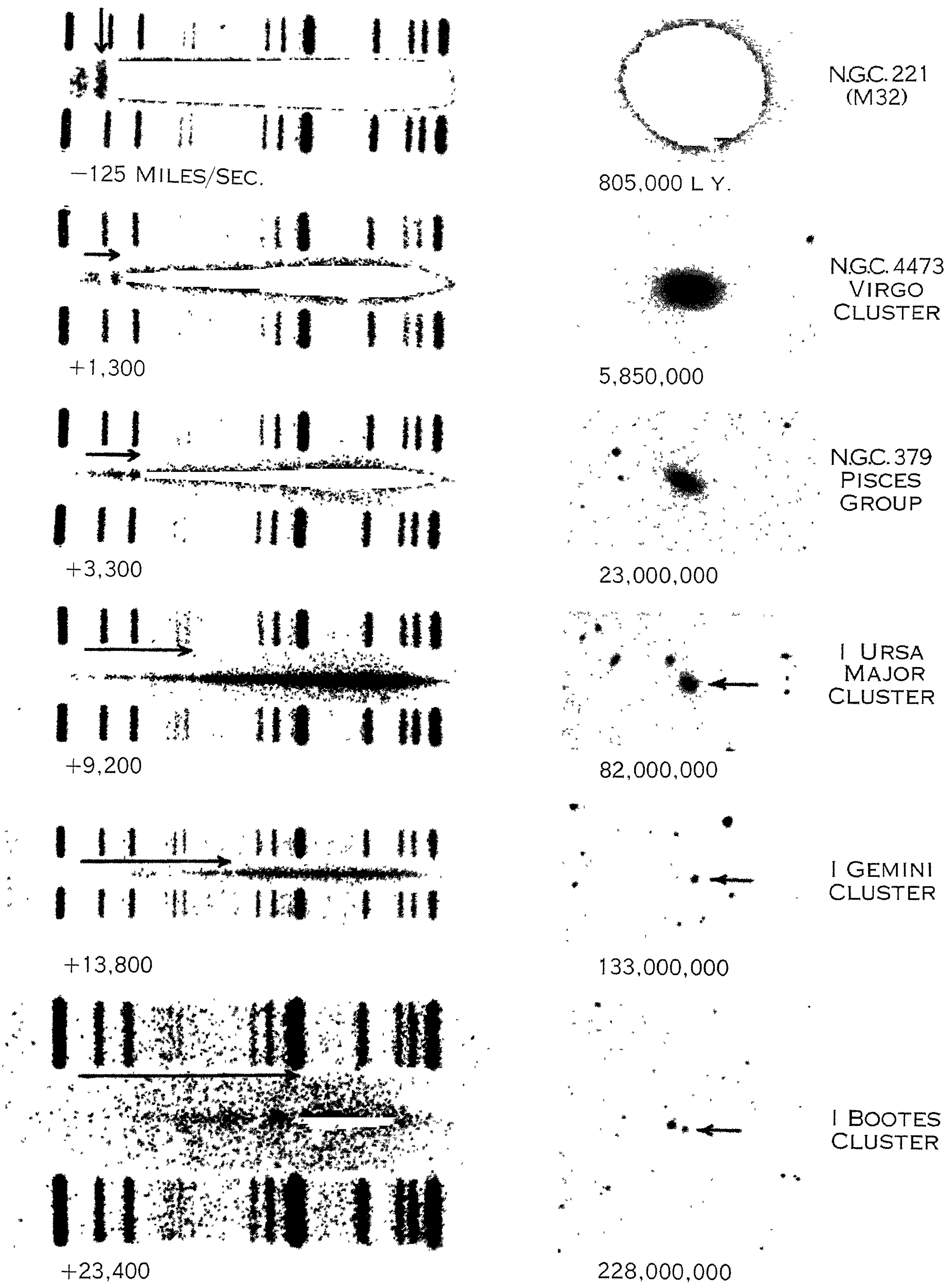


2

EXTRAGALACTIC NEBULAE: THE TWO NEAREST SPIRALS

1. Andromeda Nebula (M31, N.G.C. 224). This is a spiral, giant galaxy of stars, distant 750,000 light-years. Its full size is more than three times that shown in this photograph, or 80,000 light-years in diameter. The spiral contains star clusters, diffuse gaseous nebulae, variable stars, and thousands of millions of stars similar to those found in our own galaxy. If the latter, the Milky Way stellar system, could be viewed from a distance of nearly 1,000,000 light-years, it probably would resemble the Andromeda nebula

2. Spiral in Triangulum (M33, N.G.C. 598). This system, only 14° away from the Andromeda nebula and at the same distance, is a galaxy of more nearly average size and luminosity. It is highly resolved into stars and has many diffuse gaseous nebulae and variable stars



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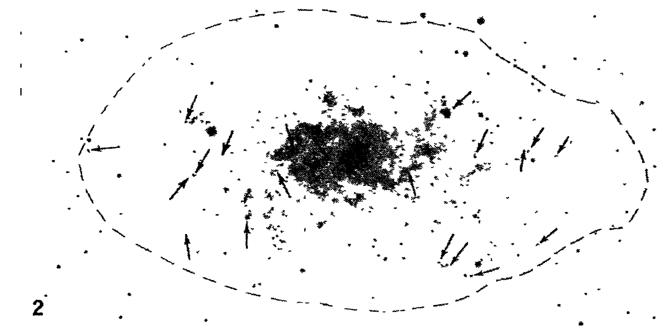
THE VELOCITY-DISTANCE RELATION

The arrows in the left-hand column of nebular spectra point to the H and K lines of calcium (unresolved in the lowest spectrum). The lengths of the arrows show the amounts the spectrum lines are displaced toward longer wave lengths; *i.e.*, they show the "red-shifts" in the spectra, expressed in miles per second. The comparison spectra are of helium

In the right-hand column, direct photographs, of nearly the same scale and exposure time, illustrate the decrease in size and apparent brightness of the nebulae with increasing distance, expressed in light-years (l.y.). When the distances are plotted against the velocities, there is obtained a straight-line relation, known as Hubble's velocity-distance relation

1



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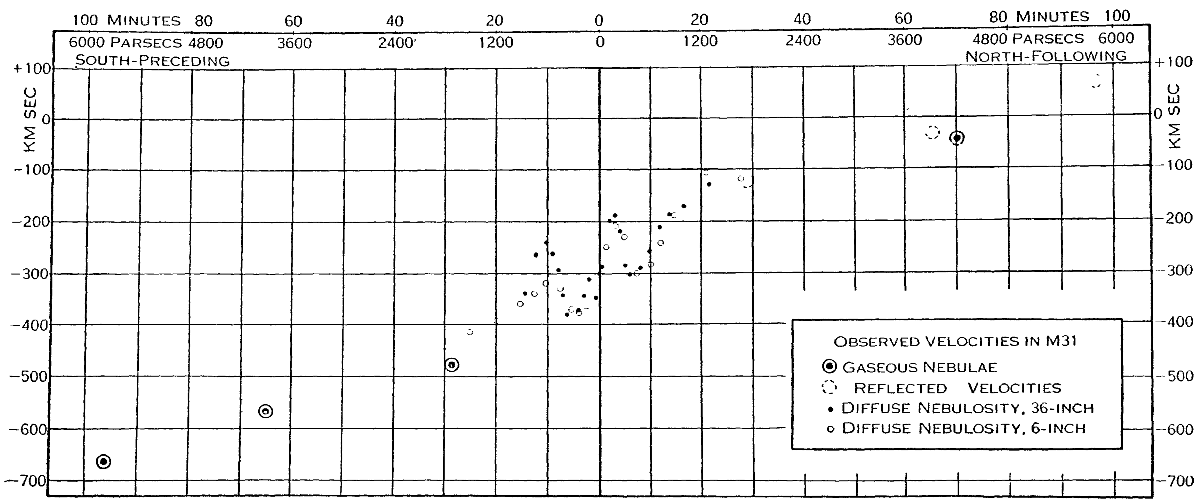

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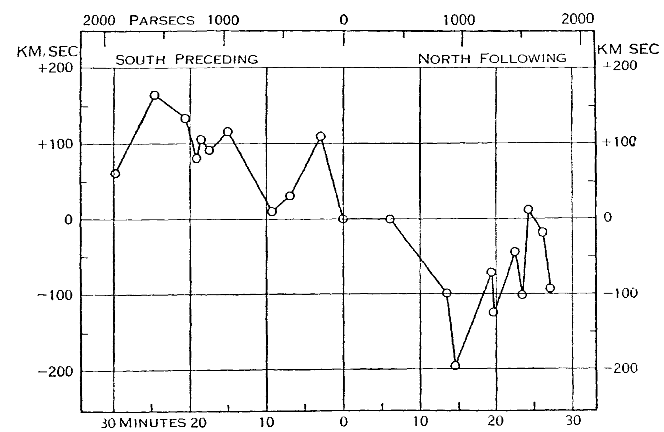

ROTATIONAL VELOCITIES OF 20 EMISSION CONDENSATIONS IN MESSIER 33

ROTATION OF THE TWO NEAREST SPIRAL NEBULAE

1. Spiral in Andromeda (M31). 2. Spiral in Triangulum (M33). The direct photographs above, with the diagrams below, show points in the spirals with their corresponding velocities (in the line of sight), which indicate that these two galaxies are rotating. The objects encircled in M31, and marked with arrows in M33, are all diffuse gaseous nebulae, observed because their bright-line spectra are easiest to record and to measure. The scale of linear distances at the top of the diagrams is in the stellar distance unit called the *parsec*, which equals 3¼ light-years. The velocity scales on the right- and left-hand margins are in *kilometres* per second; multiplication of the numbers shown by 0.621 will express them in *miles* per second

From the velocities observed, it can be shown that different parts of the spirals turn at different rates; thus, the calculated periods of rotation in M31 are 11,000,000 years for the small nuclear region, and 92,000,000 years for the main body. In M33, the main body turns once in 59,000,000 years, and the outer parts once in 60,000,000 to 200,000,000 years

nebular counts was not put on a firm quantitative basis until 1934. In that year Hubble published the results of surveys, made with the Mount Wilson reflectors, in which more than 44,000 nebulae were counted in 1,300 sample regions fairly evenly distributed over three-fourths of the sky. For the first time, the counts were calibrated and referred to specified limiting magnitudes. With all the data reduced to standard conditions, it became clear that the numbers of nebulae decreased in a very regular way as the Milky Way was approached. The rate of decrease, in fact, was just that to be expected from a thin obscuring layer in which the absorption is proportional to the light path in the stratum—a familiar analogy is the dimming of stars as they approach the horizon. The zone of avoidance along the Galaxy is thus but the effect of looking in the plane of the stratum, where the absorption is a maximum which approaches complete opacity; toward the galactic poles, the absorption is a minimum, with the light reduced by only 20%. The more populous areas, on the other hand, represent a conspicuous tendency for the nebulae to cluster. They occur in pairs, in small to large groups of several to 100 nebulae, and in great clusters which include more than 500 members, as in the Coma and Virgo aggregations.

Numbers and Distribution in Depth.—Of equal or greater importance than the delineation of regions of avoidance and of clustering is the conclusion, first reached by Hubble, that the extragalactic nebulae populate space with an approximately constant density as far as telescopes can reach. This result was obtained from counts of nebulae to successively fainter limiting magnitudes. For the brightest objects, it is only necessary to total to each limiting magnitude the number of nebulae whose magnitudes have been individually determined, as for example, in the extensive Harvard surveys reported by Shapley. For the faintest objects, on the other hand, it is much simpler to count nebulae to limiting magnitudes determined by exposures of different lengths, or by telescopes of different light-gathering power. This indirect procedure is expedient because the faintest nebulae are overwhelmingly too numerous to estimate their individual brightnesses. With the numbers of nebulae established to increasingly fainter magnitudes, it is relatively easy to test the hypothesis of constant space density. This is done by noting whether the numbers of nebulae counted are proportional to the volumes of space in which they are found. More precisely, a simple calculation shows that the rate of increase is by a factor of four when the limiting brightness decreases by one magnitude. On the basis of all the available material, Hubble found that this condition was satisfied when large volumes of space were involved. His numerical results may be transcribed into the following table, which shows how the nebulae increase in number with diminishing brightness, which in turn indicates increasing distance. The numbers tabulated represent average values which do not allow for the effects of galactic absorption or of red-shifts in the nebular spectra. Corrections for these disturbing influences, which reduce the number of nebulae, are important in precise, quantitative studies, but their detailed consideration is beyond the scope of this article.

Distribution of Extragalactic Nebulae in Depth
(Based on the Assumption of Constant Space Density)

Apparent Magnitude (Photographic)	Average Distance (Light-Years)	Numbers of Nebulae	
		Per Sq. Deg.	Whole Sky
10	3,400,000	0.00081	34
12	8,600,000	0.013	540
14	21,500,000	0.20	8,500
16	54,000,000	3.2	135,000
18	136,000,000	51	2,100,000
20	342,000,000	810	34,000,000

Deviations from Uniform Distribution.—The Harvard surveys of galaxies to the 18th magnitude, which by 1942 had covered more than half the sky observable from both northern and southern latitudes, contributed significantly to more detailed investigations of the departures from the uniformity of distribution which Hubble proved to exist in a statistical sense. According to Shapley, the Harvard counts disclose the presence of 25 clusters of galaxies at least as rich as the Virgo system, of 100 groups having a dozen or so members, and of thousands of distributional irregularities that suggest physical associations. Comparison of results from the northern and southern galactic hemispheres seems to show a 40% larger average population in the north to the 18th magnitude, but the difference disappears between the 18th to 20th magnitudes. Should further observations prove the inequality to be real, there would be required some such novel explanation as "a great cloud of galaxies 100,000,000 light-years distant beyond the northern constellations, or a major continuous south-to-north density increase." Two other more localized density surpluses were found in one great belt of tens of thousands of galaxies extending from the Milky Way through Andromeda, Triangulum, Perseus and Pegasus, and in another better-defined stratum ranging through the far southern constellations of Pictor and Dorado, in which the average density appears to be 50% higher than elsewhere in the southern sky. Notwithstanding these very interesting belts and clouds of galaxies, whenever very large volumes of space are compared, the unevenness tends to disappear, and in general the Harvard counts over large areas to brighter magnitudes fully substantiate the uniform density deduced from the Mount Wilson counts in small sample areas to very faint magnitudes.

Distance Determinations.—Distances of extragalactic nebulae are most accurately determined from studies of their constituent stars. In principle, the procedure is to identify the character of the involved stars, and then to compare their apparent brightnesses with those of corresponding stars in the galaxy. The galactic stars with which the comparison is made have known *absolute magnitudes,* that is to say, their true brightnesses, or luminosities, have been found from trigonometric methods which are similar to those used in surveying. Since the apparent and absolute magnitudes, and the distance, are related to each other by a simple formula based on the assumption that light is weakened inversely as the square of the distance, wherever an object of known absolute magnitude, such as a star, can be identified in a nebula, the latter's distance can be obtained. In practice, however, the use of involved stars as distance indicators is difficult, because large telescopes are needed to resolve nebulae into their brightest stars; also the method is limited to a comparatively small number—several hundred—of the nearer nebulae. In order of decreasing accuracy, but of wider use because of increasing luminosity, those involved stars which are useful as distance indicators are: *Cepheid variables, Supergiant stars* and *Novae.* For the millions of nebulae so distant that none of these stars can be detected in them, distances are estimated from *total magnitudes* of the nebulae, and from *red-shifts* in the nebular spectra. On the basis of these methods, largely developed by Hubble in a series of comprehensive researches from 1924 to 1940, the scale of distances in the observable universe has been extended to 500,000,000 light-years. How this was accomplished is outlined in the following paragraphs.

Cepheid Variables. Shortly after the turn of the century, Henrietta S. Leavitt of the Harvard observatory found from studies of certain variable stars in the Magellanic Clouds that the periods of light variation were closely correlated with the apparent magnitudes. Since the Cloud variables were all at nearly the same distance, the relation was actually one between period and real brightness. The significance of Miss Leavitt's discovery was at once realized by Ejnar Hertzsprung and others, who pointed out that these variables are giants, or high luminosity stars, similar to the familiar galactic Cepheids, so named after the prototype δ Cephei. Since the distances of the galactic Cepheids were approximately known from investigations of their radial and transverse motions, Miss Leavitt's *period-luminosity law* could be calibrated. In other words, the relation could be used to give distances of objects containing Cepheid variables. In this way the distances of the Magellanic Clouds have been found to be about 80,000 light-years. At this distance, Cepheids are fairly easy objects to detect, even with telescopes of moderate power, for variables having a 30-day period are somewhat brighter than the 13th magnitude at maximum light. The case is altogether different, however, for the discovery of these variables in the nearest spirals, those in Andromeda and Triangulum. Cepheids in them are so faint (18th magnitude or fainter) that they were not discovered until 1923, when Hubble began to use the 100-in. telescope to investigate the nature of the extragalactic nebulae. By 1929 he had identified 75 Cepheids in these two spirals, and had established their distances as about 900,000 light-years, without correction for galactic absorption. This result settled once

and for all the long-standing controversy concerning the true nature of the spiral nebulae: they are in reality vast "island universes," or galaxies of stars, far beyond our own Milky Way system. While the Cepheids in this manner supplied the key to the proper scale of the universe, their usefulness as extragalactic distance indicators has been restricted to about a dozen known nearby stellar systems, all of which are less than 1,000,000 light-years distant, and which comprise what is called the Local Group (*see* section below, *The Local Group*).

Supergiants.—These are bluish-white, very hot stars which generally appear as the brightest stars in the nearer of the extragalactic nebulae. From an investigation of 150 systems published in 1935, Hubble found that the very brightest stars in "late" spirals (type *Sc*) were about of the same order of luminosity—50,000 times that of the sun. This "supergiant" distance criterion has proved to be of great value, for it provided distances for a sufficient number of nebulae to permit statistical studies of entire nebulae, rather than of their constituent stars. The way was thus opened for the use of a much brighter source as a distance indicator, namely, the light of a whole nebula, discussed in the second paragraph below.

Novae. Although these temporary stars first directed attention to the study of the stellar contents of nebulae as distance indicators, and their use for that purpose antedated by a few years the Cepheids, novae originally gave an ambiguous answer to the puzzling question of the distances of the spirals. The trouble arose from the fact that there are two kinds of novae: *normal* novae and *super*novae, the latter several thousand times brighter than the former. The numerous novae in the Andromeda nebula, first photographed by G. W. Ritchey, form the fainter group, while those rarely found in the other and much fainter nebulae make up the other and brighter group. To use either group for distance determinations, however, required their comparison with the galactic novae. The point at issue, therefore, was whether the galactic novae were to be regarded as normal or supernovae. It is now known that both types of novae have occurred in the Galaxy and in the nebulae, and unless the distinction can be made in the individual cases, even the order of distance, whether galactic or extragalactic, is indeterminate. K. Lundmark, of Lund, Sweden, in 1920 pointed out the probability of two separate classes of novae, and contemporaneous discussions by Curtis and Shapley clearly set forth the difficulties of establishing by means of the novae a scale of distances for spirals. It was only after 1936, when F. Zwicky and W. Baade initiated a program on Mount Palomar to discover supernovae (with an 18-in. Schmidt-type telescope), that sufficient data were obtained on these greatest of stellar outbursts to indicate how novae in general may be used to check the order of distance. Because two different luminosity groups of supernovae were identified, and because even normal novae differ considerably in real brightness, the result is that novae as distance indicators are of value mainly as corroborative evidence.

Total Magnitudes.—In the case of the sample group of extragalactic nebulae whose distances became known from his study of the supergiant stars within them, Hubble was able to investigate the range, or scatter, in their total *absolute* magnitudes from measures of their total *apparent* magnitudes. It was found, as for the stars, that these nebulae do not have the same luminosity, but that an *average* of a sufficient number, properly selected, provides a valuable criterion of distance. This average value, called the *mean absolute magnitude* of nebulae in general, is undoubtedly the brightest light unit yet used, for it amounts to 85,000,000 suns. With a light source of this intensity, the extragalactic distance scale can be extended to more than 200,000,000 light-years. Distances of this order have been reliably determined for a number of the large clusters of nebulae, for in them it is possible to obtain an accurate average value of the most frequent total *apparent* magnitude. Comparison of the latter with the mean *absolute* magnitude of nebulae then gives, by a simple calculation, the distance to the cluster. The very greatest distances are found when a cluster is so faint that only its brightest members can be photographed. In these cases the mean or most frequent magnitude of cluster nebulae is estimated as ten times fainter than the brightest member, or seven times fainter than the 5th brightest member, which is statistically more accurate. The most remote cluster observed with the spectrograph is estimated in this way to be distant 230,000,000 light-years. Beyond this distance it is difficult to locate true clusters of nebulae, for only the brightest members can be photographed. Nevertheless, among the very faintest nebulae which can be identified on long exposures made with the 100-in. reflector, there are some which are giants. These average more than four times brighter than the normal nebulae, and thus giants can be detected twice as far. In this manner space has been penetrated to distances of the order of 500,000,000 light-years with the largest telescope in operation.

Red-Shifts.—In 1912 V. M. Slipher first measured the radial velocity, or speed in the line of sight, of an extragalactic nebula—the spiral in Andromeda. Since his initial spectroscopic observations were of the nearest and brightest objects, the fact that the radial velocities in some cases indicated approach, and in others recession, did not at first excite abnormal interest. It was noted, however, that the velocities were above average, in some cases exceeding the highest known velocities for stars. As Slipher continued his spectrum observations, extending them to include fainter nebulae, he found that the radial velocities were predominantly of recession, and, most remarkably, they were unexpectedly large, up to 1,000 mi. per second. These results naturally aroused great interest, and they provided additional evidence that the extragalactic nebulae were indeed set apart from all other objects in the sky. Attempts to connect these velocities of recession, considered enormous in their time, with other characteristics of the nebulae, met with general failure until suitable distance criteria were developed.

The Velocity-Distance Relation.—Following his discovery of Cepheids in the Andromeda nebula in 1923, Hubble proceeded to develop the method of brightest stars as a means of estimating distances of spirals. By 1929 he had deduced distances for 18 nebulae from their supergiant stars, as well as distances for four spirals in the Virgo cluster from the mean luminosity of all nebulae in the cluster. With these 22 objects, for which both radial velocities and reliable distances were available, Hubble announced in 1929, one of the most outstanding results of modern astronomy: a *velocity-distance relation* for extragalactic nebulae. According to this relation, the more distant a nebula, the greater is its velocity of recession (*red*ward shift of its spectrum lines). In the original formulation, a distance of 6,500,000 light-years was reached, but the range was rapidly extended by additional observations of fainter cluster nebulae, for which Hubble estimated distances from total magnitudes, and for which Humason measured radial velocities by a powerful spectroscope of radically new design. This new and much more extensive material demonstrated by 1936 that the relation between velocity and distance was valid for distances of more than 200,000,000 light-years and for velocities up tc 25,000 mi. per second. Moreover, the correlation was so precise it could be used to obtain distances of individual nebulae. Since the rate of increase of recession is closely 100 mi. per second for every 1,000,000 light-years, the distance of a nebula, in millions of light-years, is simply obtained by dividing its radial velocity, in miles per second, by 100. This method of estimating distances from red-shifts is especially valuable for faint nebulae, because for them the error in determining a radial velocity is small compared with their velocities. In fact, the percentage accuracy increases with the distance, and at the point where luminosity methods become increasingly uncertain, the red-shift measures become relatively precise—a most fortunate circumstance for the investigation of the depths of the universe.

The Local Group.—Following the establishment by Hubble of a reliable distance scale for extragalactic objects, it soon became evident that the Galaxy is a member of a small group of relatively nearby systems which are conspicuously isolated from the next nearest galaxies. The Local Group includes 13 recognized members, with several other objects, heavily obscured by galactic dust clouds, as possible additions. The group contains the Galaxy with its attendant Magellanic Clouds, the Andromeda nebula with four satellites, the spiral in Triangulum and four dwarf systems. These objects have proved of great value for studies of the structures and stellar constitution of a representative collection of nebulae, with the results from their investigation making possible the development of criteria for further exploration. The characteristics of some individual members are discussed below.

The Magellanic Clouds.—Chiefly as the result of observations made at the Harvard observatory's stations in the southern hemisphere, the distances, sizes and nature of their stellar contents have become fairly well known. From the period-luminosity law for Cepheid variables (see above section, *Cepheid Variables*), the distance of the large cloud is found to be 75,000 light-years, and of the small cloud, 84,000 light-years. There remained in 1946 a little uncertainty due to the presence of absorbing matter in our own Milky Way, which, it was estimated, dims the light from the clouds by 13%. The cloud centres are separated by 21°, or by 30,000 light-years. On ordinary photographs each cloud appears to be a concentrated and irregular mass of stars, the large cloud about 10,000 light-years in diameter and the small cloud half as large. On small scale photographs of long exposure, however, the brighter parts seem to be surrounded by a faint haze of stars which nearly doubles the extent of each object; thus there is the possibility that the two clouds may even overlap in some degree. Because of the relative nearness of the clouds, such objects as open star clusters (like the Pleiades and Hyades), globular star clusters, diffuse nebulae, variable stars, several novae and ordinary stars down to a luminosity ten times that of the sun, have been identified and studied. The small cloud appears to be exceptionally rich in variable stars, with 2½% of the stars brighter than the 17th magnitude showing variability; supergiants are exceptionally frequent in the large cloud, which contains the brightest known irregular variable, *S* Doradus, nearly 500,000 times more luminous than the sun. Together with more than 100 giant and supergiant stars, it is located in an enormous mass of diffuse nebulosity, hundreds of light-years across, which dwarfs in size and brilliance the Orion nebula. The radial velocities of both clouds were determined in 1918 by R. E. Wilson at the southern station of the Lick observatory, in Santiago, Chile. The motions are apparently 100 mi. and 170 mi. per second recession, for the small and large clouds, respectively, but they are almost wholly the reflection of the sun's rotation about the galactic centre 30,000 light-years distant in Sagittarius. The Magellanic Clouds have proved to be invaluable as objects in which the giant and supergiant ranges of stellar luminosity may be studied, for in these nearby systems astronomers find the very fortunate circumstance of the same distance for all stars concerned, so that differences in apparent brightness represent differences in real brightness.

The Andromeda Nebula.—As the largest and nearest spiral, this has been, and probably will continue to be, one of the most intensively investigated objects in the sky. Since it is a real giant among extragalactic nebulae, comparative studies of it with the Galaxy offer some of the most fruitful means of learning more about our own Milky Way system, so much of which is hidden from view by the stratum of interstellar dust clouds. Since the spiral lies only 21° from the galactic plane, its distance is somewhat uncertain because of galactic absorption, and the best modern estimates place the system at 750,000 light-years, with an uncertainty of perhaps 10%. At this distance the main body of the spiral, as shown on most photographs, is 30,000 light-years in diameter, but photo-electric cell measures reported by Joel Stebbins and A. E. Whitford in 1934, suggested a diameter of at least 70,000 light-years. In 1941, R. C. Williams and W. A. Hiltner, by using a highly sensitive microdensitometer of their own design, traced the outlines of the spiral, on a photograph taken with an 18-in. Schmidt telescope on Mount Palomar, to a distance of 80,000 light-years. This figure is closely comparable with the size of the Galaxy when allowance is made for the effects of galactic obscuration. Despite the large distance to the spiral, Cepheid variables, supergiant stars, normal novae and globular clusters have been detected in considerable numbers with the 100-in. telescope. There are a few gaseous nebulae known, and probably many more remain to be discovered, but because of their faintness, their identification with a spectrograph will require time.

In the most recent photographic work on the Andromeda nebula, W. Baade in 1944 reported the resolution of the amorphous nuclear region into myriads of faint stars. This remarkable achievement was accomplished by using the 100-in. telescope in the most skillful manner under critically good conditions, and by using photographic plates highly sensitive to red light. In addition, and by the same method, he resolved into stars the two close companion nebulae of the spiral. The brightest of these satellites is a typical elliptical nebula, and Baade's demonstration that it is composed of stars settled the question of the constitution of the innumerable similar nebulae. At the same time he showed that two more nearby objects, hitherto unresolved, also are companions of the Andromeda nebula, which is now revealed as a giant accompanied by four dwarfs of decreasing size and luminosity. Baade's unsurpassed photographs not only resolved all five objects, but showed that, in certain systems, especially in the elliptical nebulae, supergiant stars are absent. From a more detailed analysis, Baade was led to conclude that there are two fundamentally different types of stellar populations, which are present in different proportions in spiral, elliptical and dwarf irregular nebulae, with the different frequencies accounting for the character of the observed structures and stellar contents. The discovery was in 1946 as yet too new to be fully appraised, but it seemed likely to serve as a fruitful point of departure for many future investigations of stars in the extragalactic nebulae and in the Galaxy.

Nearby Dwarf Systems.—Besides those associated with the Andromeda Nebula, there are known four other relatively close dwarf systems, N.G.C. 6822 and I.C. 1613, which are irregular nebulae having supergiant stars, and two objects in the southern constellations of Fornax and Sculptor reported by Shapley in 1938, which are elliptical nebulae of very low central concentration lacking supergiants. Their distances, which range from 220,000 to 730,000 light-years, and their distribution in the sky, indicate that these dwarfs are essentially isolated from the other members of the Local Group. In the two irregular systems having supergiants, such familiar objects as Cepheids, globular clusters and several gaseous nebulae have been found, those in N.G.C. 6822 by Hubble, and those in I.C. 1613 by Baade. Because of the similarity in stellar contents, these dwarfs may be regarded as replicas in miniature of the Magellanic Clouds. The Sculptor and Fornax dwarfs, on the other hand, are considered to be low luminosity elliptical nebulae because their brightest stars have the same absolute magnitudes as those in the elliptical companions to the Andromeda nebula. By using the 100-in. reflector, Hubble and Baade in 1939 identified two globular clusters in the Fornax system, and found variables which probably are similar to those found in the galactic globular clusters. While the stellar contents of these dwarfs thus are similar to those of globular clusters, there is still a big gap, as yet unbridged, between elliptical nebulae and globular clusters, for the latter are from 40 to 100 times more dense than, and only 1/10 as large as, the Fornax and Sculptor systems. The importance of discovering and investigating these dwarf systems can hardly be overestimated, for such nearby pygmies offer the possibility of learning much about the stellar constitution of extragalactic nebulae in general, which are much too distant for resolution into their full stellar populations. It is interesting to note in this connection, therefore, that a significant beginning has already been made in the discovery of dwarfs among the nearest galaxies beyond the Local Group. In 1940, F. Zwicky, by means of an 18-in. Schmidt telescope on Mount Palomar, found three very faint dwarfs, apparently of the Magellanic Cloud type, in the constellations of Ursa Major, Leo and Sextans. Preliminary observations of the brightest stars (supergiants) in the latter two systems, reported in 1940 by Baade, indicate distances of about 1,200,000 light-years for these two dwarfs. Since they may also be companions to apparently closeby galaxies not yet resolved into stars, these dwarfs may prove useful as distance indicators. In any case, it is evident that far more of these small, low luminosity objects exist in extragalactic space than was hitherto believed to be the case, and the probable discovery of more such objects by means of the large 48-in. Schmidt telescope under construction on Mount Palomar will be awaited with much interest.

Rotation of Nebulae.—The most casual glance at a spiral nebula suggests rotation, and for nebulae seen nearly edge-on, the spectrograph readily discloses the component of their rotation in the line of sight. The pioneer observations of V. M. Slipher and of Max Wolf in 1914, together with those of F. G. Pease in 1916, showed that the central parts of several of the brighter nebulae, and the nuclear region of the Andromeda nebula, rotate in the fundamental planes of the systems. Because of the inherent observational difficulties, principally the extreme faintness of the nebular light (Pease's exposures extended more than 80 hours), progress in this field has been slow, and even by 1946 only the two largest and nearest spirals, those in Andromeda and Triangulum, had been studied with any approach to completeness. From observations made at the Lick observatory in 1939 by H. W. Babcock, the general nature of the rotation of the Andromeda nebula became known out to its faintest extensions shown on ordinary photographs. Except for an irregularity of motion near the nuclear region, which appears to spin somewhat faster, the spiral rotates almost as a solid body, with a period of 92,000,000 years. Now this type of rotation—as a solid body—was quite unexpected, because in the solar neighborhood of the Galaxy the stars show a "planetary" type of motion, that is to say, they move more slowly around the galactic centre the farther away from it they happen to be. Similar observations of the spiral in Triangulum, reported in 1942 by N. U. Mayall and L. H. Aller of the Lick observatory, show that this smaller galaxy rotates in both ways, the central part as a solid body, the outer parts like objects in the solar system. In a theoretical treatment of the results for both spirals, A. B. Wyse and Mayall in 1942 considered a hypothetical model having a distribution of matter capable of accounting for the observed motions. Comparison of the mass distributions deduced for the spirals, with that for the sun's region in the Galaxy, gave additional support to the current idea that the sun probably is far out from the main body of the Milky Way system of stars.

In addition to providing material for comparative studies of the dynamics and structure of the nebulae and Galaxy, spectroscopic measures of rotation in spirals offer a direct means for estimating their total masses. Such estimates involve the assumption of circular motion in the fundamental place, but, fortunately, spirals contain diffuse gaseous nebulae whose motions in the Galaxy are believed to meet this condition. On this basis, the rotation measures for the Andromeda nebula suggest a total mass of 95,000,000,000 suns for this giant, while for the Triangulum spiral, which is much more of an average system, the observations indicate matter to the amount of 2,000,000,000 suns. By way of comparison, the Galaxy is estimated to have a combined mass of 200,000,000,000 suns, but because of the many uncertainties involved, the difference by a factor of two from the figure for the Andromeda nebula cannot be considered a serious discrepancy. On the broad scale, both systems probably are comparable giants.

Direction of Rotation in Spirals.—Closely allied with the character of the rotational motion of spirals is the question of how the movement takes place with respect to the curvature of the spiral arms; in other words, do the arms appear to be winding or unwinding? Slipher likewise pioneered in this field, and on the basis of his rotation measures and his inferences of the true spatial orientation of the nebulae from their apparent or projected forms, he concluded that all spirals probably rotate in the same manner, namely, that the central part turns into the spiral arms like a coil spring being wound up. The interpretation of photographs of spirals to determine how the systems are located in space is not easy, however, and the criteria used by Slipher—asymmetries in the pattern of dark matter—were later (1934–40) construed in the opposite sense by Bertil Lindblad, whose theory of spiral stellar systems suggested a rotation with the arms leading instead of trailing. The question was completely re-examined in 1942 by Hubble, whose study of the file of hundreds of large-reflector photographs disclosed four spirals suitable as test cases. In these the spiral pattern was plain, and the sense of tilt was unambiguously determined by primary and secondary dark lanes silhouetted against the bright nuclear region. From spectrographic observations of these four crucial-test spirals, made at the Mount Wilson and Lick observatories, it was found that, in each case, the arms trailed. With supporting, but not decisive, evidence provided by similar modern observations of 11 other spirals, Slipher's earlier conclusion now may be accepted as fairly well established, namely, that all spirals rotate in the same way: as the central part turns, the arms lag behind.

Interpretation of the Red-Shift.—Although red-shifts in the spectra of extragalactic nebulae are commonly expressed as velocities of recession, the practice is more traditional than scientific, for it is by no means certain that actual motions of such a large order of magnitude—one-seventh the velocity of light—are involved. What the spectrograph records is wave length (λ), and when the observed wave lengths differ from those of normal value, the difference ($d\lambda$) is, mainly for convenience, expressed as a velocity (v) by means of Doppler's principle, which states that $d\lambda/\lambda = v/V$, where V is the velocity of light (186,000 mi. per second). Except for two facts—(1) that the ratio $d\lambda/\lambda$ is found to be constant in a given nebular spec-

trum, which is a necessary condition for a velocity shift, and (2) that the ordinarily small differences of wave length in stellar sources, such as double stars revolving around their common centre of gravity, are due to motion—there is little direct observational evidence that the very large differences from normal wave lengths of the lines in the nebular spectra represent motion in the line of sight. If the measured red-shifts actually do represent velocity, then they should produce certain small effects on the apparent brightnesses of the faintest nebulae counted. Merely the red-shift alone, apart from any motion, tends to make the nebulae too faint; however, if motion also is involved, the nebulae should appear even fainter, but by such a small amount, only a few per cent for the faintest nebulae counted, that the resources of the greatest of telescopes are strained for its detection. Hubble has examined the matter in detail by making special counts of nebulae to the faintest magnitude attainable with the 100-in. reflector, and he concluded in 1936 that either there is a probable uniform distribution of the nebulae with the red-shift *not* representing motion, or if motion is involved, some "vital factors have been neglected in the investigation." Consideration of what some of the factors are likely to be, such as the different times required for light to come from nebulae at different distances, indicated that their evaluation was more properly in the province of relativistic cosmology. In this highly theoretical field attempts have been made to settle the question, but the crucial test of whether the large nebular red-shifts are velocities probably will consist of further observations, possibly those to be made upon completion of the great 200-in. telescope on Mount Palomar.

BIBLIOGRAPHY.—A fairly complete compilation (to 1932) of articles on nebulae, mainly technical but some nontechnical, may be found in a monograph by Heber D. Curtis, "The Nebulae" published in *Der Handbuch der Astrophysik*, vol. v, part 2, pp. 774–936 (1933). For the extragalactic nebulae, a book by Edwin Hubble, *The Realm of the Nebulae* (1936), is the most scholarly, authoritative and semitechnical work available. A more recent, popularly-written book covering the same field, but dealing mainly with the work of the Harvard observatory, is one by Harlow Shapley, *Galaxies* (1943). The diffuse and planetary nebulae are described in detail by L. Goldberg and L. H. Aller in *Atoms, Stars, and Nebulae* (1943); while our own galactic star system is fully treated by B. and P. Bok in *The Milky Way* (1941). (N. U. M.)

NEBULAR THEORY: *see* COSMOGONY.

NECESSITY: *see* FREE-WILL.

NECK, that part of the body which connects the head with the trunk (*see* ANATOMY: *Superficial and Artistic*). The word is transferred to many objects resembling this part of the body in shape or function; it is thus applied to an isthmus, or to the narrowest portion of a promontory, to the narrow part of a musical stringed instrument connecting the head and body, as in the violin, or to a narrow pass between mountains, which in the Dutch form *nek*, appears in place-names in South Africa. In architecture, the "neck" is that part of the capital just above the "astragal," and the term "necking" is applied to the annulet or round, or series of horizontal mouldings, which separates the capital of a column from the plain part or shaft. In Romanesque work this is sometimes corded.

In Geology, the term "neck" is given to the denuded stump of an extinct volcano. Beneath every volcano there are passages or conduits up which the volcanic materials were forced, and after the mass has been levelled by denudation there is always a more or less circular pipe which marks the site of the crater. This pipe, filled with ashes or lava, is the characteristic of a volcanic neck. Many instances are furnished by the geological history of the British Isles. In Derbyshire, Fife, the Lothians and the Glasgow district the remains of Carboniferous volcanoes occur in every state of preservation. Some have the conical hills of lavas and ashes well preserved (*e.g.*, Largo Law in Fifeshire); others retain only a small part of the original volcanic pile (*e.g.*, Arthur's Seat, Edinburgh; the Binn of Burntisland) and of the larger number nothing remains but the "neck" which shows where once the crater was situated.

In regions of former volcanic activity necks are the most persistent of all volcanic structures, because the active volcanic magma is located deep within the earth's crust, and the pipe by which it rises to the surface is of great length and traverses a great thickness of strata. This extensive pipe was usually vertical, and nearly uniform in diameter for great depths; when exposed by denudation, it has a circular ground plan, or if shown in vertical section (or elevation) in a cliff is a pillar-shaped mass crossing the bedding planes of the strata nearly at right angles. It terminates upwards in the remains of the volcanic cone and communicates below with the reservoir from which the lavas were emitted, represented in most cases, where it has been exposed, by a large irregular mass (a batholith or boss) of coarsely crystalline igneous rock. The site of such a neck is generally indicated by a low conical hill consisting of volcanic rock, surrounded by sedimentary or igneous strata of a different kind. The low cone is due to the greater hardness and strength of the volcanic materials and is not connected with the original shape of the volcano. Two splendid sugar-loaf cones known as the Pitons of St. Lucia in the West Indies, rising from the sea with almost vertical sides to a height of nearly 3,000ft., are old volcanic necks. In Texas, New Mexico, Arizona, California and many of the western states of North America, geologists have observed conical volcanic hills having all the features which belong to necks.

Where the volcanic rocks are soft and easily disintegrated the position of a neck may be indicated by a cup-shaped hollow; this is the case with some of the diamond-bearing basic pipes of South Africa. Examples are the Kimberley diamond mines. The blueground (or serpentine breccia) occupies great pipes or funnels, circular in outline with nearly vertical sides, extending downwards to unknown depths; these are the necks of the old volcanoes.

The size of necks varies considerably; the smallest may be only 20 or 30yd. in diameter, the largest are several miles. In this respect they resemble active craters, but no necks have been met with on the earth's surface with dimensions approaching those of the so-called "craters" of the moon.

Occasionally a whole neck is composed of solid crystalline rock representing the last part of the magma which ascended from the underground focus and congealed within the crater. In Mont Pelée, for instance, the last stage of the eruptions of 1902 to 1905 was the protrusion of a great column of solidified lava which rose at one time to a height of 900ft. above the lip of the crater, but has since crumbled down. The Castle Rock of Edinburgh is a neck occupied by a plug of crystalline basalt. Necks of this kind weather down very slowly and tend to form prominent hills.

After the eruptions terminate gases or hot solutions given out by deep-lying masses of molten rock may find a passage upward through the materials occupying the crater, greatly modifying their mineral nature and laying down fresh deposits. A good example of secondary deposits within a volcanic neck is provided by the Cripple Creek mining district of Colorado. The ore-bearing veins are connected with volcanic rocks and part of these occupy a vertical circular pipe which is a typical volcanic neck. A phonolitic breccia, greatly altered, is the principal rock, and is cut by dikes of phonolite, dolerite, etc. The country rock is mostly granite and gneiss, and blocks of these are common in the breccia. A large volcano was built up in Tertiary times on the granite plateau, and has since been almost entirely removed by denudation. The gold ores were carried upwards by currents of hot water derived from the volcanic magma and were deposited along cracks and fissures in the materials which occupied the crater, and also in the surrounding rocks (*see* VOLCANO). (J. S. F.)

NECKAM, ALEXANDER (1157–1217), English schoolman and man of science, was born at St. Albans in September 1157, on the same night as King Richard I. Neckam's mother nursed the prince with her own son, who thus became Richard's foster-brother. He was educated at St. Albans Abbey school, and became schoolmaster of Dunstable, dependent on St. Albans Abbey. Later he went to Paris, where by 1180 he had become a distinguished lecturer of the university. By 1186 he was back in England, where he again held the place of schoolmaster at Dunstable. The assertion that he was ever prior of St. Nicolas, Exeter, seems a mistake, but he was certainly much at court during some part of his life. Having become an Augustinian canon, he was appointed abbot of Cirencester in 1213. He died at Kempsey in Worcestershire in 1217, and was buried at Worcester. Besides theology he studied grammar and natural history, but his name is chiefly associated with nautical science. For in his *De naturis rerum* and *De utensilibus* (the former of which, at any rate, had become well known at the end of the 12th century, and was probably written about 1180) Neckam has preserved to us the earliest European notices of the magnet as a guide to seamen—outside China, indeed,

these seem to be the earliest notices that have survived in any country or civilization. It was probably in Paris that Neckam heard how a ship, among its other stores, must have a needle placed above a magnet (the *De utensilibus* assumes a needle mounted on a pivot), which needle would revolve until its point looked north, and thus guide sailors in murky weather or on starless nights. Neckam has no air of imparting a startling novelty: he merely records what had apparently become the regular practice of many seamen of the Catholic world.

See Thomas Wright's edition of Neckam's *De naturis rerum* and *De laudibus divinae sapientiae* in the Rolls Series (1863), and of the *De utensilibus* in his *Volume of Vocabularies*. Neckam also wrote *Corrogationes Promethei*, a scriptural commentary prefaced by a treatise on grammatical criticism; a translation of Aesop into Latin elegiacs (six fables from this version, as given in a Paris ms., are printed in Robert's *Fables inédites*); commentaries, still unprinted, on portions of Aristotle, Martianus Capella and Ovid's *Metamorphoses*, and other works. Of all these the *De nat. rer.*, a sort of manual of the scientific knowledge of the 12th century, is much the most important: the magnet passage herein is in book ii. chap. xcviii. (*De vi attractiva*), p. 183 of Wright's edition. The corresponding section in the *De utensil.*, is on p. 114 of the *Vol. of Vocabs.* Roger Bacon's reference to Neckam as a grammatical writer (*in multis vera et utilia scripsit: sed . . . inter auctores non potest . . . numerari*) may be found in Brewer's (Rolls Series) edition of Bacon's *Opera inedita*, p. 457. *See* also Thomas Wright, *Biographia Britannica literaria, Anglo-Norman Period*, pp. 449–459 (1846: some points in this are modified in the 1863 edition of *De nat. rer.*); C. Raymond Beazley, *Dawn of Modern Geography*, iii. 508–509. (C. R. B.; X.)

NECKAR, a river of Germany, 247 m. long, and a right-bank tributary of the Rhine, rises in the Hercynian gneisses of the Black forest, near Schwenningen and close to the headwaters of the Danube. It flows north and then north-east along the foot of the Jurassic scarp of the Swabian Jura, passing Rottweil, Rottenburg, and Tübingen. At Plochingen it changes its course flowing away from the scarp edge to Cannstatt near Stuttgart. The valley is very picturesque, becomes broader and deeper, is now navigable and lies between vine-clad hills being cut into the middle Trias sandstones. Continuing north past hills crowned by feudal castles, it runs by Heilbronn and Wimpfen to Eberbach. It now takes a tortuous westerly course, and the scenery on its bank becomes more romantic. Winding by Neckarsteinach and Neckargemünd between wooded heights, it sweeps beneath the Königsstuhl (1,900 ft.) washes the walls of Heidelberg, and quitting the valley enters the Rhine-trough from the right at Mannheim. (*See* RHINE.)

NECKER, JACQUES (1732–1804), French statesman, finance minister of Louis XVI., was born at Geneva in Switzerland. His father was a native of Cüstrin in Brandenburg, and became a citizen of Geneva. Jacques Necker had been sent to Paris in 1747 to become a clerk in the bank of M. Vernet. He soon afterwards established the famous bank of Thellusson and Necker. Thellusson superintended the bank in London, and Necker the Paris branch. Both became extremely rich by loans to the treasury and speculations in grain. In 1763 Necker fell in love with Madame de Verménou, the widow of a French officer. But while on a visit to Geneva, Madame de Verménou met Suzanne Curchod, the daughter of a pastor near Lausanne, to whom Gibbon had been engaged, and brought her to Paris in 1764. Necker married Suzanne before the end of the year. She encouraged her husband to make himself a public position. He accordingly became an able director of the French East India Company, and defended it against the attacks of A. Morellet in 1769. Meanwhile he had made interest with the French government by lending it money, and was appointed resident at Paris by the republic of Geneva. Madame Necker entertained the chief leaders of the political, financial and literary worlds of Paris. In 1773 Necker won the prize of the Académie Française for an *éloge* on Colbert, and in 1775 published his *Essai sur la législation et le commerce des grains*, in which he attacked the free-trade policy of Turgot. His wife believed he could get into office as a great financier, and made him transfer his share in the bank to his brother Louis.

In October 1776 Necker was made finance minister of France, with the title of director of the treasury, which he changed in 1777 to director-general of the finances. He regulated the finances by attempting to divide the taille or poll tax more equally, by abolishing the "vingtième d'industrie," and establishing *monts de piété* (establishments for loaning money on security). But his greatest financial measures were his attempt to fund the French debt and his establishment of annuities under the guarantee of the state. In the operation of funding Necker rather pointed out the line to be followed than completed the operation. He treated French finance rather as a banker than as a political economist, and thus fell far short of Turgot, the greatest economist of his day. His establishment of provincial assemblies was only a timid application of Turgot's great scheme for the administrative reorganization of France. In 1781 he published his famous *Compte rendu*, in which he drew up the balance sheet of France. His dismissal in the same year was not really due to his book, but to the influence of Marie Antoinette, whose schemes for benefiting the duc de Guines he had thwarted.

In 1787 Necker was banished by "lettre de cachet" 40 leagues from Paris for attacking Calonne. In 1788 the country, which had at the bidding of the literary guests of Madame Necker come to believe that Necker was the only minister who could "stop the deficit," as they said, demanded Necker's recall, and in September 1788 he became once more director-general of the finances. Throughout the momentous months which followed the biography of Necker is part of the history of the French Revolution (*q.v.*). Necker put a stop to the rebellion in Dauphiné by legalizing its assembly, and then arranged for the summons of the states general. Throughout the early months of 1789 he was regarded as the saviour of France, but he regarded the states general as an assembly which should grant money, not organize reforms. But as he had advised the calling of the states general, and the double representation of the third estate, and then permitted the orders to deliberate and vote in common, he was regarded as the cause of the Revolution by the court, and on July 11 was ordered to leave France at once.

Necker's dismissal brought about the taking of the Bastille, which induced the king to recall him. He was received with joy in every city he traversed, but in Paris he proved himself unequal to the crisis. After his resignation (Sept. 1790) he lived at Coppet, near Geneva. Madame Necker died in 1794, and he lived with his daughter Madame de Staël (*q.v.*), and his niece, Madame Necker de Saussure. He died in 1804.

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NECKING, in architecture, a narrow, horizontal band around a pier, pilaster, column or similar vertical form; especially the band which circles a Doric capital below the echinus or projecting portion, and above the projecting moulding (either annulets or an astragal), which marks the junction of shaft and capital.

In nautical terminology, necking was defined in James Greenwood's *The Sailor's Sea-book . . .* (1850) as "a small neat moulding at the foot of the taffrail over the lights."

NECROPOLIS, a cemetery (*q.v.*) or burying place. Applied

to large cemeteries in or near cities, the term is also used for burial grounds near the sites of ancient civilizations. In 1850 George Grote in *A History of Greece* (1862) wrote, "Extensive catacombs yet remain to mark the length of time during which this ancient Nekropolis served its purpose."

The word means literally a "city of the dead"; it is derived from the Greek νεκρός, "corpse," and πόλις, "city."

NECROSIS is a term used in pathology to describe the death of a circumscribed area of tissue. It may result from loss of blood supply to an area, from toxic agents, from physical trauma or from the action of bacteria.

The characteristic changes of necrosis are due to the activity of intracellular enzymes and consist for the most part of a breakdown of organic material of the nucleus and cytoplasm of the cell. (F. L. A.)

NECTAR and **AMBROSIA** (*q.v.*), the nourishment of the gods in Homer and in Greek literature generally. Probably the two terms were not originally distinguished; but usually, both in Homer and in later writers, nectar is the drink and ambrosia the food. On the other hand, in Alcman nectar is the food, and in Sappho and Anaxandrides ambrosia the drink. Each is used in Homer as a fragrant unguent (as *Iliad,* xiv. 170; xix. 38).

NECTARINE, a smooth-skinned peach (*Prunus persica,* var. *nectarina*). In tree shape and leaf characters the peach and nectarine are indistinguishable, but the nectarine fruits look more like plums than peaches. There is an outgrowth of fuzz from the skin of peach varieties, while on the skin of nectarine varieties these epidermal hairs are absent. The stones and kernels of the two fruits are alike in appearance. Like peaches, nectarines have red, yellow or white flesh and have a characteristic aroma and flavour. They are adapted to the same soil and climatic conditions suitable for peaches and require the same cultural treatments for successful production. There are clingstone and freestone nectarines. Seeds of peach varieties that carry the factor for smooth skin may give rise to nectarines, while those that do not carry this factor will breed true. This fruit, which has been known for 2,000 years, is often referred to as the classical example of bud and seed variation. (F. P. C.)

NEED-FIRE or **WILD-FIRE,** a term of folk-lore to denote a superstition which survived in the Highlands of Scotland until a recent date and had its origin in the early ideas of the purifying nature of flame. The need- or wild-fire is made by the friction of one piece of wood on another, or of a rope upon a stake. It is a practice of shepherd peoples to ward off disease from their herds and flocks; it is kindled on occasions of special distress, and the cattle are driven through it. Its efficacy is believed to depend on all other fires being extinguished.

NEEDHAM, town of Norfolk county, Massachusetts, U.S.A., 12 mi. S.W. of Boston, on the Charles river, and served by the New York, New Haven and Hartford railroad. Pop. (1950) 16,262; (1940) 12,445. It is a residential suburb and has large factories making knit goods and surgical instruments. The town was set off from Dedham and incorporated in 1711.

NEEDLE. An instrument adapted for passing a thread through fabrics in sewing, consisting of a thin rod of steel, having a pointed end and pierced with a hole or "eye" to carry the thread.

The modern high quality needle is made from Sheffield crucible cast steel. The type of steel varies according to the purpose of the needle, thus hosiery needles are milder, *i.e.,* softer than sewing needles. In addition to grading the initial hardness of the steel to the particular type of needle there has also been a forward movement in the use of alloy steels for specific purposes. Thus with gramophone needles tungsten alloy steels have proved successful, and the high chromium or rustless steels have a very evident value in the case of surgical and hypodermic needles. The steel is hot rolled down into rod and the rod subsequently cold drawn into wire of the required diameter. The finished drawn wire is fed through straightening machines which also automatically cut the wire into pre-determined lengths. In hand sewing needles the length cut is always that required to form two needles. The cut lengths are packed in packets of a standard weight, according to diameter of wire, for delivery to the needle maker.

The first stage in the making of the needle is to secure absolute straightness and uniformity of physical condition. This is achieved by a method technically termed "rubbing." A number of blanks are heated to a uniform dull red heat, placed within two steel rings, and rubbed to and fro over a flat steel plate. The rotation of the wires within the containing rings results in perfect straightness and the gradual cooling from a dull red heat gives uniformity of physical condition.

The lengths are then automatically pointed by feeding from a container and being rotated over a revolving grindstone by a wheel running at right angles to the stone. The curvature of the face of the grindstone and the inclination of the traversing wheel are adjusted to the requisite contour of point. The lengths are reversed and the process repeated—thus giving a blank with two pointed ends. This automatic grinding applies to all hand sewing needles; it should be noted that machine needle points are swaged, *i.e.,* the points are formed by cold hammering between dies. The double length hand needle is fed into an automatic press which stamps the grooves at the head of each needle and in a second operation pierces the eyes of each needle and nearly separates the two. Complete separation and dressing of the head and eye are now effected mechanically.

The needle thus formed is in its soft state and as with steel cutting tools it requires hardening to bring it into service condition. Hardening is effected by quenching in oil from a red heat and in practice the operation has become nearly automatic. The hardened needles are then tempered by heating to a blue heat in order to give resilience or springiness. As with hardening, tempering in bulk is now an automatic process. The tempered needles are to some extent discoloured by the heating and the final stages are found in scouring to remove this discolouration, and polishing to obtain the silver bright finish. Scouring is effected by packing the needles in flexible containers with various mixtures all having a fine emery base and mechanically rolling the container up and down an iron roller path. Polishing is done in a similar manner with polishing reagents replacing the scouring mixtures. The polished needles are rolled down an inclined plane to bring the heads all in one direction; examined; graded, and made up into packets for sale. (P. Lo.)

NEEDLE-GUN, a military breech-loading rifle (Zündnadelgewehr), famous as the arm of the Prussians in 1866 and of the Germans in 1870–71. It was the invention of the gunsmith Johann Nicholas von Dreyse (1787–1867), who, beginning in 1824, had made many experiments, and in 1836 produced the complete needle-gun. From 1841 onwards the new arm was gradually introduced into the Prussian service, and later into the military forces of many other German states. Dreyse was ennobled in 1864. In practice the needle-gun proved to have numerous defects; its effective range was very short compared to that of the muzzle-loading rifles of the day, and conspicuously so as against the chassepot; the escape of gas at the breech was, moreover, very great. A paper cartridge was used. An improved model, giving greater muzzle velocity and increased speed in loading, was introduced later, but this was soon replaced by the Mauser rifle.

NEEDLEWORK. This subject may be considered under the two headings: (1) plain needlework, for purely utilitarian purposes; (2) art needlework, for decorative purposes. Plain needlework requires no such further explanation as may be given in the case of art needlework, under which title are included embroidery and other methods of decorative needlework, such as applied or appliqué work, ornamental quilting, patchwork and couching. In these last-mentioned methods the needlework is subservient to the decorative effect, which depends almost wholly upon the materials selected for the purpose; whereas in embroidery the needlework itself constitutes and is the visible decoration. The aim of this article is to indicate briefly different stitches of plain needlework and to show that these stitches are also used in art needlework.

The more necessary stitches in plain needlework for making clothes are tacking, running, hemming, feather-stitching or herringboning (all of which are practically of the same type), and button-holing in which the thread is looped as each stitch is

made. Button-holing is allied to another looped stitch, namely chain-stitching, which though frequently used in embroidery is rarely if ever used in plain needlework. For repairs of clothes and household linen, etc., the principal stitch is darning; grafting, however, is a substitute for it, and varies with the character of the stuff to be repaired, *e.g.*, knitted stockings, damask linen, cloth, etc. Darning is allied to running, and grafting to patchwork. Patchwork as a form of decorative needlework is exemplified in sumptuous canopies and seat covers made several centuries B.C. by Egyptians, and rich hangings made by Italian and French workers in the 16th century.

Long and short stitches, kindred in principle to the running stitch in plain needlework, are perhaps the more frequent of any stitches used in embroidery, and are especially appropriate when the blending of tints with a flat even surface is the effect to be aimed at. Much mediaeval work of this character, as well as that done with chain stitch and its allied split stitch, is regarded as typical of *opus anglicanum.* Chain stitch produces a comparatively broken surface in decided contrast with the smooth one of long and short stitch, split stitch and satin stitch embroidery. Satin stitch is well adapted to express, with even flat surface in designs for colour effects, each mass which is to be of one tint. In this respect, therefore, satin stitch serves a purpose in contrast to that of long and short stitch. A characteristic of satin-stitching is the sheeny effect produced, on both sides of the material embroidered, by parallel stitches taken closely together. Buttonhole stitch in relation to art needlework prevails to a great extent in cut linen and drawn-thread work (often called Greek lace), and predominates in the making of needlepoint lace. In much of the Persian drawn-thread work, however, it is superseded by whipping or tightly and closely twisting a thread round the undrawn threads of the linen. Whipping has been put to another use in certain 16th century art needlework for ecclesiastical purposes, where round the gold threads employed as the ground of a design coloured silks are dexterously whipped, closely and openly, producing gradations of tint suffused with a corresponding variation of golden shimmer.

Another important branch of art needlework with gold and silver threads is couching. When the metallic threads, arranged so as to lie closely together, are simply stitched flatly to the foundation material, the work is called flat couching or laying, a kind of treatment more frequent in Chinese and Japanese than in European art needlework. Flat couching is also carried out with floss silks. When a design for couching includes effects in relief, stout strings or cords as required by the design are first fastened to the foundation materials, and over them the metallic threads or in some cases coloured gimps are laid, and so stitched as to appear in miniature like varieties of willow-twisting or basket work.

Appliqué or applied work belongs as much as patchwork to the mediaeval category of *opus consutum,* or stitching stuffs together according to a decorative design, the greater part of which was cut out of material different in colour, and generally in texture, from that of the ground to which it was applied and stitched. Irish art needlework, called Carrickmacross lace, is for the most part of cambric applied or appliqué to net.

Quilting is also a branch of art needlework rather than embroidery. Indians and Persians using a short running stitch have excelled in it in past times. Some good quilting was done in England in the 18th century with chain-stitching which lay on the inner side of the stuff, the outer displaying the design in short stitches. In the account of his voyage to the East Indies, published in 1655, Edward Terry (1590–1665) writes of the Indians "making excellent quilts of satin lined with taffeta betwixt which they put cotton wool and worked them together with silk." In many of the rural sections of the United States, especially those of the South, great interest has been maintained in making patch quilts for bed covering. Quilting parties are still extant, and the different designs accumulated by the family are the source of much pride. (*See* also LACE; HOME SEWING; TEXTILES AND EMBROIDERIES.)

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NEEMUCH or NIMACH, a town of Central India, with a British military cantonment, within the state of Gwalior, on the border of Rajputana. The pop. of the cantonment in 1941 was 11,119. The pop. of the town (1941) was 5,955. In 1857 it was the most southerly place to which the Mutiny extended.

The brigade of Indian troops of the Bengal army, which was stationed there, mutinied and marched to Delhi, the European officers taking refuge in the fort until relieved by the Malwa field force.

NEENAH, a city of Winnebago county, Wis., U.S., 100 mi. N.W. of Milwaukee, on Lake Winnebago at its outlet into the (canalized) Fox river. It is on state highways 114 and 150, and is served by the Chicago and North Western, the Chicago, Milwaukee, St. Paul and Pacific, and the Soo Line railways, and by bus lines. Pop. (1950) 12,418; in 1940 it was 10,645. Neenah and Menasha, across the river, are practically one community. It is the centre of a large paper industry. The city was chartered in 1873. Its name means "running water" or "rapids."

NEER, VAN DER, the name of two Dutch painters.

1. AERNOUT VAN DER NEER (1603–1677), commonly called Aert or Artus, was born at Gorkum in 1603. Houbraken states that he had been steward to a Dutch nobleman, and only took up painting seriously when he settled in Amsterdam. From 1658 to 1662 he kept a wine shop, but this venture ended in bankruptcy. Though Van der Neer seems to have made Amsterdam his home, he was evidently familiar with the canals and woods about Haarlem and Leyden and the reaches of the Maes and the Rhine. Occasionally, too, he painted in the neighbourhood of Dort, the home of Albert Cuyp, with whom he drifted into a curious partnership. Cuyp is said to have painted the foreground and cows of Van der Neer's sunset landscape in the Louvre and his signature is seen on the milkmaid's pail near the edge of the Van der Neer in the National Gallery, London. At the Staedel Institute in Frankfurt there is also a landscape in which the figures, a fisherman with a dog and a sportsman, are probably by Cuyp. Van der Neer may be said to have reached maturity with his "Moonlit landscape with a ruined castle" (1646), now in the Max Flersheim collection in Paris. His favourite subjects were the Dutch waterways at sunset; moonlight scenes; daylight icescapes with frozen water, sleighers and fishermen; and paintings of fires after dark.

2. EGLON VAN DER NEER (1634–1703), son of the above, was born at Amsterdam in 1634. He was first taught by his father and afterwards by Jacob van Loo, whom he accompanied or followed to Paris in 1663. In 1666 he went to Rotterdam, from there to Brussels and finally to Düsseldorf, where he entered the service of the elector-palatine Johann Wilhelm. Later, a portrait of the princess of Neuberg led to his appointment as painter to the king of Spain. He painted landscapes in the style of Adam Elsheimer and was one of three painters employed to put figures into the town views of Jan van der Heyden. His portraits are reminiscent of Netscher and his genre pictures come near to those of Ter Borch and Metsu in delicacy of touch. The "Lady with the Book" (1665) was sold together with the Bredel collection in 1875. A young woman in white and red satin at Rotterdam (1669) recalls Mieris, whose style also reappears in Eglon's "Cleopatra" at Buckingham Palace. Two landscapes with "Tobit and the Angel," dated 1685 and 1694, in the museums of Berlin and Amsterdam, illustrate his fashion of setting Scripture scenes in Dutch backgrounds. His most important sacred composition is the "Esther and Ahasuerus" (1696), in the Uffizi at Florence. But Eglon varied his practice also with arrangements of hunting and hawking parties, pastures and fords. The latest of his panels is a mountain landscape of 1702 in the gallery of Augsburg. He died at Düsseldorf on May 3, 1703.

(J. A. C.; X.)

NEERWINDEN, a village of Belgium in province Liége, pop. (est. 1939) 891, a few miles E. by S. of Tirlemont; gives name to two battles, the first fought in 1693 between the Anglo-Allied army under William III of England and the French under the duke of Luxemburg (*see* GRAND ALLIANCE, WAR OF THE) and

the second in 1793 between the Austrians under Prince Josias of Coburg and the French under General Dumouriez. (*See* FRENCH REVOLUTIONARY WARS: *Campaigns in the Netherlands.*)

NEES VON ESENBECK, CHRISTIAN GOTTFRIED (1776–1858), German botanist and entomologist, was born at Erbach on Feb. 14, 1776, and was educated at Darmstadt and at Jena, where he took the degree of M.D. After practising as a doctor, he was appointed professor of botany in Erlangen in 1816. Three years later he became professor of natural history in Bonn, and in 1831 he was appointed to the chair of botany in the university of Breslau. For his political activities in 1848, he was deprived of his professorship in 1851, and after spending the rest of his life in poverty, he died in Breslau on March 16, 1858.

For some years he edited the *Nova acta* of the "Acad. Leopold-Carolina," in which several of his own papers were published. His best-known works are those that deal with the *Fungi*, the *Hepaticae* and the *Glumiferae*, in all which groups he made valuable additions to knowledge.

NEGAPATAM, a seaport in the Tanjore district of Madras state, republic of India, forming one municipality with Nagore, a port 3 mi. N. at the mouth of the Vettar river. Pop. (1951) 57,854. It carries on trade with Malaya and Singapore and with other Indian ports. Peanuts, cotton goods, tobacco and vegetables are exported. Vessels lie two miles offshore. Negapatam is the terminus of a branch of the Southern railway, with railway workshops, and has two technical institutes. It is also a depot for coolie emigration. Negapatam was one of the earliest settlements of the Portuguese on the Coromandel coast. It was taken by the Dutch in 1660, becoming their chief possession in India, and by the English in 1781. From 1799 to 1845 it was the headquarters of Tanjore district.

NEGAUNEE, a city of Marquette county, Michigan, U.S., 12 mi. W. by S. of Marquette, near Lake Superior, altitude, 1,564 ft. It is on federal highway 41, and is served by the Chicago and North Western, the Duluth, South Shore and Atlantic and the Lake Superior and Ishpeming railways. Pop. (1950) 6,472; (1940) 6,813. It is one of the most important mining centres of the upper peninsula, surrounded by both deep-shaft and open-pit iron mines including the world's largest underground iron-ore mine. A monument marks the spot where iron ore was first found (1844) in the Lake Superior region. Settlement began about 1870 and the city was chartered in 1873. The name is a Chippewa word meaning "first" or "he goes before," chosen by the Pioneer Iron company as meaning "pioneer."

NEGLIGENCE, a ground of civil law liability, and in criminal law an element in several offences, the most conspicuous of which is manslaughter by negligence. In order to establish civil liability on the ground of negligence, three things must be proved —a duty to take care of, the absence of due care, and actual damage caused directly by the absence of due care. The duty may be to the public in general, on the ground that any person who does anything which may involve risk to the public is bound to take due care to avoid the risk. For instance, in the words of Lord Blackburn, "those who go personally or bring property where they know that they or it may come into collision with the persons or property of others have by law a duty cast upon them to use reasonable care and skill to avoid such a collision." Where a special duty to an individual is alleged, the duty must rest on a contract or undertaking or some similar specific ground. Thus, where a surveyor has carelessly given incorrect progress certificates, and a mortgagee who has had no contractual relation with the surveyor has advanced money on the faith of the certificate, the surveyor is not liable to the mortgagee in an action of negligence; because he owed no duty to the mortgagee to be careful. When a duty to take care is established, the degree of care required is now determined by a well-ascertained standard. This standard is the amount of care which would be exercised in the circumstances by an "average reasonable man."

Ordinarily a man is responsible only for his own negligence and for that of his servants and agents acting within the scope of their authority. For the acts or defaults of the servants of an independent contractor he is not liable. But in certain cases a stricter obligation is imposed on him by law. Thus, while the occupier of premises is under no duty whatsoever to trespassers, who must take the premises as they find them, and while he is under no duty to mere licensees other than the duty of seeing that there are no concealed dangers in the nature of traps, he is under a duty to invitees and to all persons entering as of right to see that the premises are in a reasonably safe condition so far as reasonable care and skill can make them so; and from such duties he cannot release himself by employing an independent contractor to maintain or repair the premises. The effect of this doctrine is that the occupier may be liable if it can be shown that the independent contractor or his servant has been guilty of a want of due care. A similar obligation has been enforced in the case of a wreck stranded in a navigable river, and the owner was held liable for damage caused by the carelessness of the servant of an independent contractor who had undertaken to light the wreck. So too any person who undertakes a work likely to cause danger if due care is not taken is liable for damage caused by the carelessness of the servant of an independent contractor, so long as the carelessness is not casual or collateral to the servant's employment.

In an action of negligence a familiar defense is "contributory negligence." This is a rather misleading expression. It is not a sufficient defense to show that the plaintiff was negligent, and that his negligence contributed to the harm complained of. The plaintiff's negligence will not disentitle him to recover unless it is such that without it the misfortune would not have happened, nor if the defendant might by the exercise of reasonable care on his part have avoided the consequences of the plaintiff's negligence. The shortest and plainest way of expressing this rule is, that the plaintiff's negligence is no defense unless it was the proximate or decisive cause of the injury. There was an attempt in recent times to extend this doctrine so as to make the contributory negligence of a third person a defense, in cases where the plaintiff, though not negligent himself, was travelling in a vehicle or vessel managed by the negligent third person, or was otherwise under his control. In such circumstances it was said that the plaintiff was "identified" with the third person. But the case of the "Bernina," decided in 1888, where a passenger and an engineer on board the "Bushire" were killed in a collision between the "Bernina" and the "Bushire" caused by fault in both ships, but without fault on the part of the deceased, exploded this supposed doctrine, and made it clear that the defense of contributory negligence holds good only when the defendant contends and proves that the plaintiff was injured by his own carelessness.

The American law of negligence is founded on the English common law; but the decisions in different states have occasionally contradicted English decisions, and also one another.

See T. G. Shearman, *Treatise on the Law of Negligence* (1941); S. D. Thompson, *Commentaries on Negligence*, 7 vols. (1901–07); T. Beven, *Negligence in Law* (4th ed., 1928). (A. LL. D.)

NEGOTIABLE INSTRUMENT, in law, a document or other instrument purporting to represent an obligation involving so much money, and the property in which passes, like money, by mere delivery or by endorsement and delivery. Negotiable instruments arise in either of two ways: (1) by statute, (2) by custom of merchants. The most commonly recognized negotiable instruments are bills of exchange, promissory notes, bills of lading, foreign bonds, debentures payable to bearer, and endorsed share certificates, such as are issued in Canada and the United States. Negotiable instruments constitute an exception to the general rule that a man cannot give a better title than he has himself. (*See* BILL OF EXCHANGE.)

NEGRITOS (Span. for "little Negroes"), the name originally given by the Spaniards to the aborigines of the Philippine Islands, now applied to an ancient element of the population of southeast Asia, Indonesia and probably of Oceania. They are typically of short stature, with dark skin, closely curling hair, thick but not everted lips and broad noses. Prognathism is not marked. Skulls are generally mesocephalic or brachycephalic. Body and facial hair is scanty. They have everywhere been forced into mountain or forest terrain. Though many groups practise horticulture those

least affected by surrounding peoples, such as the Andamanese and some of the Semang, live by hunting and collecting. Their typical weapon is the bow. The Andamanese represent the type in its finest form, both physically and culturally; other groups show varying degrees of mixture. These include the Aeta of the Philippines, the Semang of the Malay peninsula and probably the Tapiro, Aiome and other tribes of the central New Guinea mountains, though the latter may be the result of local specialization of the Papuan stock. There is evidence of a Negrito substratum in Assam, in Indonesia and perhaps in some larger Melanesian islands.

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BY COURTESY OF THE HERLING NEW GUINEA EXPEDITION

NOGULLA NEGRITO OF NEW GUINEA WITH HIS AXE

NEGRO, the designation of the distinctly dark-skinned, as opposed to the fair, yellow and brown races of mankind (from Lat. *niger,* black). In this sense it embraces the dark races, of the intertropical and sub-tropical regions of the eastern hemisphere, from Senegambia, West Africa, to the Fijian islands in the Pacific. It is convenient, however, to refer to the dark-skinned inhabitants of this zone by the collective term of *Negroids,* and to reserve the word *Negro* for the tribes found in Africa south of the Sahara and north of a not very well-defined line running roughly from the gulf of Biafra with a south-easterly trend across the equator to the mouth of the Tana. The Bantu Negroids are south of this line. The yellowish-brown Bushman and Hottentot (*qq.v.*) peoples of South Africa possess certain Negroid characters, the tightly curled hair, the broad nose, the tendency towards prognathism; but the relation is not close. The Negroids of Africa, Melanesia and Australasia have in common a number of characteristics such as:—A dark skin, varying from dark brown, reddish-brown or chocolate to nearly black; dark tightly curled hair, flat in transverse section, of the "woolly" or the "frizzly" type; a greater or less tendency to prognathism; eyes dark brown with yellowish cornea; nose more or less broad and flat; and large teeth. The Negro hair is flat, issues from the epidermis at a right angle, is spirally twisted or crisped, has no central duct, the colouring matter being disseminated through the cortex and intermediate fibres, while the cortex itself is covered with numerous rough, pointed filaments, adhering loosely to the shaft; lastly, the Negro pile will felt, like wool, whereas true hair cannot be felted. The true Negro (western Sudan type) is of tall stature, burly, short-legged, usually long-headed, with bulging forehead. A broad headed element of obscure origin extends across the continent. (For the Negro in the United States *see* NEGRO, THE AMERICAN.)

In Africa three races have intermingled to a certain extent with the Negro; the Libyans (Berbers, *q.v.*) in the Western Sudan; and the Hamitic races (*q.v.*) and Arabs (*q.v.*) in the east. The Bantu-speaking peoples in the southern portion of the continent approach the Hamites in those characteristics in which they differ from the true Negroes, and probably have a proportion of Hamitic blood.

The colour of the skin, which is also distinguished by a velvety surface and a characteristic odour, is due to the greater abundance of the colouring matter in the mucous membrane between the inner or true skin and the epidermis. This colouring matter is not distributed equally over the body, and does not reach its fullest development until some weeks after birth. The dark colour seems to depend neither on geographical position, the isothermals of greatest heat, nor even altogether on racial purity. The extremes of the chromatic scale are found in juxtaposition throughout the whole Negro domain, in Senegambia, the Gabun, upper Nile basin, lower Congo, Shari valley, Mozambique, ranging from dusky or yellow brown to sooty black. Some of the mixed races, such as many Abyssinians, Galla, Jolof and Mandingo, are quite as black as the darkest full-blood Negro. The development of pigment in the dark-skinned races as a natural protection against the ultra-violet rays in which tropical light is so rich must be viewed as merely a part of a many sided modification of the skin under torrid conditions.

In certain of these characteristics the Negro stands on a lower evolutionary plane than the white man, and is closely related to the highest anthropoids. The characteristics are length of arm, prognathism, a heavy massive cranium with large zygomatic arches, flat nose depressed at base and the tendency of the frontal bones to fuse together and form an eminence of peculiar shape. But in respect to the character of the hair, the white man stands in closer relation to the higher apes than does the Negro.

Mental Qualities.—In reviewing the comparative studies of the differences between the Negro and the modern European, Carr-Sanders concludes that "there seems to be no marked difference in innate intellectual power. The differences are rather differences in disposition and temperament. . . . The apparent arrest of development may not be so much an inevitable result of the kind of mental faculties which are inherited as the coming into play of a peculiar tradition." (*Population Problem,* 1922, p. 397.)

It is not fair to judge of the Negro's mental capacity by tests taken directly from the environment of the white man, as for instance tests in mental arithmetic; skill in reckoning is necessary to the white race, and it has cultivated this faculty; but it is not necessary to the Negroes, who often surpass white men in acuteness of vision, hearing, sense of direction and topography. Given suitable training, the Negro is capable of becoming a craftsman of considerable skill, particularly in metal work, carpentry and carving. The bronze castings by the *cire perdue* process, and the cups and horns of ivory elaborately carved, which were produced by the natives of Guinea after their intercourse with the Portuguese of the 16th century, bear ample witness to this.

Social Conditions.—Generally speaking the Negro is first and foremost an agriculturist. Next in importance to agriculture come hunting and fishing and, locally, cattle-keeping. The last is not strictly typical of Negro culture at all; nearly all the tribes by whom it is practised are of mixed origin, except perhaps the Dinka of the upper Nile, the whole of whose existence centres round the cattle pen. The social conditions are usually primitive, especially among the Negroes proper, being based on the village community ruled by a chief. Where the country is open, or where the forest presents no great obstacle to communication, a chief has often extended his rule over several villages and has ultimately built up a kingdom administered by sub-chiefs of various grades, and has even established a court with a regular hierarchy of officials. This "empire-building" has reached its greatest proportions in the south of the forest belt in the territory of the Bantu Negroids, where arose the states of Lunda, Cazembe, etc.

The domestic life of the Negro is based upon polygyny, so vital an element of the native social system that attempts to abolish plurality of wives would result in the most serious social disorder. Descent in the Negro world is often reckoned through the female, though many tribes with a patriarchal system are found. Traces of totemism are found sporadically. Secret societies are found in their highest development among the Negroes of the west coast.

The Negro is principally a vegetarian. Meat is everywhere regarded as a great delicacy. The cattle-keeping tribes rarely slaughter for food, because cattle are a form of currency. Fish is also an important article of diet in the neighbourhood of large rivers, especially the Nile and Congo. The two cultivated plants which form the mainstay of native life, manioc in the west and centre and mealies in the south and east, are neither of African origin. Cannibalism (*q.v.*) is found in its simplest form in Africa, where the majority of cannibal tribes eat human flesh because they like it. Among the true Negroes it is confined mainly to the

Welle and Ubangi districts, though found sporadically (and due to magical motives) on the west coast, and among the Bantu Negroids in south-western Belgian Congo and the Gabun.

Religion.—In the western forests where communities are small the Negro is a fetishist, combined more or less with nature worship. Where communication is easier worship becomes more systematic, and definite supernatural agencies are recognized, presiding over definite spheres of human life. Ancestor-worship appears and often assumes paramount importance, and is typical of all the eastern and southern portions of the continent. Malignant powers receive attention from man, with a view to propitiation or coercion. Beneficent agencies require no attention, since, from their very nature, they must continue to do good. In the western culture area, among both Negro and Bantu Negroid tribes, is the belief that any form of death except by violence must be due to evil magic exercised by, or through the agency of, some human individual; to discover the guilty party the poison ordeal is freely used. Similar ordeals are used in British Central Africa to discover magicians, and the wholesale "smelling-out" of "witches," was well-known among the Zulu-Xosa tribes. Everywhere magic, both sympathetic and imitative, is practised, both by the ordinary individual and by professional magicians, and most medical treatment is based on this, although the magician is usually an herbalist of some skill. Where the rainfall is uncertain, the production of rain by magical means is one of the chief duties of the magician, a duty which becomes paramount in the eastern plains among Negroes and Bantu Negroids alike.

The Bantu Negroids all speak dialects of one tongue (*see* BANTU LANGUAGES). The Sudanic family of languages is spoken in the area recognized as the habitat of the Negro, but Hamitic speech (Nilotic group) is also used by Negroes.

See the excellent bibliography in *Africa I.* 3. p. 240 *sqq.* (1928) by Henri Labruret for the most important modern works, and A. B. Ellis, *The Tshi-speaking Peoples* (1887); *The Ewe-speaking Peoples* (1890); *The Yoruba-speaking Peoples* (1894).

NEGRO, THE AMERICAN. Negroes, numbering at mid-20th century about 15,000,000, constituted one-tenth of the population of the United States. This largest U.S. minority group has a dual basis of classification, one ethnic, the other social. Its ethnic or racial basis is the group's common descent from hundreds of thousands of Africans legally imported, mainly as slaves, between 1619 and 1808, the year of the abolition of the slave trade, and after 1808 imported clandestinely in considerable numbers until 1848, just a few years before the general emancipation in 1863. Since U.S. law and custom designated as a Negro any person with recognizable Negro blood admixture, however slight, the practical basis of the grouping became social, and usually involved varying degrees of class proscription based on the tradition of slavery and its aftermath of colour prejudice. These discriminations varied both historically and regionally, being more intense and persistent in the areas of previous mass servitude, the southern states and adjacent regions. Such circumstances generated a racial minority problem of national scope.

A New Race.—The American Negro is a new biological and cultural product. His African ancestors came from tribes as divergent as the several peoples of Europe and from a continental area as large or larger, including all of central and West Africa—the Guinea, Ivory, Slave and Gold Coasts, the area that became French West Africa, the vast stretches of the Niger valley, the Cameroons and the Congo; there were occasionally captives from the Moors and Arabs to the north, and East and South African tribes, including Hottentots and Madagascans. All these were repeatedly scrambled in the relays of transport to African slave ports, to the West Indies and again in American slave marts, sometimes deliberately with the purpose of ensuring docility and preventing revolts. This in turn forced a rapid disappearance of the original African languages and cultures and a correspondingly fast assimilation of the rudiments of the white man's civilization.

In addition to the fusing of diverse African strains, white and Indian blood was poured into the newly forming race, partly by intermarriage but more largely by casual and later systematic miscegenation. For in the heyday of plantation slavery, deliberate slave breeding for economic reasons was also heavily re-enforced by customary miscegenation. In colonial times, intermarriage between Indians and Negroes was common; anthropologists discovered considerable traces of such admixture. Samplings by Melville J. Herskovits and others indicated that direct and compounded intermixture with the various white strains of the population left less than 20% of present-day Negroes of pure or unmixed African descent. The bulk of the American Negro population thus became a mixed group of brown and brownish-yellow "mulattoes," with a sizable marginal group of quadroon and octoroon types, many of whom were not distinguishable by appearance from Caucasians. Some of these marginals actually lost their racial identity by "passing," although many who could do so refrained through a sense of group attachment and loyalty.

Under such circumstances, traditional notions of so-called racial characteristics make little sense; many observed group traits turn out to be far from generic, or explicable in terms not of heredity but of social conditioning. Even certain apparent biological traits, such as disease susceptibilities and immunities, seemed best explained by differential living conditions and environmental factors. The Negro's musicality, artistic sensitivity, predilection for emotional forms of religion, dramatic expression and mimicry and many similar culture traits stemmed from peasant tradition and conditioning and were scarce or absent in Negroes of class strata and environments removed from such folk traditions.

The characteristic result was a distinctive number of culture fusions, which, like the spirituals—Negro folk versions of Christian hymns—folk ballads and ragtime and jazz music, represented unique blends of Negro with generic American idioms and traditions. In these ways, although deprived of his original African cultural heritage, the Negro made many unique and widely accepted Afro-American contributions to American folkways and tradition, as well as later contributions, in more sophisticated versions, to American music, literature and art.

History in the United States.—Although fairly frequent participants in the earlier Portuguese and Spanish expeditions and settlements in colonial America, the first Negroes to arrive in the colonies of British America were "twenty Negars" brought to Jamestown, Va., by a Dutch man-of-war in 1619, a few months before the "Mayflower" landed at Plymouth. These and their immediate successors had the status and privileges of the indentured bond servants who first filled the colonial labour supply. Legal slavery made its appearance within 50 years of this, and the growing demand both for personal services and land cultivation led to ever-increasing importations over a period of two centuries. Thus, in colonial times Negroes came to form a large part of the population; their relative proportion in 1790 was almost one-fifth, 757,208 out of the 3,929,214 inhabitants of the U.S. This proportion steadily declined until the last quarter of the 19th century, when the relative number of the Negro population became stable at slightly less than one-tenth the total population.

In the early days slaves were used chiefly in the cultivation of tobacco, rice and indigo. Toward the end of the 18th century, when these industries were on the wane, slavery reached an unprofitable ebb period. Then suddenly large-scale cotton culture, made possible by the invention of the cotton gin in 1793, changed the whole southern economy to a boom production of this staple, thus enormously increasing the demand for slave labour to cultivate the new crop. Not only did slave importations increase, despite efforts to curb and prohibit the slave trade, but the breeding of slaves within the country became almost an industry. Negroes in the U.S. increased by 200,000 in the decade ending 1800, by 300,000 in the decade following and by more than 500,000 in the ten-year period that closed in 1830. By the middle of the 19th century, slavery had become the very foundation of the southern economy, and its extension to the west and southwest became the moot political question of the day. The personal relations which had somewhat humanized the institution in its earlier period broke down on the huge plantations, which shifted more and more to mass production by absentee landowners and were

managed and supervised by professional white overseers.

Involved in inevitable competition with the free labour economy of the north and the expanding midwest, and characterized increasingly by the abuses and cruelties of a harsh and arrogant regime, the slave economy began to draw the fire of an organized campaign of moral opposition. Abolitionist propaganda and protest, various more moderate schemes for the gradual freeing of the slaves, alternative plans for "colonization" or repatriation to Africa of freed Negroes sponsored by the American Colonization society, and finally the dramatic flight and pursuit of fugitive slaves to free territory brought the slavery controversy to a crisis in the decade 1850–60. The issue became one of the precipitating causes of the Civil War (1860–65), and resulted in the Emancipation Proclamation in 1863, by which Pres. Abraham Lincoln as a war measure freed almost 4,000,000 Negroes in bondage in the seceding states of the southern Confederacy. By that time, however, there were already about 450,000 free Negroes, mainly in the north. In 1864 enlistment in the Union army was opened to Negroes, and by the end of the war 186,000 had been enrolled, of whom 38,000 lost their lives. Of this impressive total, 93,000 came from the slave state areas, 52,000 from the free states and the balance from the border states.

The legal freedom of the Emancipation Proclamation was only a first step in the process of converting slaves into citizens. Not only did the freedmen have to struggle painfully toward real independence and some sort of educational, economic and political parity, but after the first enthusiasms of civil rights legislation guaranteeing citizenship, the franchise and equal rights, the masses in the south were subject to Reconstruction politics and southern hostility. Reactionary pressures and in some places open Ku Klux Klan terrorism slowed down the rate of educational progress and the considerable gains in self-support. Migration to the cities and to the north and midwest became increasingly the refuge of the more progressive Negroes. Later, increased reaction added the handicaps of disfranchisement by restrictive state laws on voting qualifications; without political safeguards, most constitutional rights and privileges were nullified. The peasant masses were doomed to substandard, segregated living under dominant white control, with the rural southern Negro increasingly involved in a tenant or "sharecropping" system, only a step or so removed from peonage and slavery. The younger generation in large numbers used their only available resource of mobility to migrate to towns and cities in the south for the comparative advantages of personal service and unskilled labour; then many of them began the ever-growing trek from the south to other sections of the country having more favourable educational and economic opportunities (*see* below). These trends had set in even before, but the shortages of labour during World Wars I and II speeded the movement up to the proportions of a mass exodus, with transforming cumulative effect not only on Negroes economically, educationally and culturally, but upon race relations throughout the nation, including the south.

Population.—Although its relative proportion to the general population steadily decreased after 1790, when it was almost 20%, the Negro population exhibited two basic trends: steady over-all growth and marked geographical shifts. The decline in relative numbers resulted not from a decrease in the rate of growth but from the fact that, while no significant number of Negroes came in after the slave importations ended, heavy white immigration continued until the restrictive immigration quotas of the 1920s. Starting with the first census in 1790 with 757,208 Negroes, Negro relative numbers had declined by 1860 to 14.1%, although the total number had actually increased to 4,414,830. Data for the decades 1910–50 indicated that the proportional ratio of the white and Negro populations had about reached a point of general stability at just under 10%. By 1950 the total Negro count was almost 15,000,000, or 9.9%.

More significant than the changes in numbers were the changes in population distribution. At first the Negro population was centred in the upper south, especially in tobacco-growing Virginia. This centre moved rapidly south and west into the fertile lands opening up to the mass production of cotton, rice and sugar. By the time of the outbreak of the Civil War, every state of the old south had more than 200,000 slaves; several states had almost 500,000 each—Georgia, 465,698; Alabama, 437,770; Mississippi, 437,404; and Louisiana, 357,456.

The next shift of consequence began the reverse trek of the Negro from the south to the north and west. It started with the flight of escaped slaves in the early 1800s, an exodus which increased rapidly after the "underground railroad," an abolitionist project for aiding fugitive slaves to freedom, developed an effective organization. Although there are no precise figures on the number of such refugees, the total was reliably estimated to be at least 100,000 slaves between 1810 and 1850. At its peak, the underground railroad had a network from the midsouth and borderline points as far north as Canada, with several thousand operatives.

After the Civil War and emancipation, the migration of Negroes from the south increased greatly, periodically disturbing the old south by repeated threats to its previously inexhaustible labour supply. Although generally directed northward, one of the first mass migrations was toward Kansas in the 1870s and 1880s, involving at least 100,000 migrants. Also, as cotton production steadily moved into the Mississippi delta and the western cotton lands of Texas, Negro labour moved with it. During the entire period of Reconstruction, Negro migration from Dixie continued at a slow, steady pace, until it again assumed mass proportions just before and after World War I. Agricultural depressions and the boll-weevil blight added their share of pressure until finally the expanding northern and midwestern labour market brought on a movement of tidal dimensions. It was estimated that between 1915 and 1918 at least 500,000 Negroes left the south. This trek continued with only slight abatement during the depression of the 1930s, after which World War II set off another fresh stream of migration, estimated at 1,000,000 to 1,500,000 between 1940 and 1950. In the latter displacement, large numbers also went westward to west coast industrial centres from Los Angeles, Calif., to Seattle, Wash. Cumulatively this series of shifts completely changed the sectional distribution of the Negro in the U.S. In 1860, 92.2% of the entire Negro population lived in the south; by 1900 this percentage was down to 89.7%; by 1950 it had dropped to 67.5%. While Negroes constituted 36.8% of the south's population in 1860, the proportion had fallen to 32.2% in 1900 and to 20% in 1950. By contrast, the northern Negro population had more than tripled between 1900 and 1940, growing from 880,771 to 2,790,193. Between 1940 and 1950 this shift was so accelerated that Negroes in the north increased almost 50%, from 2,790,193 to 4,109,000. At mid-20th century, more than one-third the Negro population resided in the north and the west, making up 5% and 4% of these areas, respectively.

The most significant aspect of the Negro's migration was his rapid urbanization in both the north and the south. In 1900 only 22.7% of Negroes resided in urban areas; this percentage expanded to 34% in 1920, 43.7% in 1930, 48.6% in 1940 and 61.2% in 1950. In 1910 no city in the U.S. had a Negro population of more than 100,000, but in 1920 there were 6 cities with 100,000 or more, 7 in 1930, 11 in 1940 and 16 in 1950. The great bulk of the Negro population of the north was concentrated in four metropolitan areas: New York city; Chicago, Ill.; Philadelphia, Pa.; and Detroit, Mich. Although part of a general trend, this urbanizing had special effects and significance for the Negro. Adverse effects were increased racial tensions in areas of rapid influx and serious handicaps as a result of overcrowded living in substandard, semighetto sections into which the most recent migrants moved. Undesirable housing, family, health, recreation and employment conditions often resulted. But, on the other hand, the new and generally improved economic opportunities, political privileges, better educational facilities and enlarged cultural contacts in urban areas more than offset, especially for the younger generation, the temporary hardships.

Political Status.—After federal enfranchisement in 1870 Negroes were active in Reconstruction politics, with a sizable membership in congress (26) and in all the southern state legislatures. A sharp reaction set in, however, so that within 30 years

Negroes had become disfranchised throughout the entire south by restrictive state laws on voters' qualifications. In 1944 the U.S. supreme court in *Smith* v. *Allwright* outlawed the closed white Democratic primary, the most effective of these measures. Negroes slowly regained, as registered Democratic voters, access to the ballot in all the southern states; the total number of Negro voters was estimated in 1948 as more than 750,000. In the north, the Negro, a voter of long standing, was for generations affiliated with the Republican party, partly by historical loyalty, partly through fear and resentment of the southern wing of the Democratic party. But in 1932 and 1936 the northern Negro vote turned decidedly to the support of Franklin D. Roosevelt and his New Deal program, and by ceasing to be a bloc vote greatly increased its power as virtually an independent political element. This shift, combined with enormously increased voting strength in the midwest and border states, a result of heavy migration, brought the Negro vote to the strategic position of a potential balance-of-power in national and many local urban situations. As a result, in 1950, 37 Negroes were members of 11 state legislatures and 2 Negroes were members of congress (New York and Illinois). There was also a marked increase in higher political appointments, Negroes holding three federal judgeships, positions in policy echelons of the federal government and the two political party managements, and numerous local political preferments, including several city council memberships in the south. Organized protest pressure by Negroes and liberal organizations generally also brought the legislative implementation of civil rights into the centre of national, state and local politics. Although the enactment of such re-enforcing legislation federally had been blocked in congress at mid-century, such measures were unanimously recommended by the President's Commission on Civil Rights (1948) and were enacted locally by a number of northern and midwestern states and municipalities, usually with adequate enforcement machinery. Associated with this was increasing state and local enactment of fair employment practice laws and commissions, as well as a moderately successful drive for the repeal of poll-tax restrictions.

Military Status.—About 6,000 Negro soldiers fought in the Revolutionary War, and more than twice that number in various naval and land engagements of the War of 1812. But Negroes were usually required to serve in separate contingents or in restricted status in the U.S armed forces. However, an integration experiment tried out successfully in the European theatre in 1945, with continuous pressure from Negro and liberal sources and another presidential Commission on Equalization in the Armed Forces, 1947–49, resulted in the gradual adoption of a policy of complete integration, which was climaxed in 1951 with the disbanding of the 24th infantry unit, the last remaining Negro unit of the regular army. This policy began with officer training units, spread to the air force, the induction training camps, the navy, marine corps and finally the army. It culminated a struggle begun during World War I, in which 367,000 Negroes took part, to have large-scale officer training open to Negroes; a special camp at Des Moines, Ia., which graduated 639 Negro officers, was conceded. At that time Negroes were barred from the marine corps and restricted to mess attendant and orderly service in the navy. In World War II Negroes were admitted to the marine corps in 1942 and to all ranks, including commissioned officers, in the navy. In that war 701,678 served in the army (more than 500,000 overseas), 165,000 in the navy, 5,000 in the coast guard and 17,000 in the marines; the ratio of Negro to white was about the same in the services as in the general population. (E. R. E.; A. LeR. L.)

Negro Education.—The slave south provided no facilities for educating Negroes; in fact, early legislation forbade it. Occasionally Negroes acquired literacy through beneficent private sources, and a few acquired more by migrating north or abroad. In the north a few academies under Quaker and other missionary auspices furnished standard academic training to a few fortunate Negroes.

The mass education of the Negro began with the Civil War, immediately after which army authorities and northern missionaries started programs of training not only for literacy but also for professional leaders, mainly clergymen and teachers. The foundation of the older Negro colleges, Lincoln, Fisk, Howard, etc., dates from this period. The Reconstruction governments also instituted tax-supported common-school education, one of their outstanding contributions to democratic institutions in the south. Negro legislators participated in and in many instances initiated these reforms; thus, the zealous desire of the freed Negroes for opportunities so long denied gave the south its first system of public education.

After trying originally a system open to both whites and Negroes, reactionary public opinion forced racial segregation, a dual system that at mid-20th century had been re-enforced by law in 17 southern states and the District of Columbia. Educational segregation led to increasing disparity in every phase of public education—school buildings and equipment, teacher salaries and qualifications, curriculum opportunities and requirements—as well as inequitable division of school tax appropriations. These discrepancies between the expenditures per pupil in public education varied greatly even within the south. Many private foundations, such as the General Education board, the Peabody, John F. Slater, Anna T. Jeannes, Phelps Stokes and especially the Julius Rosenwald fund, made it a special objective to stimulate improvement both in privately supported schools and various aspects of public education: school surveys, subsidies for teacher training and special programs and model school buildings. More direct legal pressure for the equalization of teacher salaries and other facilities had resulted by 1948 in reducing the average over-all differential for the south to the gap between $143.66 per white pupil and $86.16 per Negro pupil. Average salaries for Negro teachers in the south, by almost doubling between 1944 and 1948 from $895 to $1,738, reflected both the recent gains and the disparities previously tolerated. Northern states, while making no such general discrimination, nevertheless in particular localities made a practice of districting white and Negro schools separately; but by mid-century this had largely lapsed under legal and protest pressure.

Under such handicapped circumstances, the Negro's educational gains were phenomenal. Illiteracy, 85% in 1880, had been reduced to about 6% by 1950, compared with a general average of 2.7%. Negro enrolment in elementary schools in the south made only a slight increase because of heavy migration from that area; it totalled 2,026,327 in 1949. But the secondary school registration for the same area doubled from 163,185 in 1934 to 327,178 in 1949. Teacher increase was from 65,000 in 1934 to 72,803 in 1949, while, most significantly, the number of Negroes in colleges, an estimated 72,526 in 1951, had risen 28.4 times since 1900 and almost trebled the general national increase. Teachers in Negro colleges rose from 1,555 in 1900 to almost 7,000 in 1950; trends toward integration brought slightly more than 100 Negroes to general college faculty membership. Finally, largely as a result of U.S. supreme court decisions, by mid-century state land-grant colleges in at least 11 southern states had begun to open their facilities, particularly on the graduate and professional level, to Negro students from these states; cases in Missouri, Kentucky, Oklahoma, Texas, Maryland and Delaware set the precedent. Agitation continued for admission on a wider scale; most of the states where separate Negro land-grant colleges could not offer equal facilities in accordance with the supreme court rulings offered scholarship subsidies to Negro students in outside state institutions.

Cultural Advances.—Starting particularly in the 1920s, U.S. Negro talent began to win national and international recognition in artistic and cultural fields, particularly in music, poetry and art. There was also a growing interest in Negro folk materials, folklore, music and drama, as an important and distinctive phase of native U.S. culture. By mid-century, general U.S. literature had shown marked signs of a revaluation of the Negro, along with a tendency to discard the belittling traditional stereotypes previously in vogue. This tendency also gained momentum in social scholarship in general, and began to reflect itself in the more serious motion pictures.

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(A. LeR. L.)

NEGRO ECONOMIC LIFE

From the time of slavery the proportion of Negroes in the U.S. labour force was consistently higher than that of the white population, although at mid-20th century it was decreasing. As late as 1940 more than 58% of all Negroes 14 years of age and over were workers, compared with 52% of the white population of comparable age; in 1951 the figure for Negroes was 60%, for whites 56%. There was a higher rate of employment among Negroes, mainly because lower wages paid Negro men required Negro women to supplement the family income. Figures for 1950 revealed that the median money income of whites was about twice that of Negroes, being $2,700 for white males compared with $1,500 for nonwhite males (mainly Negroes) and $1,100 for white females compared with $500 for non-

white females. This discrepancy between Negro and white income caused a considerably higher percentage of Negro families to have more than one worker. In 1950, 52% of all nonwhite families (mainly Negro) had more than one earner, compared with 38% of white families. Low income was also responsible for a much higher incidence of child labour among Negroes.

Despite historic handicaps, Negro employment and professional interests came to cover a wide and expanding range of occupations by mid-century. Examination of Negro occupational distribution, however, revealed a pronounced concentration in agriculture and domestic and personal service. More than 75% of all Negro workers were in these pursuits in 1940; although a drastic decrease took place in the following ten years, about one-half of Negro workers were in similar jobs in 1950. The occupational status of Negroes showed marked change by mid-century, as they entered an increasing variety of trades and professions. Although important gains were made, the Negro was still greatly underrepresented in some professions and particularly in clerical and skilled work. While the occupational distribution of U.S. Negroes was still considerably different from that of the white population, Negroes were developing patterns of socio-economic stratification not unlike those among whites.

Agriculture.—In slavery and in freedom, Negro labour was concentrated until recently in southern agriculture. Despite tremendous migration and shifts in labour and industry, 36.1% of all gainfully employed Negroes were in agriculture in 1930; the 882,850 Negro farm operators (98.7% of them in the south) constituted 14% of all farm operators, although Negroes made up only 9.7% of the total population. During the 1930s the percentage of Negroes working in agriculture showed little change, but after 1940 there was a rapid decline.

The reasons for the Negroes' leaving the farm were many. First, they faced all the many uncertainties of agriculture generally and southern agriculture in particular, such as capital and credit problems, periodic crises caused by pests, overproduction, price changes, etc.; second, Negro farmers were confronted by special problems stemming from the race's historic position of inequality in southern society. Many obstacles were erected to discourage Negro acquisition of land; thus, while two out of five white farm workers were full or part owners in 1940, only one in eight Negroes had owner status, a differential of almost seven to one. About two-thirds of Negro, compared with one-third of white, agricultural workers were either sharecroppers or wage labourers.

Tenancy, long a crucial problem in southern agriculture, increased steadily from 1880 to 1930. In 1940 almost half of all farms were tenant-operated. More than one-third of all southern tenants and more than one-half of all Negro tenants were sharecroppers. Under this system, the landlord furnished the land, tools and seed; in return he received a share of the crop.

Mechanization, labour displacement and acreage reduction, as well as high wages in industry, speeded up the steady, long-term migratory trend. As a result, the number of Negro farm operators in the south had decreased to 680,266 in 1940 and to 665,413 in 1945. The shift from agriculture was especially rapid between 1940 and 1948; the proportion of Negroes in farm work was cut in half. During 1940–50 white farm operators declined 11.2%, while Negro operators decreased 27.7%. Farm labourers, especially Negroes, declined even more drastically; whites decreased about 14% and Negroes more than 32%. Thus, by 1950 the number of Negroes employed in agricultural industries had dropped radically to about 18%; the downward trend continued in 1951. The sharper movement of Negroes from the farm had almost removed the long-standing differential between white and Negro workers in agriculture.

The situation of Negro tenants and owners improved after 1940. Reduced pressure of racial competition resulting from migration, generally better economic conditions in the country and the benefits brought by the New Deal programs for agriculture were important factors. The decline of tenancy began about 1930 and was down to 38.7% in 1940 and 26.7% in 1950. Part of the decrease, especially between 1930 and 1940, was a result of mechanization, acreage reduction and movement down the tenure ladder to farm labourer status, but after 1940 many tenants succeeded in becoming owners.

Negroes engaged in a long, dramatic struggle to secure a firmer foothold in agriculture through land ownership, which Booker T. Washington advocated as an important avenue for entrance of the race into business. Reversing the trend of 1900–30, the number of Negro farm owners began to increase in 1930. In 1940 there were more than 173,000 Negro-owned farms in the south, with more than 10,000,000 ac. of land, valued at well over $250,000,000. By 1945 the number of Negro farm owners had risen to more than 185,000, and their land had increased by almost 1,000,000 ac. This represented a substantial achievement for a peasant people who began after slavery solely as farm labourers.

Domestic and Personal Service.—The employment of Negroes in domestic and personal service increased from 21.6% in 1910 to 28.6% in 1930. In contrast, native white workers in these classes decreased slightly from 6.7% in 1910 to 6 6% in 1930; foreign-born white workers in these categories rose from 11.8% to 12.7%. In 1940 Negro domestic and personal service workers had risen to a little over 30%. The proportion of Negro women working as domestic servants decreased considerably, while those engaged in personal services, such as beauticians, cooks, waitresses, etc., increased. Between 1940 and 1950 private household servants decreased 40.5% among whites and 18.2% among nonwhites (mainly Negroes). On the other hand, during the same period other personal service workers increased by 25.2% among whites and 41.4% among nonwhites. As new opportunities opened up for women, workers of both races left domestic service.

Industrial Workers and Artisans.—During slavery Negroes performed most of the skilled work in the south, usually dominating the handicrafts, such as cabinetmaking, blacksmithing, tailoring, shoemaking, painting, bricklaying, etc. Between 1840 and 1860 there were instances in which slaves manned cotton factories and worked in iron mines, furnaces and tobacco factories. Prior to 1865 Negro employment in the north was mainly in semiskilled and unskilled work, although white mechanics faced the competition of slaves early in the 18th century.

With the end of slavery the Negro's practical monopoly of skilled labour in the south also ended. As work lost its stigma of inferiority, Negroes felt the growing competition of whites in most areas of the labour market. Indeed, barbering, waiting, etc., formerly known as "Negro jobs," increasingly attracted large numbers of white workers. This displacement and the reluctance to accept Negroes in the mechanical industries of the south spurred Negro migration.

In the effort to gain a foothold in industry, Negroes also met many obstacles in the north. Employers there were reluctant to hire them, turning instead to white immigrant labour. European immigration was stimulated systematically, providing a huge reservoir of cheap labour. Labour unions also resisted attempts of Negroes to enter many skilled trades, some having charter restrictions against them. Such exclusion policies facilitated pitting Negro and white workers against each other; so Negroes were first brought into some industries as strikebreakers, which increased racial antipathy in the ranks of labour.

After 1935 increasing realization of the need for solidarity among workers caused organized labour to become more aware of the value of the Negro. Of particular influence in the growth of such liberalism in the labour movement was the Congress of Industrial Organizations. By organizing all workers in an industry, regardless of skill or race, it became a strong force against discrimination. Negro membership in unions rose from about 100,000 in 1930 to more than 1,250,000 in 1950.

The first opportunity for Negroes to enter northern industry in force came during World War I. The acute need for labour brought substantial numbers into many new fields, such as iron, steel, machinery, vehicle manufacturing, etc. Proving to be efficient workers, they were able for the most part to fortify their position during the 1920s. Although the rate of unemployment was higher among Negroes than among whites during the depression of the 1930s, Negro workers showed a remarkable ability to retain the gains they had won.

Pres. Franklin D. Roosevelt issued in June 1941 an executive order prohibiting discrimination in government and defense industries and establishing the Committee on Fair Employment Practice. This precedent led to the organization of many similar state and municipal commissions. Negroes in civilian jobs increased by almost 1,000,000 between 1940 and 1944, employed men rising in number from 2,900,000 to 3,200,000 and women from 1,500,000 to 2,100,000. The most outstanding change in the male Negro labour force was the shift from farm to factory, which was about 15%. The number of skilled Negro craftsmen and foremen doubled, as did the number working as operatives; *i.e.*, performing basic semiskilled factory operations. The number in both categories rose from about 500,000 to about 1,000,000 between 1940 and 1944. Similar progress was made by Negro women during this period. The number working on farms decreased about 30% while those employed as craftsmen, foremen and factory operatives almost quadrupled; proprietors, managers and officials tripled, saleswomen almost doubled and clerical workers were five times greater in number than in 1940. After World War II Negro labour maintained those gains substantially, with some advances.

The accompanying table shows the important gains in Negro employment in the U.S. between 1940 and 1950 compared with employment of white workers. In evaluating this progress, it should be kept in mind that these gains occurred in a tight labour market resulting from war and unusual peacetime economic expansion and that Negroes traditionally served as marginal workers—"the last hired and the first to be fired." Latecomers in many industries and skilled levels, they were especially affected by seniority rules. Nevertheless, the status of Negro labour was in the process of slow but progressive readjustment.

The Professions.—The position of Negroes in the professions remained different from that of Negro wage earners. While the great majority of Negro workers served in the general economy, Negro professionals were largely restricted to the racial clientele. This not only limited the opportunity for Negroes to rise in class status, but often generated vested interests in racial separatism. This paradoxical situation was improving at mid-century, not only in terms of the increasing numbers of Negro professionals but also through their greater integration into the general U.S. economy.

Negroes engaged in the professions increased from 64,648 in 1910 to 115,765 in 1930 and to approximately 125,000 in 1950; this included about 8% of the Negroes employed outside agriculture. Teachers, about 75,000 in 1949, were the largest Negro professional group; the

number on the college level rose from 1,555 in 1900 to 5,851 in 1950. A recent trend was the integration of Negro teachers into mixed collegiate faculties. Clergymen were the second largest Negro professional group. Prior to the Civil War, the church was the Negro's only free institution and, though declining in influence, was at mid-century still his principal group organization. In 1940 there were 17,487 Negro clergymen, more than two-thirds of them in the south.

Employed White and Nonwhite Persons in the United States, by Major Occupational Group, 1950 and 1940

(In thousands)

Occupational group	White			Nonwhite*		
	April 1950	April 1940	Per cent change	April 1950	April 1940	Per cent change
Total	50,488	40,225	+25.5	5,355	4,663	+14.8
Professional, technical and kindred	4,752	3,429	+38.6	192	125	+53.6
Managers, officials and proprietors, except farm	4,930	3,664	+34.6	80	63	+27.0
Farmers and farm managers	3,946	4,443	−11.2	507	701	−27.7
Clerical and kindred	6,584	4,328	+52.1	192	53	+262.3
Sales	3,662	2,866	+27.8	78	39	+100.0
Craftsmen, foremen and kindred	7,349	4,989	+47.3	283	138	+105.1
Operatives and kindred	10,054	7,680	+30.9	1,000	487	+105.3
Private household	645	1,084	−40.5	812	993	−18.2
Service, except private household	3,377	2,696	+25.2	768	543	+41.4
Farm labourers, except unpaid and foremen	1,217	1,410	−13.7	345	515	−33.0
Farm labourers, unpaid family	730	856	−14.7	211	309	−31.7
Labourers, except farm and mine	2,521	2,427	+3.9	827	671	+23.2
Occupation not reported	720	351	+105.1	60	28	+114.3

*Mainly Negro
Source U.S. Department of Commerce, Bureau of the Census, *1950 Census of Population, Preliminary Reports*, series PC-7, no. 2.

Negro physicians and dentists increased slowly, from 3,553 in 1910 to approximately 6,000 in 1950; the Negro's representation in the medical professions, however, was still proportionately less than one-fourth that of whites. Trained nurses increased from 2,433 in 1910 to more than 9,000 in 1950. In the legal profession the increase was from 798 in 1910 to 1,063 in 1940. Great strides were made in social work; while in 1930 there were fewer than 1,000 registered social workers, in 1951 there were about 5,000. During the decade 1940–50, Negroes made significant gains in many other professional and semi-professional areas, especially in technical fields and government service.

Negro Business.—Like the majority of Negro professionals, Negro businessmen at mid-century remained dependent primarily upon the Negro community; but, unlike the professionals, they had no virtual monopoly on the Negro market. Severe competition from white storekeepers diverted all but a small part of Negro purchasing power away from Negro business enterprise. Negro business also became marginal because of the marginal character of the Negro labourer on whom it depended; this combined with white competition to produce high mortality among Negro establishments. The great bulk of Negro business consisted of small retail and service enterprises such as barber shops, grocery stores, cafés, beauty parlours, cleaning and pressing shops, etc. In 1939 there were 29,827 retail stores and 27,368 service establishments owned and operated by Negroes. During the war period there was considerable expansion, resulting in an increase of nonwhite (mainly Negro) managers, officials and proprietors from 63,000 in April 1940 to 80,000 in April 1950, a gain of 27%.

Insurance.—The largest business among Negroes, insurance attained greatest self-sufficiency and independence from the white economy. Developing out of more than 100 years of religious, fraternal, sick and death benefit societies, Negro insurance firms grew steadily, holding in 1948 about one-third of the Negro life insurance. The National Negro Insurance association reported that in 1948 its 62 member companies had assets of more than $108,000,000, an annual income of more than $55,000,000 and insurance in force worth almost $1,000,000,000. In 1950 the 65 Negro insurance companies had improved their position further, with assets of $134,201,324, annual income of $88,779,016 and insurance in force worth $1,074,179,222. This represented marked progress, but, viewed in the larger context, Negro companies had only about 0.2% of the assets of all insurance companies, less than 0.5% of the total insurance in force and just over 0.5% of the total annual income.

Banks, Savings and Loan Associations.—The Negro bank symbolizes the effort of Negroes to provide the economic basis for a racial middle class within a segregated economy. The early difficulties and failures of these banks were caused in great part by the poverty and inability of the Negro economy to support such institutions. Two-thirds of the Negro banks failed during the depression of the 1930s, only nine surviving the banking holiday of 1933. Although 600 banks failed between 1933 and 1936, none were Negro; 50 banks were closed between 1940 and 1950, but none among Negroes. In 1950 the 14 Negro banks had total deposits of $29,000,000 and capital accounts of $2,728,000, in each instance gains over the previous year; gross earnings rose to $1,188,000. The total assets of 25 Negro savings and loan associations reporting in 1949 were $16,404,918, an increase of 45.3% over 1948; their volume of cash and governmental obligations was $1,774,321, up 120.8%.

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NEGRO ART

Negro art, in the broader sense, may be said to include work portraying Negro life by other than Negro artists; in a narrower sense, to include all work of Negro artists. The American Negro, though possessing a strong African heritage in decorative and plastic art, was hampered in his expression in the field of the formal arts by conditions of the slave system, and the sudden displacement by Christianity of the pagan background in which the original African arts flourished. However, in favourable centres such as Philadelphia, Charleston and New Orleans craft artisans of exceptional skill in wood and ironwork flourished until the breakdown between 1840 and 1850 of craft skill by the factory system. Of these the most famous were the Negro art-smiths of New Orleans. In formal painting, the pioneer Negro artist was Edward Bannister (Providence, R.I.), a landscape painter, prize winner at the Centennial exposition at Philadelphia (1876) and founder of the Providence Art club. At the same exhibition, Edmonia Lewis, pioneer sculptor, exhibited her busts of William Story, Charles Sumner and Frederick Douglass. Other early Negro artists between 1865 and 1885 were Edward Stidham (Philadelphia), portraitist; William Dorsey (Philadelphia), landscape painter; and Robert Duncanson (Cincinnati), figure painter.

These were followed, after a dead interval, by the two Negro artists who achieved rank in U.S. painting and sculpture, Henry Ossawa Tanner (1859–1937) and Meta Warrick Fuller. Tanner's painting, mostly of biblical subjects, in addition to the romantic realism of his French masters, reflects the mysticism and religious faith of his Negro parentage and, like the work of Israels, combines utmost sophistication of technique with naïve simplicity of theme. His technical skill was attested by many prize awards and also by his inclusion in the Luxembourg, Wilstach, Pennsylvania Academy of Fine Arts, Carnegie institute, Chicago Art institute and other collections. A school of formal academic painting followed Tanner: William Harper (1874–1910), landscape painter of note; William Edouard Scott (1884–   ), portraitist and mural painter; William Farrow (1885–   ), landscapist and etcher; Charles Dawson (1889–   ), portrait painter and engraver; Edward Harleston (1890–1931), portraitist and figure painter of merit; and Laura Wheeler Waring (1887–1948), type portraitist and decorative illustrator.

In sculpture, the outstanding Negro has been Meta Warrick Fuller (1877–   ), educated at the Pennsylvania School of Industrial Art and pupil of Colarossi academy, St.-Gaudens and Rodin. She achieved recognition in the Paris salons of 1903 and 1904 with her forceful symbolic works, "Oedipus," "Secret Sorrow," "The Wretched," "The Impenitent Thief" and "John the Baptist." Later she turned to the delineation of Afro-American types with her series of 14 groups representing the history and progress of the Negro, for the Jamestown exposition (1907), and her "Ethiopia Unbound," executed for the New York Emancipation Semi-

Centennial (1913). Later still she turned to portrait sculpture and to abstract symbolic groups. In similar vein but with slightly more attention to racial types, May Howard Jackson (1878–1931) did meritorious work in sculpture. Though occasionally racial in theme and feeling, the work of the foregoing artists has been traditional in ambition, sympathy, and technique, and their success has come to them primarily as artists.

Since 1920 the younger Negro artists have broken largely with academic tradition and style, and there has emerged, along with considerable modernism, a school of Negro art more distinctive and original and devoted more consciously to racial portrayal and expression. This activity has focused mainly in a New York or Harlem group, including M. Gray Johnson (1896–1934), Palmer Hayden (landscapist), Aaron Douglas (1898–) figure painter and illustrator, Albert Smith (1896–1939), William H. Johnson (1902–), Lesesne Wells (1902–), Augusta Savage (1900–) sculptor, Richmond Barthé (1901–) sculptor; and in a Chicago group, including Archibald J. Motley (1891–), Hale Woodruff (1900–), Charles Seebree; and in the West, Sargent Johnson (1888–) sculptor. Modernist trends, together with liberal participation in the Federal art projects, have since 1935 integrated the Negro artist more closely with contemporary American art.

One trend has been toward using African motifs and symbolization of the African and West Indian backgrounds, another toward abstraction and modernistic primitivism, and later, realistic genre of the urban scene and a use of Negro life as art of social interpretation and social protest.

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NEGRO DRAMA

Negro drama in the United States represents the same tendency toward the development of race or group drama as is to be found among other cultural minorities. It exemplifies the development of a group consciousness and the consequent urge for artistic expression of a people possessing a common tradition and race experience. Negro drama is likewise a recognized phase of American drama.

In the period previous to the Civil War the Negro appeared as a minor character in L. Beach's *Post Free* (1807) and in Anna Cora Mowatt's *Fashion* (1845). In the '40s the minstrel show was making its appearance. Charles Callender, Lew Dockstader and Primrose and West, in turn presented caricatures of the Negro that have persisted in the American theatre. Following the Civil War the novel by Harriet Beecher Stowe, *Uncle Tom's Cabin*, was dramatized and produced throughout the North, soon to be followed by another drama of the same type, *The Octoroon*, by Dion Boucicault. These plays accustomed the public to Negro drama designed to appeal to its sympathy rather than its ridicule. The minstrel characterization of the Negro continued until 1895, when John W. Isham organized a musical show, *The Octoroons*, the first of a long line of musical comedies which have opened the doors of opportunity to a group of notable Negro actors, including Williams and Walker, Cole and Johnson, S. H. Dudley, T. Leubie Hill, Ernest Hogan, Sissle and Blake, Miller and Lyles, Florence Mills and Adelaide Hall. These musical shows have contributed little to the direct stream of Negro drama, yet they have demonstrated the exceptional histrionic talents of the race. They may yet furnish the material for the evolution of new dramatic forms in the future. Witness the interesting experiment of Laurence Stallings and Frank Harland in the jazz opera *Deep River*, in *Show Boat*, and the folk-operas, *The Emperor Jones* and *Porgy and Bess*.

In 1910, Edward Sheldon's *The Nigger* was produced, and in 1913, the first important Negro pageant, *The Star of Ethiopia* written by W. E. B. DuBois, and in 1916, the first successful problem drama written by a Negro, *Rachel*, a three-act play by Angelina Grimke.

The first important step in the development of an authentic Negro drama was taken on April 5, 1917, when Mrs. Norman Hapgood, in association with Robert Edmond Jones, presented a group of Negro actors in three one-act plays written for the Negro theatre by the American poet, Ridgely Torrence.

In the years immediately after the World War Negro drama suddenly assumed a place of major importance in American drama. The production of Eugene O'Neill's, *The Emperor Jones* (1919), proved a landmark. Charles Gilpin, a Negro, who played the title rôle, was selected by the New York Drama League as one of the ten persons who had contributed the most to the American theatre during that year.

The Ethiopian Art theatre was organized by Raymond O'Neill in co-operation with Mrs. Sherwood Anderson, in Chicago in 1923. Its main contribution to Negro drama was the presentation of a one-act folk play, *The Chip Woman's Fortune*, written by a Negro playwright, Willis Richardson, who has contributed a number of meritorious one-act plays to Negro drama.

Supplementing these Little Theatre groups, a definite movement for the establishment of an experimental laboratory of Negro drama and for the development of a national Negro theatre was instituted in 1920 at Howard university, in Washington. The organizer of this undertaking was Montgomery Gregory, who was assisted by Alain Locke, Marie Moore Forrest, Cleon Throckmorton and the university authorities. Their leading idea was that the medium of dramatic expression offered the Negro race one of its best means both of developing its own traditions and of making a substantial contribution to American culture. The Howard Players successfully produced several one-act plays written by members of the group. Hampton, Tuskegee, Atlanta university and the Gilpin Players, Cleveland, have done effective work in educational and experimental race drama.

The Carolina Playmakers of the University of North Carolina, under Frederick Koch, have made notable contributions to Negro drama. Prof. Paul Green of this university ranks with Eugene O'Neill as the leading dramatist of Negro life. *White Dresses*, *Granny Boling*, *The No 'Count Boy* and the Pulitzer prize play, *In Abraham's Bosom*, are among his successful dramas. The awakened national interest in Negro drama chiefly occasioned by the production of *The Emperor Jones* has resulted in a succession of plays of Negro life on the New York stage. Some of these plays were: *Goat Alley* by E. Howard Culbertson, *Roseanne* by N. Stephens, *Taboo*, by Mary Hoyt Wiborg, *All God's Chillun Got Wings*, by Eugene O'Neill, *Porgy*, by Du Bose Heyward, *The Green Pastures* by Roark Bradford and Marc Connelly, *Run, Little Children* by Hall Johnson, *Stevedore* by Paul Peters and George Sklar, *Mulatto* by Langston Hughes, *Mamba's Daughters* by Du Bose Heyward. These successes have brought forward the stellar Negro acting talents of Richard B. Harrison, Paul Robeson, Rose McClendon, Abbie Mitchell, Rex Ingraham and others.

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NEGRO MUSIC

Early American Negro music consists almost entirely of folk-music, the proportion written by individual composers being comparatively small. This music is of many kinds but it may be divided into two general classifications, sacred and secular. The sacred music consists of the well known spirituals, while the secular is work, play and love songs, the blues and dance music—ragtime and jazz. The great bulk consists of songs; ragtime and jazz, however, are instrumental as well as vocal.

The spirituals rank first in value and beauty. They, indeed, constitute one of the finest bodies of folk songs in the world. Just how far back the making of spirituals by the Negro in America goes cannot be exactly determined, but it is safe to say more than 150 years, since he began creating these songs shortly after his adoption of Christianity, along with the establishment of his own separate places of worship.

The spirituals are primarily a fusion of African music and Christian sentiments. They possess the fundamental characteristics of African music, its strong rhythmic quality, and show a marked similarity to African songs in verse forms and intervalic structure. However, the spirituals, upon the base of the primitive rhythms, rise a step beyond African music through a higher melodic and an added harmonic development. The spirituals remain distinctive Negro folk-songs.

The texts of the spirituals are based almost exclusively upon the Bible. The stories in the Bible gave the Negro bards great scope for the play of their imagination and are often told dramatically and in vivid and gorgeously coloured pictures

It is probable that many of these songs are irretrievably lost, for no systematic effort to record them was made before the Civil War. They were first introduced to the public of America and Europe in 1871 by the Fisk Jubilee singers. They have recently been given a new vogue on the concert stage by Harry T. Burleigh, Roland Hayes, Paul Robeson, J. Rosamond Johnson, Taylor Gordon, Marian Anderson, and other famous Negro singers.

Negro secular music, unlike the spirituals, has gone through many changes and developments. Most of the various styles of Negro secular music have successively been taken over, adapted and made national. And so it appears that as one style of the Negro's secular music became lost to him he set about creating another. Before and for a while after the Civil War the Negro made many plantation songs both of the ballad and the patter type. The plantation songs

became the mainstay of the black-face minstrel stage; they were adapted and imitated and remained popular for several decades.

In the last decade of the past century ragtime, a highly syncopated form of music, came into notice. It is fundamentally an instrumental form, and was the result of experiments by Negro players on the piano—then a new instrument to them. Words were adapted to these syncopated rhythms and gave birth to the ragtime song, which achieved great popularity in the first decade or so of the present century. The Negro dialect text of the ragtime song was ultimately discarded for straight English, and this form of Negro music took on a national character, and so remains.

About 1910 a distinctly new type, the blues, was invented in the South and rapidly spread over the country They are as truly folk-songs as the Spirituals; basic differences being that they are an expression of the individual and not of the group, and that they follow a rigid verse form and are less varied and rich than the Spirituals. This "blue" note has become one of the main elements of American popular music and has been experimented with by serious composers. (*See* BLUES.) Jazz (*q.v.*) is somewhat a combination and culmination of ragtime and the blues.

Another class of Negro folk-songs are the work-songs. These, originated by gangs of men at work, call for rhythmic motions performed in unison; the picks or the hammers rising, falling and resting in perfect rhythm with the music.

Outstanding among early Negro composers of note was James Bland (1851–1911), who wrote *Carry Me Back to Old Virginia* and *In the Evening by The Moonlight*, songs which have attained a semi-classic niche. Later Negro composers of note have achieved distinction in the fields of symphonic and chamber music, opera, and oratorio; among them: Will Marion Cook, Harry T. Burleigh, J. Rosamond Johnson, R. Nathaniel Dett, Clarence Cameron White, William L. Dawson, Florence B. Price, and William Grant Still.

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See BLUES and JAZZ, also COLERIDGE-TAYLOR, SAMUEL.

NEGRO POETRY

As early as the year 1760 Jupiter Hammon, a slave belonging to a Mr. Lloyd of Queens village, Long Island, N.Y., published a poem 88 lines in length, entitled *An Evening Thought, Salvation by Christ, with Penitential Cries*. Hammon published several other poems, all of them religious. However, it is with Phillis Wheatley (*c.* 1753–84), a young slave, that American Negro poetry properly begins.

Between Phillis Wheatley and Paul Laurence Dunbar there were about 30 Negroes who published poetry, the publications ranging in size from pamphlets to books of from 100 to 300 pages. These writers must be considered more in the light of what they attempted than of what they accomplished. A number of them showed marked talent and feeling, but barely a half-dozen demonstrated more than mediocre mastery of technique. Such were George Horton (1797–1880), Frances E. Harper (1825–1911), Charles Reason (1818–98), James Madison Bell (1826–1902) and Albery Whitman (1851–1901).

Paul Laurence Dunbar (1872–1906) (*q.v.*) was the first American Negro poet to show real poetic talent. Contemporary Negro poets were: James Edwin Campbell, Daniel Webster Davis, George M. McClellan, J. Mord Allen, James D. Corrothers (1869–1917), William H. A. Moore and Joseph S. Cotter, Sr.

The decade after the death of Dunbar was fallow, but William Stanley Braithwaite (b. 1878) achieved recognition as a poet, critic and anthologist. His work, however, is not in subject-matter or form related to race. In general, his poems are mystic in tone.

Immediately after the entry of the United States into World War I (1917) there emerged a group of poets who almost completely discarded dialect and the traditional material of Negro poetry, including pathos and humour. The distinguishing notes of their poetry were disillusionment, protest and challenge. In this group were Claude McKay, Fenton Johnson, Joseph Cotter, Jr., Georgia Douglas Johnson, Roscoe Jamison, Lucien Watkins and James Weldon Johnson (1871–1938). This period of protest found its most powerful voice in Claude McKay (1890–1948).

A half-dozen years after the beginning of the period of protest, American Negro poetry began discarding propaganda for propaganda's sake, and essayed a more purely artistic use of racial art material and cultural background. Two new poets arose in this latest period. They were Countee Cullen (1903–1946) and Langston Hughes (b. 1902). Cullen was a poet of lyrical power and beauty. He wrote only in the well approved forms of literary English, but many of his best poems contain a racial note of deep poignancy. In 1925 he published his first volume, *Color;* this was followed in 1927 by *The Ballad of the Brown Girl* and *Copper Sun.* Hughes is more the folk poet in the selection of subject-matter and forms. Much of his material is taken from the humbler strata of life, and he has made effective use of the form of the Blues (see *Music,* p. 219). He is the author of *The Weary Blues* (1926) and *Fine Clothes to the Jew* (1927). In this period James Weldon Johnson published *God's Trombones—Seven Negro Sermons in Verse* (1927), founded on the oldtime Negro plantation sermons. The newer Negro poets writing distinctive verse are: Jean Toomer (1894–), Anne Spencer, Arna Bontemps, Angelina Grimke (1880–), Lewis Alexander, Jessie Fauset, Sterling Brown, Waring Cuney, and Frank M. Davis.

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(J. W. J.; A. LER. L.)

NEGRO FOLKLORE

The folk-lore of the Negro of the United States, for all its surface appearance of naïve simplicity, is a complex thing. Its origins are mixed, and often lost in obscurity. Some elements are clearly African in their beginnings, while others are as definitely related to the lore of the whites. The "big house" of colonial days, as well as the jungle of Africa has had its share in shaping Negro folk-lore. The transplanted race cherishes the superstitions, the ballads, the stories of both the new home and the old, and what it borrows makes its own as distinctly as what it originated.

There is a rich body of folk-tales current among the American Negroes, some of which have been preserved in print, and many of which are transmitted orally by the firesides and door-steps of the south. A still greater mass, no doubt, has been lost for lack of chroniclers and tellers. The best-known body of their published folk-tales is that collected by Joel Chandler Harris—made familiar by the name of Uncle Remus.

In his songs and stories the Negro shows his fondness for animals, his admiration for their craft, his interest in their prowess. He endows them with human attributes of thought and speech, and gives them greater cunning than natural history would authorize, often similar to the fable-forms of African sagas.

The Negro shows great variety in his songs, contrary to the popular conception that he sings only spirituals. The spirituals, which are melodious and haunting in their tunes, and which express humility and sweetness of spirit, owe something at least to the hymns and religious songs heard on the southern plantation. There are various groups of secular songs. There are numerous work songs, for the Negro, a truly rhythmic person, works better and faster when he sings at his task.

The American Negro has had his part in transmitting the traditional songs and ballads of England and Scotland, and has made them his own. There are many ballads that the Negro has made for himself, owing nothing to the whites. There are lullabies, old dance songs or "reels," children's game songs, counting songs, songs of love, of war and of other themes.

There is a mass of folk-beliefs, of superstitions, current among the southern Negroes, belief in ghosts, in witches, in the power of "voodoo" and so forth. In fact, the Negro folk-lore constitutes the largest and most varied body of lore to be found in America to-day.

(D. Sc.)

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HARLEM

Harlem was originally a village on Manhattan island, now the local name for that part of the borough of Manhattan, New York city, beginning at 106th street and extending north between the East and Harlem rivers and Eighth avenue. Its settlement, on the site of what is now Mount Morris park, dates from 1636. In 1658 Peter Stuyvesant named the village New Haarlem, after Haarlem, the town in Holland from which many of its inhabitants came. The old village is charmingly described by Washington Irving in his *Knickerbocker's History of New York*. Harlem retained its quiet aspect, surrounded by farms, until 1836, when daily communication by horse railroad was established with New York. Thereafter, by degrees, the village became a populous suburb and was finally transformed into a densely built residential section of the metropolis. The name now refers more specifically to the district north of 116th street, which since 1920 has become the most populous urban Negro community in the world.

The Negro Metropolis.—During World War I about 500,000 Negroes, taking advantage of the restrictions placed upon European immigration, and lured by war-time wages, turned from agricultural pursuits in the South to the highly specialized industries of the North. In New York city the migrants, uniting their fortunes with a stream of 60,000 Negroes coming from Central America and the West Indies, swept uptown and formed above 125th street a fabulous Negro city of 250,000 souls. This district does not constitute, however, the only

point of Negro mass contact on Manhattan Island. On the crest of "San Juan Hill" is a colony of 5,000 to 6,000 Negroes which in point of density and hardihood easily outstrips Harlem. Within the shadow of the old Fifty-third street elevated are remnants of a Negro settlement which antedates by at least a quarter of a century the glamorous "Mecca of the New Negro." But the concentration of the Negro population in Harlem has dwarfed the various settlements of the race in other parts of New York city. In the evolution of Negro communities in the north the dominating motive has always seemed to be economic, until Harlem arose as an exception with a mixed metropolitan population of professional, mercantile, semi-industrial and working class elements.

Economic Status.—In Harlem, unlike other Negro urban communities, there are few banks, insurance companies or large realty firms under Negro management. There is little outlet for the young Negro trained in business or finance. The highly-organized and competitive character of metropolitan business is largely responsible, but it is also true that the Harlem district has been slow in awakening to the necessity of the co-operative spirit in business. Lately, particularly since the Harlem riots of 1935, labour organization, mass pressure for increased employment, and participation in civic improvements have shown marked increase, due in part to an increase in group solidarity and in part to the added pressure of the economic depression. Harlem is still as a community, however, precariously unbalanced economically, between a top-heavy professional class and the underpaid and economically exploited masses there is very little middle-class buttressing. The majority of business enterprises in Harlem are not owned or operated by Negroes.

Cultural Ascendancy.—In spite of this curious showing, Harlem's ascendancy over the rest of the Negro communities of the country is a striking and vital one. Harlem is, to begin with, the goal of the Negro artist, poet, painter, musician or writer. Because Harlem is a part of New York it has done most to focus attention on the creative gifts of the American Negro. Likewise, because of the welter of native Negro races simmering in its orbit, it is a sort of market place for all sorts of ideas concerning Negro life, and the history and the future of the race.

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NEHEMIAH, governor of Judaea under Artaxerxes (generally thought to be the first of that name, 465–424, although possibly the second, 404–359 B.C.). The book of Nehemiah forms the concluding portion of the great compilation, Chronicles–Ezra–Nehemiah. Nehemiah's own account, written after 432 in the first person, and confined to chapters i–vi, is the only authentic information which we possess in regard to his life and work. (*See* further EZRA AND NEHEMIAH, BOOKS OF; JEWS.)

NEHRU, PANDIT JAWAHARLAL (1889–), Indian national leader, born Nov. 14 in Allahabad, a son of Motilal Nehru (*q.v.*). He went in 1905 to England where he studied at Harrow and Cambridge. He became thoroughly at home in English and European civilization, writing an English style of great distinction, and conversant with the literature and history of most leading European countries. In 1912 he was called to the bar and returned to India where he joined the Indian National Congress and became active in Indian politics. Soon he was prominent as a follower of Gandhi and was for the first time arrested and sentenced to imprisonment in 1921. The vicissitudes of the Indian national struggle brought him several times into jail, and he became second in rank to Gandhi himself. He was elected for the first time in 1929 president of the Indian National Congress, an office he occupied again in 1936–37 and 1946. Though he remained always loyal to Gandhi, he did not share the latter's traditionalist, conservative and pacifist views. Deeply interested in agrarian reforms and in the improvement of the living conditions of the Indian masses, he found an enthusiastic following in the Indian youth and visited Europe, the Soviet Union and China several times. Nehru was named prime minister and minister for foreign affairs and scientific research when India became a British dominion in 1947, and he was sworn in as premier on Jan. 26, 1950, when the Republic of India was established. He wrote an autobiography which was published in England in 1936 and which became there a best-seller. A U.S. edition appeared in 1941 under the title *Toward Freedom.* While in jail he wrote letters to his daughter, published later as *Glimpses of World History* (Eng. ed. 1934, U.S. ed. 1942). His works include his addresses and articles, collected as *The Unity of India* (1942), and *The Discovery of India* (1946). (H. Ko.; X.)

NEHRU, PANDIT MOTILAL (1861–1931), Swarajist leader, a Kashmiri Brahman, was born on May 6, 1861. At the Allahabad bar he came to the front, earning a large income, and exercising hospitality and friendly intimacy with European society. He was for some years a member of the United Provinces legislative council. After World War I, through repression of disorder in the Punjab in 1919, his views changed. In 1919 he founded the *Independent*, an aggressively Nationalist paper, and accepted the presidentship of what was now the extremist Indian national congress. His support of Gandhi's campaign of non-co-operation took the form of suspension of his lucrative practice at the bar and the abandonment of luxurious western habits. At the close of 1921 he was imprisoned for six months for breaking the law against seditious assemblies. He so far modified his non-co-operation attitude as to accept election to the second legislative assembly at the close of 1923, and took his place there as leader of the Swaraj party. On the death of C. R. Das in 1925 he was elected president of the all-India Swaraj party, and under his guidance it was fused in the following year into the National Congress party. This organization promoted a boycott of the Simon commission and led in formulating under his chairmanship the All Parties Conference Report, or Nehru Report. It lays down a scheme of dominion status for India. (F. H. BR.)

NEILL, JAMES GEORGE SMITH (1810–1857), British soldier, was born near Ayr, Scotland, on May 26, 1810, and educated at Glasgow university. Entering the service of the East India company in 1827, he received his lieutenant's commission a year later. When the Indian Mutiny broke out Neill, who was in command of the 1st Madras Europeans, left Madras with his regiment at a moment's notice, and proceeded to Benares. The day after his arrival he completely and ruthlessly crushed the mutineers (June 4, 1857). He next relieved Allahabad, which became the place of concentration for Havelock's column. The two officers, through a misunderstanding in their respective instructions, disagreed, and when Havelock went on from Cawnpore (which Neill had reoccupied shortly before) he left his subordinate there to command the lines of communication.

The famous march from Cawnpore to Lucknow began on September 19; on the 21st there was a sharp fight, on the 22nd incessant rain, on the 23rd intense heat. On the 23rd the fighting opened with the assault on the Alum Bagh, Neill at the head of the leading brigade recklessly exposing himself. Next day he was again heavily engaged, and on the 25th he led the great attack on Lucknow itself. The fury of his assault carried everything before it, and his men were entering the city when a bullet killed him.

See J. W. Kaye, *Lives of Indian Officers* (1889); and J. C. Marshman, *Life of Havelock* (1867).

NEISSE, a town in the province of Prussian Silesia, Germany, at the junction of the Neisse and the Biela, 32 mi. by rail S.W. of Oppeln. Pop. (1939) 37,893. Neisse, one of the oldest towns in Silesia, is said to have been founded in the 10th century, and afterward became the capital of a principality of its own name, which was incorporated with the bishopric of Breslau about 1200. Its first walls were erected in 1350, and it was thrice besieged during the Thirty Years' War. The end of the first Silesian War left Neisse in the hands of Frederick the Great. The Roman Catholic parish church of St. James (Jakobikirche) dates mainly from the 13th century, but was finished in 1430. The chief secular buildings are the old episcopal residence, the old Rathaus (1499) and the beautiful Renaissance *Kämmerei* (exchequer) with a high gabled roof ornamented with frescoes.

NEISSE, three rivers of Germany. (1) The Glatzer Neisse, 121 mi. long, rises on the Schneeberg, at an altitude of 1,400 ft., flows north past Glatz, turns east and pierces the Eulengebirge in the Wartha pass, then continues eastward past Neisse until it joins the Oder (left) between Oppeln and Brieg. It is navigable to any appreciable extent only in the lowest 11 kilometres. (2) The Lausitzer or Görlitzer Neisse, 140 mi. long, rises near Reichenberg in Bohemia, on the south side of the Riesengebirge, flows north past Reichenberg, Görlitz, Forst and Güben, and enters the Oder above Fürstenberg. Less than 40 mi. are navigable. (3) The Wütende Neisse is a tributary of the Katzbach.

NEJD, a country of Arabia, occupying the core of that ancient land-block. The old block has been uptilted on the west, consequently Nejd tends to slope very gradually from west to east. The name itself implies an upland, and this is its distinc-

tive character as compared with the adjoining coastal districts of Hejaz and al-Hasa, representing the shelving down of the plateau on the west and east respectively.

In general elevation Nejd varies from 5,000 ft. on its western border to 2,500 in Qasim in the northeast, and somewhat less in the southeast. In the north Jabal Shammar, and in the east J. Tuwaiq and J. 'Aridh rise about 1,500 ft. above the general level, but, on the whole, Nejd may be described as an open steppe, of which the western and southern portion is desert, or at best pasture land only capable of supporting a nomad population; while in the north and east, owing to greater abundance of water, numerous fertile oases are found with a large settled population. (*See* Arabia.)

Nomadic tribes, following their flocks and herds over the steppe, have roamed over the territory from time immemorial, raiding the settled dwellers of the oasis in times of difficulty or scarcity. The four most prominent tribes of Bedouin are the Shammar, Harb, 'Utaiba and Mutair. The first-named represent that part of the great Shammar tribe which has remained in its ancestral home on the southern edge of the Nufud (the northern branch long ago emigrated to Mesopotamia); many of its members have settled down to town life, but the tribe still retains its Bedouin character. The Harb are probably the largest of the Bedouin tribes in the peninsula, and are divided into a number of sections. Their territory is the steppe between Qasim and Medina. The 'Utaiba territory extends from near Mecca along the road leading thence to Qasim. The Mutair occupy the desert from Qasim northward toward Kuwait.

Nejd became nominally a dependency of the Turkish empire in 1871, when Midhat Pasha established a small garrison in al-Hasa, and created a new civil district under the government of Basra, under the title of Nejd, with headquarters at Hufuf. Its real independence was not, however, affected, and the emirs, Mohammed Ibn-Rashid, at Ha'il, and 'Abdallah Ibn-Sa'ud, at Riyadh, ruled in western and eastern Nejd respectively, until 1892, when the former, by his victory at 'Unaiza, became amir of all Nejd. His successor, 'Abd-al-'Aziz Ibn-Rashid, was, however, unable to maintain his position, and in spite of Turkish support, sustained a severe defeat in 1905 at the hands of Ibn-Sa'ud, who thus became the dominant power in Nejd. By 1914 Ibn-Sa'ud, with his Wahhabi followers had wrested the province of Hasa from the Turks, and his power thus reached the Persian gulf. Remaining inactive during World War I, Ibn-Sa'ud in 1920 had captured and annexed Abha and other parts of 'Asir, leaving only the coastal strip. In 1921, Ha'il and the dominion of the amir of Jabal Shammar were in his possession, and by the end of 1925 he had overthrown the new Hashimite kingdom of the Hejaz. He was proclaimed at Jidda, in 1926, as king of Hejaz and sultan of Nejd. From Riyadh, Ibn-Sa'ud ruled over the new kingdom called, after 1932, Saudi Arabia, comprising Hejaz, 'Asir, Nejd and al-Hasa.

His administration is patriarchal and his law the *sharī'a*, administered by Wahhabi officials. A few simple taxes on cattle and possessions are collected. The chief administrative regions of the sultanate are Hasa; 'Aridh, with the town of Riyadh; Wadi Dawasir; Aflaj; Kharj; Sudair; Mahmal; Washm; Qasim; Jabal Shammar, with the town of Ha'il; Jauf; and numerous scattered oasis-groups, each ruled by an amir.

Of the towns, Hufuf and Riyadh have a population of about 30,000 each; Ha'il, Hauta, 'Unaiza, Buraida, Jauf, Mubarraz, Shaqra and Sakaka have populations between 10,000 and 20,000. The entire population of Nejd is estimated at 2,320,000. Besides the population of the towns mentioned above, and the nomadic tribes, there are many villages in hollows of the valleys of the tableland, wherein is concentrated the fertility and much of the population of Nejd. Gardens, houses, cultivation and villages lie hidden from view among the depths while one journeys over the dry flats, till one comes suddenly on a mass of emerald green beneath.

The products of Nejd include dates, wheat, barley, hides, wool, fruit, *samn* (clarified butter), camels, sheep, horses, etc. The export of camels to Syria and Egypt has been much reduced. Tea, coffee, sugar, rice, motor vehicles and piece-goods are imported.

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NEKRASOV or **NEKRASSOV, NIKOLAI ALEXEYEVICH** (1821–1877), Russian poet, was born on Nov. 22 (O.S.) 1821, in Podolia, the son of a landowner in the government of Yaroslâv, where the boy was brought up. He studied at St. Petersburg, against the will of his father, who left him to his own resources. At the age of 19 he published a small volume of poems (*Dreams and Sounds*), most of which had appeared in periodicals, and in 1846 he bought from Pletnev the *Sovremennik,* which in his hands became from 1856 onwards the favourite organ of young radical writers. It was suppressed in 1866, but in 1868 Nekrasov acquired, with Saltykov, the *Otechestvennye Zapiski,* in which the traditions of the *Sovremennik* were maintained. He died at St. Petersburg on Dec. 27 (O.S.) 1877.

Nekrasov was a people's poet, and expressed the sorrows and sufferings of the common people in poems which made him the idol of the reformers, and the joy and humour of everyday life in admirable adaptations of folksong, and in charming poems for children. Among the most famous of his works are *The Red-Nosed Frost* (1863), depicting a heroic peasant woman, and the great satirical work *"Who can be happy and free in Russia?"* (1879, Eng. trans. J. M. Soskice, 1901.) The latter is a species of *Canterbury Tales,* though with a definite purpose running through the series. Seven peasants make their way on foot throughout Russia to solve the question of who is happy. They are told a series of tales, by typical characters, landowners, priests, peasants and others, and Nekrasov concludes on a note of hope for the future. This last canto, owing to the censorship, did not appear until 1881. His work includes love poems, elegies and narrative poems. The most recent edition of his poems was published in 2 vols. in 1919, and they have been translated into German by H. J. Köcher (2 vols. Leipzig, 1885–88). English translations of some of his poems, including *The Red-Nosed Frost,* are to be found in C. T. Wilson's *Russian Lyrics* (1887); and J. Pollen, *Rhymes from the Russian* (1891). *See* also a French translation of some of his poems *Poésies populaires,* by E. Halperine-Kaminsky and C. Morice, with a preface by E. M. Vogüé.

NEKTON, the name applied collectively to the larger, actively swimming animals of the open sea (mainly fishes), in contradistinction to the passively drifting plankton (*q.v.*), and the sedentary, bottom-living benthos (*q.v.*). (*See* Marine Biology.)

NELEUS, in Greek legend, son of Poseidon and Tyro, brother of Pelias. The two children were exposed by their mother, who afterwards married Cretheus, king of Iolcus in Thessaly. After the death of Cretheus, the boys, who had been brought up by herdsmen, quarrelled for the possession of Iolcus. Pelias expelled Neleus, who migrated to Messenia, where he became king of Pylos (Apollodorus i, 9; Diod. Sic. iv, 68) and ancestor of the Neleidae, who are historically traceable as the old ruling family in some of the Ionic states in Asia Minor, after the Dorian migration. By Chloris, daughter of Amphion, Neleus was the father of 12 sons (of whom Nestor was the most famous) and a daughter Pero; *cf.* Melampus. According to Pausanias (ii, 2. 2, v. 8. 2) Neleus restored the Olympian games and died at Corinth, where he was buried on the isthmus.

NELLORE, a town and district of India, in the Madras presidency. The town is on the right bank of the Penner river, and has a station on the East Coast railway, 109 mi. N. of Madras city. Pop. (1941) 56,315. There are Lutheran, American Baptist and Roman Catholic missions, and a college.

The District of Nellore has an area of 7,942 sq.mi. It comprises a tract of low-lying land extending from the base of the Eastern Ghats to the sea. Its general aspect is forbidding: the coast line is a fringe of blown sand through which the waves occasionally break. Farther inland the country begins to rise, but the soil is not naturally fertile, nor are means of irrigation readily at hand. About one-half of the total area is cultivated; the rest is either rocky waste or is covered with low scrub jungle. Nellore, with the other districts of the Carnatic, passed under

direct British administration in 1801. The population in 1941 was 1,617,026. The principal crops are millets, rice, and pulses. The breed of cattle is celebrated. The East Coast railway runs through the length of the district.

NELSON, HORATIO NELSON, VISCOUNT (1758–1805), duke of Bronte in Sicily, British naval hero, was born at the parsonage house of Burnham Thorpe, in Norfolk, on Sept. 29, 1758. His father, Edmund Nelson, was rector of the parish and his mother, Catherine Suckling, was a grandniece of Sir Robert Walpole (1st earl of Orford). This connection proved useless to the future admiral, who, in a letter to his brother, the Rev. William Nelson, written in 1784, speaks of the Walpoles as "the merest set of cyphers that ever existed—in public affairs I mean." His uncle, Captain Maurice Suckling later became comptroller of the navy.

Early Life.—Horatio, who had received a summary, and broken, education at Norwich, Downham and North Walsham, was entered on the "Raisonnable" when Captain Suckling was appointed to her in 1770 on an alarm of war with Spain. The dispute was settled, and Captain Suckling was transferred to the "Triumph," the guardship at Chatham, whither he took his nephew. In order that the lad might have more practice than could be obtained in a harbour ship, his uncle sent him to the West Indies in a merchant vessel, and on his return gave him constant employment in boat work on the river. In a brief sketch of his life, which he drew up in 1799, Nelson says that in this way he became a good pilot for small vessels "from Chatham to the Tower of London, down the Swin, and the North Foreland; and confident of myself among rocks and sands, which has many times since been of great comfort to me." Between April and October of 1772 he served with Captain Lutwidge in the "Carcass," in an expedition to the Arctic seas under the command of Captain Phipps (Baron Mulgrave). On his return from the north he was sent to the East Indies in the "Seahorse," in which vessel he met his lifelong friend Thomas Troubridge. At the end of two years he was invalided home. In after times he spoke of the depression under which he laboured during the return voyage, till "after a long and gloomy reverie, in which I almost wished myself overboard, a sudden glow of patriotism was kindled within me, and presented my king and my country as my patron. My mind exulted in the idea. 'Well then,' I exclaimed, 'I will be a hero, and, confiding in Providence, I will brave every danger.'" He spoke to friends of the "radiant orb" which from that hour hung ever before him, and "urged him onward to renown." On his return home he served during a short cruise in the "Worcester" frigate, passed his examination as lieutenant on April 9, 1777, and was confirmed in the rank next day. He went to the West Indies with Captain Locker in the "Lowestoft" frigate, was transferred to the flagship of Sir Peter Parker (1721–1811), and was then promoted in rapid succession to the command of the "Badger" brig, and the "Hinchinbrook" frigate. By this appointment, which he received in 1779, he was placed in the rank of post captain (from which promotion to flag rank was by seniority), at the age of twenty. In the main he owed his rapid rise to his power of winning the affection of his comrades or superiors. Parker and his wife remained his friends through life.

Active Service.—In 1780 he saw his first active service in an expedition to San Juan de Nicaragua; he was brought to death's door by fever, and invalided home once more. In 1781 he was appointed to the "Albemarle" frigate, and after some convoy service in the North Sea and the Sound was sent to Newfoundland and thence to the North American station. "Fair Canada," as he has recorded in one of his letters, gave him the good health he had so far never enjoyed. From Quebec he sailed for the West Indies where he made the personal acquaintance of Admiral Lord Hood. The admiral presented him to the duke of Clarence, afterwards King William IV., as an officer well qualified to instruct him in "naval tactics"—a marked compliment to a very young officer from one of the greatest exponents of the art. He appeared, says the Prince, "to be the merest boy of a captain I ever beheld; and his dress was worthy of attention. He had on a full-laced uniform; his lank unpowdered hair was tied in a stiff Hessian tail of an extraordinary length; the old-fashioned flaps of his waistcoat added to the general quaintness of his figure, and produced an appearance which particularly attracted my notice; for I had never seen anything like it before, nor could I imagine who he was or what he came about. My doubts were, however, removed when Lord Hood introduced me to him. There was something irresistibly pleasing in his address and conversation; and an enthusiasm, when speaking on professional subjects, that showed he was no common being." The slight oddity of appearance, the power to arouse affection, and the glow indicating the fire within, are noted by all who ever looked Nelson in the face.

The Peace of Versailles which closed the American War gave him leisure to visit France, there to study the language of his "country's enemies" and their writings on the subject of naval warfare. And now when the vast majority of naval officers were condemned to idleness on shore, he had the good fortune to be appointed to the command of the "Boreas" frigate, for service in the West Indies. Nelson signalized his arrival in the West Indies by refusing to acknowledge a half-pay officer acting as commissioner of the dockyard at Antigua as his superior. He insisted on enforcing the Navigation Laws against the Americans, who by becoming independent had become foreigners. He called the attention of the government to the corruption prevailing in the dockyard of Antigua. His line impressed the admiralty as somewhat assuming, and his strong measures against the interloping trade brought on him many lawsuits, which, though he was defended at the expense of the government, caused him much trouble for years. In the West Indies on March 12, 1787, he married Frances Nisbet (1761–1831), the widow of a doctor in Nevis, whose favour he first gained by being found romping on all fours with her little boy under the drawing-room table. The marriage was one of affection and prudence, rather than of love.

Outbreak of War.—When war broke out with revolutionary France, Nelson was appointed (Nov. 30, 1793) captain of the "Agamemnon" (64), and joined his ship on Feb. 7. From this date till June 1800, rather more than seven years, he was engaged on continual active service, with the exception of a few months when he was invalided home. This period is the most varied, the busiest, the most glorious and the most debated of a very full career. It subdivides naturally into three sections: (1) From the date of his appointment as captain of the "Agamemnon" till he was disabled by the loss of his arm in the unsuccessful attack on Santa Cruz de Tenerife on July 24, 1797, he served as captain, or commodore, under Hood, Hotham and Jervis, successive commanders-in-chief in the Mediterranean. (2) After an interval of nine months spent at home in recovering from his wound, and from the effects of a badly performed operation, he returned to the Mediterranean, and was at once sent in pursuit of the great French armament which sailed from Toulon under the command of Napoleon for the conquest of Egypt. His victory of the Nile (*q.v.*), on Aug. 1, 1798, placed him at once in the foremost rank among the warriors of a warlike time, and made him a national hero. (3) From his return to Naples after the battle of the Nile until his return to England in the summer of 1800, he was immersed in Mediterranean affairs which, owing to his own presence there, tended to centre round the shores of Naples and Sicily.

The Mediterranean.—The first of these three passages in his life is full of events which must, however, be told briefly. In May he sailed for the Mediterranean with Hood, and was engaged under his orders in the occupation of Toulon by the allied British and Spanish forces. In August 1793 he was despatched to Naples to convoy the troops which the Neapolitan government had undertaken to contribute towards the garrison of Toulon. It was on this occasion that he made the acquaintance of Emma Hamilton (*q.v.*), the wife of Sir William Hamilton, minister at the Court of Naples. References to Lady Hamilton begin to appear in his letters to his wife, but, as might be expected, they indicate little beyond respectful admiration, and he makes a good deal of her kindness to his stepson, Josiah Nisbet, whom he had taken to sea. After the allies had been driven from Toulon by

Napoleon, Nelson was employed throughout 1794 in the operations connected with the occupation of Corsica. In April and May he was engaged in the capture of Bastia, and June and July in the taking of Calvi. During the operations at Calvi, Nelson received a wound in his right eye which healed without leaving disfigurement, though the sight gradually faded. From the date of the occupation of Corsica till the island was evacuated (1794–96) he was incessantly active. He served under Hotham, who succeeded Hood in the command, and was engaged in the indecisive actions fought by him in the Gulf of Lyons in March and July 1795. The complacency of the new admiral fretted the eager spirit of Nelson, who declared that, for his part, he would never think that the British fleet had done very well if a single ship of the enemy got off while there was a possibility of taking her. Happily he was detached to the Riviera of Genoa, where, first as captain, and then as commodore, he had an opportunity to prove his qualities for independent command by harassing the communications of the French, and co-operating with the Austrians. In Sir John Jervis, who superseded Hotham, he found a leader after his own heart. When Spain, after first making peace with France at Basel, declared war on England, and the fleet under Jervis withdrew from the Mediterranean, Nelson was despatched to Elba on a hazardous mission to bring off the small garrison and the naval stores. He sailed in the "Minerve" frigate, having another with him. After a smart action with two Spanish frigates which he took off Carthagena on Dec. 20, and a narrow escape from a squadron of Spanish line of battle ships, he fulfilled his mission, and rejoined the flag of Jervis on the eve of the great battle (Feb. 14, 1797) off Cape St. Vincent. (*See* St. Vincent, Battle of.) The judgment, independence and promptitude he showed in this famous engagement revealed him to the nation as one of the heroes of the navy. Nelson receiving the swords of the Spanish officers on the deck of the "San Josef" became at once a popular figure.

Blockade of Cadiz.—A few days after the victory he became rear-admiral by seniority, but continued with Jervis, who was made a peer under the title of Earl St. Vincent. Nelson's own services were recognized by the K.B. During the trying months in which discontent in the fleet was developing toward the mutinies at Spithead and the Nore, he remained with the flag, and in the blockade of Cadiz. In July 1797 he was sent to Santa Cruz de Tenerife and made a desperate attempt to capture the place. The enterprise was, in fact, rash in the last degree, for the soldiers from the garrisons of Elba and Corsica having gone home, no troops were available for the service, and a fortified town was to be taken by man-of-war boats alone. The Spaniards were on the alert, and the attack, made with the utmost daring on the night of July 24, was repulsed with heavy loss. Some of the boats missed the mole in the dark and were stove in by the surf, others which found the mole were shattered by the fire of the Spaniards. Nelson's right elbow was shot through, and he fell back into the boat from which he was directing the attack. The amputation of his arm was badly performed in the hurry and the dark. He was invalided home, and spent months of extreme pain in London and at Bath. On April 10, 1798, he came back to the fleet off Cadiz as rear-admiral, with his flag in the "Vanguard" (74).

He was now one of the most distinguished officers in the navy. Within the next six months he was to raise himself far above the heads of all his contemporaries. A great armament was preparing at Toulon for some unknown destination. To discover its purpose, and to defeat it, the British government resolved to send their naval forces again into the Mediterranean, and Nelson was chosen for the command not only by Jervis, with whom the immediate decision lay, but also by ministers.

Command in the Mediterranean.—Having joined the flag of Lord St. Vincent outside of the straits of Gibraltar on April 30, Nelson was detached on May 2 into the Mediterranean, with three line-of-battle ships and five frigates, to discover the aim of the Toulon armament. Napoleon had, however, enforced rigid secrecy, and beyond the fact that a powerful combined force was collected in the French port he could learn nothing. On May 20 the "Vanguard" was dismasted in a gale. "I ought not," wrote Nelson, "to call what has happened by the cold name of accident; but I believe firmly that it was the Almighty's goodness to check my consummate vanity." The "Vanguard" was saved from going on shore by the skill of Captain Ball of the "Alexander," for whom Nelson had henceforth a peculiar regard. The "Vanguard" was refitted under cover of the little island of San Pietri off Sardinia. In the meantime the frigates attached to his command had returned to Gibraltar, in the erroneous belief that the liners would be taken there to make good the damage suffered in the gale. "I thought Hope would have known me better," said Nelson. On April 30 he was off Toulon again, only to find that the French were gone. Deprived of his best means of obtaining information by the disappearance of his frigates, he remained cruising till he was joined, on June 7, by Troubridge with ten sail of the line. And now he started on his fierce pursuit of the enemy, seeking him in the dark, for there were no scouts at hand; exasperated at being left without the eyes of his fleet; knowing that St. Vincent would be blamed for choosing so young an admiral; but resolved to follow the enemy to the antipodes if necessary. From Sardinia to Naples, from Naples to Messina, from Messina to Alexandria, from Alexandria, where he found the roadstead empty, back to Sicily, and then when at last a ray of light came to him, back to Alexandria—he swept the central and eastern Mediterranean. Unlike most admirals of his time, he freely discussed his plans with his captains. He had his reward in their devotion and perfect comprehension of what he wished them to do. At the same time he acquired an absolute confidence in the efficiency of his squadron, the magnificent force which had been formed by years of successful war, and by the careful training of his predecessors. The captains were the band of brothers he himself had made them.

The great victory of Aug. 1, 1798 (*see* Nile, Battle of), brought Nelson yet another wound. He was struck on the forehead by a langridge shot, and had for a time to go below. For this victory he was made a baron.

Blockade of Naples.—After providing for the blockade of what remained of the French in Alexandria, Nelson set sail for Naples and arrived there on September 22nd. Pitt's Second Coalition against France was then on the point of completion, and Naples, naturally enough in view of the French behaviour on her borders, was preparing to side with Austria and Russia in the defence of monarchy; indeed she was already organising an army under the direction of the Austrian general, Mack, but no decision as to how the troops should be used had as yet been arrived at. Nelson immediately tried to enliven the proceedings and suggested what should have been a perfectly feasible plan, by which the Neapolitan Army was to advance northwards against the French front, while the fleet was to capture Leghorn, thus cutting the French communications. Leghorn was duly taken, but the army showed little aptitude for fighting, soon becoming a mere disorderly rout, pursued by the French. This had the effect of rousing all the Jacobins in the country which was soon in such an uproar that the royal family found it necessary to retreat to Palermo—an evacuation carried out of course by Nelson and his ships, with the valuable co-operation of Lady Hamilton (*q.v.*), wife of the British Ambassador. From Palermo, Nelson kept up a double blockade—one squadron under Captain Ball was detached to force Malta to capitulate, and another, under Captain Troubridge, was sent to the Bay of Naples to operate against the Neapolitan Jacobins.

The King and Queen, however, found this method of blockade too slow, and determined to appeal to the conservative instincts of many of their subjects, who had lazily acquiesced in the Jacobin coup d'état, through the agency of an eminent ecclesiastic—Cardinal Ruffo. His Eminence landed in Italy, and his appeal for an "Army of the faith" was soon answered by thousands flocking to his banner, and he was even joined by a detachment of Russians and Turks. While these events were taking place, a French fleet of 26 vessels, under Admiral Bruix, set out from Brest and was joined by 17 Spanish warships at Cartagena. Such a force constituted a threat to Nelson who called up his ships


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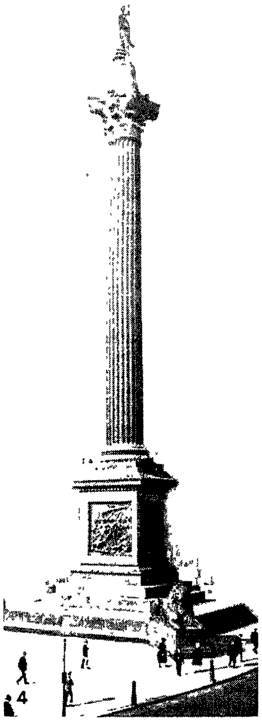
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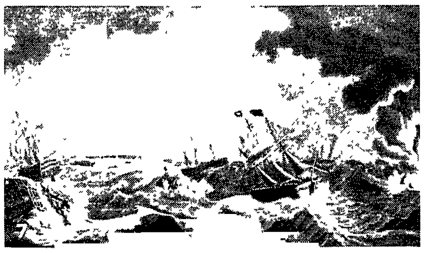
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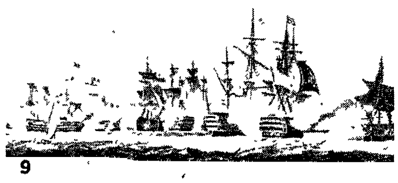
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PORTRAITS OF LORD NELSON AND SCENES RELATING TO HIS LIFE

1. "Lord Nelson in the cabin of the 'Victory'," after a painting by C. Lucy
2. Admiral Lord Nelson, after the portrait by L. F. Abbott
3. "Lord Nelson being carried below in the 'Victory' after being fatally wounded at the Battle of Trafalgar, Oct. 21, 1805." Engraved by James Walker after a painting by J. A. Atkinson
4. The Nelson monument, Trafalgar Square, London. This monument, consisting of a granite column 170 ft. 2 in. high surmounted by a statue of Nelson, was completed in 1844 and stands in the southern side of the square, which is named in commemoration of the admiral's last victory. On the base are represented four battle scenes in bronze, cast from the metal of captured French cannon
5. The "Victory," Nelson's flagship at Trafalgar, which underwent a complete restoration, completed in 1928
6. "Rear Admiral Sir Horatio Nelson." Engraved in 1798 by W. Barnard after a painting by L. F. Abbott
7. "Destruction of the French and Spanish prizes after the victory of Trafalgar." Engraved in 1806 by L. Hall after a painting by J. T. Serres
8. The rectory at Burnham Thorpe, Norfolk, where Nelson was born Sept. 29, 1758. The building was pulled down in 1802
9. "Representation of the Memorable Battle of Trafalgar," an engraving by Jos. Jeakes after a contemporary painting, showing the British fleet engaging the combined fleets of France and Spain. The flagship "Victory" is second from the right

from Malta and Naples and prepared for resistance. He managed, however,—and this was important in view of Ruffo's successful beginning—to maintain the blockade of the latter by means of a squadron of small ships placed under Captain Foote of the frigate "Seahorse."

The Franco-Spanish threat proved an idle one and the allied fleet soon retired, but, in the meanwhile, Ruffo was driving all before him and finally shut up the French in the Castle of St. Elmo, in the city of Naples, and the native insurgents in the sea-washed castles of Uovo and Nuovo. From this commanding position he began to parley with the enemy, and the king, hearing of this, and nervous of what the Cardinal might do—he had not been empowered to make terms of peace—asked Nelson to proceed to Naples and take matters into his hands.

Ruffo's Treaty of Peace.—Nelson sailed for Naples, with Sir William and Lady Hamilton on board, on June 21st, and arrived there on the 24th to find the white flag flying from the castles and from his own flotilla. Supposing this to indicate an armistice, he at once made signal for the resumption of hostilities, only shortly to be informed by Captain Foote that matters had gone further and that a treaty of peace had been signed by which the native insurgents were to be allowed to leave their strongholds with all the honours of war, and were to be carried by ship to countries that would be glad to receive them. In making such a treaty there can be no doubt that Ruffo had greatly exceeded his instructions, though it is probable that he was actuated by motives of humanity since his control over his bloodthirsty army was incomplete. Nelson refused to listen to Ruffo's arguments or to admit the validity of his undertakings. Furthermore, he argued, there was no need for the insurgents, if they unconditionally surrendered as he proposed to make them, to trust themselves to the mob on shore, since they could be accommodated in boats without being taken to friendly countries. He agreed to let the armistice run its course, but let it be known that at the end of it he would expect unconditional surrender. This he received, and the rebels were placed in boats. One, Carraciolo, reached the hills, only to be caught at last and brought to Ruffo who, in his turn, because Carraciolo was a naval officer, handed him over to Nelson in his capacity as Commander-in-Chief of the Neapolitan fleet. Nelson at once convened a court martial of Neapolitan officers to try the rebel. The Court sentenced him to death by a majority vote, and this sentence was duly carried out.

For refusing to carry into effect Ruffo's peace terms and for not interfering to prevent the execution of Carraciolo, Nelson has been violently, and at times virulently, attacked, but it cannot be said that his traducers had ever succeeded in making out a very strong case against him. The whole matter is too involved to be fully discussed here; the conclusions which have been reached by scholars on either side have almost invariably reflected the political *parti pris* of the writers.

The whole question of Nelson's conduct at Naples is of course bound up with his friendship with Lady Hamilton. No one denies that it was now that Nelson's friendship for this woman ripened into the intimacy that was eventually to separate him from his wife. But that a private attachment, culpable as it may have been, warped his judgment in public matters no one has yet shown, nor has anyone explained why it should.

Return to England.—These events were shortly followed by the reduction of the French and by the restoration of the Neapolitan royal family in July, while in the same month Nelson laid himself open to a sharp rebuke from the Admiralty for disobeying the orders of Lord Keith who had been appointed to succeed Lord St. Vincent in the Mediterranean command. Keith, puzzled as to the objective of a combined Franco-Spanish fleet, decided that Minorca was in danger, and ordered Nelson to its defence. Nelson decided that it was not in danger and did not go. His judgment was correct, but his disobedience was inexcusable. On Jan. 20th, 1800, having in the meantime been created Duke of Bronté by the King of Naples, Nelson joined Keith at Leghorn to take part in an attempt on Corsica, during which he captured "Le Généreux" which had escaped him at the Nile. Shortly afterwards he obtained leave to go home and, not being spared a battleship, he travelled overland with Sir William and Lady Hamilton, being greatly fêted on the way. He landed in England in November.

Battle of Copenhagen.—His leave, though it was long enough to promote the final separation between him and his wife, was short. He became Vice-Admiral on Jan. 1, 1801, and soon after was offered the post of second-in-command to Sir Hyde Parker in the fleet which was to break up the armed neutrality of the northern powers. It is difficult to see why such a brilliant man was subordinated to one of such ordinary gifts as Parker, who appears at the beginning to have been suspicious of the abilities of his second-in-command. Nelson, however, choked down his natural disgust, and treated Parker with such tact that the Admiral's hostility soon melted into something approaching friendship. Indeed Nelson had his Commander-in-Chief to some extent under his thumb by the time they reached Copenhagen, and so was permitted, with rather more than half the fleet, to carry out his famous attack on the city and its defences that resulted in the battle of Copenhagen (*q.v.*). This battle showed up strongly Nelson's ability to hit upon the weak point in a defensive scheme, and is famous also for his action in putting his telescope to his blind eye when, in the middle of the fight, his attention was directed to Parker's signal ordering his withdrawal, and declaring he could not see it. It was an order that could not be obeyed without serious consequences to the fleet. In May, Parker was recalled and Nelson assumed the command, but the armed neutrality was dissolved and this left him with little to do. His health, too, was bad and in June he came home, his services being recognised by the bestowal of the title of Viscount. In the interval, before the Peace of Amiens, he was in command of a flotilla of small ships that were to combat Napoleon's threat of invasion. More in the hope of satisfying public opinion than for any other reason, an attack was launched on Boulogne with the object of destroying the flat-bottomed boats situated there. The port, however, was too strongly defended even for a Nelson.

During the short period of the Peace of Amiens (1802–3), Nelson, in company with Sir William and Lady Hamilton, lived at his house and estate that he had purchased at Merton in Surrey. Here he passed his days in quiet country pursuits, and his happiness was added to by a reconciliation with his father who had at first found it impossible to overlook his son's association with Lady Hamilton. This, probably the happiest period of his life, was all too short. War reopened in May, and Nelson was at once selected for the Mediterranean Command.

The Mediterranean Command, 1803.—He arrived off Toulon in July 1803, and instituted a strict blockade of that port. The French under Latouche-Tréville continually tried to lure him into indecisive actions in which, by damaging some of his ships, they might force him to withdraw, but Nelson consistently refused such offers and the French Admiral, writing to Napoleon, stated that he had offered battle but the English had withdrawn. Nelson declared that if he captured Tréville he would make him eat the letter, but he never had the chance to fulfil his boast, even figuratively, for Tréville died and was succeeded by Villeneuve. In the spring of 1805 the French eluded the blockade and made for the West Indies. This move was part of a large scheme directed towards the invasion of England and its details are too numerous for discussion. The series of naval movements arising from it are known as the Trafalgar Campaign, and the whole matter will be found fully dealt with under NAPOLEONIC CAMPAIGNS. Nelson, after searching the Mediterranean, decided, more by intuition than anything else, that Villeneuve had gone to the West Indies, and thither he followed him. On hearing of his enemy's arrival, Villeneuve returned precipitately to Europe, again pursued by Nelson, and got into Ferrol and then into Cadiz where he was blockaded by Collingwood, Nelson having meanwhile gone home on leave to enjoy again the rural delights of Merton. His enjoyment was indeed brief. No sooner had the news reached England that the allied fleet was in Cadiz than, with the approval and encouragement of Lady Hamilton, he offered his services, "to give M. Villeneuve a drubbing." They were immediately accepted, and he left Merton for the last time

on Sept. 13th and on the 29th was off to Cadiz.

Trafalgar.—The victory of Trafalgar (*q.v.*) which followed on Oct. 21 set the seal on his fame. Tactically it was a masterpiece and his famous signal "England expects that every man will do his duty," made as the fleet moved into battle, together with his death in the moment of victory, added, and still add, to its lustre. The "Victory," after passing through the French line, was engaged with the "Bucentaure" and the "Redoutable," and Nelson, as he walked up and down his quarter-deck with his flag-captain, Thomas Hardy, was struck by a bullet from a sharpshooter firing from the top of the last-named ship. His spine was broken, and he was carried below to the cockpit, suffering great pain. Here, amidst the din and racket of battle and the groans of the injured and dying, he lingered for a few hours. To the last he retained his interest in the battle and Hardy came to him from time to time to tell him of its progress. As his sight grew dimmer and he felt the end approaching he asked Hardy to kiss him. "Now I am satisfied," he said, "Thank God I have done my duty." "These words," says Southey in his moving account, "he repeatedly pronounced and they were the last he uttered." His body was brought home and laid in state in the Painted Hall at Greenwich Hospital, and was buried in St. Paul's.

So died the most famous of English seamen, and, indeed, the most famous of all seamen. He was more than merely a tactically and strategically brilliant Commander; he was a true leader of men—and men of all types, for the common seamen trusted and venerated him as much as did his officers. These latter were, in their turn, trusted by him and were ever in his confidence—his "band of brothers" he called them. No officer under Nelson could ever complain that he went into action not knowing his Commander's plans and intentions—and it is as much to this as to his tactical ability that his successes were due. The common seamen he always treated with humanity and kindness and these qualities were extended to his junior officers whom, remembering his own misery during his first days at sea, he was ever willing to encourage. On the other side it has been said that he was vain, liked flattery, and was an egotist. This is merely to say that he had the common faults of genius.

Nelson had no children by his wife. In November 1805, in recognition of Nelson's great services to his country, his brother William (1757–1835) was created Earl Nelson of Trafalgar.

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NELSON, a city in British Columbia, situated at the head of navigation on the west arm of Kootenay lake. Pop. (1951) 6,634. It is the commercial and administrative centre of a mining, lumbering, fruit-growing district and is the headquarters of the Kootenay division of the Canadian Pacific. It is also a station on the Great Northern railway. Chief manufactures include match blocks, wire, veneers, jams, doors, beer, machinery.

NELSON, a municipal borough in the Nelson and Colne parliamentary borough, Lancashire, Eng., 32½ mi. N. from Manchester by the London Midland Region railway. Pop. (1951) 34,368. Area 5.4 sq.mi. Of modern growth, it possesses a town hall, market hall, free library, technical school, park and recreation ground. The transport services are controlled by a committee including Burnley and Colne. Nelson's chief products are cotton and synthetic fibres. It was incorporated in 1890.

NELSON, a seaport of New Zealand, the seat of a bishop and capital of a provincial district of the same name; at the head of Tasman bay on the northern coast of the South Island. Pop. (1945 census) 13,030 (16,577 with suburbs). It has a mild climate. The town and the district surrounding are famous for apple orchards; and hops are extensively cultivated. Christ Church cathedral is finely placed on a mound which was originally intended as a place of refuge from hostile natives. The harbour is protected by the long and remarkable Boulder Bank, whose southern portion forms the natural breakwater to that anchorage. The chief industries are meat- and fruit-preserving and timber milling. Nelson is connected by rail with Blenheim and Christchurch, and by steamer and air service with Wellington. The settlement was established by the New Zealand company in 1841.

NELSON, a river of Keewatin district, Canada, discharging the waters of Lake Winnipeg in a northeasterly direction into Hudson bay. It drains an area of 360,000 sq.mi. and, including its tributary the Saskatchewan, is 1,600 mi. long. It is navigable for small steamers for a distance of about 80 mi., after which it is unnavigable except for canoes. It has a total fall between the lake and sea of 710 ft. Here its chief tributary is the Burntwood. Norway house at its source and York factory at its mouth are important stations of the Hudson's Bay company.

NELSON, a hold in wrestling. *See* WRESTLING.

NELSONVILLE, a city of Athens county, Ohio, U.S.A., 62 mi. S.E. of Columbus, on the Hocking river and the Chesapeake and Ohio railway. Pop. (1950) 4,845; and (1940) 5,368. It is an important coal-mining centre, and makes brick and tile from the clay which abounds in the vicinity. The city was founded in 1818 and incorporated in 1838. It was named after Elisha Nelson, who built the first house.

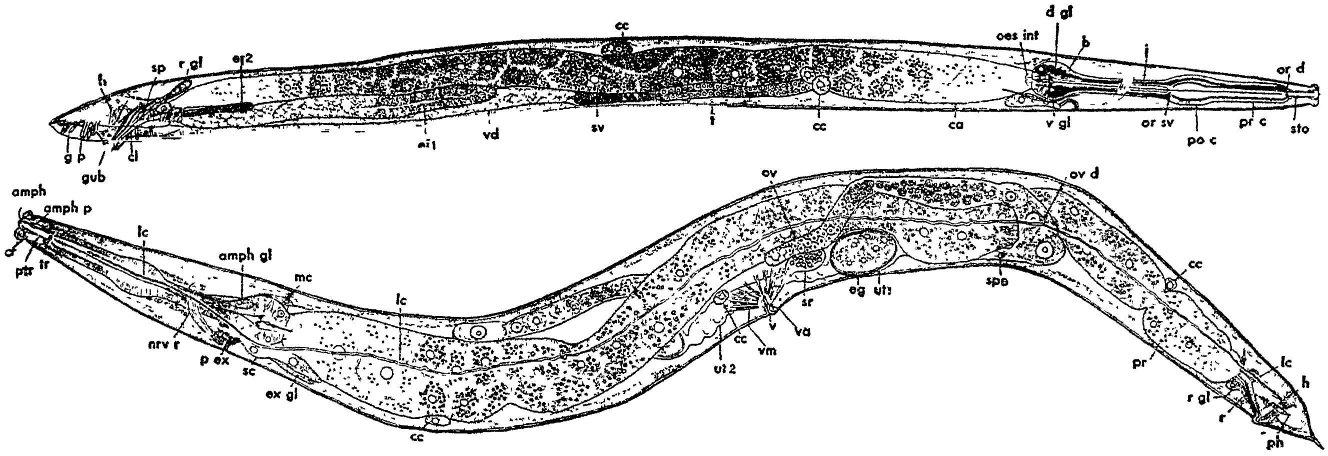
NEMATHELMINTHES, a term employed in zoology to denote a phylum of animals comprising the round-worms (Nematoda, *q.v.*) hook-worms (Acanthocephala), Nematomorpha (*q.v.*), to which are sometimes added the arrow-worms (Chaetognatha, *q.v.*), and various other groups of minor importance and doubtful affinities. Nemathelminthes is probably, even in its most restricted sense, an artificial group.

NEMATODA, a group of unsegmented roundworms ("threadworms") formerly placed with the Acanthocephala and Nematomorpha (*qq. v.*) in a phylum Nemathelminthes, now ranked as a distinct phylum related more closely to the Rotatoria and Gastrotricha. Nematodes vary in size from one-fourth of a millimetre to a metre in length. Free-living soil and aquatic species are mostly small (not more than 5 mm. long), while species parasitic in animals tend to be larger. Microscopic species are commonly called "eelworms," this terminology being highly descriptive of the general body form and mode of locomotion.

Nematodes are of practically universal occurrence; nearly every sample of soil or natural water, nearly every plant and nearly every animal has its nematode inhabitants. Thousands of species in the oceans, streams, woods and cultivated fields are harmless saprophytes, or prey upon other microscopic soil fauna. However, a few hundred species have become widely known because of intimate association with man or his domestic animals and plants. The vinegar eel, *Turbatrix aceti,* is a harmless saprophyte used as class material in laboratories. The wheat eelworm, *Anguina tritici,* is best known for its ability to remain dormant in the dry wheat kernel, having been revived after 20 years of dormancy. The Guinea worm, *Dracunculus medinensis,* is the most ancient known parasite of man, since the plague of fiery serpents visited upon the Israelites (Num. 21:6-9) is supposed to have been caused by this parasite. The Guinea worm reaches several feet in length, and at maturity it is coiled just under the skin where it causes a blister. To avoid blood poisoning, treatment involves extraction of the nematode without breaking. Moses is supposed to have set up the brass serpent to impress upon his people the need for complete extraction.

General Morphology.—Basically cylindrical animals; form of gravid females sometimes modified, *i.e.,* fusiform, saclike, or pear-shaped; bisexual, males commonly less numerous and smaller than females.

External covering, a simple or complex, noncellular cuticle, striated or annulated in some forms and often bearing setae (free-living forms). Beneath this layer there is a cellular or syncytial hypodermis, which commonly projects into the body cavity in the form of lateral and median chords; the latter contain the longitudinal nerves and the lateral excretory tubes. Laterally or sublaterally situated unicellular hypodermal glands may empty externally through cuticular pores. Aquatic species usually have a terminal caudal pore through which caudal glands extrude an adhesive thread. A single layer of longitudinal unstriated muscle cells is situated beneath the hypodermis and between the chords. Thus the body wall is composed of three layers, the cuticle, hypodermis and somatic musculature. The body cavity is not segmented but is often traversed by specialized muscles, *i.e.,* male copulatory muscles, vulvar muscles and somato-intestinal muscles. Pseudocoelomic membranes and mesenteries form an incomplete lining of the body cavity, covering musculature to a greater or lesser extent and supporting the reproductive system and digestive tract, which otherwise floats freely in the liquid-filled body cavity. There is no circulatory system.



FROM CHITWOOD AND CHITWOOD, "AN INTRODUCTION TO NEMATOLOGY"

FIG. 1.—RHABDITIS STRONGYLOIDES

amph, amphid
amph gl, amphidial gland
amph p, amphidial pouch
b, bulb
ca, cardiac region
cc, coelomocyte
cl, cloaca
cr, cheilorhabdion
d gl, dorsal gland
eg, fertilized egg
ej1, ejaculatory gland (cement gland)
ej2, (supplementary rectal gland)
ex gl, excretory gland
g p, genital papillae
gub, gubernaculum
h. dilator ani
i, isthmus
lc, lateral canal
mc, mesenterial cell
nrv r, nerve ring
oes int, oesophago-intestinal valve
or d, orifice dorsal gland
or sv, orifice subventral gland
ov, ovary
ov d, oviduct
p ex, excretory pore
ph, phasmid
po c, metacorpus
pr c, procorpus
pr, prerectum
ptr, protorhabdions
r, rectum
r gl, rectal gland
s c, sinus cell
sp, spicule
spe, sperm
sr, seminal reservoir
sto, stoma
sv, seminal vesicle
sv gl, subventral gland
t, testis
tr, telorhabdion
ut, uterus
v, vulva
va, vagina
vd, vas deferens
vm, vulvar muscles

The tubular digestive tract consists of the anterior terminal oral opening, the mouth cavity or stoma, oesophagus, oesophago-intestinal valve, intestine, intestino-rectal valve, rectum and ventral or subterminal anus in the female. In the male the rectum and gonoducts empty into a common cloaca. All parts of the digestive tract except the intestine are lined with cuticle, which is apparently of ectodermal origin.

The oral opening is usually surrounded by three or six lips bearing six groups of tactile papillae and two lateral pores, the amphids, which are supposed to be chemical sense organs. In some forms the oral opening is directly followed by the oesophagus, while more commonly there is a cylindrical, prismoidal or capsuliform stoma. The stoma may contain a protrusible hollow spear or stylet. In other forms the stoma may contain variously formed teeth. The oesophagus is basically a triradiate, syncytial, muscular, sucking organ often equipped with a valvular sucking bulb. Digestive glands and nerve cells are situated within the syncytial musculature. The oesophageal glands open into the lumen of the oesophagus. The general form of the oesophagus and the position of oesophageal gland orifices are much used in taxonomic work. The intestine is composed of a single layer of low cuboidal to columnar epithelial cells usually bearing an internal "bacillary border," homologous with cilia in other organisms. Usually the intestine is a simple tube, but occasionally there are outpocketings or caecae, and rarely it becomes atrophied or is transformed into a solid storage organ, the trophosome. Rectal or cloacal glands usually empty into the digestive tract just posterior to the intestino-rectal valve.

The female reproductive system is composed of two, one, or rarely three to many tubular ovaries continuous with uteri opening into a single vagina with vulvar orifice on the ventral side of the body, between the excretory pore and the anus. Sexes are usually separate but occasionally parthenogenic or hermaphroditic forms occur, in which latter case sperm are produced by ovarian cells and males are not necessary in reproduction.

The male reproductive system is composed of one or two tubular testes continuous with seminal vesicle, *vas deferens* and ejaculatory duct, opening ventrally with the rectum into a common cloaca. Secondary male sexual organs, the paired (or single) sclerotized spicules, are formed in the dorsal wall of the cloaca. These are inserted into the female during copulation. Sometimes the cuticle of the caudal region of the male is expanded in the form of caudal alae or a bursa (supported by muscular rays), which aids in copulation.

The nervous system is composed of a group of ganglia in the cervical region joined by a perioesophageal ring or commissure, from which six nerves extend anteriad to tactile cephalic papillae and to the amphids or chemoreceptors. The ventral nerve, situated in the hypodermis, extends posteriad from the nerve ring to the anal region and contains several ganglia; it is connected by hypodermal commissures with the dorsal and lateral nerves which are also situated in the hypodermis. Sublateral and caudal or genital tactile papillae are often present, and in one class, the Phasmidia, there is a pair of posterior lateral chemoreceptors, the phasmids.

The excretory system may take the form of a single ventral gland cell or a more complex closed lateral tube system, but in either case it opens ventrally through a cervically situated excretory pore.

Development.—Nematodes may be oviparous, viviparous or ovoviviparous; cleavage is determinate, each of the first few cells being destined to form a specific part of the body. The larva, at hatching, commonly resembles the adult except in those forms of parasites in which the stoma and oesophagus of the free-living saprophytic larva become modified in keeping with new feeding habits in the parasitic stages (*e.g.*, hookworm, *Ancylostoma duodenale*). Growth is marked by a series of cuticular moults (usually four), without internal reorganization. The gonads develop in the body cavity and attain connection with the vulva in the female and cloaca in the male at the time of the last moult. Free-living nematodes tend to produce only a few young, one at a time; each uterus usually contains from one to ten eggs, and both uterus and ovary are relatively short tubes with not more than one flexure. As parasitism becomes more advanced, there is an increase in egg production correlated with extensive coiling and complexity of the ovaries and uteri.

Plant-parasitic nematodes may remain dormant in soil, passing the winter in the egg stage, hatching in the spring to infect new hosts (the root knot nematode, *Heterodera marioni*); the eggs may be encased in a cyst formed by the body of the dead mother (the golden nematode of potatoes, *H. rostochensis*), in which case they may remain dormant five to ten years in the absence of the proper host plant; in other cases it is the fourth-stage larva which has the ability to lie dormant (the wheat eelworm, transmitted in the seed itself). Plant parasites all appear to have some period in their life in which stopover privileges are provided.

Animal-parasitic nematodes usually have a period of development outside the final host. The eggs may have a period of incubation outside the host, after which they hatch when swallowed with contaminated feed or water (*Ascaris lumbricoides*); they may hatch in faeces, feed as saprophytes passing through required growth stages and then infect the final host by active penetration of the skin (*Ancylostoma duodenale*, cause of ground itch), or they may be taken in orally with contaminated feed (grass in the case of trichostrongyl parasites of ruminants). The life history is said to be direct if only one host is required. Development is indirect when eggs or larvae must first enter another or intermediate host, there undergoing required growth stages before infecting the final host. This is the case in the Guinea worm, whose larvae infect the water flea, *Cyclops*, and are finally acquired by man when he swallows the infected *Cyclops* in drinking water. Finally there is the type of indirect development represented by *Wuchereria bancrofti* (cause of filariasis in man) and *Dirofilaria immitis* (cause of heartworm in dogs); in these cases the parasites pass their larvae into the blood stream, from which they are acquired by biting insects (mosquitoes), and, after passing growth stages in the intermediate host, re-enter the final host through the skin. Animal parasites may immediately take up residence in that part of the final host in which they mature (*Enterobius vermicularis*, the pinworm of man), or they may go through extensive migrations, from the intestine, through the blood stream to the lungs, then be coughed up and swallowed before settling down in the intestine (*e.g.*, *Ascaris lumbricoides*). Some of the most extensive damage is done to the host in the migrations.

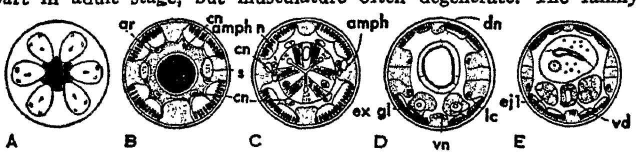
Classification.—Class Phasmidia. Nematodes with lateral caudal pores, phasmids, simple porelike amphids, a tubular excretory system. Hypodermal glands, setae and caudal glands absent.

Order Rhabditida.—Oesophagus essentially consisting of three parts: corpus, isthmus and bulbar region (at least in larval stages).

Suborder Rhabditina.—Vagina transverse, simple reproductive system. Free-living primitive parasites of animals, all plant parasites.

Superfamily Rhabditoidea.—Stoma not styletiform, oesophagus three-part in adult stage. Saprophytic (Rhabditidae, Cephalobidae, Cylindrogasteridae, Diplogasteridae [*Turbatrix aceti*]); parasites of molluscs and amphibians (Angiostomatidae), parasites of earthworms (Drilonematidae), of insects (Steinernematidae), and parasites of vertebrates with alternation of generations, one generation saprophytic, other parasitic (Rhabdiasidae, Strongyloididae).

Superfamily Tylenchoidea.—Stoma styletiform, oesophagus three-part in adult stage, but musculature often degenerate. The family



FROM CHITWOOD AND CHITWOOD, "AN INTRODUCTION TO NEMATOLOGY"

FIG. 2.—RHABDITIS STRONGYLOIDES (CROSS SECTIONS, DIAGRAMMATIC)
A—Head; B—Stomatal region; C—Oesophageal region; D—Anterior intestinal region; E—Posterior region of male. *ar*, arcade; *cn*, cephalic nerve; *s*, sensilla of amphid; *dn*, dorsal nerve; *ex gl*, excretory gland cell; *lc*, lateral canal of excretory system; *vn*, ventral nerve *ejl*, ejaculatory gland; *vd*, vas deferens; *amph*, amphid; *amph n*, amphidial nerve

Tylenchidae includes all known plant-parasite nematodes, the better-known being the root-knot nematode, *Heterodera marioni* (with more than 1,000 host plants); the stem-and-bulb eelworm, *Ditylenchus dipsaci*; the chrysanthemum nematode, *Aphelenchoides oleisistus*; and the wheat eelworm, *Anguina tritici*. This group feeds by inserting the stylet into plant cells and sucking the juices. Economic losses caused by the nematode parasites of plants probably exceed those due to animal parasites, though they are less spectacular. There is scarcely a single cultivated crop in any part of the world that is not limited in its production or extensive use because of injuries sustained or anticipated from plant-parasitic nematodes. "Land sickness" is often due to building up of heavy nematode soil populations. The Tylenchoidea also include the Allantonematidae, which are parasites of insects, the insects becoming infected through the ingestion of eggs or larvae and the larvae then penetrating the intestinal wall to reach the body cavity or gonoducts, where they reach adulthood.

Suborder Strongylina.—Vagina tubular, reproductive system highly developed. Oesophagus of adult never terminated by bulbar swelling, lips usually rudimentary. Parasites of vertebrates in adult stage, young larvae usually saprophytic in soil or faeces, final host infected orally or through skin. Earthworms, molluscs and arthropods occasionally act as vectors.

Superfamily Strongyloidea.—Stoma well developed, body usually thick. Families Strongylidae and Ancylostomatidae (inhabit intestine, *e.g.*, hookworms), Syngamidae (urinary or respiratory system, *e.g.*, gapeworms), Cloacinidae and Diaphanocephalidae (intestine of marsupials and reptiles, respectively).

Superfamily Trichostrongyloidea.—Stoma rudimentary, body thin. Parasites of digestive tract of all groups of vertebrates. Families Trichostrongylidae and Heligmosomidae.

Superfamily Metastrongyloidea.—Stoma rudimentary, body thin. Parasites of respiratory system of mammals. Families Metastrongylidae and Pseudaliidae.

Suborder Ascaridina.—Vagina tubular, reproductive system highly developed; oesophagus of adult usually terminated in bulbar swelling; three or six lips, generally well developed. Parasites of digestive tract of arthropods or vertebrates in adult stage; infection usually direct. Families Thelastomatidae and Rhigonematidae (parasites of arthropods); Oxyuridae (*e.g.*, *Enterobius vermicularis*, pinworm of man), Atractidae, Cosmocercidae, Kathlaniidae, Heterakidae, Quimperiidae and Ascarididae (*e.g.*, *Ascaris lumbricoides*), include parasites of all groups of vertebrates.

Order Spirurida.—Oesophagus divisible into two regions, a narrow muscular anterior part and a wide, glandular, posterior part; vagina tubular; adults parasitic in vertebrates, larvae in arthropods.

Suborder Camallanina.—Oesophageal glands uninucleate, phasmids of larvae pocketlike; intermediate hosts, copepods. Families Camallanidae and Cucullanidae, with well developed stoma, parasites of digestive tract of fish, amphibia and reptiles; families Dracunculidae (*e.g.*, Guinea worm) and Philometridae, with rudimentary stoma, tissue parasites of vertebrates.

Suborder Spirurina.—Oesophageal glands multinucleate, phasmids of larvae porelike; intermediate hosts, arthropods. Parasites of all parts of body of all groups of vertebrates; those with a well-developed stoma or lips usually inhabit digestive tract in adult stage (families Thelaziidae, Spiruridae, Acuariidae, Gnathostomatidae and Physalopteridae), and are usually transmitted by scavenger insects or copepods; those with rudimentary stoma and lips inhabit tissues or the blood stream and are transmitted by sucking insects, *i.e.*, mosquitoes, stable flies (families Dipetalonematidae, Stephanofilariidae, Desmidocercidae and Filariidae, *e.g.*, heartworm).

Class Aphasmidia.—Nematodes without lateral caudal pores (phasmids), amphids often externally modified, excretory system absent or not tubular; hypodermal glands, setae and caudal glands commonly present; caudal alae usually absent.

Order Chromadorida.—Amphids basically spiral or circular, subventral oesophageal glands opening in mid-region of oesophagus, posterior part of oesophagus not greatly elongated, usually bulbar. Free-living in soil, fresh water or marine, rarely commensal.

Suborder Monhysterina.—Oesophago-intestinal valve vertically flattened or circular, ovaries outstretched or reflexed. Amphids uni- or dispiral, ovaries reflexed, ends of oesophageal lumen tuboid: families Plectidae and Camacolaimidae. Amphids spiral, ovaries outstretched, ends of oesophageal lumen tuboid: families Axonolaimidae and Comesomatidae. Amphids circular, ovaries outstretched, ends of oesophageal lumen convergent: families Monhysteridae, Linhomoeidae and Siphonolaimidae.

Suborder Chromadorina.—Oesophageal-intestinal valve basically triradiate; ovaries reflexed; amphids circular spiral or vesiculate. Includes families Desmoscolecidae and Greeffiellidae, with vesiculate amphids, coarsely annulated cuticle and tubular gland setae; families Desmodoridae, Epsilonematidae and Draconematidae, with basically spiral amphids, and annulated cuticle; and families Chromadoridae, Cyatholaimidae, Microlaimidae and Tripyloididae, with basically spiral amphids, cuticle punctate or finely striated.

Order Enoplida.—Amphids pocketlike or porelike (parasites), oesophagus cylindrical, conoid or greatly elongated posteriad.

Suborder Enoplina.—Dorsal oesophageal gland opens into stoma, sublateral rows of somato-intestinal muscles absent. Free-living, aquatic or terrestrial. Includes families Enoplidae, Oncholaimidae and Ironidae, with subventral glands opening into stoma; and families Tripylidae, Mononchidae and Alaimidae, with subventral glands opening into mid-region of oesophagus.

Suborder Dorylaimina.—Mouth with protrusible stylet, sublateral rows of somato-intestinal muscles absent, dorsal and subventral glands opening into mid-region of oesophagus. Includes families Dorylaimidae, Leptonchidae and Diphtheroporidae, which are free-living, usually terrestrial or fresh water, with well-developed oesophageal musculature. Families Mermithidae and Tetradonematidae, larval stages parasitic in arthropods, adult free-living in soil or fresh water but do not feed; oesophagus degenerate, glands reduplicate in double chain of cells. Families Trichuridae, Trichinellidae (*Trichinella spiralis*) and Cystoopsidae, adults parasitic in vertebrates, posterior part of oesophagus degenerate with reduplicate glands usually in single chain; with direct life history, eggs infective (*Trichuris*); with indirect life history, arthropods or annelids serving as intermediate hosts (*Cystoopsis*, *Capillaria*); with indirect life history, larvae in muscles of first mammal, orally infective to second mammal (man), in which adult matures and larvae migrate from intestine to muscles (*Trichinella spiralis*).

Suborder Dioctophymatina.—Dorsal and subventral oesophageal glands opening into stoma; four sublateral rows of somato-intestinal muscles. Adults and late larval stages parasitic in vertebrates, young larval stages parasitic in arthropods. Families Sobolophymatidae and Dioctophymatidae (*e.g.*, *Dioctophyma renale*, kidney worm of man). (B. G. C.)

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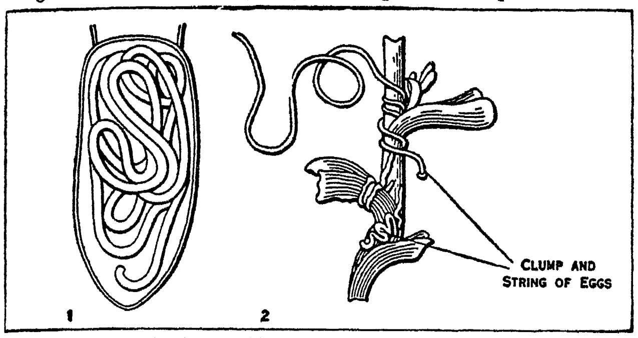
NEMATOMORPHA (Gordiacea or "hairworms"), a group of elongate, thread-like, unsegmented worms, probably related to the Nematoda (*q.v.*), but differing from them in certain respects. The adults occur mainly in fresh water (occasionally in wet earth), and are sometimes found in tangled masses. The species vary in length from a few inches to two or three feet, but none are thicker than whipcord. They are usually of a brownish colour.

The body-wall consists of (1) a stout cuticle, with an outer layer (smooth or with shagreen-like "areoles," sometimes bearing spines or bristles of various kinds) and an inner layer of obliquely crossed fibres; (2) a single subcuticular layer of cells; and (3) a layer of longitudinal muscle-fibres. Most of the space within the body-wall is filled with parenchymatous tissue, in which the internal organs are embedded. There is an alimentary canal, opening posteriorly into a cloaca together with the genital ducts. A

mouth is usually absent in the adult. No circulatory or excretory organs are known. There is a single ventral nerve-cord, with anterior and posterior ganglia.

The sexes are separate, the males being usually smaller than the females and, in some genera, distinguishable by having the tail bifurcate. The tail of the female is usually undivided, but in *Paragordius* it has three prongs. The gonads are paired in both



FROM "THE CAMBRIDGE NATURAL HISTORY" (MACMILLAN)

FIGS. 1 AND 2.—GORDIID WORMS (MAGNIFIED)

1. Abdomen of a beetle (*Pterostichus niger*), with the terga removed, showing a gordiid worm within
2. A female gordiid worm depositing its eggs on a water plant

sexes, and are continuous with their ducts. In the gravid female the ovaries give off thin-walled lateral pockets, which ultimately break down and discharge the ova into spaces in the parenchyma. The eggs, held together by a cement-like substance, are laid in strings or masses, usually on plants or stones under water. The first larval stage is a minute creature armed with spines and having a boring organ anteriorly, by means of which it enters a host (usually an aquatic animal). In species which attack insects such as grasshoppers, the second larval stage may apparently be reached without change of host. In others it may develop in a second host, usually a beetle, which preys upon the first. The second larval stage is elongate and worm-like, and develops directly into the adult form. Pigment is developed, and the larval cuticle shed, just before emergence from the host. This usually takes place on contact with water, the worm bursting its way out through a soft place in the body-wall.

The group includes the genera *Gordius, Paragordius, Chordodes* and *Parachordodes,* to which a fifth, *Gordionus,* has been added by G. W. Müller. It is still uncertain whether *Nectonema* (a pelagic marine form provided with rows of bristles) is more closely related to this group or to the Nematoda. (H. A. B.)

NEMEA, BATTLE OF, 394 B.C. This was the decisive battle, in the sense that it broke the force of the hostile offensive, of the "Corinthian War," against Sparta, waged by the coalition of Thebes, Corinth, Athens and Argos, but instigated by Persia. In its initial pattern it was the typical frontal battle of the time, and both lines as they advanced experienced the characteristic "drift" to the right, so that each right wing overlapped the opponent's left wing. Thus on one flank the Spartans dispersed the Athenians, and on the other Sparta's allies were shattered by the Argives and Corinthians. Then, however, the Spartans, instead of pursuing blindly ahead like Clearchus and his men at Cunaxa, checked their pursuit and caught in flank three successive bodies of the enemy as they were marching back to their base. With this success the menace to Sparta waned, and the initiative in further operations passed to her. (*See* further CUNAXA, BATTLE OF, 401 B.C.; CORONEIA, BATTLE OF.)

NEMERTEA (NEMERTINEA). The nemerteans, or nemertines, commonly called ribbon worms, which constitute the invertebrate phylum Nemertea, are characterized by the soft, extensible, ciliated body, without external indication of segmentation and without distinct body cavity, the internal organs being separated by gelatinous parenchyma; the body is provided with a highly specialized eversible proboscis and a usually straight intestine opening at the posterior end of the body (fig. 1). There are no external appendages except the caudal cirrus, sucker and tentacles, found in a few species.

Nemerteans vary greatly in size and shape; some are long, flattened and ribbonlike and may grow to a length of 1 to 4 metres (fig. 3); others are threadlike and from a few millimetres to several metres in length when mature; some are cylindrical (fig. 2); others are broad and flat. In nearly all forms the body may be contracted to a small fraction of the length which it has in full extension.

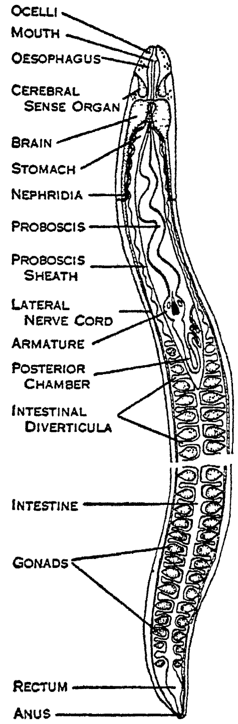


FIG. 1.—ORGAN SYSTEMS OF A HOPLONEMERTEAN

Most of the species are marine and littoral; many of them burrow in sand or mud; others hide beneath stones or creep about among algae and other growths between tide marks or in shallow water. The members of the tribe Pelagica are strictly bathypelagic, with flattened, gelatinous bodies adapted for floating idly or swimming sluggishly far beneath the surface of the deep oceans. A few species inhabit fresh-water streams and lakes; others have migrated to the land, living in moist earth or beneath fallen logs, stones or dead foliage. Certain species live as commensals in the mantle cavities of pelecypods or of tunicates, in the canals of sponges or beneath actinians; and finally there are several species which are parasitic on the gills and among the egg masses of crabs.

The nemerteans are all carnivorous, feeding on protozoa, turbellarians and other worms, molluscs, crustaceans and the young of all the invertebrates with which they come in contact. Some have such distensible mouths that they can devour animals of almost their own diameter. Others have small mouths and suck in only the juices of their prey.

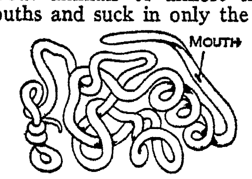


FIG. 2.—A PALEONEMERTEAN, PROCEPHALOTHRIX SPIRALIS

When food is not obtainable the nemertean is able to live for a long time upon the nourishment to be obtained from its own tissues. Individuals of some species may thus survive starvation for a year or more. In the meantime the body may have shrunk to a small fraction (1/20 or less) of its former size. Some of the small forms may survive unfavourable conditions by coiling their bodies in a firm cyst of secreted mucus, to resume activity at a later time.

Many of the species are brightly coloured in life, with shades of red, orange, yellow, green, gray and brown predominating. Some have a uniform coloration, while others have definite patterns or markings of contrasting colours, with rings, longitudinal lines, spots or reticulations. The physical basis of the colour patterns consists of pigment granules secreted within the epithelial cells of the integument or in the underlying connective tissue cells or both.

Morphology and Physiology.—The morphological character-

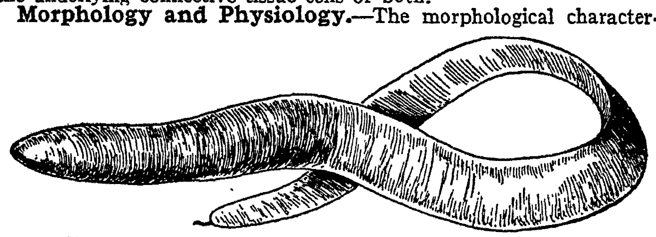


FIG. 3.—A HETERONEMERTEAN, CEREBRATULUS MELANOPS

istics of a nemertean are shown in fig. 1. Although there is no external indication of segmentation, most of the internal organs are arranged metamerically. The body is covered with a layer of ciliated epithelial cells, interspersed with mucous and sensory cells. The epithelium is supported on a basement layer of firm gelatinous tissue, beneath which, in the Heteronemertea, is a thick layer of mucous glands and connective tissue, the cutis. The musculature of the body wall consists of two or more layers of circular, spiral and longitudinal muscles which enable the worm to carry on rapid changes in body form. Locomotion is accomplished by creeping or gliding, by alternate elongation and contraction, by twisting spirally or, in a few species, by swimming.

The proboscis is sometimes used as an aid in creeping or burrowing.

The *proboscis* is formed by an invagination of the anterior body wall and consequently has essentially the same muscular and epithelial layers but in reverse order. In its normal position within the body it lies within the proboscis sheath, which forms a closed, saclike cavity, the rhynchocoel, filled with a corpusculated fluid. In a few species of hoplonemerteans the sheath is provided with paired diverticula. The anterior end of the proboscis is anchored firmly into the tissues of the head near the brain, while the posterior end commonly terminates in a long retractor muscle attached to the proboscis sheath or in some species to the musculature of the body wall in addition. The proboscis is everted through the rhynchodeum by the combined action of its own muscles and such contractions of the musculatures both of the sheath and body walls as will exert pressure on the fluid in the rhynchocoel. It is withdrawn by reducing this pressure, aided by its own musculature and by the retractor muscle, if present. In the Anopla the tenacious mucus and paralyzing secretions of the everted proboscis aid in capturing the prey, while in the Enopla the stylet is also used. Most of the Enopla have two or more pouches of accessory stylets which may replace the central stylet if lost or broken (fig. 4). In the heteronemertean *Gorgonorhynchus* the proboscis is dichotomously branched.

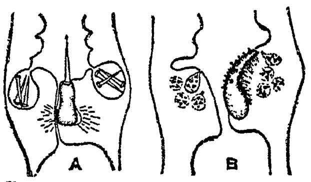


FIG. 4.—PROBOSCIS ARMATURE IN (A) AMPHIPORUS GRISEUS, A REPRESENTATIVE OF THE MONOSTYLIFERA AND IN (B) PELAGONEMERTES BRINKMANNI, A REPRESENTATIVE OF THE POLYSTYLIFERA

The *digestive system* consists of an anterior mouth which may either open ventrally posterior to the brain or terminally in connection with the proboscis opening. In the Bdellonemertea and some Hoplonemertea the mouth joins the rhynchodeum to form an atrium. The mouth leads to a slender œsophagus and thence to a more spacious stomach. The intestine continues as a straight tube, usually with numerous paired lateral diverticula, from the stomach to the rectum, which opens at the posterior end of the body (fig. 1). Some forms have a large caecum, with caecal diverticula, which extends forward from the anterior end of the intestine, while in some of the Paleonemertea and all of the Bdellonemertea there are no intestinal diverticula whatever (fig. 5). Digestion of the food materials is accomplished mainly by enzymes secreted into the stomach and intestine, although the fats are taken by phagocytosis directly into the cells of the lining epithelium. In these cells also the nutrients are stored in vacuoles until needed in the body metabolism.

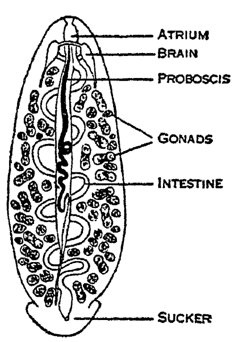


FIG. 5.—ORGAN SYSTEMS OF A BDELLONEMERTEAN

The *circulatory system* consists typically of three longitudinal blood vessels, united at both ends of the body, and in most species with reservoirs, or lacunae, in the head and œsophageal region and with numerous anastomosing cross branches throughout the body.

The *excretory system* is highly diversified. Typically there is a pair of profusely branching nephridia in close proximity with the lateral blood vessels and having one or more pairs of efferent ducts leading to the exterior of the body (fig. 1). Each of the numerous minute branches originates from a multinucleate terminal organ (metanephridium) or from a single cell (protonephridium) with long flagella which draw fluid from the surrounding parenchyma into the nephridial canal. Other cells in the walls of the canals excrete metabolized waste products. In the terrestrial nemerteans (*Geonemertes*) there are several thousand separate nephridia, each with its own efferent duct. Excretory organs have not been found in any of the bathypelagic species.

Nervous System.—The central nervous system consists of a four-lobed brain, from which a pair of large lateral nerve cords extend to the posterior end of the body. Many species have in addition a dorsomedian and a ventromedian nerve with branches communicating with the lateral nerve cords. Connected with the central nervous system are one or more pairs of proboscidial nerves and numerous, often paired, peripheral nerves associated with the muscular and digestive systems, integument, ocelli and such other sense organs as may be present.

Sense Organs.—In addition to the sensory epithelium everywhere present in the integument, some of the species have other specialized sense organs, including ocelli, cerebral, lateral and frontal sense organs, cephalic grooves and pits. In a single family (Ototyphlonemertidae) there is a pair of statocysts connected with the brain. With the exception of these organs of equilibrium and the ocelli very little experimental evidence has been obtained as to the precise nature of the sense organs. Chemical senses, including the recognition of food substances, positional sense, tactile sense and a certain degree of light sense must be located in the epithelium on all parts of the body, for headless fragments respond to the corresponding stimuli.

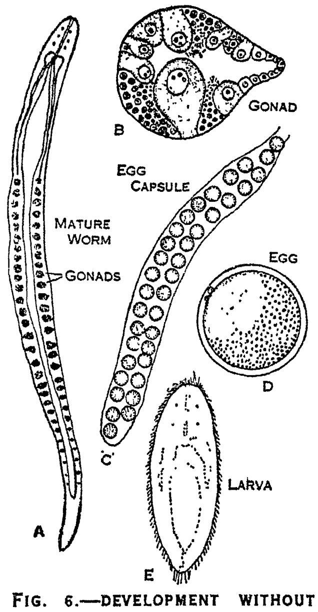


FIG. 6.—DEVELOPMENT WITHOUT METAMORPHOSIS IN A HOPLONEMERTEAN, PROSTOMA RUBRUM

Reproduction.—In most nemerteans the sexes are separate, although a few species are hermaphroditic. The gonads are simple sacs which usually alternate with the intestinal diverticula and may therefore be very numerous (figs. 1 and 6). In most species the sexual cells from each gonad are discharged directly into the water. Fertilization is thus external except for the few cases of viviparity in which the development of the embryo takes place within the body of the parent. There is evidence of sex recognition in some species, for a male and a female may be found side by side in a sheath of mucus. After ovulation and fertilization the parents leave the sheath which then forms a capsule for the developing embryos (fig. 6). In a few of the bathypelagic nemerteans the spermaries have been shifted to the head, and in the parasitic *Carcinonemertes* there is a common sperm duct which opens into the rectum.

Embryonic development may be direct, leading to the formation of a larva similar to the adult (fig. 6), or it may be indirect, with a free-swimming, hemispherical larva of complicated pattern known as the pilidium (fig. 7). The young worm later develops by metamorphosis within the pilidium. Increase in length occurs by constant additions to the posterior end of the body.

Regeneration.—Enemies are numerous, particularly annelids, crustaceans and fishes. Contributing to survival, however, is the tendency of most individuals with long bodies to break in fragments whenever any part of the body is seized. If only the posterior portion of the body is lost the missing parts are soon restored by regeneration. In certain species, any small fragment of the body, with or without the head, will regenerate into a minute worm of normal proportions (fig. 8). Fragmentation thus becomes a method of asexual propagation. Only a few species, however, have the capacity of restoring a missing head, but a lost or injured proboscis is promptly replaced.

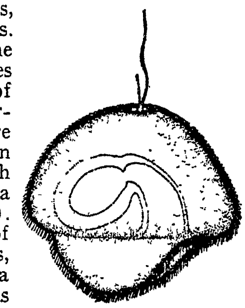


FIG. 7.—PILIDIUM OF A HETERONEMERTEAN, CEREBRATULUS

Classification.—Approximately 570 species of nemerteans had been described previous to 1946. Nearly 200 of these are found along the coasts of Europe, 100 on the Pacific coast of North America, 54 on the Atlantic coast of North America and 57 are bathypelagic, floating far beneath the surface of the oceans.

The phylum is conveniently divided into two classes, each of which consists of two orders.

CLASS 1. ANOPLA. Mouth posterior to brain; central nervous system imbedded in body wall, either between the muscular layers or external thereto; proboscis not armed with stylets.

Order 1. PALEONEMERTEA. Body musculature of either two or three layers; cutis absent. Example, *Procephalothrix* (fig. 2).

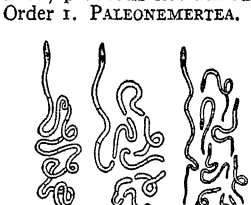


FIG. 8.—ASEXUAL REPRODUCTION BY FRAGMENTATION, LINEUS SOCIALIS

Order 2. HETERONEMERTEA. Body musculature of three layers, to which a thin inner circular and an outer spiral layer are sometimes added; cutis well developed. Examples, *Lineus* (fig. 8), *Cerebratulus* (fig. 3).

CLASS 2. ENOPLA. Mouth anterior to brain; central nervous system situated in parenchyma internal to body musculature; proboscis (except in Bdellonemertea) armed with one or more calcareous stylets.

Order 3. HOPLONEMERTEA. Proboscis with armature; intestine straight, with paired lateral diverticula; sucker absent.

Suborder 1. Monostylifera, with single stylet on awl-shaped basis. Examples, *Amphiporus* (fig. 4A), *Prostoma* (fig. 6).

Suborder 2. Polystylifera, with several stylets on curved basis.

Tribe 1. Reptantia, adapted for creeping or burrowing.

Tribe 2. Pelagica, adapted for swimming or floating in the ocean depths. Example, *Pelagonemertes* (fig. 4B).

Order 4. BDELLONEMERTEA. Proboscis without armature; intestine convoluted, slender, without diverticula; with sucker at posterior end

of body. Commensal in marine pelecypods. Example, *Malacobdella* (fig. 5).

Geographical Distribution.—Nemerteans are found along all the seacoasts of the world and off the shores to depths of hundreds of metres. Some of the species are circumpolar, extending southward along the coasts as far as Madeira, southern New England, California and Japan. A few species live in both the northern and southern hemispheres. Some are limited to the polar seas and others to the tropics. Some of the bathypelagic species live at depths of 1,000 to 2,000 metres or more and the population may be carried for thousands of miles by the deep ocean currents, reproducing generation after generation in their endless circuits throughout the great oceans.

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(W. R. CE.)

NEMESIANUS, MARCUS AURELIUS OLYMPIUS, Roman poet, a native of Carthage, flourished about A.D. 283. He was a popular poet at the court of the Roman emperor Carus (Vopiscus, *Carus*, 11). He wrote poems on the arts of fishing (*Halieutica*), aquatics (*Nautica*) and hunting (*Cynegetica*), but only a fragment of the last, 325 hexameter lines, has been preserved. It is neatly expressed in good Latin, and was used as a school text-book in the 9th century. Four eclogues, formerly attributed to Titus Calpurnius (*q.v.*) Siculus, are now generally considered to be by Nemesianus, and the *Praise of Hercules*, generally printed in Claudian's works, may be by him.

Complete edition of the works attributed to him in E. Bährens, *Poetae Latini Minores*, iii. (1881) and J. P. Postgate's *Corpus Poetarum Latinorum*, ii.; *see* also L. Cisorio, *Studio sulle Egloghe di N.* (1895) and *Dell' imitazione nelle Egloghe di N.* (1896); and M. Haupt, *De Carminibus Bucolicis Calpurnii et N.* (1853), the chief treatise on the subject.

NEMESIS. (1) A goddess worshipped at Rhamnus in Attica. She is closely connected with Artemis, probably a local form of her or of some other very similar goddess. In mythology (posthomeric; the story is told in the cyclic *Cypria*) she is loved by Zeus who catches her after a transformation-race; she lays an egg, from which Helen (*q.v.*) is hatched out, generally by Leda (*q.v.*), it is a disputed point whether Leda or Nemesis is the mother of Helen in the original form of the story. There seems also to have been a legend (Catullus, lxiv., 393) that on some occasion (Marathon?) she appeared in person to encourage her worshippers in battle. (2) The indignant disapproval felt at wrong-doing; in particular, such disapproval on the part of the gods, and the consequent punishment of a sinful (or over-prosperous) man, hence (first in Hesiod) that disapproval personified. There was an old cult of "the Nemeseis" at Smyrna (Pausanias, ix., 35–36) but whether of this abstraction or of the fertility-goddess of Rhamnus, is not clear. That the abstraction was worshipped, at least in later times, is beyond doubt, however; a fragment of Antimachus (in Strabo, xiii., 1, 13) says that Adrastus was the first to erect an altar to her. In Rome especially her cult was very popular, particularly among soldiers, by whom she was worshipped as patroness of the drill-ground (Nemesis campestris); associated with Fortune, she seems also to have been adored as presiding over races; she had a cult-association, the Nemesiaci.

BIBLIOGRAPHY.—L. R. Farnell, *Cults of the Greek States*, ii. (1896); O. Rossbach in Roscher's *Lexikon, s.v.* (bibl.); G. Wissowa, *Religion und Kultus* (2nd ed., 1912).

(H. J. R.)

NEMESIUS (*fl. c.* A.D. 390), a Christian philosopher, author of a treatise περὶ φύσεως ἀνθρώπου (*On Human Nature*), was, according to the title of his book, bishop of Emesa (in Syria). His book is an attempt to compile a system of anthropology from the standpoint of the Christian philosophy. Moses and Paul are put side by side with Aristotle and Menander, and there is a clear inclination to Platonic doctrines of pre-existence and metempsychosis. In physiology he is in advance of Aristotle and Galen, though we can hardly assert—as has sometimes been thought—that he anticipated Harvey's discovery of the circulation of the blood.

Editions: Antwerp 1575; Oxford, 1671; Halle, 1802; Migne's *Patrol. Gr.* vol. 40. Versions: Latin by Alsanus, ed. Holzinger (1887); by Burgundio, ed. Burkhardt (1891–96). Literature: Bender, *Untersuch. über Nemesius* (1898).

NEMOPHILA, a genus of North American herbs of the water-leaf family (Hydrophyllaceae), comprising some 20 species found chiefly in the Pacific coast region, 13 of which are native to California. They are more or less diffuse annuals, with parted, divided or lobed leaves, and delicate blue or white flowers, blossoming in early spring. Several are grown as border plants, especially the baby blue-eyes (*N. insignis*) and the five-spot (*N. maculata*). Other interesting species are the climbing nemophila or fiesta-flower (*N. aurita*), the small white nemophila (*N. heterophylla*) and the small flowered nemophila (*N. parviflora*), the last named ranging from California to Washington.

NEMORENSIS LACUS (mod. *Nemi*), a lake in the Alban hills, in an extinct subsidiary crater in the outer ring of the ancient Alban crater, east of the Lake of Albano. It is about 3½ m. in diameter and some 110 ft. deep; the precipitous slopes of its basin are over 300 ft. high, and are mainly cultivated. In ancient times it was included in the territory of Aricia and bore the name "Mirror of Diana." The worship of Diana here was originally celebrated with human sacrifices; even in imperial times the priest of Diana was a man of low condition, a gladiator or fugitive slave, who won his position by slaying his predecessor in fight, having first plucked a mistletoe bough from the sacred grove. The temple itself was one of the richest in Latium; Octavian borrowed money from it in 31 B.C. The remains of its precinct are situated a little above the level of the lake, on the north-east—a large platform, the back of which is formed by a wall of concrete, with niches, resting against the cliffs Excavations (now covered in again) led to the discovery of the temple itself, a comparatively small building, 98 by 52 ft., containing objects, none earlier than the 4th century B.C. A road descended to it from the Via Appia from the south-west. The lake is drained by a tunnel of about 2 m. long, of Roman date.

On the west side of the lake remains of two ships (really floating palaces moored to the shore) have been found, one belonging to the time of Caligula (as is indicated by an inscription on a lead pipe), and measuring 210 ft. long by 66 wide, the other even larger, 233 by 80 feet. The first was decorated with marbles and mosaics, and with some very fine bronze beamheads, with heads of wolves and lions having rings for hawsers in their mouths (and one of a Medusa), now in the Museo delle Terme at Rome. Various attempts have been made to raise the first ship, from the middle of the 15th century onwards, and the ancient emissarium has now been cleared in order to lay bare the remains of the ships. Caesar had a villa constructed there.

See J. G. Frazer, *The Golden Bough* (1913–14); L. Morpurgo in *Monumenti dei Lincei*, xiii. (1903), 297 *sqq.*

NEMOURS, LORDS AND DUKES OF. In the 12th and 13th centuries the lordship of Nemours, in Gâtinais, France, was in possession of the house of Villebeon, a member of which, Gautier, was marshal of France in the 13th century. The lordship was sold to King Philip III. in 1274 and 1276 by Jean and Philippe de Nemours, and was then made a county and given to Jean de Grailly, captal de Buch in 1364. In 1404 Charles VI. of France gave it to Charles III. of Evreux, king of Navarre, and erected it into a duchy in the peerage of France (*duché-pairie*). Charles III.'s daughter, Beatrix, brought the duchy to her husband Jacques de Bourbon, count of La Marche, and by the marriage of their daughter, Eleanor, to Bernard of Armagnac, count of Pardiac, it passed to the house of Armagnac. The duchy reverted to the French crown in 1505, after the extinction of the house of Armagnac-Pardiac. In 1507 it was given by Louis XII. successively to his nephew, Gaston de Foix (d. 1512), Guiliano de Medici and his wife Philiberta of Savoy in 1515, to Louise of Savoy in 1524, and to Philip of Savoy, count of Genevois, in 1528, whose descendants possessed the duchy until its sale to Louis XIV. In 1572 Louis gave it to his brother Philip, duke of Orleans, whose descendants possessed it until the Revolution. The title of duc de Nemours was afterwards given to Louis Charles, son of King Louis Philippe, who is dealt with separately below.

The following are the most noteworthy of the earlier dukes of Nemours.

James of Armagnac, duke of Nemours (*c.* 1433–1477), was the son of Bernard d'Armagnac, count of Pardiac, and Eleanor of Bourbon-La Marche. As comte de Castres, he served under Charles VII. in Normandy in 1449 and 1450, and in Guienne. Louis XI. loaded him with honours, married him to his god-daughter, Louise of Anjou, and recognized his title to the duchy of Nemours in 1462. Sent by Louis to pacify Roussillon, Nemours felt that he had been insufficiently rewarded for the rapid success of this expedition, and joined the League of the Public Weal in 1465. The king's patience eventually became exhausted by his intrigues; his château at Carlat was attacked, and he was condemned by the parlement, and beheaded on Aug. 4, 1477.

See B. de Mandrot, *Jacques d'Armagnac, duc de Nemours* (1890).

Charles Emmanuel (1567–1595), son of James, duke of Nemours and Anne of Este, widow of Francis, duke of Guise, was called in his youth prince of Genevois. Involved in political intrigues by his relationship with the Guises, he was imprisoned after the assassination of Henry, duke of Guise, and his brother the cardinal of Lorraine, in 1588, but escaped. He was governor of Paris when it was besieged by Henry IV. After quarrelling with his half-brother Charles of Lorraine, duke of Mayenne, he withdrew to his government of Lyonnais, where he endeavoured to make himself independent. He was imprisoned, however, in the château of Pierre-Encise by the archbishop of Lyons. After his escape he attacked Lyons, but was defeated owing to the intervention of the constable de Montmorency. He died at Annecy in July 1595.

His brother Henry (1572–1632), called originally marquis de Saint-Sorlin, succeeded him as duke. In 1588 he took the marquisate of Saluzzo from the French for his cousin, the duke of Savoy. The princes of Guise, his half-brothers, induced him to join the League, and in 1591 he was made governor of Dauphiné. He made his submission to Henry IV. in 1596. After quarrelling with the duke of Savoy he joined the Spaniards in their war against Savoy. After peace had been proclaimed on Nov. 14, 1616, he retired to the French court. He died in 1632, and was succeeded by his eldest son, Louis, and on the death of the latter in 1641 by his second son, Charles Amadeus (1624–1652), who served in the army of Flanders in 1645, and in 1646 commanded the light cavalry at the siege of Courtrai. In 1652 he took part in the war of the Fronde, and was wounded at the Faubourg St. Antoine. On July 30, 1652, he was killed in a duel by his brother-in-law, François de Vendôme, duke of Beaufort. He had two daughters, Marie Jeanne Baptiste (d. 1724), who married Charles Emmanuel of Savoy in 1665; and Marie Françoise Elisabeth, who married Alphonso VI., king of Portugal, in 1666. His brother Henry (1625–1659), archbishop of Reims, withdrew from orders and succeeded to the title.

In 1657 Henry married Marie d'Orleans-Longueville (1625–1707), daughter of Henry II. of Orléans, duke of Longueville. This duchess of Nemours is a famous personage. At an early age she was involved in the first Fronde, which was directed by her father and her stepmother, Anne Geneviève de Bourbon-Condé, the celebrated duchesse de Longueville; and when her husband died in 1659, leaving her childless, her life was mainly spent in contesting her inheritance with her stepmother. She left some interesting *Mémoires,* which are published by C. B. Petitot in the *Collection complète des mémoires* (1819–1829).

NEMOURS, LOUIS CHARLES PHILIPPE RAPHAËL, Duc de (1814–1896), second son of the duke of Orleans, afterwards King Louis Philippe, was born on Oct. 25, 1814. In 1830 he became a chevalier of the order of the Saint Esprit and entered the chamber of peers. As early as 1825 his name was mentioned for the throne of Greece, and in 1831 he was elected king of the Belgians, but Louis Philippe declined the honour for his son. In Feb. 1831 he accompanied the French army which entered Belgium to support the new kingdom against Holland, and took part in the siege of Antwerp. He accompanied the Algerian expeditions against the town of Constantine in the autumn of 1836, and again in 1837, taking it by assault on Oct. 13. He sailed a third time for Algeria in 1841, and served under General Bugeaud. On his return to France he became commandant of the camp of Compiègne. He had been employed on missions to England in 1835, 1838 and 1845, and to Berlin and Vienna in 1836. His marriage in 1840 with Victoria, daughter of Duke Ferdinand of Saxe-Coburg, was marked by a check to Louis Philippe's government in the form of a refusal to bestow the marriage dowry proposed by Thiers in the chamber of deputies. The death of his elder brother, Ferdinand, duke of Orleans, in 1842 gave him a position of greater importance as the natural regent in the case of the accession of his nephew, the young count of Paris, but he was not popular. On the outbreak of the revolution of 1848 he held the Tuileries long enough to cover the king's retreat, but took no active measures against the mob. He followed his sister-in-law, the duchess of Orléans, and her two sons to the chamber of deputies, but was separated from them by the rioters, and only escaped in the uniform of a national guard. He then settled with his parents in England. His chief aim was a reconciliation between the two branches of the house of Bourbon, as indispensable to the re-establishment of the French monarchy in any form. These wishes were frustrated on the one hand by the attitude of the comte de Chambord, and on the other by the determination of the duchess of Orléans to maintain the pretensions of the count of Paris. Lengthy negotiations ended in 1857 with a letter, written by Nemours, in which he insisted that Chambord should adhere to the tricolour flag and to the principles of constitutional government.

Nemours had lived at Bushey House after the death of Queen Marie Amélie in 1866. In 1871 the exile imposed on the French princes was withdrawn, but he only returned to Paris after their disabilities were also removed. In March 1872 he was restored to his rank in the army as general of division, and placed in the first section of the general staff. In 1881 new decrees against the princes of the blood led to his withdrawal from Parisian society. He died at Versailles on June 26, 1896, the duchess having died at Claremont on Nov. 10, 1857.

See R. Bazin, *Le Duc de Nemours* (1907); Paul Thureau-Dangin, *Histoire de la monarchie de juillet* (4 vols., 1884, etc.).

NEMOURS, a town of France, in the department of Seine-et-Marne, on the Loing and its canal, 26 mi. S. of Melun, by rail. Pop. (1936) 4,942. Nemours derives its name from the woods (*nemora*) in which it formerly stood, and discoveries of Gallo-Roman remains indicate its early origin. It derives its historical importance from the lordship of Nemours.

NENADOVIĆ, MATEYA (1777–1854), Serbian patriot, was born in 1777. He is generally called Prota Mateya, since as a boy of 16 he was made a priest, and a few years later became archpriest (Prota) of Valyevo. His father, Alexa Nenadović. *Knez* (chief magistrate) of the district of Valyevo, was one of the prominent Serbs murdered by the Janissaries of the Belgrade Pashalik to intimidate the people (1804). The result, on the contrary, was a general popular rising. Prota Mateya became the deputy-commander of the insurgents of the Valyevo district, but soon exchanged this post for that of chief diplomatic envoy of the insurgents. In the years 1814–15 he visited Vienna to plead the cause of Serbia to the Congress. Prota Mateya's memoirs are the most valuable authority for the history of the first and second Serbian wars of independence. The best edition is that of the Serbian Literary Association in Belgrade (1893).

NENAGH, a town of co. Tipperary, Eire, near the river Nenagh, 96½ mi. S.W. from Dublin by the Ballybrophy and Limerick branch of the Great Southern railway. Pop. (1936) 4,902. Of the old castle, Nenagh Round, dating from King John, there still exists the circular donjon or keep. There are no remains of the hospital founded in 1200 for Austin canons, nor of the Franciscan friary, founded in the reign of Henry III. Nenagh was one of the ancient manors of the Butlers, who received for it the grant of a fair from Henry VIII. In 1550 the town and friary were burned by O'Carroll. In 1641 the town was taken by Owen Roe O'Neill, but shortly afterwards it was recaptured by Lord Inchiquin. It surrendered to Ireton in 1651, and was burned by Sarsfield in 1688.

NENNIUS (*fl.* 796), a Welsh writer to whom we owe the *Historia Britonum*, wrote in Brecknock or Radnor. His work exists in 30 manuscripts, the earliest of which is not much earlier than the year 1000. All are defaced by interpolations which give to the work so confused a character that critics were long disposed to treat it as an unskilful forgery. A new turn was given to the controversy by Heinrich Zimmer, who, in his *Nennius vindicatus* (1893), traced the history of the work and, by a comparison of the manuscripts with the 11th-century translation of the Irish scholar, Gilla Coemgim (d. 1072), succeeded in stripping off the later accretions from the original nucleus of the *Historia*. Zimmer follows previous critics in rejecting the *Prologus maior* (§§ 1, 2), the *Capitula*, or table of contents, and part of the *Mirabilia* of the concluding section. But he proves that Nennius is the compiler of the *Historia* proper (§§ 7–65). The only part of the *Historia* which deserves to be treated as a historical document is the section known as the *Genealogiae Saxonum* (§§ 57–65). This is merely a recension of a work composed *c.* 679 by a Briton of Strathclyde. The author's name is unknown; but he is, after Gildas, our earliest authority for the English conquest of England. Nennius himself gives us the oldest legends relating to the victories of King Arthur; the value of the *Historia* from this point of view is admitted by the severest critics. The chief authorities whom Nennius followed were Gildas' *De excidio Britonum*, Eusebius, the *Vita Patricii* of Murichu Maccu Machtheni, the *Collectanea* of Tirechan, the *Liber occupationis* (an Irish work on the settlement of Ireland), the *Liber de sex aetatibus mundi*, the chronicle of Prosper of Aquitaine, the *Liber beati Germani*. The sources for his notices of King Arthur (§ 56) are unknown.

See J. Stevenson's edition of the *Historia Britonum* (English Hist. Soc., 1838), based on a careful study of the mss.; A. de la Borderie, *L'Historia Britonum* (Paris and London, 1883), which summarizes the older negative criticism; H. Zimmer, *Nennius vindicatus* (Berlin, 1893); T. Mommsen in *Neues Archiv der Gesellschaft für ältere deutsche Geschichtskunde*, xix. 283. (H. W. C. D.)

NEODYMIUM, the third commonest metallic element belonging to the rare-earth group (symbol Nd, atomic number 60, atomic weight 144·3), was discovered by von Welsbach in 1885 when he split "didymium" into praseodymium and neodymium. This metal occurs along with cerium, lanthanum, praseodymium, etc., in the minerals monazite, cerite, allanite, etc. It is best prepared by the fractional crystallisation of the double magnesium nitrate from water. The oxide, Nd_2O_3, is usually obtained as a light blue powder, but traces of praseodymium give it a yellow-brown tint. The oxide is rapidly dissolved by hydrochloric and nitric acids, giving amethyst solutions which show a very intense and characteristic absorption spectrum. The metal is prepared by the electrolysis of the fused anhydrous chloride, $NdCl_3$. It slowly oxidizes in air and is gradually attacked by cold water. It melts at 840° C. (*See* RARE EARTHS.) (C. J.)

NEOGNATHAE, the term now used in ornithology (*q.v.*) instead of the older term Carinatae (*q.v.*) to denote the section of the class Aves to which the majority of modern birds belong.

NEO-GREC, in architecture and the allied arts, a style developed in the second quarter of the 19th century in France, in which an attempt was made to instil into generally classic design a spirit at once modern, original and yet full of the restraint, delicacy and perfection of Greek details. It was largely the result of the efforts of three men—J. Duban, H. Labrouste and L. Duc. It found its most complete expression in Paris, especially in the Colonne de Juillet (1831–40) by Duc; the Library of S. Geneviève (1843–50) by Labrouste; the École des Beaux Arts (1820–39) by Duban; and the west wing of the Palais de Justice (1857–68) by Duc. The style is important, less for these complete works, than for its tremendously widespread influence throughout the middle of the 19th century, not only in Europe, but also in America. Its chief characteristics are modified orders; imaginatively modernized classic detail; much use of simple, flat surfaces, often with chamfered edges; pediment forms without horizontal cornices; and delicate, refined, incised ornament.

NEO-HEGELIANISM. For a decade or a decade and a half after 1860 the history of British and American philosophy is the story of a growing revolt against the empirical method of John Stuart Mill and his school. The movement might have died had it not found something positive to feed upon. But it happened that a wide field of historical thought, largely unexplored by English thinkers, was there for it to turn to, namely, the German philosophy of the opening of the century, both the "criticism" of Kant and the idealistic continuation of Kantianism by Fichte, Schelling and Hegel; and "Neo-Hegelian" is the epithet attached, largely against their will, to the English group who gave the lead in this direction.

Of course no one can be prevented from using the word in other senses. Good precedent can be quoted for applying it indifferently to any revived interest in idealistic ways of thinking occurring in any country since the time of Hegel. The strongest instance in favour of an extension of meaning is the Croce-Gentile school, the most noteworthy product of contemporary thought in Italy. But on the one hand the Italian declarations of independence whenever Neo-Hegelianism is imputed to them have been so emphatic that it is hard for the historian to persist in calling them by the name; and on the other hand custom certainly sanctions the position adopted here, that Neo-Hegelianism used as a quasi-technical term is normally applied to a movement in the recent history of Anglo-Saxon thought. Perhaps the readiest conspectus of the movement will be had by treating it under two heads: its historical background and its essential teaching.

Its Historical Background.—It is important to distinguish the historical setting of the Neo-Hegelian thinkers, which is British, from the story of German thought which bulks most largely in their own account of their historical setting. The latter is a chapter in what they saw, the former yields the reason for their seeing it.

As is well known the scepticism of David Hume provoked a native Scottish reply as well as a German one. This, descending through Reid and Hamilton to Calderwood, Ferrier, Fraser and others in the 19th century set up an independent movement towards idealism which by 1860 had become pronounced especially in Scottish philosophy.

But important as it is for the historian to recognize how the Neo-Hegelian thinkers were thus provided with a reception in advance, it is even more important to consider the historical place in which they saw themselves to be standing, namely, the Kantian succession. When Kant came on the philosophical stage he found philosophy at an impasse. It was precisely the impasse to which they believed the doctrines of the empiricists Mill, Bain, Lewes, Spencer and others had brought it back. The work of Kant had been to examine the assumptions which led philosophy thither; and they held that further progress was impossible until the principle of the Kantian criticism was understood.

When Kant called attention to knowledge his interest was centred upon that which knowledge discloses, the "Nature" with which man is conversant in science and in everyday experience. There were two obvious features of it. First, its constituents were not things as they are in themselves but things as they appear to the human senses. Secondly,—and this was his problem—these appearances were not disconnected sensations. They had a certain order. They displayed themselves before us as objective. Kant asked how such objectivity was possible; and his answer consisted in saying that there was a logic of the process. The original use of the understanding whereby it arranged those appearances as an orderly world proceeded according to a logic which Kant distinguished as synthetic from the traditional formal or analytic logic, and which he called transcendental.

The idealistic successors of Kant—Fichte, Schelling and Hegel—saw in the critical philosophy a principle of reconciliation. The gulf fixed for common sense between mind and the world could be bridged. Kant had bridged it only imperfectly, leaving as he did things-in-themselves quite as much cut off from mind as the objects of common sense seemed to common sense to be. The post-Kantians sought, each in his own way, to bring the wheel full circle. Their instrument, with whatever differences, was still Kant's instrument, logic, the new "transcendental" logic, the logic of synthesis whereby the world is put together, as distinct from the formal analytic logic of the Aristotelian tradition. As

Hegel takes it over this logic has suffered two changes. It has ceased to be a mere theory of thought and become a theory of being; and it has learnt to move by dialectical procession. So reconstituted, logic emerges as an abstract version of the literal process by which the absolute spirit reveals itself as the universe, by dint of breaking forth into all the forms which the universe wears to human consciousness, nature, history, society, art, religion.

The dominion which his principle gave to Hegel over intellectual Europe at the beginning of the 19th century is one of the romances of philosophical history. There were three impressive features of him and his system. First, here was a thinker with apparently sufficient range to confront the entire field of man's then recorded experience of himself and the universe; in the second place he seemed to succeed in throwing whole territories of experience for the first time into some sort of order; and thirdly—the really remarkable circumstance—these results precipitated themselves in obedience to the assumption that the universe was the expression of spirit. It may be difficult to account for the currency of these beliefs about Hegel, but granted their currency there is nothing surprising in the impression he made.

Its Essential Teaching.—The mere existence of the Hegelian *corpus* doubtless touched the imagination of the Neo-Hegelian thinkers. It was there to show what a spiritual view of the world could be; and its presence helped to temper their disbelief in its particulars with a general belief in the possibility of "something of the kind." None of them were disciples in the way in which the original Hegelians had been. Green, more sensitive than most others to the error in some of Hegel's substantial results, even mistrusted the method by which they were obtained. To the Neo-Hegelians, Hegelianism was powerful as criticism. Green in particular was convinced by the critical regress which shows self-consciousness to be the only starting point for philosophy. He sets forth the argument in his *Prolegomena to Ethics* published posthumously in 1883 (5th ed. 1906).

This is one of the important works of the school. It is initially a constructive criticism of the empirical standpoint in ethics, its interest being to show the impossibility of either, with materialism, deriving self-consciousness from something other than itself or, with hedonism, defining the moral end by reference to something other than itself. Against the objection, almost inevitably arising, that Green is here eliminating the possibility of a logical or rational account of these matters at all, there is but one resource. It is to inquire what logic is and how far the new meaning which Kant threw into it is defensible.

Neo-Hegelianism is thus at heart a logical doctrine, and Bosanquet, whose *Logic* (1896, 2nd ed. 1911) together with Bradley's *Principles of Logic* (1883, 2nd ed. 1922) may be said to provide the technique of the whole way of thinking, expresses the spirit of it equally accurately and simply when he suggests that a colour-harmony may have logical necessity as well as a syllogism. The logic which permits such a saying is a logic of coherence. Stress upon coherence is a leading feature of Bosanquet's mind and writing. He does not, in vindicating his general position, press upon his reader the logical compulsiveness of the Kantian starting-point as Green does. He is content to exhibit the coherence which comes into our view of things when we decide to read the universe in the light of our highest experiences in it. Only in those is the coherence of the world revealed to us. And when we see how it coheres we see it as it is.

In the logical doctrine of coherence a metaphysical doctrine is involved, that of "degrees of reality." What we call our "highest" experiences occur only intermittently; and they suggest rather than express what is meant by coherence. As will, I seek the good; I rarely if ever actually find it in realizing the social will. On the other side, as intelligence, I seek the true; I shall only comparatively seldom find it in the propositions which were supremely important to my human nature as it is. None the less these rare experiences are those showing reality, giving reality in proportion as they are full and unqualified. This coincidence of reality with what man encounters when "at his fullest stretch" is the theme of the two volumes of Gifford Lectures in which Bosanquet's long term of philosophical activity culminates, *The Principle of Individuality and Value* (1912, 2nd ed. 1927) and *The Value and Destiny of the Individual* (1913, 2nd ed. 1923).

But since man is not always at his fullest stretch, and since what he encounters and experiences in his casual moods must also be real, a doctrine of grades or degrees of reality is involved. This vital implication of Neo-Hegelianism is bared to the bone only in the metaphysical essay by F. H. Bradley, *Appearance and Reality* (1893, 8th impression, 1925) usually allowed to be the greatest work emanating from the Neo-Hegelian school.

Bradley argues for one ultimate system of experience which is reality, and shows that nothing finite is real taken as it stands. For reasons equally compelling, however, he must insist that the finite is real somehow. "Anything that in any sense 'is' qualifies the absolute reality and so is real." The solution of the antinomy lies in the relativity of everything finite. No exception to this law offers itself. "There is no mere appearance or utter chance or absolute error, but all is relative." The absolute or infinite experience, therefore, which logically must be, can in fact be; and so we are entitled to say that it is. The absolute is vindicated and the finite defended through the admission of degrees in truth and reality.

Bradley's essay made history both within the school and without. All three features of the finite stressed by him, the defects which condemn it, the "relativity" which suggests salvation for it and the absolute in which it is saved, bit into contemporary thought. For example, both his line of attack upon the finite and his line of defense brought mathematics and physics into the idealistic argument. Apropos of his line of defense, we find the "relativity" of recent mathematical theory regarded by Viscount Haldane as a particular case of the general principle of relativity involved in the idealistic construction of experience. Apropos of his attack, we find Royce reducing all Bradley's charges against the finite to one, namely that it involves an infinite regress; and, thinking the very possibility of idealism to be at stake, he evolves a mathematical counterargument. Besides bringing up mathematical argument in defense of idealism, Bradley's dialectical attack on the finite also provoked mathematical resistance. This came from Russell and the realists. Curiously enough it took exactly the same form, a defense of the finite against the charge of involving an infinite regress of a self-contradictory kind. Still deeper was the bite of the Bradleian absolute. Intended by him as the saviour of the finite, it was everywhere taken as annihilating it. It, in consequence, drew upon itself almost the whole resistance of a generation to that conception of a quiescent absolute, to which the western mind seems constitutionally averse. Thus it generated Pragmatism in England, and played a great part in differentiating such Neo-Hegelianism as appeared in the United States from the English type.

The earliest Neo-Hegelian influences which reached the U.S. found, as in England, an idealism already there, one derived largely from the same Scottish sources. There were such teachers as Noah Porter of Yale and Thomas McCosh of Princeton. A channel through which the Neo-Hegelian interest in the U.S. found important expression was the *Journal of Philosophical Studies,* edited by W. T. Harris (1835–1909) of St. Louis, Mo.

The note of U S. idealism is its solicitude for personality and the individual. This is conspicuous in Howison and still more where the influence of Lotze was stronger, as in Bowne. The feature of Royce's central work, *The World and the Individual* (1901), is its combination of a doctrine of the absolute with a doctrine of the unique individual. The substance of reality is experience, and every finite idea of which it is composed has an "internal meaning" embodying a purpose which, in the absolute, is fulfilled. The absolute is needed in order that all ideas may reach fulfilment, both those within the experience of individuals and those beyond.

Royce's absolutism can hardly be said to have survived as a school. Yet it would be untrue to say that in the United States the idealism which recognizes an absolute has merely disappeared, leaving its empty room to be divided between a pragmatism which emphasizes human values and a realism which thirsts for facts There are signs of a younger idealistic thought ambitious to vindicate the absolute realistically by touching it, so to speak, at the very nadir of fact, through the perception that all knowledge of objects is necessarily also a revelation of subject, and therefore a traffic with mind. On some such assumption seems to rest the work of W. E. Hocking (*The Meaning of God in Human Experience,* 1912), and it is possibly in a note such as this, not without its echoes on both sides of the Atlantic, that the eventual issue of the Neo-Hegelian incident in the history of philosophy is to be discerned.

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NEO-KANTIANISM. The philosophical movement called Neo-Kantianism commenced in Germany in the 1860s. Beginning with certain epistemological inquiries, it extended gradually over

the whole field of philosophy. The individual thinkers who belong to this movement differ from each other in their interpretation of the Kantian doctrine as well as in the results which they reach from the Kantian premises. But, notwithstanding differences of detail, there is a certain methodical principle common to all of them. They all see in philosophy not merely a personal conviction, an individual view of the world, but they inquire into the possibility of philosophy as a science with the intention of formulating its conditions. They take their cue from the most general statement of the Kantian problem in the preface to the *Critique of Pure Reason* and in the *Prolegomena*. But in returning to the fundamental aim of Immanuel Kant, to lead philosophy "into the safe road of a science," Neo-Kantianism finds itself confronted with a new task inasmuch as it must face a different state of science itself.

Helmholtz.—The first decisive impetus toward the reception and revival of Kant's fundamental ideas started within the circle of natural science itself. Hermann von Helmholtz' particular mentality and his significance for the development of natural science in the 19th century are determined by the fact that he was both a physicist and a physiologist. His main work, the *Handbuch der physiologischen Optik* (1856; 3rd ed., 1909–11), shows both methods of inquiry in their mutual interdependence and ideal union. Here the fundamental problem of Kant's *Transcendental Aesthetics,* the question of the epistemological significance of space and spatial perception, is emphatically restated. For the solution of this question, Helmholtz goes back to the researches and results of Johannes Müller in the field of the physiology of the senses.

In his *Vergleichende Physiologie des Gesichtssinns* (1826), Müller had developed the doctrine of the "specific energy" of sense organs; he had shown that the quality of the individual sense data—the constitution of colour, tone, smell, etc.—is not to be explained from the constitution of the external stimulus, but from the peculiarity of the organ that conveys the sensation. This result is taken up by Helmholtz in his lecture *Über das Sehen des Menschen* (1855) and interpreted as an empirical confirmation of that which Kant had determined by general a priori considerations. The true and permanent achievement of Kantian philosophy, according to this interpretation, consists in having shown the participation of the innate laws of the mind in the formation of our ideas.

This interpretation was accepted by contemporary philosophers, especially by Friedrich Albert Lange (1828–1875). Lange, in his *History of Materialism* (1866), propounds as the essence of Kantian philosophy the proposition that what we call the "reality" of things is in truth nothing but their "appearance for the human species." Thus, the concept of causality, for instance, being rooted, according to this theory, in our psychophysical organization, is prior to all experience, an a priori disposition of the human mind. Accordingly, it has within the field of human experience unlimited validity; but beyond this no significance whatever. By extending this interpretation to all parts of the Kantian system, Lange arrives at the conclusion that not only is the concept of the "thing-in-itself" the "concept of a perfectly problematical something" having significance only as a "limiting term" (*Grenzbegriff*), but that even the "intelligible world," which was used by Kant as the foundation of ethics, is a "world of poetry." This poetry, to be sure, is, according to Lange, "a necessary fruit of the mind, issuing from the inner and most vital roots of the species." But in this very implication, which threatened to transform the Kantian transcendental idealism into a fictionism of the type developed later by Vaihinger, the deficiencies of the empirico-physiological interpretation of Kantian apriorism became clearly apparent.

Zeller.—In the meantime, the attempt had already been made in German philosophy to put Kantian apriorism on a basis broader and more solid than that which the doctrine of the specific energy of sense organs was capable of affording. In a lecture which Eduard Zeller had delivered in the year 1862 as an introduction to his course on logic and epistemology in Heidelberg, he had pointed out that epistemology formed the formal basis of philosophy as a whole, that it was epistemology "from which the final decision on the correct method in philosophy and science generally had to come." Hegel's *Wissenschaft der Logik* and his *Phänomenologie des Geistes* had been the last grandiose attempts to comprise the whole of knowledge in its content and to develop it constructively from one unifying idea. Zeller tries to show that the attempt did not reach its goal and could not reach it, "because it overlooks the conditions of human knowledge, for it purports to grasp with one swoop from above the ideal of knowledge which, in reality, we can approach only gradually through complicated labour from below" But the magic circle of the Hegelian system—so he says—will not allow itself to be broken, so long as the presuppositions of the latter are not investigated anew and more thoroughly than before; and this very investigation necessarily leads back to Kant.

What is here expressed as a purely programmatic idea, Otto Liebmann (1840–1912) tried to carry out in his main philosophical writings. The very first of Liebmann's writings, *Kant und die Epigonen* (1865), attempts to show that the successors of Kant all missed the way which he had clearly recognized and indicated. In an intensive criticism of the "idealistic," the "realistic" and the "empirical" tendencies of post-Kantian philosophy, Liebmann tries to point out that all these movements—the system of Fichte, Schelling and Hegel, as well as the systems of Herbart, Fries and Schopenhauer—suffer from a common fault. They all assign to the concept of the "absolute" or of the "thing-in-itself" a central place and make it the fundamental concept of metaphysics, whereas Kant's doctrine, if rightly understood and further developed, implies the very opposite, namely, that this concept is a nonconcept, that all cognition moves within the realm of mere relationships, but can never grasp or positively determine an "absolute."

Hermann Cohen.—However, it was only in Hermann Cohen (1842–1918) that neo-Kantianism reached its climax. In his three great works on Kant, *Kants Theorie der Erfahrung* (1871; 2nd ed., 1885), *Kants Begründung der Ethik* (1877; 2nd ed., 1910) and *Kants Begründung der Aesthetik* (1888), Cohen gave for the first time a critical interpretation of the entire Kantian system which, with all its penetration into the specific detail of Kant's fundamental doctrines, sets, nevertheless, one single systematic idea into the centre of the investigation. This idea is that of the "transcendental method."

From Friedrich Albert Lange, with whom Cohen was closely connected by ties of personal friendship, Cohen differs especially in that he rejects any psychological interpretation of Kant's apriorism, any explanation of the a priori by the "psychophysical organization" of man.

In his study *Das Prinzip der Infinitesimal Methode und seine Geschichte* (1883) he tries to prove that the concept of the "infinitely small," as it was established in the Leibnizian differential calculus and in the Newtonian calculus of "fluxions," is, at the same time, the indispensable and basic intellectual means for any scientific cognition of "reality." Reality is never "given" in any sense, neither in sensation nor in mere intuition, but it must be produced by means of pure thought. The various ways and directions in which thought moves in this "production of the object" are the problems which logic has to trace. This idea found its development in Cohen's main systematic work, the *Logik der reinen Erkenntnis* (1902; 2nd ed., 1914), to which were added, as a second and third part of his system of philosophy, the *Ethik des reinen Willens* (1904) and the *Aesthetik des reinen Gefühls* (1912).

Natorp.—In closest personal and scientific contact with Cohen, Paul Natorp (1854–1924) further pursued and carried out the fundamental methodical idea of "critical idealism." For him, too, the object of knowledge is not given in itself as a ready-made thing, but "becomes" only in the eternal process of knowing, in a constantly renewed production of objects. This process never lies completed before us, as a firm and final result, an "absolute" in the dogmatic-metaphysical meaning of the term; it is, however, possible to recognize the direction in which it moves, the general form of the production of the object. Natorp developed this main idea of his theoretical philosophy especially in his study *Die logischen Grundlagen der exakten Wissenschaft* (1910) and in a more concentrated survey in the essay *Philosophie, ihr Problem und ihre Probleme* (1911). Of special importance, furthermore, is his *Allgemeine Psychologie nach kritischer Methode* (1912), which established an entirely new view of its aim and method and anticipated in decisive points Edmund Husserl's phenomenology.

Riehl.—Cohen's insistent reference to the doctrine of Kant as the basis of all scientific philosophy and his account of the "transcendental" had a great effect even on thinkers who ultimately differed from Cohen in the conception of the critical system. Thus, for instance, the main work of Alois Riehl, *Der philosophische Kritizismus und seine Bedeutung für die positive Wissenschaft* (1876, 1879, 1887), is in its first edition still under the influence of Cohen's view of the transcendental.

Riehl, too, emphasizes that the question of the objective stock and the objective validity of knowledge should not be confounded with the question of the formation of ideas within the subjective consciousness. Kant's decisive achievement, according to Riehl, consists just in this, that he distinguished clearly the two questions, the "transcendental" and the "psychological," that he separated the problem of the objective significance of knowledge from the genetic question of its derivation.

But this idealism of the general forms of pure intuition and pure understanding constitutes, according to Riehl, only one phase of the Kantian doctrine, which has its counterpart in another equally legitimate and equally indispensable one. For the particulars of experience, the definite spatial and temporal order of empirical phenomena, as well as the specific causal laws subsisting between them, are never to be deduced from those general forms. Here we find ourselves necessarily referred to that other factor which Kant called the "material" factor of knowledge. The concepts of understanding as well as the pure forms of space and time give only the universal and necessary form of experienced reality, while its content can never be given to us otherwise than through sensation, through immediate sense perception. Thus the latter forms the specific and indispensable basis of our conviction regarding the reality of things.

Riehl characterizes this view as "critical realism" and sees in it the specific kernel of Kant's teaching. "For the specific and definite forms of things as given in empirical intuition, that is, the position, shape, size, the definite and determinate duration and sequence of things, there must be, according to the explicit teaching of Kant, a source in the things themselves. For they cannot be derived from the universal form of intuition which originates solely in the mentality of the subject. . . . The things-in-themselves, with their proportions as expressed in the specific forms of intuition and the empirical laws of nature, are for Kant a presupposition just as essential as the a priori elements of

cognition. The necessary combination of both, their union in experience, is the upshot of his teaching. Our knowledge of things is a mediate cognition of the things themselves through the appearances of the things to our senses" (*Zur Einführung in die Philosophie der Gegenwart,* 4th ed., p. 109 f. [1913]).

The Positivistic View.—Among all the thinkers of the Neo-Kantian movement, Riehl is the one who is most strongly influenced by the positivistic view of the nature and the task of philosophy. Scientific philosophy, in the strict sense of the word, is for him almost synonymous with pure epistemology and the methodology of the special sciences.

Hence, there remains no special field of study reserved as its proper domain; rather it is merely the texture and the logical structure of knowledge, of science itself, with which philosophic reflection can be concerned. "Instead of things, it investigates the understanding which recognizes things; instead of nature, the science of nature; instead of phenomena, their presuppositions in the consciousness of man." However, through this confinement of philosophy to the pure science of knowledge, Riehl ends by allowing the theory of values to fall out of it entirely.

To be sure, Riehl admits that there must be a "teleology of human life" for which mere knowledge of nature is not sufficient; but he himself did not study systematically the problems of this teleology, especially the ethical and aesthetic problems and the philosophy of history; he touched upon them only occasionally. "Views of the world" (*Weltanschauungen*)—so he declares explicitly—are not a matter of mere understanding; and they are for that reason subjective in the main; they do not belong to science but to faith. This separation of knowledge from faith carried with it the danger that scientific value was attributed to natural knowledge exclusively, while the pure sciences of the mind (*Geisteswissenschaften*), the sciences of the historical reality of man's mental achievements, were deprived of their specific methodical foundation.

Windelband and Rickert.—Here lies the problem from which started that tendency of Neo-Kantianism which was founded by Wilhelm Windelband and carried on by Heinrich Rickert. The epochal works of Wilhelm Dilthey (1833–1912), especially his *Einleitung in die Geisteswissenschaften* (1883), had led the attention of 19th-century German philosophy back to the foundations of the historical world in the sciences of the mind. In trying to present, and to solve, this problem in the spirit of the strictly critical philosophy, it was first of all necessary to draw a sharp line between the form of science exemplified by history and that represented by natural science.

This is the task which Windelband sets himself in his address *Geschichte und Naturwissenschaft.* The pure "sciences of laws" are here contrasted with the "sciences of events," the "nomothetic" procedure of natural science with the "ideographic" procedure of history. Rickert elaborates this distinction in his work *Die Grenzen der naturwissenschaftlichen Begriffsbildung,* which he calls a logical introduction to the historical sciences (1896–1902; 2nd ed., 1913). In this justification, the isolated place which the pure science of knowledge had received with Riehl is abolished.

For Windelband and Rickert (*cf.* especially Rickert's *Der Gegenstand der Erkenntnis* [1892; 2nd ed., 1904]) the theory of knowledge, too, is included in the group of the sciences of values, because it is a science of "oughts," of the universally valid norms of truth. In this respect, it stands on the same level as the other studies of values, especially with ethics and aesthetics. Philosophy, as a general theory of values, as the science of the "consciousness of norms" (*Normalbewustsein*), is essentially a philosophy of culture. Its task may be said to consist in establishing a connection between the realm of "reality" and the realm of values. It is only the concept of value that makes history possible as a science, for only through the values attached to culture can we obtain a definite principle of selection within the infinite manifold of the historical facts, and thus establish the conception of a historical individuality which is capable of description. If we now survey the path of the Neo-Kantian movement from its first beginnings to its present stage, we may say by way of summary that it has gradually encircled the total orbit of knowledge by trying to advance more and more from the "abstract" to the "concrete," from the general principles of knowledge to the specific content of mental culture. (E. Cr.)

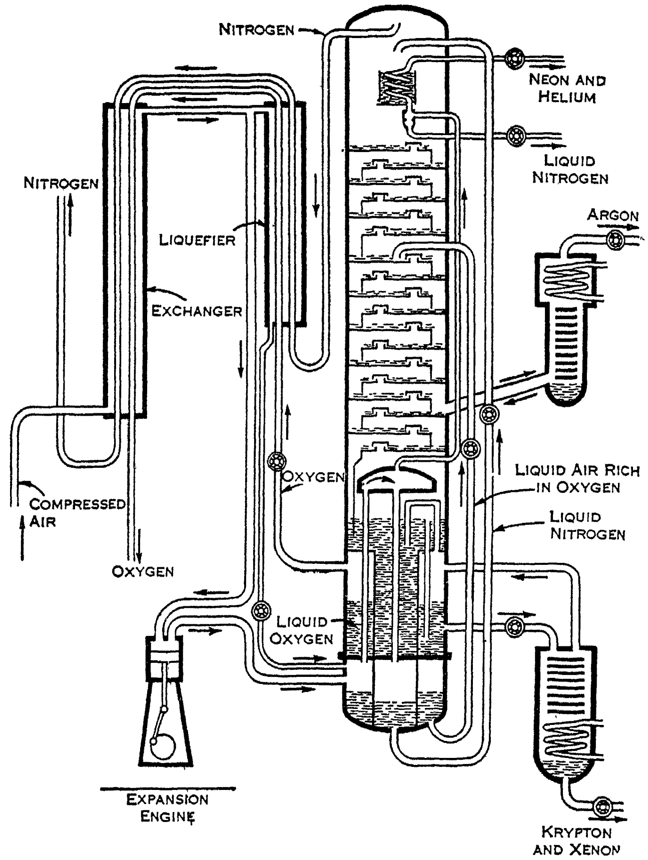
NEOLITHIC: *see* ARCHAEOLOGY.

NEON, a rare inert gas of the atmosphere (*q.v.*) represented by the symbol Ne. It is the second member of the helium family of elements, composed of helium, neon, argon, krypton, xenon and radon, which comprises Group zero of the periodic system.

Neon has an atomic number of 10 and an atomic weight of 20.183. Its stable isotopes, listed in order of decreasing abundance, have mass numbers of 20, 22 and 21. Radioactive isotopes of mass numbers 19 and 23 may be obtained by nuclear reactions. Electrons of the atom occupy and fill the K and L ($2s^2$, $2p^6$) shells.

The element was discovered in 1898 by Sir William Ramsay and M. W. Travers as a component of the most volatile fraction of liquefied crude argon obtained from air and was given a name meaning "the new one."

Neon is widely distributed in nature and occurs in traces not only in the atmosphere but also in gases trapped within the earth. The content in dry air is close to 0.0018% by volume. Industrial production of the element is accomplished by fractional distillation of air using equipment such as that shown in the figure. The most volatile fraction taken from such a still is composed of helium, neon and nitrogen. The latter gas is removed by chemical absorption and the neon is then separated from helium by selective adsorption on activated



FROM METZGER IN "INDUSTRIAL & ENGINEERING CHEMISTRY"
EQUIPMENT FOR THE FRACTIONAL DISTILLATION OF LIQUID AIR TO ISOLATE NEON AND OTHER GASES OF THE ATMOSPHERE

charcoal at low temperature. The price of neon in the United States in the early 1950s was about $1.50 per litre when sold in cylinders of 50-l. capacity.

The following physical constants have been selected from technical literature, most of the values being taken from a table critically compiled by F. P. Gross: density of the gas at 1 atm. pressure and 0° C, 0.8999 g. per litre; density of the liquid at its boiling point, 1.204 g. per millilitre; normal boiling point, −246.09° C.; freezing point, −248.61° C.; critical temperature, −228.75° C.; critical pressure, 26.86 atm.; heat of vaporization at the normal boiling point, 20.8 cal. per gram; heat of fusion, per gram, 3.97 cal.; ionization potential for first electron, 21.5 v.; solubility in water (neon at 1 atm. pressure) at 25° C., 0.0101 ml. (measured at 1 atm. pressure and 0° C.) per millilitre of water; at 15° C., 0.0108 ml. of neon per millilitre of water. Since the ratio of the specific heat of the gas at constant pressure to that at constant volume is 1.642, it may be concluded that a single atom of the element comprises a molecule.

Neon is used in a variety of lamps and other electrical devices which take advantage of its unusually high electrical conductivity and light-emissive power. The brilliant orange-red light emitted from "neon tubes" in which an electrical discharge passes through the gas under a pressure of a few millimetres of mercury first became a familiar sight in the 1920s. Most gaseous conduction lamps and fluorescent lamps contain neon as a component of the gaseous mixture which carries the electricity. Other neon-tube devices include lightning arresters, high-voltage testers and negative glow lamps. The latter can be built with electrodes in the form of figures or letters suitable for display purposes or house numbers.

Neon forms no stable chemical compounds and appears to attract other atoms only by the relatively weak interatomic action known as van der Waals forces. Procedures for the analytical determination of neon provide for measuring the gas after it has been isolated by chemical absorption of reactive gases on hot calcium or other reagent and separation of helium, argon, krypton and xenon by physical means. Such a physical separation is usually accomplished by fractional desorption from cold activated charcoal or by diffusion (of helium) through hot quartz. The element is recognized by its characteristic spectrum which contains many beautiful red lines.

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NEOPHYTE, a word used in the Eleusinian and other mysteries to designate the newly initiated, and in the early church applied to newly baptized persons. These usually wore the white garments which they received at their admission to the church (*see* BAPTISM) for eight days, from Easter eve till the Sunday after Easter (hence called *Dominica in albis*), but they were subject to strict supervision for some time longer.

See Bergier, *Dict. de théologie*, s.v.; Martigny, *Dict. des antiquités*, pp. 433–435; Siegel, *Christliche Alterthümer*, iii. 17 *seq.*; Riddle, *Christ. Antiquities*, pp. 313, 522; Walcott, *Sacred Archaeology*, s.v., and the *Catholic Encyclopaedia*, s.v.

NEOPLATONISM, the name given specially to the last school of pagan philosophy, which grew up mainly among the Greeks of Alexandria from the 3rd century onwards. The term has also been applied to the Italian humanists of the Renaissance, and in modern times, somewhat vaguely, to thinkers who have based their speculations on the Platonic metaphysics or on Plotinus, and incorporated with it a tendency towards a mystical explanation of ultimate phenomena.

Historical Position and Significance.—Just as the Later Roman empire was at once the supreme effort of the old world and the outcome of its exhaustion, so Neoplatonism is in one aspect the consummation, in another the collapse, of ancient philosophy. Never before in Greek or in Roman speculation had the consciousness of man's dignity and superiority to nature found such adequate expression; never before had real science and pure knowledge been so undervalued and despised by the leaders of culture as they were by the Neoplatonists.

It is a proof of the strength of the moral instincts of mankind that the only phase of culture which we can survey in all its stages from beginning to end culminated not in materialism, but in the boldest idealism. This idealism, however, is also in its way a mark of intellectual bankruptcy. Contempt for reason and science leads in the end to barbarism—its necessary consequence being the rudest superstition. As a matter of fact, barbarism did break out after the flower had fallen from Neoplatonism. The philosophers themselves, no doubt, still lived on the knowledge they repudiated; but the masses were trained to a superstition with which the Christian church, as the executor of Neoplatonism, had to reckon and contend. By a fortunate coincidence, at the very moment when this bankruptcy of the old culture must have become apparent, the stage of history was occupied by barbaric peoples. This has obscured the fact that the inner history of antiquity, ending as it did in despair of this world, must in any event have seen a recurrence of barbarism. The present world was a thing that men would neither enjoy nor master nor study. A new world was discovered, for the sake of which everything else was abandoned.

Such is Neoplatonism. The pre-Socratic philosophy took its stand on natural science, to the exclusion of ethics and religion. The systems of Plato and Aristotle sought to adjust the rival claims of physics and ethics (although the supremacy of the latter was already acknowledged); but the popular religions were thrown overboard. The post-Aristotelian philosophy in all its branches makes withdrawal from the objective world its starting-point. It might seem, indeed, that Stoicism indicates a falling off from Plato and Aristotle towards materialism, but the ethical dualism, which was the ruling tendency of the Stoa, could not long endure its materialistic physics, and took refuge in the metaphysical dualism of the Platonists. But this originated no permanent philosophical creation. From one-sided Platonism issued the various forms of scepticism, the attempt to undermine the trustworthiness of empirical knowledge. Neoplatonism, coming last, borrowed something from all the schools. First, it stands in the line of post-Aristotelian systems; it is, in fact, as a subjective philosophy, their logical completion. Secondly, it is founded on scepticism; for it has neither interest in, nor reliance upon, empirical knowledge. Thirdly, it can justly claim the honour of Plato's name, since it expressly goes back to him for its metaphysics, directly combating those of the Stoa. Yet even on this point it learned something from the Stoics; the Neoplatonic conception of the action of the Deity on the world and of the essence and origin of matter can only be explained by reference to the dynamic pantheism of the Stoa. Fourthly, the study of Aristotle also exercised an influence on Neoplatonism. This appears not only in its philosophical method, but also—though less prominently—in its metaphysic. And, fifthly, Neoplatonism adopted the ethics of Stoicism; although it was found necessary to supplement them by a still higher conception of the functions of the spirit. Philosophy as represented by Neoplatonism, its sole interest being a religious interest, and its highest object the supra-rational, must be a philosophy of revelation.

This is not a prominent feature in Plotinus or his immediate disciples, who still exhibit full confidence in the subjective presuppositions of their philosophy. But the later adherents of the school did not possess this confidence; they based their philosophy on revelations of the Deity, and they found these in the religious traditions and rites of all nations. The Stoics had taught them to overstep the political boundaries of states and nationalities, and rise from the Hellenic to a universal human consciousness. Through all history the spirit of God has breathed; everywhere we discover the traces of His revelation. The older any religious tradition or mode of worship is, the more venerable is it, the richer in divine ideas. Hence the religions of the East had a peculiar interest for the Neoplatonist. Neoplatonism seizes on the aspiration of the human soul after a higher life, and treats this psychological fact as the key to the interpretation of the universe. Hence the existing religions, after being refined and spiritualized, were made the basis of philosophy.

Neoplatonism thus represents a stage in the history of religion; indeed this is precisely where its historical importance lies. In the progress of science and enlightenment it has no positive significance, except as a necessary transition which the race had to make in order to get rid of nature-religion, and that under-valuing of the spiritual life which formed an insuperable obstacle to the advance of human knowledge. Neoplatonism, however, failed as signally in its religious enterprise as it did in its philosophical. While seeking to perfect ancient philosophy, it really extinguished it; and in like manner its attempted reconstruction of ancient religions only resulted in their destruction. For in requiring these religions to impart certain prescribed religious truths, and to inculcate the highest moral tone, it burdened them with problems to which they were unequal. And further, by inviting them to loosen, though not exactly to dissolve, their political allegiance—the very thing that gave them stability—it removed the foundation on which they rested.

There is one other question which we are called upon to raise here. Why did not Neoplatonism set up an independent religious community? Why did it not provide for its mixed multitude of divinities by founding a universal church, in which all the gods of all nations might be worshipped along with the one ineffable Deity? The answer to this question involves the answer to another—Why was Neoplatonism defeated by Christianity? Three things were wanting in Neoplatonism; they are admirably indicated in Augustine's *Confessions* (vii. 18–21). First, and chiefly, it lacked a religious founder; second, it could not tell how the state of inward peace and blessedness could become permanent; third, it had no means to win those who were not endowed with the speculative faculty. The philosophical discipline which it recommended for the attainment of the highest good was beyond the reach of the masses; and the way by which the masses could attain the highest good was a secret unknown to Neoplatonism.

Yet the influence of Neoplatonism on the history of our ethical culture is immeasurable, above all because it begot the consciousness that the only blessedness which can satisfy the heart must be sought higher even than the sphere of reason. That man shall not live by bread alone, the world had learned before Neoplato-

nism; but Neoplatonism enforced the deeper truth—a truth which the older philosophy had missed—that man shall not live by knowledge alone.

Origin.—As forerunners of Neoplatonism we may regard, on the one hand, those Stoics who accepted the Platonic distinction between the sensible world and the intelligible, and, on the other hand, the so-called Neopythagoreans and religious philosophers like Plutarch of Chaeronea and especially Numenius of Apamea. The Jewish and Christian thinkers of the first two centuries approach considerably nearer than Numenius to the later Neoplatonism. Here we have Philo, to begin with. Philo, who translated the Old Testament religion into the terms of Hellenic thought, holds as an inference from his theory of revelation that the divine Supreme Being is "supra-rational," that He can be reached only through "ecstasy," and that the oracles of God supply the material of moral and religious knowledge. The religious ethics of Philo—a compound of Stoic, Platonic and Neopythagorean elements—already bear the peculiar stamp which we recognize in Neoplatonism. While his system assigns the supremacy to Greek philosophy over the national religion of Israel, it exacts from the former, as a sort of tribute to the latter, the recognition of the elevation of God above the province of reason. The claim of positive religion to be something more than the intellectual apprehension of the reason in the universe is thus acknowledged. Religious syncretism is also a feature of Philo's system, but it differs essentially from what we find in later Neoplatonism. For Philo pays no respect to any cultus except the Jewish; and he believed that all the fragments of truth to be found amongst Greeks and Romans had been borrowed from the books of Moses. The earliest Christian philosophers, particularly Justin and Athenagoras, likewise prepared the way for the speculations of the Neoplatonists—partly by their attempts to connect Christianity with Stoicism and Platonism, partly by their ambition to exhibit Christianity as "hyperplatonic." In the introduction to his *Dialogue with Trypho*, Justin follows a method which bears a striking resemblance to the later method of Neoplatonism: he seeks to base the Christian knowledge of God—that is, the knowledge of the truth—on Platonism, Scepticism and "Revelation." A still more remarkable parallel to the later Neoplatonism is afforded by the Christian Gnostics of Alexandria, especially Valentinus and the followers of Basilides. Like the Neoplatonists, the Basilidians believed, not in an emanation from the Godhead, but in a dynamic manifestation of its activity. The same is true of Valentinus, who also placed an unnameable being at the apex of his system, and regarded matter, not as a second principle, but as a product of the one divine principle.

But were the oldest Neoplatonists really acquainted with the speculations of Philo, or Justin, or Valentinus, or Basilides? Did they know the Oriental religions, Judaism and Christianity in particular? And, if so, did they really derive anything from these sources?

To these questions we cannot give definite answers. Since Neoplatonism originated in Alexandria, where Oriental modes of worship were accessible to every one, and since the Jewish philosophy had also taken its place in the literary circles of Alexandria, we may safely assume that even the earliest of the Neoplatonists possessed an acquaintance with Judaism and Christianity. But if we search Plotinus for evidence of any actual influence of Jewish and Christian philosophy, we shall search in vain. We have to come down to Iamblichus and his school before we find complete correspondence with the Christian Gnosticism of the 2nd century; that is to say, it is only in the 4th century that Greek philosophy in its proper development reaches the stage at which certain Greek philosophers who had embraced Christianity had arrived in the 2nd century. The influence of Christianity—whether Gnostic or Catholic—on Neoplatonism was at no time very considerable, although individual Neoplatonists, after Amelius, used Christian texts as oracles, and put on record their admiration for Christ.

History and Doctrines.—The founder of the Neoplatonic school in Alexandria is supposed to have been Ammonius Saccas (*q.v.*). But the *Enneads* of his pupil Plotinus are the primary and classical document of Neoplatonism. The doctrine of Plotinus is mysticism, and like all mysticism it consists of two main divisions. The first or theoretical part deals with the high origin of the human soul, and shows how it has departed from its first estate. In the second or practical part the way is pointed out by which the soul may again return to the Eternal and Supreme. Since the soul in its longings reaches forth beyond all sensible things, beyond the world of ideas even, it follows that the highest being must be something supra-rational. The system thus embraces three heads—(1) the primeval Being, (2) the ideal world and the soul, (3) the phenomenal world.

The primeval Being is, as opposed to the many, the One; as opposed to the finite, the Infinite, the unlimited. It is the source of all life, and therefore absolute causality and the only real existence. It is, moreover, the Good, in so far as all finite things have their purpose in it, and ought to flow back to it. But one cannot attach moral attributes to the original Being itself, because these would imply limitation. It has no attributes of any kind; it is being without magnitude, without life, without thought; in strict propriety, indeed, we ought not to speak of it as existing; it is "above existence," "above goodness." It is also active force without a substratum; as active force the primeval Being is perpetually producing something else, without alteration, or motion, or diminution of itself. This production is not a physical process, but an emission of force; and, since the product has real existence only in virtue of the original existence working in it, Neoplatonism may be described as a species of dynamic pantheism. Directly or indirectly, everything is brought forth by the "One."

The original Being first of all throws out the *nous,* which is a perfect image of the One and the archetype of all existing things. It is at once being and thought, ideal world and idea. As image, the *nous* corresponds perfectly to the One, but as derived it is entirely different. What Plotinus understands by the *nous* is the highest sphere accessible to the human mind, and, along with that, pure thought itself.

The image and product of the motionless *nous* is the soul, which, according to Plotinus is, like the *nous,* immaterial. Its relation to the *nous* is the same as that of the *nous* to the One. It stands between the *nous* and the phenomenal world, is permeated and illuminated by the former, but is also in contact with the latter. The *nous* is indivisible; the soul *may* preserve its unity and remain in the *nous,* but at the same time it has the power of uniting with the corporeal world and thus being disintegrated. It therefore occupies an intermediate position. As a single soul (world-soul) it belongs in essence and destination to the intelligible world; but it also embraces innumerable individual souls; and these can either submit to be ruled by the *nous,* or turn aside to the sensual and lose themselves in the finite.

The human souls which have descended into corporeality are those which have allowed themselves to be ensnared by sensuality and overpowered by lust. They now seek to cut themselves loose from their true being; and, striving after independence, they assume a false existence. They must turn back from this; and, since they have not lost their freedom, a conversion is still possible.

Here, then, we enter upon the practical philosophy. Along the same road by which it descended the soul must retrace its steps back to the supreme Good. It must first of all return to itself. This is accomplished by the practice of virtue, which aims at likeness to God, and leads up to God. In the ethics of Plotinus all the older schemes of virtue are taken over and arranged in a graduated series. The lowest stage is that of the civil virtues, then follow the purifying, and last of all the divine virtues. The civil virtues merely adorn the life, without elevating the soul. That is the office of the purifying virtues, by which the soul is freed from sensuality and led back to itself, and thence to the *nous.* By means of ascetic observances the man becomes once more a spiritual and enduring being, free from all sin. But there is still a higher attainment; it is not enough to be sinless, one must become "God." This is reached through contemplation of the primeval Being, the One—in other words, through an ecstatic approach, the soul may see God, the fountain of life, the source of being, the origin of all good, the root of the soul. In that

moment it enjoys the highest indescribable bliss; it is as it were swallowed up of divinity, bathed in the light of eternity. Porphyry tells us that on four occasions during the six years of their intercourse Plotinus attained to this ecstatic union with God.

Such is the religious philosophy of Plotinus, and for himself personally it sufficed, without the aid of the popular religion or worship. Nevertheless he sought for points of support in these. God is certainly in the truest sense nothing but the primeval Being; but He reveals Himself in a variety of emanations and manifestations. The *nous* is a sort of second god, the λόγοι which are wrapped up in it are gods, the stars are gods.

Amongst his pupils, Amelius and Porphyry are the most eminent. Amelius modified the teaching of Plotinus on certain points; and he also put some value on the prologue to the Gospel of John. To Porphyry (*q.v.*) belongs the credit of having recast and popularized the system of his master Plotinus. He was not an original thinker, but a diligent student, distinguished by great learning, by a turn for historical and philological criticism, and by an earnest purpose to uproot false teaching, especially Christianity, to ennoble men and train them to goodness. The system of Porphyry is more emphatically practical and religious than that of Plotinus. The object of philosophy, according to Porphyry, is the salvation of the soul. The origin and the blame of evil are not in the body, but in the desires of the soul. Hence the strictest asceticism (abstinence from flesh, and wine, and sexual intercourse) is demanded, as well as the knowledge of God. As he advanced in life, Porphyry protested more and more earnestly against the rude faith of the common people and their immoral worships. His work *Against the Christians* was directed, not against Christ, nor against what he believed to be Christ's teaching, but against the Christians of his own day and their sacred books, which, according to Porphyry, were the work of deceivers and ignorant people. In his trenchant criticism of the origin of what passed for Christianity in his time, he spoke bitter and severe truths, which have gained for him the reputation of the most rabid and wicked of all the enemies of Christianity. His work was destroyed, it was condemned by an edict of the emperors Theodosius II. and Valentinian in the year 448, and the copious extracts which we find in Lactantius, Augustine, Jerome, Macarius Magnus and others show how profoundly he had studied the Christian writings, and how great was his talent for real historical research.

Porphyry marks the transition to a new phase of Neoplatonism, in which it becomes completely subservient to polytheism, and seeks before everything else to protect the Greek and Oriental religions from the formidable assault of Christianity. In the hands of Iamblichus (*q.v.*), the pupil of Porphyry, Neoplatonism is changed "from a philosophical theory to a theological doctrine."

The numerous followers of Iamblichus—Aedesius, Chrysanthius, Eusebius, Priscus, Sopater, Sallust, and, most famous of all, Maximus (*q.v.*), rendered little service to speculation. Some of them (Themistius in particular) are known as commentators on the older philosophers, and others as the missionaries of mysticism. The work *De mysteriis Aegyptiorum* is the best sample of the views and aims of these philosophers. Their hopes rose high when Julian ascended the imperial throne (361–363). But the emperor himself lived long enough to see that his romantic policy of restoration was to leave no results; and after his early death all hope of extinguishing Christianity was abandoned.

But undoubtedly the victory of Christianity in the age of Valentinian and Theodosius had a purifying influence on Neoplatonism. During the struggle for supremacy, the philosophers had been driven to make common cause with everything that was hostile to Christianity. But now Neoplatonism was thrust from the great stage of history. The church and church theology, to whose guidance the masses now surrendered themselves, took in along with them their superstition, their polytheism, their magic, their myths, and all the machinery of religious witchcraft. The more all this settled and established itself—certainly not without opposition—in the church the purer did Neoplatonism become. While maintaining intact its religious attitude and its theory of knowledge, it returned with new zest to scientific studies, especially the study of the old philosophers. If Plato still remains the divine philosopher, yet we can perceive that after the year 400 the writings of Aristotle are increasingly read and valued. In the chief cities of the empire Neoplatonic schools flourished till the beginning of the 5th century; during this period, indeed, they were the training-schools of Christian theologians. At Alexandria the noble Hypatia (*q.v.*) taught, to whose memory her impassioned disciple Synesius, afterwards a bishop, reared a splendid monument. But after the beginning of the 5th century the fanaticism of the church could no longer endure the presence of "heathenism." The murder of Hypatia was the death of philosophy in Alexandria, although the school there maintained a lingering existence till the middle of the 6th century. But there was one city of the East which, lying apart from the crowded highways of the world, had sunk to a mere provincial town, and yet possessed associations which the church of the 5th century felt herself powerless to eradicate. In Athens a Neoplatonic school still flourished.

The most distinguished teachers at Athens were Plutarch (*q.v.*), his disciple Syrianus (who did important work as a commentator on Plato and Aristotle, and further deserves mention for his vigorous defence of the freedom of the will), but above all Proclus (411–485). Proclus is the great schoolman of Neoplatonism. Forty-four years after the death of Proclus the school of Athens was closed by Justinian (A.D. 529); but it had already fulfilled its mission in the work of Proclus. The works of Proclus, as the last testament of Hellenism to the church and the middle ages, exerted an incalculable influence on the next thousand years. They not only formed one of the bridges by which the mediaeval thinkers got back to Plato and Aristotle; they determined the scientific method of thirty generations, and they partly created and partly nourished the Christian mysticism of the middle ages.

The disciples of Proclus are not eminent (Marinus, Asclepiodotus, Ammonius, Zenodotus, Isidorus, Hegias, Damascius). The last president of the Athenian school was Damascius (*q.v.*). When Justinian issued the edict for the suppression of the school, Damascius along with Simplicius (the painstaking commentator on Aristotle) and five other Neoplatonists set out to make a home in Persia. They found the conditions were unfavourable and were allowed to return (*see* CHOSROES I.).

At the beginning of the 6th century Neoplatonism had ceased to exist in the East as an independent philosophy. Almost at the same time, however—and the coincidence is not accidental—it made new conquests in the church theology through the writings of the pseudo-Dionysius. It began to bear fruit in Christian mysticism, and to diffuse a new magical leaven through the worship of the church. In the West, where philosophical efforts of any kind had been very rare since the 2nd century, and where mystical contemplation did not meet with the necessary conditions, Neoplatonism found a congenial soil only in isolated individuals. G. Marius Victorinus (*q.v.*) translated certain works of Plotinus, and thus had a decisive influence on the spiritual history of Augustine (*Confess.*, vii, 9; viii, 2). It may be said that Neoplatonism influenced the West only through the medium of the church theology, or, in some instances, under that disguise. Even Boethius (it may now be considered certain) was a catholic Christian, although his whole mode of thought was certainly Neoplatonic (*see* BOETHIUS, ANICIUS MANLIUS SEVERINUS).

Neoplatonism and the Theology of the Church.—The question as to the influence of Neoplatonism on the development of Christianity is not easily answered, because it is scarcely possible to get a complete view of their mutual relations. The answer will depend, in the first instance, upon how much is included under the term "Neoplatonism." If Neoplatonism is understood in the widest sense, as the highest and fittest expression of the religious movements at work in the Graeco-Roman empire from the 2nd to the 5th century, then it may be regarded as the twin-sister of the church dogmatic which grew up during the same period; the younger sister was brought up by the elder, then rebelled against her and at last tyrannized over her. In so far as Neoplatonism and the church dogmatic set out from the felt need of redemption, in so far as both sought to deliver the soul from sensuality and recognized man's inability without divine

aid—without a revelation—to attain salvation and a sure knowledge of the truth, they are at once most intimately related and at the same time mutually independent. It must be confessed that when Christianity began to project a theology it was already deeply impregnated by Hellenic influences. But the influence is to be traced not so much to philosophy as to the general culture of the time, and the whole set of conditions under which spiritual life was manifested. When Neoplatonism appeared, the Christian church had already laid down the main positions of her theology; or if not, she worked them out alongside of Neoplatonism—*that* is not a mere accident—but still independently. It was only by identifying itself with the whole history of Greek philosophy, or by figuring as pure Platonism restored, that Neoplatonism could stigmatize the church theology of Alexandria as a plagiarism from itself. These assumptions, however, were fanciful. Although our sources are unfortunately very imperfect, the theology of the church does not appear to have learned much from Neoplatonism in the 3rd century—partly because the latter had not yet reached the form in which its doctrines could be accepted by the church dogmatic, and partly because theology was otherwise occupied. Her first business was to plant herself firmly on her own territory, to make good her position and clear away old and objectionable opinions. Origen was quite as independent a thinker as Plotinus; only, they both drew on the same tradition. From the 4th century downwards, however, the influence of Neoplatonism on the Oriental theologians was of the utmost importance. The church gradually expressed her most peculiar convictions in dogmas, which were formulated by philosophical methods, but were irreconcilable with Neoplatonism (the Christological dogmas); and the further this process went the more unrestrainedly did theologians resign themselves to the influence of Neoplatonism on all other questions. The doctrines of the incarnation, the resurrection of the flesh and the creation of the world in time marked the boundary line between the church's dogmatic and Neoplatonism; in every other respect, theologians and Neoplatonists drew so closely together that many of them are completely at one. In fact, there were special cases, like that of Synesius, in which a speculative reconstruction of distinctively Christian doctrines by Christian men was winked at. If a book does not happen to touch on any of the above-mentioned doctrines, it may often be doubtful whether the writer is a Christian or a Neoplatonist. In ethical precepts, in directions for right living (that is, asceticism), the two systems approximate more and more closely. But it was here that Neoplatonism finally celebrated its greatest triumph. It indoctrinated the church with all its mysticism, its mystic exercises and even its magical cultus as taught by Iamblichus. The works of the pseudo-Dionysius contain a gnosis in which, by means of the teaching of Iamblichus and Proclus, the church's theology is turned into a scholastic mysticism with directions on matters of practice and ritual. And as these writings were attributed to Dionysius, the disciple of the apostles, the scholastic mysticism which they unfold was regarded as an apostolic, not to say a divine, science. The influence exercised by these writings, first on the East, and then—after the 9th (or 12th) century—on the West, cannot be overestimated. It is impossible to enlarge upon it here; suffice it to say that the mystical and pietistic devotion of our own day, even in the Protestant churches, is nourished on works whose ancestry can be traced, through a series of intermediate links, to the writings of the pseudo-Areopagite.

In the ancient world there was only one Western theologian who came directly under the influence of Neoplatonism; but that one is Augustine, the most important of them all. It was through Neoplatonism that Augustine got rid of scepticism and the last dregs of Manichaeism. In the seventh book of his *Confessions* he has recorded how much he owed to the perusal of Neoplatonic works. On all the cardinal doctrines—God, matter, the relation of God to the world, freedom and evil—Augustine retained the impress of Neoplatonism; at the same time he is the theologian of antiquity who most clearly perceived and most fully stated wherein Neoplatonism and Christianity differ. The best ever written by any church father on this subject is to be found in chaps. ix.-xxi. of the seventh book of the *Confessions*.

Why Neoplatonism succumbed in the conflict with Christianity is a question which the historians have never satisfactorily answered. As a rule, the problem is not even stated correctly. We have nothing to do here with our own private ideal of Christianity, but solely with catholic Christianity and catholic theology. These are the forces that conquered Neoplatonism, after assimilating nearly everything that it contained. Further, we must consider the arena in which the victory was won. The battlefield was the empire of Constantine and Theodosius. It is only when these and all other circumstances of the case are duly realized that we have a right to inquire how much the essential doctrines of Christianity contributed to the victory, and what share must be assigned to the organization of the church.

In mediaeval theology and philosophy mysticism appears as the powerful opponent of rationalistic dogmatism. The empirical science of the Renaissance and the two following centuries was itself a new development of Platonism and Neoplatonism, as opposed to rationalistic dogmatism, with its contempt for experience. Magic, astrology and alchemy—all the outgrowth of Neoplatonism—gave the first effectual stimulus to the observation of nature, and consequently to natural science, and in this way finally extinguished barren rationalism. Thus in the history of science Neoplatonism has played a part and rendered services of which Plotinus or Iamblichus or Proclus never dreamt. So true is it that sober history is often stranger and more capricious than all the marvels of legend and romance.

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(A. HA.; J. M. M.)

NEOPTOLEMUS (also called PYRRHUS), in Greek legend, the son of Achilles (*q.v.*) and Deïdameia. He was brought up by his grandfather Lycomedes in the island of Scyros, and taken to Troy in the last year of the war by Odysseus, since Helenus had declared that the city could not be captured without the aid of a descendant of Aeacus. He distinguished himself by his valour and took part in the capture, slaying Priam. He was the ancestor of the Molossian kings, who therefore claimed to be of pure Hellenic stock. He was murdered by Orestes at Delphi, where he was buried, and a festival held in his honour every 8th year.

NEOPYTHAGOREANISM, a Graeco-Alexandrian school of philosophy, which became prominent in the 1st century A.D. Very little is known about the members of this school, and there has been much discussion as to whether the Pythagorean literature which was widely published at the time in Alexandria was the original work of 1st-century writers or merely reproductions of and commentaries on the older Pythagorean writings. The only well-known members of the school were Apollonius of Tyana and Moderatus of Gades. In the previous century Cicero's learned friend P. Nigidius Figulus (d. 45 B.C.) had made an attempt to revive Pythagorean doctrines, but he cannot be described as a member of the school. Further, it is necessary to distinguish from the Neopythagoreans a number of Eclectic Platonists, who, during the 1st century of our era, maintained views which had a similar tendency (*e.g.* Apuleius of Madaura, Plutarch of Chaeronea and, later, Numenius of Apamea).

Neopythagoreanism was the first product of an age in which abstract philosophy had begun to pall. The Stoics discovered that their "perfect man" was not to be found in the luxurious, often morbid society of the Graeco-Roman world; that something more than dialectic ethics was needed to reawaken a sense of responsibility. A degenerate society cared nothing for syllogisms grown threadbare by repetition. Neopythagoreanism was an attempt to introduce a religious element into pagan philosophy in place of what had come to be regarded as an arid formalism. The founders of the school sought to invest their doctrines with the halo of tradition by ascribing them to Pythagoras and Plato, and there is no reason to accuse them of insincerity. They went back to the later period of Plato's thought, the period when Plato endeavoured to combine his doctrine of Ideas with the Pythag-

orean number theory, and identified the *good* with the *one*, the source of the duality of the infinite and the measured (τὸ ἄπειρον and πέρας) with the resultant scale of realities from the *one* down to the objects of the material world. They emphasized the fundamental distinction between the soul and the body. God must be worshipped spiritually by prayer and the will to be good, not in outward action. The soul must be freed from its material surrounding, the "muddy vesture of decay," by an ascetic habit of life. Bodily pleasures and all sensuous impulses must be abandoned as detrimental to the spiritual purity of the soul. God is the principle of good, matter the groundwork of evil. In this system we distinguish not only the asceticism of Pythagoras and the later mysticism of Plato, but also the influence of the Orphic mysteries and of oriental philosophy. The Ideas of Plato are no longer self-subsistent entities; they are the elements which constitute the content of spiritual activity. The soul is no longer an appanage of οὐσία, it is οὐσία itself; the nonmaterial universe is regarded as the sphere of mind or spirit.

Thus Neopythagoreanism is a link in the chain between the old and the new in pagan philosophy. It connects the teaching of Plato with the doctrines of Neoplatonism and brings it into line with the later Stoicism and with the ascetic system of the Essenes. A comparison between the Essenes and the Neopythagoreans shows a parallel so striking as to warrant the theory that the Essenes were profoundly influenced by Neopythagoreanism. Lastly, Neopythagoreanism furnished Neoplatonism with the weapons with which pagan philosophy made its last stand against Christianity.

See APOLLONIUS OF TYANA; ESSENES; NEOPLATONISM; PYTHAGORAS; and Eduard Zeller's *Philosophie der Griechen.*

NEPAL, an independent state, situated on the northeastern frontier of India, lying between 80° 15′ and 88° 10′ E. long. and between 26° 20′ and 30° 10′ N. lat.; area, 54,000 sq.mi. Its extreme length is about 525 mi., and its breadth varies from 90 to 140 mi.

It is bounded on the north by Tibet; on the east by Sikkim; on the south by Bengal and the United Provinces; on the west by Kumaon, from which it is separated by the Kali river. Its population in 1950 was estimated at about 7,000,000.

Physical Features.—Nepal consists physically of two distinct territories: (1) the *tarai,* or strip of level, cultivated and forest land lying along the southern border; and (2) the great mountainous tract stretching northward to Tibet. Along the northern frontier stand many of the highest peaks of the Himalayan range, such as Mount Everest (29,141 ft.), Makalu (27,790 ft.), Kanchenjunga (28,140 ft.), Dhaulagiri (26,800 ft.), Gauri Sankar (23,440 ft.) and peaks varying from 20,000 to 24,000 ft. In clear weather this magnificent snowy range may be seen in an almost continuous line from the top of some of the lower ranges near Kathmandu. South of these are numerous parallel lower ranges, varying from 6,000 to 16,000 ft. in height, which are broken up by cross ranges.

These mountain ranges determine the course of the rivers, which are divided by the cross ranges into four groups. The first of these extends from Kumaon eastward as far as Dhaulagiri and consists of the affluents of the Kali (Sarda), Sarju, Kurnali, Eastern Sarju and Rapti, all of which ultimately form the Gogra or Gogari and flow into the Ganges. The second group, known to the Nepalese as the Sapt Gandaki, rises from the peaks between Dhaulagiri and Gosain Than and unites at Tribeni Ghat to form the Gandak. The third is a group of smaller rivers draining the great valley of Nepal, the valleys of Chitlong, Banepa and Panouti and portions of the *tarai* around the Churiaghati range of hills. These are the various branches of the Bara Gandak, the lesser Rapti, the Baghmati and Kumla. East of this again is the fourth group, known to the Nepalese as the Sapt Kosi, rising from the peaks between Gosain Than and Kanchenjunga and uniting to form the Sun Kosi, which falls into the Ganges. There is thus a natural division of the country into four portions. The westernmost is the country of the Baisi (22) rajas and contains the towns of Jumla, Doti and Sulliana. The second is the country of the Chaubisi (24) rajas and contains the towns of Malebum, Palpa, Gurkha and Nawakot. The third is the district containing Nepal proper, with the capital and many large towns. The fourth is the eastern portion of Nepal, comprising the country of the Kiratis and many small towns, such as Dhankota, Ilam and Bijapur.

The only portion of Nepal (with the exception of some portions of the *tarai* country which lies at the foot of the hills) ever visited by Europeans is the valley of Kathmandu, and even this can be entered only by special permission of the Nepal government. A narrow-gauge railway was opened by the Nepal government in Feb. 1927 and runs to Amlekhganj, 25 mi. from the Indian border at Raxaul, a small junction on the Oudh-Tirhut railway in the Champaran district in northern Bihar, due south of Kathmandu; a second railway, opened in 1940, runs a distance of 35 mi. from Jayanagor, on the Oudh-Tirhut railway, to Bijulpura. The road from Raxaul to Kathmandu is 75 mi., the first 50 mi. of which lie across the alluvial plain of the *tarai* through a sal forest to the foot of the hills, whence the road follows the beds of rivers and across low ridges till the small hamlet of Bhimphedi is reached. Up to this point the road is practicable for wheeled traffic. Motorcars run over it throughout the year except when abnormal rains cause breaches of the road. From Bhimphedi there is only a mountain track, which crosses two ridges (elevation about 8,000 ft.) and reaches the valley of Kathmandu about 9 mi. from the city, whence a fair carriage road is available. A ropeway was constructed from near Bhimphedi to the Kathmandu valley; it is operated by electricity from the power station in the valley, which also supplies electric light to the city.

In and around the Nepal valley the year may be divided into the rainy, cold and hot seasons. The rains begin in June and last till October, the average fall being about 60 in. annually. The cold season extends from the middle of October to the middle of April. From April to the beginning of the rains is the hot season, but the thermometer seldom exceeds 90° in the shade. The mean temperature is 60°. Violent thunderstorms are common, and occasionally severe earthquakes occur.

Flora and Fauna.—The flora and fauna are varied. Nepal may again be divided into three zones: (1) the *tarai* and lower ranges of hills up to 4,000 ft. in height; (2) the central ranges and high-lying valleys, up to 10,000 ft.; and (3) the alpine region, from 10,000 to 29,000 ft. in height.

The low alluvial land of the *tarai* is the granary of Nepal, but the greater portion consists of swamps, jungles and forests. Considerable stretches of land are, however, being reclaimed from year to year. The crops grown there are those of India—cotton, rice, wheat, pulse, sugar cane, tobacco, opium, indigo and some fruits and vegetables. The forests yield a magnificent supply of sal, sisu and other valuable forest trees and acacias, mimosas, cotton trees (*Bombax*), dak (*Butea frondosa*), large bamboos, rattans, palms and numerous ferns and orchids. On the Churiaghati range the common *Pinus longifolia* grows freely. Tea can be grown at heights between 2,000 and 4,000 ft. The middle zone supplies rice, wheat, maize, barley, oats, ginger, turmeric, chillies, potatoes, Cucurbitaceae, pineapples and many varieties of European fruits, vegetables and flowers. The forests contain tree rhododendron, *Pinus longifolia,* oak, horse chestnut, walnut, maple, hill bamboo, wild cherry, pear, allies of the tea plant, paper plant (*Daphne*), rose and many other inhabitants of temperate climes, and orchids, ferns and wild flowers. In the alpine zone exist Coniferae of many kinds, juniper, yew, box, holly, birch, dwarf rhododendron and other alpine flora.

The fauna follow a similar distribution. In the lowest zone are found the tiger, leopard, wolf, hyena and jackal, the elephant and rhinoceros, the gaur (*Gavaeus gaurus*), gayal (*Gavaeus frontalis*), wild buffalo or arna and many species of deer and the black bear (*Ursus labiatus*), peafowl, francolins, wild jungle fowl, the smaller vultures, etc. In the middle zone are found the leopard, the Himalayan black bear (*Ursus tibetanus*), the wild dog, cats of many sorts, squirrels, hares, porcupines, the pangolin and some species of deer and antelope, the larger vultures and eagles, pheasants (*Gallophasis*), *chikor,* hill partridges, etc. In the alpine zone are found the true bear (*Ursus isabellinus,* or brown bear), the yak, musk deer, wild goats and sheep, marmots, the eagle-vulture

(*Gypaetus*), the blood pheasant (*Ithaginis cruentus*), snow pheasant (*Tetraogallus himalayensis*), snow partridge (*Lerwa nivicola*), the horned pheasant (*Ceriornis saiyra*), crested pheasant (*Catrens wallichi*), etc. Geese, ducks, waders of all sorts and other migratory birds abound in the two lower zones.

HISTORY

Nepal and the somewhat similar country of Kashmir are peculiar among the Hindu states of the Indian subcontinent in possessing a historical literature. The Nepalese *Vamsavali* professes to start from a very early period in the Satya Yuga, when the present valley was still a lake. The earlier portion of it is devoted to the Satya and Treta Yugas and contains mythological tales and traditions having reference to various sacred localities in the country. During these two Yugas and also the Dwapara Yuga, the *Vamsavali* deals in round numbers of thousands of years.

In the beginning of the Kali Yuga, the Gupta dynasty is said to have been founded by Ne-Muni, from whom the country takes its name of Nepal. Lists are then given of the various dynasties, with the lengths of the reigns of the rajas. The dynasties mentioned are the Gupta, Ahir, Kirati, Somavanshi, Suryavanshi, Thakuri or first Rajput, Vaishya Thakuri, second Rajput and Karnataki dynasties. The country was then invaded by Mukundasena, and after his expulsion various Vaishya Thakuri dynasties are said to have held the throne for a period of 225 years. The chronology of the *Vamsavali* up to this period is confused and inaccurate; but the records begin to be clearer from the time of the invasion and conquest of the country by Harisinha-deva, raja of Simraun, in 1324. He was driven from Simraun by Tughlak Shah of Delhi, but seems to have found little difficulty in the conquest of Nepal. There were only four rajas of this Ayodhya dynasty, and then the throne was occupied by Jayabhadra-Malla, a descendant of Abhaya-Malla, one of the Rajput dynasty, who reigned in the 13th century. The seventh raja of this dynasty, Jayastithi-Malla, who reigned for 43 years (1386–1429), instituted legal codes and introduced the caste system to the Newars. In the reign of the eighth raja, Yaksha-Malla, the kingdom was divided into four separate states: Banepa, Bhatgaon or Bhaktapur, Kantipur or Kathmandu and Lalitapur or Patan. The Malla dynasty in the other three branches continued in power up to the conquest of the country by the Gurkhas in 1768. (*See* GURKHA.)

The Gurkhas were driven from their own country by the victorious Moslems and took refuge in the hilly districts about Kumaon, whence they gradually pushed their way eastward to Lamjung, Gurkha, Nayakot and ultimately the valley of Nepal, which under Raja Prithwi Narayana they finally captured. In the struggle which took place at Bhatgaon, Jayaprakasa (the raja of Kathmandu) was killed. Ranjit-Malla, the aged raja of Bhatgaon, retired to Benares, where he died. Tej Narsinha, the raja of Patan, died in confinement. During the latter years of the war Jayaprakasa applied to the British for assistance, and a small force, under Captain Kinloch, was sent into the *tarai* in 1765, but it was repulsed by the Gurkhas.

Prithwi Narayana died in 1774. He left two sons, Pratapasinha Sah and Bahadur Sah. The former succeeded his father but died in 1777, leaving an infant son, Rana Bahadur Sah, and his brother, who had been in exile, returned to Nepal as regent. The mother of the infant king, however, was opposed to him, and he had to flee again to British territory, where he remained till the death of the rani, when he again became regent. In 1790 the Gurkhas invaded Tibet and were at first successful; but they were brought into contact with the Chinese, who in 1791 sent a large force to invade Nepal. In 1792 the Chinese advanced as far as Nayakot and there dictated terms to the Nepalese. In 1791 the Gurkhas had entered into a commercial treaty with the British; William Kirkpatrick was therefore dispatched to Nepal and reached Nayakot in the spring of 1792, after the conclusion of peace. This embassy resulted in the ratification of another commercial treaty on March 1, 1792.

Rana Bahadur removed his uncle, Bahadur Sah, from the regency in 1795 and put him to death two years later. From this time to 1799 the king, who seems to have been insane, perpetrated the most barbarous outrages and his conduct became so intolerable that he was forced to abdicate in favour of his infant son, Girvan-yuddha Vikram Sah. Rana Bahadur recovered the throne in 1804 but was assassinated in 1805.

In Oct. 1801 another treaty was signed by the British and Nepalese authorities. A British resident was then sent to the Nepalese court, but was withdrawn in 1803, from which time the Nepalese carried on a system of encroachment and outrage on the frontier, which led to a declaration of war by the British in Nov. 1814. The fortunes of war were not constant on either side, and fighting was almost continuous. By the treaty of Sagauli (1815), which was finally ratified in March 1816, the Nepalese relinquished much of their newly acquired territory and agreed to allow a British residency to be established at Kathmandu. In November the raja died and was succeeded by his infant son, Surendra Vikram Sah, Gen. Bhimsena Thapa acting as regent.

In 1839 Bhimsena's enemies succeeded in driving him from power, and he committed suicide, or was murdered, in prison. The Kala Pandry faction then came into power, and there were frequent grave disputes with the British. In 1843 Matabar Singh, the nephew of Bhimsena, returned from exile, gained favour at court and speedily effected the destruction of his old enemies, the Kala Pandrys, who were seized and executed in May. At this time a nephew of Matabar Singh, Jung Bahadur, the eldest of a band of seven brothers, rose rapidly in the army and in favour at the court, especially with one of the ranis. He killed his uncle on May 18, 1845, obtained, with the aid of the rani, a prominent position in the government and soon after destroyed his enemies by what is known as the Kot massacre, on Sept. 15, 1846. From that time till the day of his death Jung Bahadur was in reality the ruler of Nepal. His old friend, the rani, was banished, and all posts of any consequence in the state were filled by Jung and his relations. In 1850 Jung Bahadur paid a visit to England and there proved himself to be a staunch friend of the British. On his return in 1851 he devoted himself to reforming the administration of the country, and it must be allowed that he eventually proved himself the greatest benefactor his country ever possessed. A treaty for the extradition of criminals was proposed in 1853 and ratified in Feb. 1855. In 1854 the Nepalese commenced a war against Tibet, which ended with a peace favourable to Nepal in March 1856.

In June 1857 intelligence of the mutiny of the native troops in Hindustan reached Nepal. Jung Bahadur, in spite of great opposition, stood firm as a friend of the British. On June 26, 4,000 troops were dispatched and rendered excellent service. Jung followed on Dec. 10 with a force of 8,000 men, 500 artillerymen and 24 guns, but too late to be of much use. Many of the mutineers and rebels, including Nana Sahib, took refuge in the Nepalese *tarai*, and it was not till the end of 1859 that they were finally swept out of the country. Jung Bahadur was knighted and decorated for his services and his troops received pay and handsome donations if wounded. Quantities of arms were presented to the Nepalese government and some territory was restored. This ground contains valuable sal and sisu forests and yields yearly a revenue of several lakhs of rupees.

After termination of the mutiny Nepalese history was uneventful. In spite of friendly relations with the British, many of the early restrictions against entering the country and trading there continued to be rigidly enforced. Sir Jung Bahadur died suddenly in 1877. His brother, Sir Ranadip Singh Bahadur, G.C.S.I., succeeded him as prime minister. Shortly after his accession to power a plot was formed against him, but nearly 40 of the conspirators were seized and executed, while others escaped into exile. He was, however, murdered in 1885 and was succeeded by his nephew Sir Shumsher Jung, G.C.S.I., who died in 1901 and was succeeded by his brother Deb Shumsher Jung. In June of that year a palace revolution placed another brother, Chandra Shumsher Jung, in power, while Deb Shumsher fled to India. Chandra Shumsher ruled Nepal with much ability. He gave effective aid to the British during the Tibet war of 1904, and the relations with the government of India became more cordial after his accession. In 1906 Chandra Shumsher was created a G.C.S.I.,

and in 1908 he visited England as a guest of the government, when he was invested with the G.C.B. and created major general in the British army and honorary colonel of the 4th Gurkha rifles.

During World War I, Sir Chandra Shumsher Jung placed the entire resources of his country at the disposal of the Allies. From 1915 to 1918 about 10,000 men of the Nepalese army served in India and on the Indian frontier. The 20 Gurkha battalions of the Indian army were increased to 40. In the brief Afghan War (1919), 2,000 Nepalese troops assisted the Indian government. Chandra Shumsher Jung was also responsible for the abolition of slavery in Nepal.

Replacing the old treaty of Sagauli, a new treaty of friendship was signed on Dec. 21, 1923, an important provision of which was the recognition by the British government of the complete independence of Nepal.

In World War II as in World War I the government ot Nepal supported the Allied war effort with men and money. Afterward, with a new situation having arisen in consequence of the partition of British India, the Republic of India and Nepal signed two treaties regulating their political and commercial relations (Aug. 1, 1950). In Nov. 1950, however, the agitation of the Nepal Congress party for a more democratic form of government led to disturbances and to the flight to India of the Maharajadhiraja Tribhuvana Bir Bikram Jung Bahadur (who had come to the throne in 1911). On representations by the Indian government Tribhuvana was restored, and a far-reaching program of constitutional reforms was announced at Kathmandu on Feb. 18, 1951. Ten months later the Congress party's spokesmen in the cabinet resigned because their efforts to implement this program were being thwarted by their reactionary colleagues.

SOCIAL AND ECONOMIC CONDITIONS

Population.—The races occupying Nepal are of mixed Mongol origin. To the north, in the higher mountains and valleys, dwell the Bhotias or Tibetans, to the west the Gurungs and Magars. The Murmis, Gorkhalis and Newars occupy the central parts, the Kirantis, Limbus and Lepchas the eastern. There are also Brahmans and Chhatris in the hills. There are other lesser tribes in the *tarai* and other malarious districts, known as Kumhas, Tharus, Manjis, etc., but generally classed together by the Nepalese as Aoulias, or dwellers in the districts where the *aoul,* a special type of malaria, prevails. The Gorkhalis or Gurkhas are descendants of the Brahmans and Rajputs who were driven from India by the Moslems and took refuge in the western hilly lands, where they ultimately became dominant and intermarried with the other races.

The Bhotias, Newars, Limbus, Kirantis and Lepchas are all Buddhists, but their religion became so mixed with Hinduism as to be hardly recognizable. The Newars entirely abandoned the monastic institutions of Buddhism and in great measure adopted the rules of caste, though these sit but lightly upon them. They burn their dead, eat the flesh of buffaloes, goats, sheep, ducks and fowls and drink beer and spirits. The Gorkhalis, Magars and Gurungs are Hindus, but the last two are by no means strict in the observance of their religion. Where temples are so numerous (there are 2,733 shrines in the valley), priests both Hindu and Buddhist abound. The festivals, too, are many, and holidays incessant. The *raj guru,* or high priest, is an influential person in the state and a member of council and has a large income from government lands as well as from fines for offenses against caste.

The various races have separate languages, or at least dialects. The Gorkhalis and western tribes use Parbatia (*see* PAHARI LANGUAGE), which, unlike the other dialects, is of Sanskrit origin. The Newars have a distinct language and alphabets, of which three are known to their pandits, though only one is in use; their language, called Gubhajius, resembles Tibetan but is interspersed with many Sanskrit words. The Bhotias use the Tibetan language and alphabet.

There are three large towns in the Nepal valley: Kathmandu (the capital, said to contain approximately 108,800 inhabitants in 1941), Patan (104,928) and Bhatgaon (93,176). The houses are from two to four stories in height, built of brick and tiled. The windows and balconies are of wood, and many are elaborately carved. There are numerous handsome temples in all the towns, the majority of which are pagoda-shaped and built of brick, with roofs of tiles or copper, which is sometimes gilt. The streets are narrow, many of them paved with brick or stone.

Agriculture.—Military service being the main occupation of the Gorkhalis, the agriculture of the valley is carried on chiefly by the Newars. The soil varies from light micaceous sand to dense ferruginous clay. The whole valley is cultivated and irrigated where practicable, and the slopes of the hills are terraced, so that there is little grazing ground, and few sheep or cattle are kept. There are some milch cows and buffaloes, which are stall-fed or grazed in the jungles at the foot of the hills. Animals for food and sacrifice are all imported and are consumed as fast as they are brought in. In the cold season the Bhotias bring large flocks of sheep and goats laden with bags of borax, salt and saltpetre. The animals are sold for food except for a few that are retained to carry back the bags. Poultry is kept and used by the Newars, especially ducks, the eggs of which are in great demand even among the orthodox Hindus. The crops grown in the valley consist of rice, wheat, pulse, murwah, maize, buckwheat, chillies, radishes, mustard, garlic, onions. ginger, turmeric, sugar cane, potatoes, peanuts, cucumbers and pumpkins, etc. Only foodstuffs may be grown in the valley, hence its suitability for producing tea, cotton and tobacco is unknown. These, however, are grown in other parts of the country, both in the hills and the *tarai.* Large cardamoms are extensively grown in the eastern hills and form an important article of export. The hemp plant (*Cannabis indica*) grows wild.

Many European fruits, flowers and vegetables have been introduced and grow freely. The country is famous for its oranges and pineapples. Garden and wild flowers are sold for use as religious offerings and for wear in the hair. Apples and pears, of English stock, apricots, peaches and plums do well; grapes grow freely but seldom ripen before the rains begin, when they rot.

Minerals.—The lowest zone abounds in fossils, and deposits of lignite and even of true coal are encountered, the latter notably at a place south of Palpa. The middle zone is rich in limestone, marbles and minerals such as iron, copper, zinc, lead and sulphur. Copper is found near the surface in many places, and there are remains of mines both at Markhu and in the great valley of Nepal. Mineral springs, hot and cold, are numerous. Traces of silver and gold have been found in the alpine zone.

Trade and Manufacture.—All the trade and manufactures of the country are in the hands of the Newars and of a few Kashmiris or natives of India. The trade in European goods is chiefly carried on by the latter, while the Newars deal in corn, oil, salt, tobacco and articles of domestic manufacture. The trade with India is carried on at numerous marts along the frontier, at each of which a customs station is established, and the taxes are collected by a *thikadar* or farmer. The Newars also carry on the trade with Tibet, through a colony which has been established at Lhasa for many years, but this trade has diminished since the opening of the Lhasa-Darjeeling route. There are two principal routes to Tibet. One runs northeast from Kathmandu to the frontier station of Kuti or Nilam, crossing the Himalayan range at a height of 14,000 ft.; the other passes from the valley at the northwest corner and at first runs upward along the main branch of the Gandak, crossing the Himalaya near Kerung at 9,000 ft. All goods on these routes are carried on men's backs, except the salt, etc., carried in bags by the Bhotia sheep and goats.

The Newars are skilful workmen. Their bricks and pottery are good. There are excellent carpenters, though the use of the large saw is still unknown and planks are cut with chisel and mallet. Many of the wood carvings on the temples are of the highest artistic excellence. The modern coinage is struck by machinery, a regular mint having been established by Sir Jung Bahadur at Kathmandu and since improved by his successors.

Government and Law.—Till the fall of the Chinese empire Nepal maintained relations with China and periodically sent an embassy with presents to Peking. The country is in name independent as regards its foreign relations and domestic affairs, but

it was in practice much influenced by India. Until 1951 the government was in the hands of the Rana family, which held from 1846 the right to the position of hereditary prime minister; but in Jan. 1951, under pressure from the Nepal Congress party with whom the king, formerly powerless, had entered into an alliance, the prime minister announced that an assembly would be convened to devise a new constitution and that a cabinet of 14 members, half representing the Congress party, would be formed.

In Nov. 1951 the prime minister was forced to resign in favour of a Congress successor, and the power of the Rana family was thus virtually ended.

The old savage legal code with its ordeals by fire and water and its punishments by mutilation and torture was abolished by the prime minister Sir Jung Bahadur after his return from England in 1851. Treason, rebellion and desertion in wartime are punishable by death, and murder and the killing of cows are also capital offenses. Manslaughter and the maiming of cows are punishable by imprisonment for life, other offenses against the person, property or caste by imprisonment or fine. Brahmans and women are exempt from capital punishment.

The marriage laws are peculiar. Among the Gurkhas the laws resemble those of other Hindus as regards the marriage of widows, polygamy, etc., but among the Newars every girl while still an infant is married with much ceremony to a bel fruit, which is then thrown into some sacred stream. As the fate of the fruit is unknown, a Newari is supposed never to become a widow. At the age of puberty a husband is selected, but the woman can at any moment divorce herself by placing a betel nut under her husband's pillow. Slavery was completely abolished throughout the kingdom in 1925 by the prime minister Gen. Sir Chandra Shumsher Jung.

The revenue is mainly drawn from the land tax, customs, mines, forests and monopolies. About 10% of the *tarai* lands and 20% of the hill lands are private property. Some lands were assigned by the Gorkhali rajas to Brahmans, soldiers and others, and these are untaxed. Others, which were the gifts of the old Newar kings, pay from four to eight annas per *bigha*. A considerable revenue in the shape of royalty is obtained from mines of copper, iron, etc. The taxes on merchandise amount to 12%–14% on the value of the goods carried to and from India and to 5%–6% on goods exported to Tibet.

Army.—The Gorkhalis are a military race. The standing army consists of about 45,000 men, in a fair state of efficiency. There is also a reserve, consisting of men who have served for a few years and taken their discharge but can be called on again to enter the ranks. These would probably raise the strength to between 70,000 and 80,000 men. The regiments are formed on the British system and similarly drilled and officered. Each man carries in addition to a bayonet a *kukri* or native knife. There is practically no cavalry, the country not being suited for horses. The artillery is on a larger scale and consists nearly entirely of mountain guns. There is a large arsenal well provided with supplies of gunpowder and military stores. Rifles and ammunition are for the most part obtained from India.

In addition to its own army, Nepal supplies recruits to Gurkha units of the Indian and British armies.

Education and Health.—There is a college at Kathmandu affiliated with Patna university, and there are many schools in the valley of Nepal. The central institution has three departments, English, Sanskrit and Persian—or more correctly perhaps Urdu.

Kathmandu is a storehouse of ancient Sanskrit literature, and some of the oldest manuscripts in that language known to scholars have been found there. There is also a fair English library.

All families of good position have at least one *baid*, or medical man, in constant attendance, and there are also many general practitioners. There are two large central hospitals, civil and military, at Kathmandu, and other smaller hospitals are distributed over the country, with free beds and provision for outdoor treatment. There is also a small hospital for the British legation. (H. Wn.; X.)

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NEPENTHES, an Egyptian drug spoken of by Homer in the *Odyssey* (iv, 221). Generally in the form "nepenthe" the name is given to any drug producing exhilaration and also occasionally to the herb or plant from which such a drug is produced. It is also applied to an interesting genus of plants, comprising 60 species, chiefly East Indian, known as the "pitcher plants" because of the formation of the leaves. Numerous varieties and artificial hybrids of several species, especially *N. ampullaria* and *N. Rafflesiana*, are grown as curiosities in hothouses.

NEPHELINE, a rock-forming mineral consisting of sodium, potassium and aluminum silicate, with the approximate formula $Na_6K_2Al_8Si_9O_{34}$. Its crystals belong to the hexagonal system, and usually have the form of a short six-sided prism terminated by the basal plane. The hardness is 5.5. The specific gravity (2.6), the low index of refraction and the feeble double refraction are nearly the same as in quartz; but since in nepheline the sign of the double refraction is negative, while in quartz it is positive, the two minerals can be distinguished under the microscope. An important determinative character of nepheline is the ease with which it is decomposed by hydrochloric acid, with separation of gelatinous silica (which may be readily stained by colouring matters) and cubes of salt. A clear crystal of nepheline when immersed in acid becomes for this reason cloudy; hence the name, from Gr. νεφέλη, a cloud.

Although in naturally occurring nepheline sodium and potassium are always present in approximately the atomic ratio 3 : 1, artificially prepared crystals have the composition $NaAlSiO_4$; the corresponding potassium compound, $KAlSiO_4$, which is the mineral kaliophilite, has also been prepared artificially. It has therefore been suggested that the orthosilicate formula, $(Na,K)AlSiO_4$, represents the true composition of nepheline, and that the excess of silica is a result of the presence of albite, leucite or silica molecules in "solid solution" in the mineral.

The mineral is specially liable to alteration, and in the laboratory various substitution products of nepheline have been prepared. In nature it is frequently altered to zeolites (especially natrolite), sodalite, kaolin or compact muscovite. Two varieties are distinguished, differing in external appearance and mode of occurrence. "Glassy nepheline" has the form of small, colourless, transparent crystals and grains with a vitreous lustre. It is characteristic of the later volcanic rocks rich in alkalies, such as phonolite, nepheline-basalt, leucite-basalt, etc., and also of certain dike rocks, such as tinguaite. The best crystals are those which occur with mica, sanidine, garnet, etc., in the crystal-lined cavities of the ejected blocks of Monte Somma, Vesuvius. The other variety, known as elaeolite, occurs as large, rough crystals, or more often as irregular masses, which have a greasy lustre and are opaque, or at most translucent, with a reddish, greenish, brownish or gray colour. It forms an essential constituent of certain alkaline plutonic rocks of the nepheline-syenite series, which are typically developed in southern Norway.

The colour and greasy lustre of elaeolite (Gr. ἔλαιον, oil, and λίθος, stone; Ger. *Fettstein*) are caused by the presence of numerous microscopic enclosures of other minerals, possibly augite or hornblende. These enclosures sometimes give rise to a chatoyant effect like that of cat's-eye and cymophane; and elaeolite when of a good green or red colour and showing a distinct band of light is sometimes cut as a gem stone with a convex surface.

NEPHELINE-SYENITE, or Elaeolite-Syenite, a holocrystalline plutonic rock which consists largely of nepheline and alkali feldspar. The rocks are mostly pale coloured, gray or pink, and in general appearance they are not unlike granites, but dark green varieties are also known. They do not contain quartz since that mineral and nepheline are mutually exclusive. From ordinary syenites they are distinguished not only by the presence of nepheline but also by the occurrence of many other minerals rich in alkalis or in rare earths. Orthoclase and albite are the principal feldspars; usually they are intergrown to form perthite. In some rocks the potash feldspar, in others the soda feldspar, predominates. Soda-lime feldspars, such as oligoclase and andesine, are rare or entirely absent. Fresh, clear microcline is very characteristic of some types of nepheline-syenite. Sodalite, colourless and transparent in the slides, but frequently pale blue in the hand specimens, is the principal feldspathoid mineral in addition to nepheline. As a rule, these two crystallize before feldspar, but they may occur in intimate intergrowth with it. The commonest ferromagnesian mineral is pale green augite, which may be surrounded by rims of dark green, pleochroic soda-augite

(aegirine). The latter forms long flat prisms or bundles of radiating needles. The hornblende may be brown, brownish-green, blue or blue-black, belonging as a rule to the varieties which contain soda; it is often intergrown with the pyroxene or enclosed in it. Dark-brown aenigmatite occurs also in these rocks. Olivine is rare, but may be found in some basic forms of nepheline-syenite.

The commonest accessories are sphene, zircon, iron ores and apatite. Cancrinite occurs in several nepheline-syenites; in others there is fluorspar or melanite garnet. Small amounts of primary calcite also occur in some nepheline-syenites. A great number of interesting and rare minerals have been recorded from these rocks and the pegmatite veins which intersect them. Among these may be mentioned eudialyte, eucolite, mosandrite, rinkite, johnstrupite, låvenite, hiortdahlite, perofskite and lamprophyllite. Many of these contain fluorine and the rare earths.

Nepheline-syenites are rare rocks; there is only one occurrence in Great Britain and one each in France and Portugal. They are known also in Bohemia and in several places in Norway, Sweden and Finland. In America these rocks have been found in Texas, Arkansas and Massachusetts, also in Ontario, British Columbia and Brazil. South Africa, Madagascar, India, New South Wales, Tasmania, Timor and Turkestan are other localities for the rocks of this series. They exhibit also a remarkable individuality since each occurrence has its own special features; moreover, a variety of types characterizes each occurrence since these rocks are very variable.

For these reasons, together with the numerous rare minerals they contain, they have attracted a great deal of attention from petrographers.

Many types of nepheline-syenite have received designations derived from the localities in which they were discovered. The laurdalites (from Laurdal in Norway) are gray or pinkish, and in many ways closely resemble the laurvikites of southern Norway, with which they occur. The foyaites include the greater number of known nepheline-syenites and are called after Foya in the Serra de Monchique (southern Portugal), from which they were first described. They are gray, green or reddish, and mostly of massive structure with preponderating potash feldspar, some nepheline and a variable (often small) amount of femic minerals. Pyroxene-, hornblende- and biotite-foyaites have been recognized according to their mineral composition. Examples of the first-named occur in southern Norway with the laurdalites; they contain aegirine and black mica. At Norra Kärr (southern Sweden) pectolite forms an important constituent of a variety of nepheline-syenite (Kaxtorpite). The same mineral occurs in the lujaurites of Sekukuniland (Transvaal). In Transylvania there is a well-known rock of this group, very rich in microcline, blue sodalite and cancrinite. It contains also orthoclase, nepheline, biotite, aegirine, acmite, etc. To this type the name ditroite has been given from the place where it occurs (Ditro). Pyroxene-foyaite has been described also from Pouzac in the Pyrenees (southern France). Mica-foyaite is not very common, but is known at Miask in the Ural mountains (miaskite), where it is coarse-grained, and contains black mica, sodalite and cancrinite.

Hornblende-foyaites occur in Brazil (Serra de Tingua), containing sodalite and often much augite; in the western Sahara and Cape Verde Islands; at Zwarte Koppies, Trans.; Madagascar; São Paulo, Braz.; Paisano pass, west Texas; and Montreal, Que. The rock of Salem, Mass., is a mica-foyaite rich in albite and aegirine; it accompanies granite and essexite.

Litchfieldite is another well-marked type of nepheline-syenite, in which albite is the dominant feldspar. It is named after Litchfield, Me., where it occurs in scattered blocks. Biotite, cancrinite and sodalite are characteristic of this rock. A similar nepheline-syenite is known from Hastings Co., Ont., and contains hardly any orthoclase, but only albite feldspar. Nepheline is very abundant and there is also cancrinite, sodalite, scapolite, calcite, biotite and hornblende. The lujaurites are distinguished from the rocks above described by their dark colour, which is the result of the abundance of minerals, such as augite, aegirine, arfvedsonite and other kinds of amphibole. Typical examples are known at Lujaur Urt, Kola peninsula, where they occur with umptekites and other very peculiar rocks. Other localities for this group are at Julianehaab in Greenland (with sodalite-syenite); at their margins they contain pseudomorphs after leucite. The lujaurites frequently have a parallel banding or gneissose structure.

Sodalite-syenites, in which sodalite very largely or completely takes the place of nepheline, occur in Greenland, where they contain also microcline-perthite, aegirine, arfvedsonite and eudialyte. Cancrinite-syenite, with a large percentage of cancrinite, has been described from Dalecarlia, Swed., and from Finland.

The chemical peculiarities of the nepheline-syenites are well marked, as will be seen from the following analyses. They are exceedingly rich in alkalis and in alumina (hence, the abundance of feldspathoids and alkali feldspars) with silica varying from 50% to 56%, while lime, magnesia and iron are never present in great quantity, though somewhat more variable than the other components. As a group, also, these rocks have a low specific gravity.

	SiO_2	Al_2O_3	FeO	Fe_2O_3	CaO	MgO	K_2O	Na_2O
Laurdalite	54.55	19.07	3.12	2.41	3.15	1.98	4.84	7.67
Ditroite	56.30	24.14	..	1.99	0.69	0.13	6.79	9.28
Litch-fieldite	60.39	22.57	2.26	0.42	0.32	0.13	4.77	8.44
Lujaurite	54.14	20.61	2.08	3.28	1.85	0.83	5.25	9.87

(J. S. F.; X.)

NEPHELINITES. The group of effusive rocks which contains nepheline with plagioclase feldspar is subdivided into nepheline-tephrites and nepheline-basanites, while those which contain nepheline but not feldspar are nephelinites and nepheline-basalts. The tephrites differ from the basanites in the absence of olivine, and the same distinction subsists between the nephelinites and nepheline-basalts.

Lavas with nepheline, plagioclase and augite = nepheline-tephrites; lavas with nepheline, plagioclase, augite and olivine = nepheline-basanites; lavas with nepheline and augite = nephelinites; lavas with nepheline, augite and olivine = nepheline-basalts.

In their essential and accessory minerals, appearance and structure, these rocks have much in common, and tend to occur in a natural association as basic rocks comparatively rich in alkalis and alumina. The nephelinites and tephrites are linked to the phonolites and pass into them by various gradations. They are usually richer in alkalis and silica and contain less iron, lime and magnesia than the basanites and nepheline-basalts, a difference which finds expression in the presence of olivine and the smaller amount of feldspars and feldspathoids in the latter.

Leucite appears in some tephrites; haüyne is more frequent as small dodecahedra often filled with black inclusions. The pyroxene varies a good deal, and includes green aegirine and the purple titan-augite. It has often good crystalline form, and occurs as eight-sided monoclinic prisms. Hornblende is much less common, but biotite is very characteristic of certain nephelinites. Of the feldspars, labradorite is probably the most common, with more acid varieties of plagioclase. Sanidine is by no means absent, but may be considered as an accessory. The olivine presents no peculiarities. Melilite, perofskite, pseudobrookite, melanite garnet, iron oxides, apatite and chromite are occasionally found.

All these rocks are practically confined to lavas of Tertiary and recent ages, though some occur as dikes or small intrusive masses. The plutonic facies of these rocks are found among the theralites, shonkinites, essexites and ijolites. In the British Isles they are exceedingly scarce, though nepheline-basanite occurs in a dike which is presumably Tertiary, cutting the Triassic rocks at Butterton, Staffs., and nepheline-basalt has been found in a single neck at John o' Groat's and at one or two places near North Berwick. They attain a great development in the Canary Islands and in the Azores, Cape Verde Islands and Fernando Noronha. In Germany they are represented among the Tertiary eruptive rocks of the Rhine district and Thuringia, at the extinct craters of the Eifel and at the Kaiserstuhl. In central Bohemia there are many occurrences of nepheline-tephrites, basanites and basalts which though

fine grained contain all their minerals in excellent preservation. The nephelinite of Katzenbuckel in the Odenwald is well known. Contrasted with the phonolites and leucitophyres they are scarce in Italy and the Mediterranean province, but leucite-bearing nepheline-tephrites occur at Monte Vulture and nepheline-basalts in Tripoli. In America these rocks occur in Texas, in the Bearpaw mountains of Montana and at Cripple Creek, Colorado. From Argentina some members have been described: they have a great extension in East Africa (Somaliland and Masai-land) and occur also in North Nigeria. A few also have been described from New South Wales, New Zealand (Dunedin) and Tasmania.

(J. S. F.)

NEPHRITIS: *see* BRIGHT'S DISEASE; KIDNEY, DISEASES OF.

NEPOMUK or **POMUK, JOHN OF,** the national saint of Bohemia. It is necessary to distinguish between the John of Nepomuk of history and the legendary one. A John of Pomuk, son of a German called Wölfel, was vicar-general to the archbishop of Prague, John of Jengenstein, in 1393, and having thwarted King Wenceslaus IV. of Bohemia in a plan to seize the revenues of the abbey of Kladrub, was arrested and tortured, finally being carried to the bridge of Prague and thrown into the Vltava. It is difficult to connect this historical event with the legend of St. John of Nepomuk, who was canonized by Rome in 1729, mainly through the influence of the Jesuits, who hoped that this new cult would obliterate the memory of Hus. The Austrian chronicler Thomas Ebendorffer of Haselbach, who lived two generations later, first states that it was reported that King Wenceslaus had ordered that the confessor of his queen—an office that John of Pomuk never held—should be thrown into the Vltava because he would not reveal the secret of confession. The story is afterwards told in greater detail by the untrustworthy Bohemian historian Wenceslaus Hajek. It appears certain that the person canonized in 1729 was not the historical John of Pomuk or Nepomuk.

See A. H. Wratislaw, *Life, Legend and Canonization of St. John Nepomuk* (1873), a valuable work founded on the best Bohemian authorities; also A. Frind, *Der geschichtliche Heilige Johann von Nepomuk* (1861); O. Abel, *Die Legende vom heiligen Johann von Nepomuk* (1855); and particularly vol. iii. of W. W. Tomek's *History of the Town of Prague* (Czech) (12 vols., Prague, 1855–1901).

NEPOS, CORNELIUS (*c.* 99–24 B.C.), Roman historian, friend of Catullus, Cicero and Atticus, was born in Upper Italy (perhaps at Verona or Ticinum). He wrote: *Chronica,* an epitome of universal history; *Exempla,* a collection of anecdotes; letters to Cicero; lives of Cato the elder and Cicero; and *De viris illustribus,* parallel lives of distinguished Romans and foreigners, in sixteen books. One section of this work (more commonly known as *Vitae excellentium imperatorum*) and the biographies of Cato and Atticus from another (*De Latinis historicis*), have been preserved. Erotic poems and a geographical treatise are also attributed to him. The *Lives* contain many errors (especially in chronology), but supply information not found elsewhere. The language is as a rule simple and correct. The *Lives* were formerly attributed to Aemilius Probus of the 4th century A.D.; but the view maintained by Lambinus (in his famous edition, 1569)—that they are all the work of Nepos—is now generally accepted. In modern times G. F. Unger (*Der sogenannte C. N.*, 1881) has attempted to prove that the author was Hyginus, but his theory has not been favourably received.

Editions of the *Lives* (especially selections) are extremely numerous; text by E. O. Winstedt (Oxford, 1904), C. L. Roth (1881), C. G. Cobet (1881), C. Halm and A. Fleckeisen (1889), with lexicon for school use; with notes, O. Browning and W. R. Inge (1888), J. C. Rolfe (U.S. 1894), A. Weidner and J. Schmidt (1902), C. Erbe (1892), C. Nipperdey and B. Lupus (ed. maj., 1879, school ed., 1895), J. Siebelis and O. Stange (1897).

NEPOS, JULIUS, emperor of the West (474–475), was the nephew and successor of Marcellinus, count of Dalmatia. Being connected by marriage with Leo I., he was selected by him as emperor after the death of Olybrius. After capturing his rival Glycerius, he was recognized as emperor in Italy, Rome and Gaul. The only event of his reign was the cession of Auvergne to the Visigoths. Nepos was overthrown in 475 by the Patrician Orestes, and fled to Salona, where he was assassinated (480 or 481), possibly at the instigation of Glycerius, who had been compelled to enter the Church.

NEPTUNE (*Neptunus,* Etruscan *Nethuns*). An Italian god of fresh water, associated with Salacia (? from *salire,* referring to the bubbling of springs). Not later than 399 B.C. (*see* Livy, v. 13, 6), he was identified with Poseidon (*q.v.*) and henceforth was known as a sea-god.

Neptune's ancient festival (Neptunalia) was on July 23; *i.e.,* in the heat of summer, when water is most wanted and streams are drying up. He had no temple until the 3rd century B.C., so far as we know; it was near the Circus Flaminius.

In like manner Portunus, originally the god of city gates (*portae*) became god of harbours (*portus*) as Roman overseas trade became important.

See Wissowa, *Religion und Kultur,* 2nd ed., p. 225.

NEPTUNE—astronomical symbol ♆—is one of the nine planets of the solar system. Its mean distance from the sun is 30.1 times that of the earth; its period of revolution 164.8 years.

Neptune is so far from the sun and from the earth that it is invisible without optical aid, but a telescope of moderate aperture reveals it as a very small disk of greenish hue about 2.3 seconds of arc in diameter, equal in brightness to an eighth magnitude star. Although no surface markings can be seen on its apparent surface, which is the top of an extensive opaque or cloud-filled atmosphere, Neptune's rotation period, 16 hours, has been determined from spectroscopic observations of its equatorial speed of rotation. The direction of rotation is the same as that of the earth.

The mass of the planet, which can be accurately determined from the motion of its satellite, is 17.2 times that of the earth; its diameter is 31,000 miles; and its mean density 1.6 times that of water, or 0.29 that of the earth.

Although Neptune shines by reflected sunlight, its colour is quite greenish because much of the red in the incident solar light is absorbed in Neptune's atmosphere.

The spectrum shows that this absorption, like that in the atmospheres of Jupiter, Saturn and Uranus, is due primarily to strong bands of methane (CH_4). The bands due to methane are more intense in the spectrum of Neptune than in that of Jupiter; those due to ammonia (NH_3) are much weaker.

Because of Neptune's great distance from the sun, its temperature must be very low, probably not higher than −330° F.

Neptune's Satellite.—Neptune, like the earth, has only one satellite. It was discovered by William Lassell in 1846, less than a month after the discovery of Neptune. Although it has been called Triton, it is more generally known simply as "the satellite of Neptune." It revolves around Neptune at a distance of 220,000 miles with a period of 5 days 21^h 2^m and 38^s in a plane inclined 40° to Neptune's orbit. The direction of its motion is opposite to that of Neptune's rotation. The mass of Neptune's satellite, which has been accurately determined from its effect on the motion of Neptune, is 0.0013 that of Neptune.

From the motion of the plane of the satellite's orbit and the period of Neptune's rotation, the oblateness of the planet and the nature of its internal constitution can be inferred. From such deductions it is concluded that internally Neptune closely resembles Jupiter.

The Discovery of Neptune.—By far the most interesting thing about Neptune is the story of its discovery. The account which follows was written by the late Professor Simon Newcomb.

The detection of Neptune through its action upon Uranus before its existence had been made known by observation is a striking example of the precision reached by the theory of the celestial motions. So many agencies were concerned in the final discovery that the whole forms one of the most interesting chapters in the history of astronomy.

The planet Uranus, before its actual discovery by Sir William Herschel in the year 1781, had been observed as a fixed star on at least 17 other occasions, beginning with Flamsteed in 1690. In 1820 Alexis Bouvard of Paris constructed tables of the motion of Jupiter, Saturn and Uranus, based upon a discussion of observations up to that year. Using the mutual perturbations of these planets as developed by Laplace in the *Mé-*

canique Céleste, he was enabled satisfactorily to represent the observed positions of Jupiter and Saturn; but the case was entirely different with Uranus. It was found impossible to represent all the observations within admissible limits of error, the outstanding differences between theory and observation exceeding 1′. In these circumstances one of two courses had to be adopted, either to obtain the best general representation of all the observations, which would result in the tables being certainly erroneous, or to reject the older observations which might be affected with errors, and base the tables only on those made since the discovery by Herschel. A few years of observation showed that Uranus was deviating from the new tables to an extent greater than could be attributed to legitimate errors of theory of observation, and the question of the cause thus became of growing interest. Among the investigators of the question was F. W. Bessel, who tried to reconcile the difficulty by an increase of the mass of Saturn, but found that he could do so only by assigning a mass not otherwise admissible. Although the idea that the deviations were probably due to the action of an ultra-Uranian planet was entertained by Bouvard, Bessel and doubtless others, it would seem that the first clear statement of a conviction that such was the case, and that it was advisable to reach some conclusion as to the position of the disturbing body, was expressed by the Rev. T. J. Hussey, an English amateur astronomer. In a letter to Sir George B. Airy in 1834 he inquired Airy's views of the subject, and offered to search for the planet with his own equatorial if the required estimate of its position could be supplied. Airy expressed himself as not fully satisfied that the deviation might not arise from errors in the perturbations. He therefore was not certain of any extraneous action; but even if there was, he doubted the possibility of determining the place of a planet which might produce it. In 1837 Bouvard, in conjunction with his nephew Eugène, was again working on the problem; but they appear not to have gone farther than to collect observations and to compare the results with Bouvard's tables.

In 1835 F. B. G. Nicolai, director of the observatory at Mannheim, in discussing the motion of Halley's comet, considered the possibility that it was acted upon by an ultra-Uranian planet, the existence of which was made probable by the disagreement between the older and more recent observations.

In 1838 Airy showed in a letter to the *Astronomische Nachrichten* that not only the heliocentric longitude, but the tabulated radius vector of Uranus was largely in error, but made no suggestions as to the cause. In 1843 the Royal Society of Sciences of Göttingen offered a prize of 50 ducats for a satisfactory working up of the whole theory of the motions of Uranus, assigning September 1846 as the time within which competing papers should be presented. It is also recorded that Bessel, during a visit to England in 1842, in a conversation with Sir John Herschel, expressed the conviction that Uranus was disturbed by an unknown planet. He went so far as to set his assistant Fleming at the work of reducing the observations, but died before more was done.

The question had now reached a stage when it needed only a vigorous effort by an able mathematician to solve the problem. Such a man was found in John Couch Adams, then a student of St. John's College, Cambridge, who seriously attacked the problem in 1843, the year in which he took his bachelor's degree. He soon found that the observations of Uranus could be fairly well represented by the action of a planet moving in a radius of twice the mean distance of Uranus, which would closely correspond to Bode's law. During the two following years he investigated the possible eccentricity of the orbit, and in September 1845 communicated his results to Professor James Challis. In 1845, about the 1st of November, Adams also sent his completed elements to Airy, stating that according to his calculations the observed irregularities in the motion of Uranus could be accounted for by the action of an exterior planet, of which the motions and orbital elements were given. It is worthy of note that the heliocentric longitude of the unknown body as derived from these elements is only between one and two degrees in error, while the planet was within half a degree of the ecliptic. Two or three evenings assiduously devoted to the search could not therefore have failed to make the planet known. Adams's paper was accompanied by a comparison of his theory with the observations of Uranus from 1780, showing an excellent agreement. Airy in replying to this letter inquired whether the assumed perturbation would also explain the error of the radius-vector of Uranus, which he seemed to consider the crucial test of correctness.

The Elements.—At Arago's suggestion the investigation had been taken up by U. J. J. Leverrier, who had published some excellent work in theoretical astronomy. Leverrier's first published communication on the subject was made to the French Academy on the 10th of November 1845, a few days after Adams's results were in the hands of Airy and Challis. A second memoir was presented by Leverrier in 1846 (June 1). His investigation was more thorough than that of Adams. He first showed that the observations of Uranus could not be accounted for by the attraction of known bodies. Considering in succession various explanations, he found none admissible except that of a planet exterior to Uranus. Considering the distances to be double that of Uranus he then investigated the other elements of the orbit.

The following are the elements found by Adams and Leverrier:

	Leverrier	Adams	
		Hypothesis I	Hypothesis II
Semi-major axis	36·154	38·38	37·27
Eccentricity	0·1076	0·16103	0·12062
Long. of perihelion	284° 45′	315° 57′	299° 11′
Mean longitude	318° 47′	325° 8′	323° 2′
Epoch	1847, Jan. 1	1846, Oct. 1	1846, Oct. 1
True longitude	326° 32′	328°	329°

The longitude of the planet was 327° 57′ on Oct. 1, 1846.

The close agreement of these elements led Airy to suggest to Challis, on the 9th of July 1846, a search for the planet with the Northumberland telescope. He proposed an examination of a part of the heavens 30° long in the direction of the ecliptic and 10° broad, and estimated the number of hours' work likely to be employed in this sweep. The proposed sweeps were commenced by Challis on the 29th of July. The plan required each region to be swept through twice, and the positions of all the known stars found to be compared, in order that the position of the planet might be detected by its motion. On the 31st of August Leverrier's concluding paper was presented to the French Academy, and on the 18th of September he wrote to John G. Galle (1812–1910), then chief assistant at the Berlin observatory, suggesting that he should search for the computed planet, with the hope of detecting it by its disk, which was probably more than 3″ in diameter. This letter, probably received on the 23rd of September, was communicated to J. F. Encke, the director of the observatory, who approved of the search. H. L. d'Arrest, a student living at the observatory, expressed a wish to assist. In the evening the search was commenced, but it was not found possible to detect any planet by its disk. Star charts were at the time being prepared at the observatory under the auspices of the Berlin Academy of Sciences. It was suggested by d'Arrest that this region might be covered by one of the charts. Referring to the chart, which was lying in a drawer, it was found that such was the case. Comparing the stars on the chart one by one with the heavens it was found that an eighth magnitude star now visible was not on the chart. This object was observed until after midnight, but no certain motion was detected. On the following evening the object was again looked for, and found to have moved. The existence of the planet was thus established. It was afterwards found that Challis had observed the planet on Aug. 4, but had failed to detect it.

The question whether Leverrier should receive the sole credit of the discovery was warmly discussed. Arago took the extreme ground that actual publication alone should be considered, rejecting Adams's communications to Airy and Challis as quite unworthy of consideration. He also suggested that the name of Leverrier should be given to the planet, but this proposal was received with so little favour outside of France that he speedily withdrew it, proposing that of Neptune instead.

The observations at the first opposition showed that the planet was moving in a nearly circular orbit, and was at a mean distance from the sun much less than that set by Leverrier as the smallest possible. The latter had in fact committed the error of determining the limits by considering the variations of the elements one at a time, assuming in the case of each that while it varied the others remained constant. But a simultaneous variation of all the elements would have shown that the representation of the observations of Uranus would be improved by a simultaneous diminution of both the eccentricity and the mean distance, the orbit becoming more nearly circular and the planet being brought nearer to the sun. But this was not at first clearly seen, and Benjamin Peirce of Harvard University went so far as to maintain that there was a discontinuity between the solution of Adams and Leverrier and the solution offered by the planet itself, and that the coincidence in direction of the actual and computed planet was an accident. But this view was not well founded, and the only explanation needed was to be found in Leverrier's faulty method of determining the limits within which the planet must be situated. As a matter of fact the actual motion of the planet during the century preceding, as derived from Leverrier's elements, was much nearer the truth than the elements themselves were. This arose from the fact that his very elliptic orbit, by its large eccentricity, brought the planet near to the sun, and therefore near to its true position, during the period from 1780 to 1845, when the action on Uranus was at its greatest.

The observations of the first opposition enabled Sears Cook Walker of the National Observatory, Washington, in February 1847 to compute the past positions of the planet, and identify it with a star observed by Lalande at Paris in May 1795. This being communicated to the Paris observatory, an examination of Lalande's manuscript showed that he had made two observations of the planet, on the 8th and 10th of May and finding them discordant had rejected one as probably in error, and marked the other as questionable. A mere re-examination of the region to see which observation was in error would have led him to the discovery of the planet more than half a century before it was actually recognized. The identity of Lalande's star with Neptune was also independently shown by Petersen of Altona.

Bibliography.—The principal sources for the history of the discovery of Neptune are the *Astronomische Nachrichten*, vols. xxv., xxvi., xxviii., and Lindenau's paper in the *Ergänzungsheft* to this publication, pp. 1–31 (Altona, 1849). In the *Memoirs of the Royal Astronomical Society*, vol. xvi., Airy gave a detailed history of the circumstances connected with the discovery, so far as he was cognizant of them. Documents pertaining to the subject are found in the *Monthly Notices of the Royal Astron. Society*. B. A. Gould, *Report to the Smithsonian Institution on the History of the Discovery of Neptune*, published by the Smithsonian Institution (Washington, 1850), is the most complete and detailed history of all the circumstances connected with the discovery, and with the early investigations on the orbit of the planet, that has been published. Leverrier's investigation was published *in extenso* as an addition to the *Connaissance des temps*, and Adams's as an appendix to the *Nautical Almanac* for 1851. Peirce's discussions, so far as published at all, are found in the *Proceedings of the American Academy of Arts and Sciences*. The first computations of the orbit after the discovery were made by Sears Cook Walker, and published by the Smithsonian Institution (1848–1850). General tables of the motion of Neptune are in Kowalski's *Tables du mouvement de la planète Neptune;* Newcomb's *Investigation of the Orbit of Neptune*, Washington, Smithsonian Institution (1866); Leverrier's *Annales de l'Observatoire de Paris; Memoirs*, vol. xiv. (1877), and lastly Newcomb's "Tables" in *Astron. Papers of the American Ephemeris*, vol. vii., part iv.

(S. N.; T. E. R. P.; S. B. N.)

NEPTUNIUM: *see* Transuranium Elements.

NÉRAC, a town of France, in the department of Lot-et-Garonne, 16 mi. W.S.W. of Agen by road. Pop. (1946) 3,836. Nérac in the 11th century was a possession of the monks of St. Pierre de Condom. The lords of Albret deprived them of their authority and at the beginning of the 14th century founded a castle on the Baise. Nérac, the inhabitants of which had adopted the Reformed religion, was seized by the Catholics in 1562.

The conferences, held there at the end of 1578 between the Catholics and Protestants, ended in the peace of Nérac, 1579. In 1580 the town was used by Henry IV as a base for attacks on the Agenais, Armagnac and Guienne. A Chambre de l'Edit for Guienne and a Chambre des Comptes were established there by Henry IV. In 1621, however, the town took part in the Protestant rising, was taken by the troops of Louis XIII and its fortifications dismantled. Soon after it was deprived both of the Chambre de l'Edit and of the Chambre des Comptes, and its ruin was completed by the revocation of the Edict of Nantes in 1685. The town, once the capital of the dukes of Albret, is divided by the Baise into Grand-Nérac and Petit-Nérac. The river is spanned by the 16th century bridge of Pont Vieux, and by the Pont Neuf, of modern construction. From the left bank a staircase leads to the rue Henri Quatre, where stands a wing of the castle in which Henry IV lived. The former palace of the Chambre des Comptes is now occupied by the tribunal of commerce, the library and the museum. The remains of a Roman villa have been found near the promenade of La Garenne. A road leads from the south end of La Garenne to the ruins of the feudal castle of Nazareth. The Château du Tasta of the 15th century is within a short distance of Nérac. The industries include brewing and cork-working. It has a large trade in wines, brandy, corks, fruit and vegetables.

NERBUDDA: *see* Narbada.

NERCHINSK, a town of Asiatic Russia, in the Sretensk district of the Far Eastern area, in lat. 52° 10′ N., long. 116° 32′ E., on the left bank of the Nercha, 2½ m. above its confluence with the Shilka. Population 15,300. It is a centre for the collection of furs, cattle and brick-tea from China and for the distribution of manufactured goods imported from industrial Russia. There are tanneries, candle factories and a fur coat factory. The town is a market for the agricultural products of the fertile river valley.

The fort dates from 1654, and the town was founded in 1658 by Pashkov, who in that year opened direct communication between the Russian settlements in Transbaikalia and those on the Amur which had been founded by Cossacks and fur-traders coming from the Yakutsk region. In 1689 was signed between Russia and China the Treaty of Nerchinsk, which stopped for two centuries the further advance of the Russians into the basin of the Amur. After that Nerchinsk became the chief centre for the trade with China. The opening of the western route through Mongolia, by Urga, and the establishment of a custom-house at Kiakhta in 1728 diverted this trade into a new channel. But Nerchinsk acquired fresh importance from the influx of immigrants into eastern Transbaikalia, the discovery of rich mines and the arrival of great numbers of convicts. In 1812 it was transferred from the banks of the Shilka to its present site.

NERCHINSK (in full Nerchinskiy Zavod), a town and silver-mine of Asiatic Russia in the Sretensk district of the Far Eastern Area, in lat. 51° 59′ N., long. 116° 39′ E., 150 mi. E.S.E. of another Nerchinsk (*q.v.*) (with which it is often confused), on a small affluent of the Argun. Population 3,153. It has a chemical laboratory for mining purposes, and a meteorological and magnetic observatory (51° 18′ N., 119° 37′ E., 2,200 ft. above sea-level) founded in 1842. The average yearly temperature is 25·3° F, with extremes of 97·7° and −52·6°.

Nerchinsk Mining District (29,450 sq.m.) includes all the silver, lead and tin mines and gold-fields between the Shilka and the Argun, together with a few on the left bank of the Shilka. It is traversed by several parallel chains of mountains which rise to 4,500 ft., and are intersected by a complicated system of deep, narrow valleys, densely wooded, with a few expansions along the larger rivers, where the inhabitants with difficulty raise some rye and wheat. The Nerchinsk mountains, not yet fully surveyed, form the watershed between the streams flowing south-east into the Argun and the Onon, Unda and Shilka on the north-west. They consist of crystalline slates and limestones interspersed with granite, syenite and diorite; they contain rich ores of silver, lead, tin and iron, while the diluvial and alluvial valley formations contain auriferous sands; asbestos is found near the tin.

The Nerchinsk silver mines began to be worked in 1704, but during the first half of the 18th century their yearly production did not exceed 8,400 oz., and the total amount for the first 150 years (1704–1854) amounted to 11,540,000 ounces. Transport

and climatic difficulties have prevented the exploitation of the minerals in the region and the silver mines were closed in 1900. If the present scheme of linking the mines to the main railway is carried out, production may redevelop. The more easily reached veins of silver have been exhausted and expensive plant would be needed to work the deeper veins. Gold was first discovered in 1830, and between 1833 and 1855 260,000 oz. of gold dust were obtained. In 1864 a large number of auriferous deposits were discovered.

Until 1863 all the labour was performed by serfs and convicts, numbering usually nearly four thousand.

NEREUS, in Greek mythology, the eldest son of Pontus and Gē, and father of the Nereïds. He is represented as a beneficent and sage old man of the sea. The only myth concerning him is that Heracles compelled him, although, like Proteus, he assumed various forms, to tell him the way to the Hesperides (Apollodorus ii. 115).

The Nereïds are mermaids. Amphitrite (consort of Poseidon) and Thetis (*see* Peleus) are the best known; Galatea is a Sicilian figure, loved by the Cyclops Polyphemus. The name has nothing to do with the modern Greek *νερόν* (really *νεαρόν*, "fresh" [water]).

NERGAL, the name of a solar deity in Babylonia, the main seat of whose cult was at Kutha or Cuthah, represented by the mound of Tell-Ibrahim. The importance of Kutha as a religious and at one time also as a political centre led to his surviving the tendency to concentrate the various sun-cults of Babylonia in Shamash (*q.v.*). He becomes, however, the representative of a certain phase only of the sun and not of the sun as a whole. Portrayed in hymns and myths as a god of war and pestilence, Nergal represents the sun of noon-time and of the summer solstice which brings destruction to mankind. Nergal is pictured also as the deity who presides over the nether-world, and stands at the head of the special pantheon assigned to the government of the dead, who are supposed to be gathered in a large subterranean cave known as Arallis or Irkalla. In this capacity there is associated with him a goddess Allatu or Ereshkigal, though there are indications that at one time Allatu was regarded as the sole mistress of Arâlu. Ordinarily the consort of Nergal is Laz. Nergal was pictured as a lion and his symbol is a griffin with panther's head, sometimes supporting his other symbol, a weapon with two panther heads.

As in the case of Nin-urta, Nergal appears to have absorbed a number of minor solar deities, which accounts for the various names or designations under which he appears, such as Lugalgira, Sharrapu ("the burner," perhaps a mere epithet), Ira or Gira, Gibil (though this name more properly belongs to Nusku, *q.v.*). A certain confusion exists in cuneiform literature between Nin-urta and Nergal, perhaps due to the traces of two different conceptions regarding these two solar deities. Nergal is called the "raging king," the "furious one," and the original Sumerian name consists of three elements, Ne-urugal, "might of the great dwelling" and thus at the head of the nether-world a pantheon is indicated. In the astral-theological system he is the planet Mars, while in ecclesiastical art the great lion-headed colossi serving as guardians to the temples and palaces seem to be a symbol of Nergal, just as the bull-headed colossi probably typify Nin-urta.

The name of his chief temple at Kutha was E-shid-lam, from which the god receives the designation of Shidlamtäea, "the one that rises up from Shidlam." The cult of Nergal does not appear to have been as widespread as that of Nin-urta. He is frequently invoked in hymns and in votive and other inscriptions of Babylonian and Assyrian rulers, but we do not learn of many temples to him outside of Kutha. Sennacherib speaks of one at Tarbisu to the north of Nineveh, but although Nebuchadrezzar II. (606–586 B.C.), the great temple-builder of the neo-Babylonian monarchy, alludes to his operations at E-shid-lam in Kutha, he makes no mention of a sanctuary to Nergal in Babylon. Local associations with his original seat—Kutha—and the conception formed of him as a god of the dead acted in making him feared rather than actively worshipped. He is often spoken of as a god who passed judgment on the souls of the dead, and in the late period arose the theory of compensation at his hands in Arallu for the righteous, and thus arose the late Hebrew belief in rewards after death to explain the problem of providence.

Bibliography.—Josef Böllenrücher, *Gebete und Hymnen an Nergal* (Leipzig, 1904), where earlier monographs are mentioned; Thureau Dangin, *Revue d'Assyriologie*, xi. 103–104 on Nergal as patron of pastures (Paris, 1914). On the "Seven Gods," messengers of the god Nergal-Girra, *see* F. Jean, *ibid.*, xxi. 93–104 (Paris, 1924).

NERI, PHILIP (Filippo de), Saint (1515–1595), Italian churchman, was born at Florence on July 21, 1515, the youngest child of Francesco Neri, a lawyer of that city, and his wife Lucrezia Soldi. He received his early teaching from the friars at San Marco, the famous Dominican monastery in Florence. At sixteen Philip was sent to his uncle, Romolo, a merchant at San Germano, to assist him in his business, and with the hope that he might inherit his possessions. But in 1533 Philip went to Rome, where he acted as a private tutor, and was able to study under the Augustinians, and to begin those labours amongst the sick and poor which gained him in later life the title of "Apostle of Rome." His nights were spent in prayer and meditation in the churches of the city and in the catacombs. In 1538 he began his missionary work; somewhat in the manner of Socrates he traversed the city, seizing opportunities of entering into conversation with persons of all ranks, and of leading them on, with playful irony, questions and counsel, to consider the topics he desired to set before them.

In 1548 he founded the confraternity of the Santissima Trinità de' Pellegrini e de' Convalescenti, to minister to the thousands of poor pilgrims to Rome, and also to relieve the patients discharged from hospitals. In 1551 he was ordained priest. He settled, with some companions, at the hospital of San Girolamo della Carità, and while there tentatively began, in 1556, the institute with which his name is more especially connected, that of the Oratory. The scheme at first was for a series of evening meetings in a hall (the Oratory), at which there were prayers, hymns, readings from Scripture, from the fathers, and from the *Martyrology,* followed by a lecture, or by discussion of some religious question proposed for consideration. The musical selections (settings of scenes from sacred history) were called *oratorios.* In 1564 the Florentines invited Philip to take charge of their church in Rome, San Giovanni dei Fiorentini, then newly built. At this time the new society included amongst its members Caesar Baronius, the ecclesiastical historian, Francesco Maria Tarugi, afterwards archbishop of Avignon, and Paravicini, all three subsequently cardinals, and also Gallonius, author of a work on the *Sufferings of the Martyrs,* Ancina, Bordoni, and other men of ability and distinction.

The Florentines, however, built in 1574 a large oratory or mission-room for the society contiguous to San Giovanni. Eventually the society took the church of Santa Maria in Vallicella, in the middle of Rome. The building was pulled down, and a splendid church erected on the site. Neri then formally organized, under permission of a bull dated July 15, 1575, a community of secular priests, entitled the Congregation of the Oratory. The new church was consecrated early in 1577, but Neri himself did not migrate from San Girolamo till 1583, and then only in virtue of an injunction of the pope that he, as the superior, should reside at the chief house of his congregation. He was at first elected for a term of three years (as is usual in modern societies), but in 1587 was nominated superior for life. He desired that all congregations formed on his model outside Rome should be autonomous, a regulation formally confirmed by a brief of Gregory XV. in 1622. Neri's only interference in political matters was in 1593, when he induced Clement VIII to withdraw the excommunication and anathema of Henry IV. of France. Neri administered the Oratory until his death (May 26, 1595) at Rome. He was succeeded by Baronius. Neri was beatified by Paul V. in 1600, and canonized by Gregory XV. in 1622.

Bibliography.—J. Marciano, *Memorie istoriche della Congregazione dell' Oratorio* (5 vols., Naples, 1693–1702); articles by F. Theiner and Hilgers in Wetzer und Welte's *Kirchenlexicon,* and by Reuchlin and Zöckler in Herzog-Hauck's *Realencyklopädie.* Neri's works include *Ricordi,* or *Advice to Youth, Letters* (Padua, 1751), and a few sonnets printed in the collection of the *Rime Oneste.* Lives by Mrs. Hope (London, 1859); Abp. Capecelatro (2 vols., 1879; 2nd ed., 1884; Eng. trans., 1882; 2nd ed. by T. A. Pope, 1894).

NERNST, WALTER (1864–1941), German physical chemist, was born on June 25, 1864, at Briesen, West Prussia. He became an assistant to Wilhelm Ostwald (*q.v.*) at the University of Leipzig. He was named professor of physical chemistry at Göttingen in 1894. In 1905 he was appointed ordinary professor of physical chemistry in the University of Berlin, and in 1922 became the director of the Physikalisch-technischen Reichsanstalt, Charlottenburg, a position he held until 1924. In 1925 he became director of the Physical Institute in the University of Berlin.

On the technical side Nernst is known for the invention of an electric glow lamp which was more efficient, although more complicated than the old carbon lamps. The Nernst lamp is still used in scientific work to a small extent as a concentrated source of light. In physical chemistry Nernst is responsible for a great deal of the fundamental work on reversible galvanic cells. In 1889 he showed that the production of electromotive force in galvanic cells could be explained in terms of "solution pressure" of the metal electrodes tending to send charged ions into the solution, this tendency being balanced by the osmotic pressure of the dissolved ions. In 1889 he also introduced the important theory of solubility product in explaining precipitation reactions. He studied diffusion in solutions, including liquid contact potentials, and in 1918 put forward the "atom chain reaction" theory in photochemistry. With H. von Wartenberg he devised a method for measuring vapour densities at very high temperatures; they investigated the dissociation of various elements and compounds. Nernst is noted for the statement of the so-called third law of thermodynamics (heat theorem), and for initiating important measurements of specific heats at low temperatures from the standpoint of the quantum theory. In 1920 he received the Nobel prize for chemistry. He died Nov. 18, 1941, at Berlin. In 1951 his ashes were reinterred at Göttingen. (R. E. O.)

NERO (Nero Claudius Caesar Augustus Germanicus) (A.D. 37–68), Roman emperor 54–68, was born at Antium on Dec. 15, 37. He was the son of Gnaeus Domitius Ahenobarbus and Agrippina the younger, and his name was originally L. Domitius Ahenobarbus. His father died when Nero was scarcely three years old. In the previous year (39) his mother had been banished by order of her brother Caligula (Gaius), and Nero found shelter in the house of his aunt Domitia. The emperor Claudius recalled Agrippina, who spent the next 13 years in a struggle to obtain the succession of the throne for Nero. She married Claudius in 49, and in 50 he adopted Nero as his son. Seneca was recalled from exile to be his tutor. On his 14th birthday he assumed the *toga virilis*, and was introduced to the Senate by Claudius with the title of *princeps inventutis*. This made his succession almost certain, and Agrippina subsequently got rid of the partisans of Britannicus and installed Burrus as praefect of the praetorian guard.

Succession.—In 52, in Claudius' absence, Nero was praefect of the city. He married Claudius' daughter Octavia. On Oct. 13, 54 Claudius died, poisoned by Agrippina's orders and Nero was presented to the soldiers on guard as their new sovereign. From the palace steps he proceeded to the praetorian camp, and thence to the senate-house, where he was made emperor.

Agrippina's bold stroke had been completely successful. Only a few voices were raised for Britannicus; nor is there any doubt that Rome was prepared to welcome the new emperor with genuine enthusiasm. His prestige and his good qualities, carefully fostered by Seneca, made him popular, while his darker passions were as yet unsuspected. His first acts confirmed this favourable impression. He modestly declined the title of *pater patriae*; the memory of Claudius, and that of his own father Domitius were duly honoured. He promised to follow the principles of Augustus, and his clemency, liberality and affability were the talk of Rome.

Much of the credit of all this is due to Seneca and Burrus. Seneca had seen from the first that the real danger with Nero lay in the savage vehemence of his passions, and he made it his chief aim to stave off by every means in his power the dreaded outbreak. The policy of indulging his tastes and helping him to enjoy the sweets of popularity without the actual burdens of government succeeded for the time. During the first five years of his reign, little occurred to damp the popular enthusiasm. Nero's promises were fulfilled, and the senate found itself free to discuss and even to decide important administrative questions. Abuses were remedied, the provincials protected from oppression, and the burdens of taxation lightened. On the frontiers no serious disaster occurred, and even the murder of Britannicus was accepted as a necessary measure of self-defence. But an essential part of Seneca's policy was to remove Nero from the influence of his mother.

Agrippina's Eclipse.—In 55, he found a powerful ally in Nero's passion for the beautiful freedwoman Acte, a passion which he deliberately encouraged. Agrippina's angry remonstrances served only to irritate Nero, and caresses equally failed. She then threatened to espouse the cause of Britannicus. Nero retaliated by poisoning Britannicus. Agrippina then tried to win over Nero's neglected wife Octavia, and to form a party of her own. Nero dismissed her guards, and placed her in a sort of honourable confinement (Tac. *Ann.* xiii. 12–20). During nearly three years she disappears from the history, and with her retirement things again for the time went smoothly. In 58 Nero was enslaved by Poppaea Sabina, a woman of a very different stamp from her predecessor. She was resolved to be Nero's wife, and her first object was the removal of Agrippina. By rousing Nero's jealousy and fear she induced him to seek her death, with the aid of a freedman Anicetus, praefect of the fleet of Misenum. Agrippina was invited to Baiae, and after an affectionate reception, was conducted on board a vessel so constructed as, at a given signal, to fall to pieces. But Agrippina saved herself by swimming, and wrote to her son, announcing her escape, and affecting entire ignorance of the plot. A body of soldiers under Anicetus then surrounded her villa, and murdered her in her own chamber. Nero was horrorstruck at the enormity of the crime and terrified at its possible consequences. But a six months' residence in Campania, and the congratulations which poured in upon him from the neighbouring towns, where the report had been officially spread that Agrippina had fallen a victim to her treacherous designs upon the emperor, gradually restored his courage. In Sept. 59 he re-entered Rome amid universal rejoicing. Races, exhibitions and games in the Greek fashion rapidly succeeded each other.

Poppaea.—The result of the death of Agrippina was the growing influence over Nero of Poppaea and her friends. In 62 Burrus died, it was said by poison, and Seneca retired from his post. Their place was filled by Poppaea, and the infamous Tigellinus, whose sympathy with Nero's sensual tastes had gained him the command of the praetorian guards in succession to Burrus. The fear of conspiracy was skilfully used by them to direct Nero's suspicions against possible opponents. Cornelius Sulla, who had been banished to Massilia in 58, was put to death on the ground that his residence in Gaul was likely to arouse disaffection in that province, and a similar charge proved fatal to Rubellius Plautus, who had for two years been living in retirement in Asia. Nero's taste for blood thus whetted, Octavia was divorced, banished to the island of Pandateria and murdered. Poppaea's triumph was now complete. She was married to Nero; her head appeared on the coins with his; and her statues were erected in the public places of Rome.

In the course of 61 occurred the rebellion of Boudicca (Boadicea) and the Iceni in Britain, resulting in the sack of Colchester and the destruction of the ninth legion before it was suppressed by Suetonius Paulinus. Further disasters were the destruction of Pompeii and the evacuation of Armenia in 63.

The Burning of Rome.—A far deeper and more lasting impression was produced by the great fire in Rome. The fire broke out on the night of July 18, 64, among the wooden booths at the south-east end of the Circus Maximus. Thence in one direction it rapidly spread over the Palatine and Velia up to the low cliffs of the Esquiline, and in another it laid waste the Aventine, the Forum Boarium and Velabrum till it reached the Tiber and the solid barrier of the Servian wall. After burning fiercely for six days it started afresh and desolated the regions of the Circus Flaminius and the Via Lata, and after it was finally quenched only four of the 14 *regiones* remained untouched; three had been utterly destroyed and seven reduced to ruins. The conflagration is said by all authorities later than Tacitus to have been deliberately caused by Nero himself. But Tacitus, though he mentions the rumours,

declares that its origin was uncertain, and in spite of such works as Profumo's *Le fonti ed i tempi dello incendio Neroniano* (1905), there is no proof of his guilt. By Nero's orders, the open spaces in the Campus Martius were utilized to give shelter to the homeless crowds, provisions were brought from Ostia and the price of corn lowered. In rebuilding the city every precaution was taken against the recurrence of such a calamity. Broad regular streets replaced the narrow winding alleys. The new houses were limited in height, built partly of hard stone and protected by open spaces.

This disaster undoubtedly told against Nero, being widely regarded as evidence of the wrath of the gods. The work of rebuilding included the erection of Nero's famous palace, the "golden house," and the laying-out of its wonderful grounds.

To defray the enormous cost, Italy and the provinces, says Tacitus, were ransacked, and in Asia and Achaia especially the rapacity of the imperial commissioners recalled the days of Mummius and of Sulla. It was the first occasion on which the provincials had suffered from Nero's rule, and the discontent it caused helped to weaken his hold over them at the very moment when the growing dissatisfaction in Rome was gathering to a head. Early in 65 Nero was panic-stricken by the discovery of a conspiracy involving such men as Faenius Rufus, Tigellinus's colleague in the prefecture of the praetorian guards, Plautius Lateranus, one of the consuls elect, the poet Lucan, and, lastly, not a few of the tribunes and centurions of the praetorian guard itself. Their chosen leader, whom they destined to succeed Nero, was C. Calpurnius Piso, a handsome, wealthy and popular noble, and a boon companion of Nero. The plan to murder Nero was betrayed by a freedman Milichus. Piso, Faenius Rufus, Lucan and Seneca himself were executed.

In the next few months many more fell victims to his fear and resentment. Conspicuous among them was Paetus Thrasea, whose unbending virtue had long made him distasteful to Nero, and who was now suspected, possibly with reason, of sympathy with the conspirators. Poppaea died in the autumn of 65, and the general gloom was increased by a pestilence which followed the fire. Early in the summer of 66 the Parthian prince Tiridates came to Italy to receive the crown of Armenia at Nero's hands. It represented the final triumph of the arms and policy of Corbulo in the East, and at least a temporary solution of the Parthian problem.

Greece.—Towards the end of 66 Nero visited Greece with a retinue of soldiers, courtiers, musicians and dancers. The spectacle presented by Nero's visit was unique. He went professedly as an enthusiastic worshipper of Greek art and a humble candidate for the suffrages of Greek judges. At each of the great festivals, which to please him were for once crowded into a single year, he entered in regular form for the various competitions, scrupulously conformed to the tradition and rules of the arena, and awaited in nervous suspense the verdict of the umpires. The dexterous Greeks humoured him to the top of his bent. He planned and commenced the cutting of a canal through the Isthmus of Corinth.

Meanwhile the general dissatisfaction was coming to a head, as we may infer from the urgency with which the imperial freedman Helius insisted upon Nero's return to Italy. Revolt started in Gaul with the insurrection of Julius Vindex, governor of Gallia Lugdunensis. It is probable that the aims of Vindex included the liberation of northern Gaul, which would explain both the enthusiasm of the Gallic chiefs, and the opposition of the legions of the Rhine. This force defeated Vindex at Vesontio (Besançon) and offered the throne to their own commander Virginius Rufus, who refused it. Meanwhile the governors of Hispania, Tarraconensis and Galba and Otho, had rebelled, and Galba had claimed the throne. Nero returned from Greece to Naples for further revels.

Suicide.—The revolts in Spain and Germany terrified him too late into something like energy. The senate almost openly intrigued against him, and the populace were silent or hostile. The fidelity of the praetorian sentinels even was more than doubtful. When finally the palace guards forsook their posts, Nero despairingly stole out of Rome to seek shelter in a freedman's villa some four miles off. There he heard of the senate's proclamation of Galba as emperor, and of the sentence of death passed on himself. On the approach of the horsemen sent to drag him to execution, he collected sufficient courage to save himself by suicide. Nero died on June 9, 68, in the 31st year of his age and the fourteenth of his reign, and his remains were deposited by the faithful Acte in the family tomb of the Domitii on the Pincian hill. With his death ended the line of the Caesars, and Roman imperialism entered a new phase. His statues were broken, his name everywhere erased, and his "golden house" demolished.

The Roman populace for a long time reverenced his memory as that of an open-handed patron, and in Greece the recollections of his magnificence, and his enthusiasm for art, were still fresh when the traveller Pausanias visited the country a century later. The belief that he had not really died, but would return again to confound his foes, was long prevalent, not only in the remoter provinces, but even in Rome itself; and more than one pretender was able to collect a following by assuming the name of the last of the race of Augustus. More lasting still was the implacable hatred of those who had suffered from his cruelties. Roman literature, faithfully reflecting the sentiments of the aristocratic salons of the capital, while it almost canonized those who had been his victims, fully avenged their wrongs by painting Nero as a monster of wickedness. In Christian tradition he even appears as the mystic Antichrist, who was destined to come once again to trouble the saints. Even in the middle ages, Nero was still the very incarnation of splendid iniquity, while the belief lingered that he had only disappeared for a time, and as late as the 11th century his restless spirit was supposed to haunt the slopes of the Pincian hill.

The chief ancient authorities for Nero's life and reign are Tacitus (*Annals*, xiii.–xvi., edit. Furneaux), Suetonius, Dio Cassius (*Epit.* lxi., lxii., lxiii.) and Zonaras (*Ann.* xi.). The most important modern work is that of B. W. Henderson, *The Life and Principate of the Emperor Nero* (1903; *see* an important notice in *Class. Rev.* vol. xviii. p. 57), which contains full bibliography of ancient and modern writers: *see* also H. Schiller's *Nero*, and *Geschichte d. Kaiserzeit;* Lehmann, *Claudius und Nero;* Desider Kostolanyi, *Nero* (1928).

NERVA, MARCUS COCCEIUS (A.D. ?35–98), Roman emperor from Sept. 18, 96 to Jan. 25, 98, was born at Narnia in Umbria on Nov. 8, probably in the year 35. He came of a senatorial family, his father and grandfather having been jurists.

He was praetor (66) and twice consul, in 71 with the emperor Vespasian for colleague and again in 90 with Domitian. Towards the close of the latter's reign (93) he is said to have been banished to Tarentum on a charge of conspiracy. On the murder of Domitian in September 96 Nerva was declared emperor by the people and the soldiers. He is described as a quiet, kindly, dignified man, honest of purpose, but unfitted by his advanced age to bear the weight of empire. Nevertheless, his selection, in spite of occasional exhibitions of weakness, justified the choice. The new emperor recalled those who had been exiled by Domitian; what remained of their confiscated property was restored to them, and a stop was put to the vexatious prosecutions which Domitian had encouraged. But the popular feeling demanded more than this. The reaction against the informers became as dangerous as the previous system. It was checked by Nerva, who was actuated by the taunt of Titus Catius Caesius Fronto that, "bad as it was to have an emperor who allowed no one to do anything, it was worse to have one who allowed everyone to do everything."

Nerva seems to have followed the custom of announcing the general lines of his future policy. He showed himself anxious to respect the traditional privileges of the senate, and such maxims of constitutional government as still survived. He pledged himself to put no senator to death. His councillors in all affairs of state were senators, and the hearing of claims against the *fiscus* was entrusted to a praetor and a court of *iudices*.

The economical condition of Italy evidently excited his alarm and sympathy. The last mention of a *lex agraria* in Roman history is connected with his name. Under the provisions of this *lex*, large tracts of land were bought up and allotted to poor citizens. The cost was defrayed partly from the imperial treasury, but partly also from Nerva's private resources, and the execution of the scheme was entrusted to commissioners. He also founded or restored colonies at Verulae, Scyllacium and Sitifis in Mauretania. An entirely new departure was the main-

tenance at the public cost of the children of poor parents in the towns of Italy, which was combined ingeniously with the provision of loans for farmers. The treasury found the money, which was lent on the security of farms, and the farmers paid the interest to their municipality for the maintenance of poor children.

Private individuals were also encouraged to follow the imperial example. In the hands of Trajan, Hadrian and the Antonines, Nerva's example bore fruit in the institution of the *alimentationes,* the most genuinely charitable institution of the pagan world. These measures Nerva supplemented by others which aimed at lightening the financial burdens on the declining industry of Italy. The cost of maintaining the imperial postal system (*vehiculatio*) was transferred to the *fiscus;* from the same source apparently money was found for repairing the public roads and aqueducts; and lastly, the lucrative but unpopular tax of 5% on all legacies or inheritances (*vicesima hereditatum*), was so readjusted as to remove the grosser abuses connected with it. At the same time Nerva did his best to reduce the overgrown expenditure of the state. A commission was appointed to consider the best modes of retrenchment, and the outlay on shows and games was cut down to the lowest possible point. Early, apparently, in 97 he detected a conspiracy against his life headed by L. (or C.) Calpurnius Crassus, but he contented himself with a hint to the conspirators that their designs were known, and with banishing Crassus to Tarentum. The praetorian guards, at the instigation of one of their two prefects. Casperius Aelianus, whom Nerva had retained in office, imperiously demanded the execution of Domitian's murderers, the chamberlain Parthenius and Petronius Secundus, Aelianus's colleague. Nerva vainly strove to save, even at the risk of his own life, the men who had raised him to power, but the soldiers brutally murdered the unfortunate men, and forced him to propose a vote of thanks for the deed. This humiliation convinced Nerva of the necessity of placing the government in stronger hands than his own. He resolved to adopt as his colleague and destined successor, M. Ulpius Trajanus, a distinguished soldier, at the time in command of the legions on the Rhine. In Oct. 97, in the temple of Jupiter on the Capitol, Trajan was formally adopted as his son and declared his colleague in the government of the empire. For three months Nerva ruled jointly with Trajan, but on Jan. 25, 98, he died somewhat suddenly. He was buried in the sepulchre of Augustus, and divine honours were paid him by his successor. The verdict of history upon his reign is best expressed in his own words—"I have done nothing which should prevent me from laying down my power, and living in safety as a private man." The memory of Nerva is still preserved by the ruined temple in the Via Alessandrina (il Colonacce) which marks the site of the Forum begun by Domitian, but which Nerva completed and dedicated.

BIBLIOGRAPHY.—Dio Cass. lxviii. 1–4; Aurelius Victor 12, and *Epit.* 24; Zonaras xi. 20; compare also Pliny, *Epistolae* and *Panegyricus;* Tillemont, *Histoire des empereurs romains,* ii.; C. Merivale, *History of the Romans under the Empire,* ch. 63; H. Schiller, *Geschichte der römischen Kaiserzeit,* i. pt. 2 (1883), p. 538; J. Asbach, *Römisches Kaiserthum und Verfassung bis auf Trajan* (Cologne, 1896); A. Stein in Pauly-Wissowa's *Realencyclopädie* (*s.v.* Cocceius, 16); J. B. Bury, *The Student's Roman Empire,* ch. 23 (1893); M. I. Rostovtsev, *Social and Economic History of the Roman Empire* (1926); B. W. Henderson, *Five Roman Emperors* (1927). (H. F. P.; X.)

NERVAL, GÉRARD DE (1808–1855), the adopted name of Gérard Labrunie, French man of letters, born in Paris on May 22, 1808. His father was an army doctor, and the child was left with an uncle in the country, while Mme. Labrunie accompanied her husband in his campaigns. She died in Silesia. In 1811 his father returned, and beside Greek and Latin taught the boy modern languages and the elements of Arabic and Persian. Gérard found his favourite reading in old books on mysticism and the occult sciences. His first work, *La France guerrière, élégies nationales,* was published while he was still a schoolboy at the Collège Charlemagne. In 1828 he published a translation of Goethe's *Faust,* the choruses of which were afterwards used by Berlioz for his legend-symphony, *The Damnation of Faust.* A number of poetical pieces and three comedies combined to acquire for him, at the age of 21, a considerable reputation, and led to his association with Théophile Gautier in the preparation of the dramatic *feuilleton* for the *Presse.* He conceived a violent passion for the actress Jennie Colon, in whom he thought he recognized a certain Adrienne, who had fired his childish imagination. Her marriage and her death in 1842 were blows from which his nervous temperament never really recovered. He travelled in Germany with Alexandre Dumas, and alone in various parts of Europe, leading a very irregular and eccentric life. In 1843 he visited Constantinople and Syria, where, among other adventures, he nearly married the daughter of a Druse sheikh. He contributed accounts of his travels to the *Revue des Deux Mondes* and other periodicals. After his return to Paris in 1844 he resumed for a short time his *feuilleton* for the *Presse,* but his eccentricities increased and he committed suicide by hanging, on Jan. 25, 1855. The literary style of Gérard is simple and unaffected, and he has a peculiar faculty of giving to his imaginative creations an air of naturalness and reality. In a series of novelettes, afterwards published under the name of *Les Illuminés, ou les précurseurs du socialisme* (1852), containing studies on Rétif de la Bretonne, Cagliostro and others, he gave a sort of analysis of the feelings which followed his third attack of insanity. Among his other works the principal are *Les Filles du feu* (1854), which contains his masterpiece, the semi-autobiographical romance of *Sylvia; Scènes de la vie orientale* (1848–50); *Contes et facéties* (1852); *La Bohême galante* (1856); and *L'Alchimiste,* a drama in five acts, the joint composition of Gérard and Alexandre Dumas. His *Poésies complètes* were published in 1877.

See the notices by Théophile Gautier and Arsène Houssaye, prefixed to the posthumous *Le Rêve et la vie* (1855); Maurice Tourneux's sketch in his *Âge du romantisme* (1887); and a sympathetic study of temperament in the *Névrosés* (1898) of Mme. Arvède Barine. *See* also G. Ferrières, *Gérard de Nerval* (1906).

NERVE, originally a sinew or tendon (*cf.* "strain every nerve") but now used for the conducting fibres of the nervous system in anatomy and secondarily as a psychical term for courage or firmness and in "nervousness" for the opposite quality. Here the anatomy of the nerves is dealt with; *see* also NERVOUS SYSTEM; MUSCULAR SYSTEM, ANATOMY OF; NEUROPATHOLOGY; etc.

CRANIAL

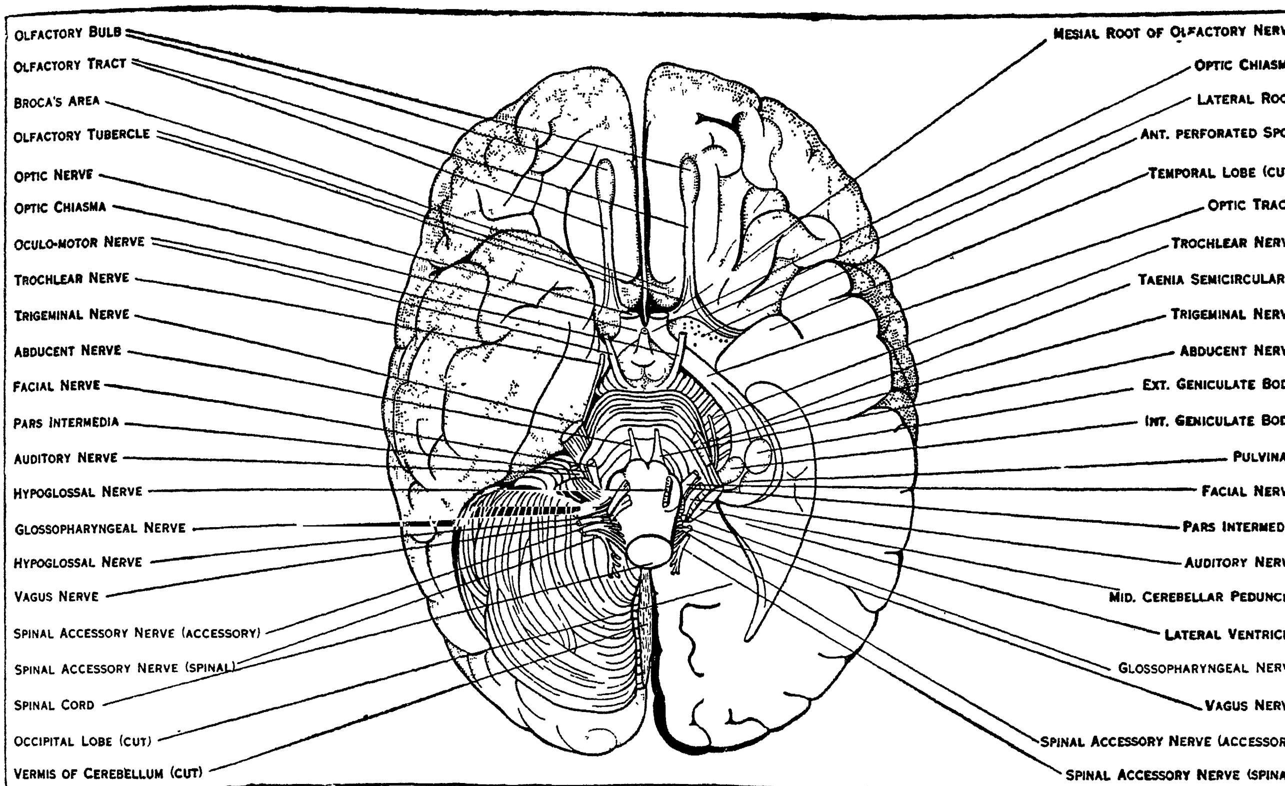
The 12 pairs of cranial nerves rise directly from the brain. With one exception they all contain medullated fibres (*see* NERVOUS SYSTEM). The following is a list:—

(1) Olfactory; (2) Optic; (3) Oculomotor or Motor oculi; (4) Trochlearis or Patheticus; (5) Trigeminal or Trifacial; (6) Abducens; (7) Facial; (8) Auditory; (9) Glossopharyngeal; (10) Vagus or Pneumogastric; (11) Spinal accessory; (12) Hypoglossal.

Olfactory.—The first, or olfactory nerve, consists of the *olfactory bulb* and *tract,* which are a modified lobe of the brain and lie beneath the sulcus rectus on the frontal lobe of the brain (fig. 1). At its posterior end the tract becomes continuous with the brain; anteriorly is the bulb from which some twenty small non-medullated nerves pass through the cribriform plate of the ethmoid to supply the sensory organs in the olfactory mucous membrane (*see* OLFACTORY SYSTEM).

Optic.—The second or optic nerve consists of the *optic tract,* the *optic commissure* or *chiasma,* and the *optic nerve* proper. The optic tract begins at the lower visual centres or internal and external geniculate bodies, the superior quadrigeminal body and the pulvinar (fig. 1), but these again are connected with the higher visual centre in the occipital lobe by the optic radiations (fig. 2). In the chiasma some of the fibres cross and some do not, so that the right optic tract forms the right half of both the right and left optic nerves. The fibres from the internal geniculate body of one side cross in the chiasma to the same body of the opposite side, forming *Gudden's commissure.* The optic nerve passes through the optic foramen into the orbit, where it is penetrated by the central artery of the retina, and pierces the sclerotic internal to the posterior pole of the eyeball. *See* also EYE, HUMAN.

Oculomotor.—The third or oculomotor nerve rises from a nucleus in the floor of the aqueduct of Sylvius and comes to the surface on the inner side of the crus cerebri (fig. 1), pierces the dura mater, and lies in the outer wall of the cavernous sinus,



FROM D. J. CUNNINGHAM, "CUNNINGHAM'S TEXTBOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 1.—VIEW OF INFERIOR SURFACE OF BRAIN. WITH LOWER PORTION OF THE TEMPORAL AND OCCIPITAL LOBES; THE CEREBELLUM ON THE LEFT SIDE IS REMOVED TO SHOW ORIGINS OF THE CEREBRAL NERVES

where it divides into an upper and lower branch. Both these enter the orbit through the sphenoidal fissure, the upper branch supplying the superior rectus and levator palpebrae superioris muscles, the lower the inferior and internal rectus and the inferior oblique, thus supplying five of the seven orbital muscles.

Trochlear.—The fourth or trochlear nerve is very small, and comes from a nucleus a little lower than that of the third nerve. It crosses to the opposite side in the fourth ventricle, winds round the outer side of the crus cerebri (fig. 1) and enters the outer wall of the cavernous sinus to reach the orbit through the sphenoidal fissure. Here it enters the superior oblique muscle on its orbital surface.

Trigeminal.—The fifth or trigeminal nerve consists of motor and sensory roots. The motor root rises from a nucleus in the upper lateral part of the floor of the fourth ventricle, and by a descending (mesencephalic) tract near the Sylvian aqueduct (fig. 3). The large sensory root goes to a sensory nucleus a little external to the motor one, and also, by a spinal or descending root, to the substantia gelatinosa Rolandi as low as the second spinal nerve (fig. 3). The superficial origin of the fifth nerve is from the side of the pons (fig. 1), and the two roots at once pass into a small compartment of the dura mater, where the large crescentic *Gasserian ganglion* is formed upon the sensory root, and from this the three branches, ophthalmic, maxillary, mandibular, come off. The motor root only joins the mandibular branch. The *ophthalmic division* runs in the outer wall of the cavernous sinus, where it divides into frontal, lachrymal and nasal branches. They all enter the orbit through the sphenoidal fissure. The *maxillary division* leaves the skull through the foramen rotundum, and then runs across the roof of the spheno-maxillary fossa; here the *spheno-maxillary* or *Meckel's ganglion* hangs from it by two roots. The nerve then runs in the floor of the orbit, giving off *superior dental* branches, until it emerges on to the face at the infraorbital foramen, where it divides into *palpebral, nasal* and *labial branches.* The *mandibular division* leaves the skull through the foramen ovale, and at once gives off motor branches for the muscles of mastication; these are derived from the motor root of the fifth, except that for the buccinator, which really supplies only the skin and mucous membrane in contact with the muscle. After the motor branch is given off, the nerve divides into *lingual, inferior dental* and *auriculo-temporal.* The lingual is joined by the *chorda tympani* branch of the facial nerve.

Abducent.—The sixth or abducent nerve rises from a nucleus in the floor of the fourth ventricle deep to the eminentia teres (fig. 3). It appears on the surface of the brain just below the pons and close to the middle line (fig. 1), pierces the dura mater and runs in the floor of the cavernous sinus to the sphenoidal fissure. Entering the orbit it supplies the external rectus muscle.

Facial.—The seventh or facial nerve begins in a nucleus which is about the same level as that for the sixth, but much deeper from the floor of the fourth ventricle as well as farther from the middle line (fig. 3). The fibres of the facial loop round the nucleus of the sixth, and then emerge in the triangular interval between the medulla, pons and cerebellum, close to the eighth nerve (fig. 1). Entering the internal auditory meatus the facial nerve passes into a canal in the petrous bone (*aqueductus Fallopii*), emerges at the stylo-mastoid foramen on the base of the skull, and enters the parotid gland, in which it forms a plexus called the *pes anserinus.* From this, branches pass to all the muscles of the face except those of mastication.

Auditory.—The eighth or auditory nerve is in two bundles, *cochlear* and *vestibular.* The former comes from the cochlear nuclei which lie deep to the acoustic tubercle in the floor of the fourth ventricle (fig. 3); the latter rises from the dorsal nucleus, nucleus of Deiters and the nucleus of the descending root, which are more deeply placed. The *nucleus of Deiters* is connected with the cerebellum, and is concerned in maintaining the equilibrium (*q.v.*) of the body; the cochlear nuclei are connected with the inferior quadrigeminal body by the lateral fillet as well as with the internal geniculate body, and thus with the higher auditory centre in the temporo-sphenoidal lobe by the auditory radiations. The vestibular root passes in front of the restiform body (fig. 3), and the cochlear behind that body. Together they enter the internal auditory meatus, pierce the lamina cribrosa, the vestibular nerve supplying the utricle and superior and external semicircular canals, the cochlear nerve, the posterior canal, the saccule

and the cochlea (*see* Ear, Anatomy of).

Glossopharyngeal.—The ninth or glossopharyngeal nerve is chiefly, if not entirely, sensory, and its deep termination in the brain is the solitary bundle (fig. 3). It appears on the surface between the olive and restiform body (fig. 1), leaves the skull through the posterior lacerated foramen, runs downward and forward, between the internal and external carotid arteries, and

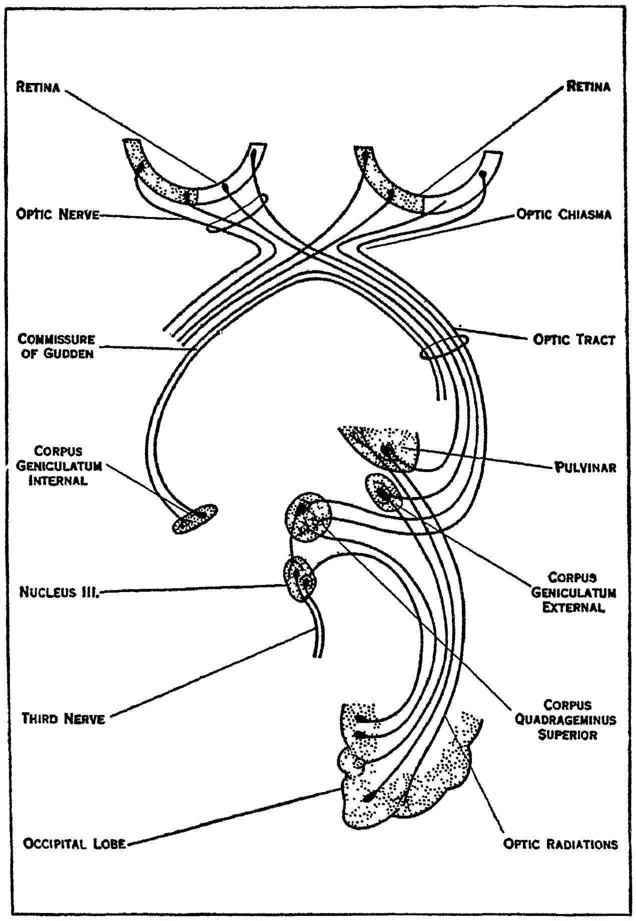


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FIG. 2.—DIAGRAM OF THE CENTRAL CONNECTIONS OF THE OPTIC NERVE AND OPTIC TRACT

eventually reaches the back of the tongue (*see* Tongue).

Vagus.—The tenth nerve or vagus has sensory and motor fibres; the former go to the solitary bundle mentioned in the description of the last nerve (fig. 3), while the latter come from the dorsal nucleus and nucleus ambiguus, both of which are found deep to the lower half of the fourth ventricle. The nerve appears on the surface between the olive and restiform body and just below the ninth (fig. 1). It leaves the skull through the posterior lacerated foramen, gives off *auricular* and *pharyngeal branches* and the *superior laryngeal branch* which is the sensory nerve of the larynx (fig. 4). The accessory part of the eleventh nerve joins the tenth, and from this communication motor twigs to the pharynx, larynx, alimentary and respiratory tracts are derived, as well as inhibitory fibres of the heart. In the neck the vagus accompanies the carotid artery and internal jugular vein, and gives off cardiac branches. It enters the thorax between the subclavian artery and vein. On the right side its recurrent laryngeal branch loops under the subclavian artery (fig. 4), and runs up to supply all the muscles of the larynx except one (*see* Respiratory System, Anatomy of). In the thorax the left vagus passes in front of the arch of the aorta, under which the left recurrent laryngeal loops, and on both sides a thoracic cardiac branch is given to the deep cardiac plexus. Both vagi pass behind the root of their own lung, and break up to form the *pulmonary plexus;* they then reach the oesophagus, where they again break up into an *oesophageal plexus.* As the diaphragm is approached the two nerves become distinct again, but the left one now lies in front and the right behind the food tube, so that, when the stomach is reached, the left vagus supplies the front of the organ and communicates with the *hepatic plexus,* while the right goes to the back and communicates with the *coeliac, splenic* and *renal plexuses.*

Spinal Accessory.—The eleventh or spinal accessory nerve is entirely motor, and consists of a *spinal* and an *accessory* part. The former rises from the anterior horn of the grey matter of the spinal cord as low as the fifth cervical nerve. Its fibres come to the surface mid-way between the anterior and posterior nerve-roots, and run up through the foramen magnum to join the accessory part, the deep origin of which is the lower part of the nucleus ambiguus. The accessory part joins the vagus, while the spinal part pierces the sterno-mastoid muscle and runs downward and backward across the posterior triangle of the neck to enter the trapezius; both these muscles are in part supplied by the nerve.

Hypoglossal.—The twelfth or hypoglossal nerve is motor, and rises from a nucleus in the floor of the fourth ventricle. It emerges from the brain between the anterior pyramid and the olive (fig. 1), and leaves the skull in two bundles through the

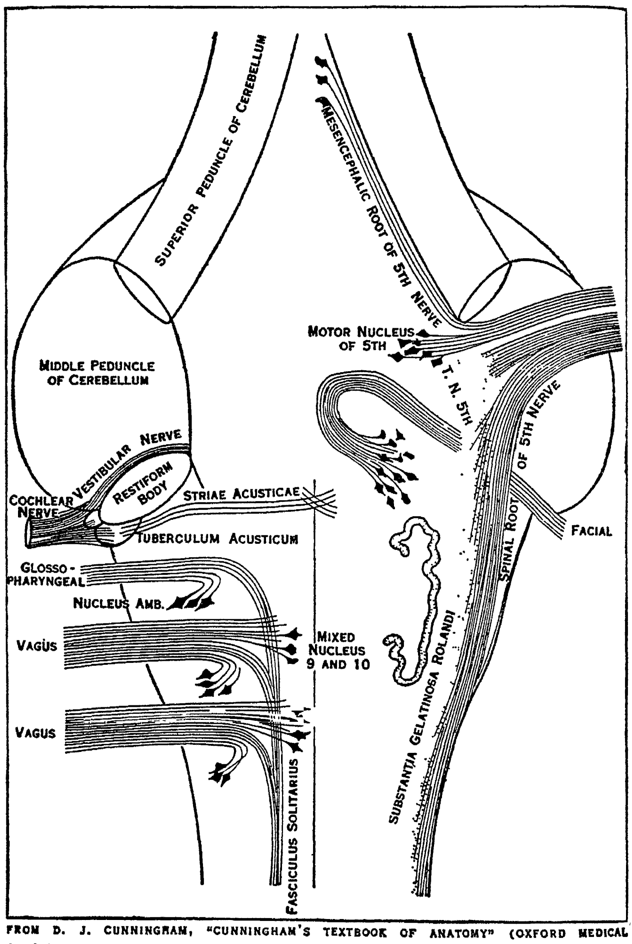

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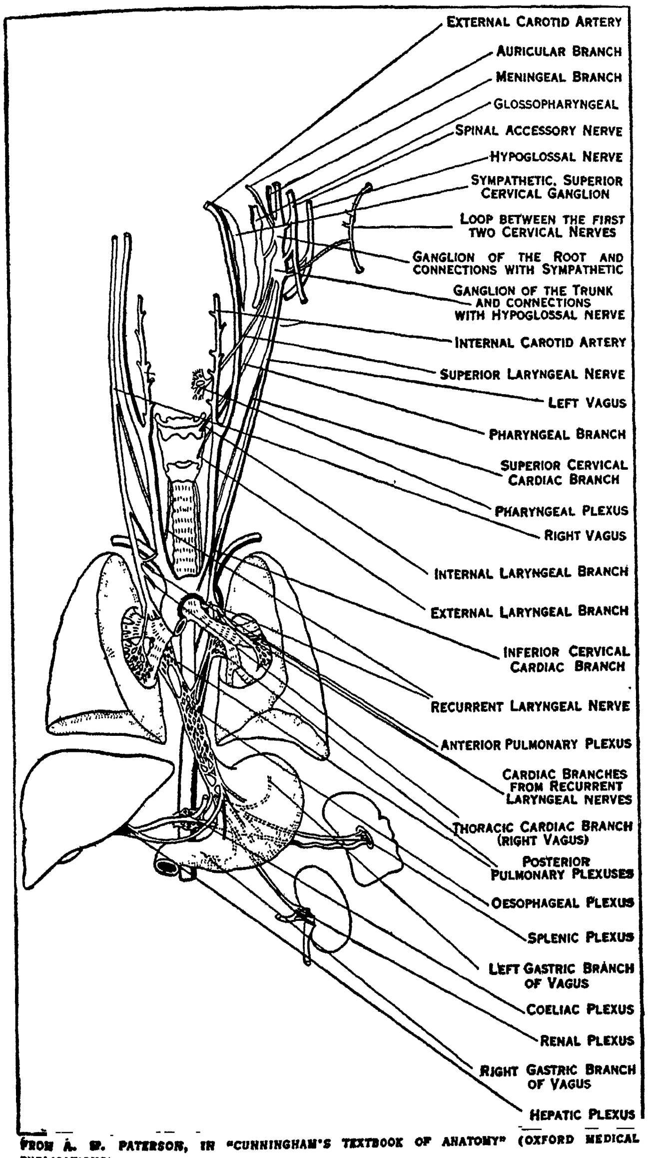
FIG. 3.—DEEP ORIGINS OF CRANIAL NERVES FROM THE FLOOR OF THE FOURTH VENTRICLE

anterior condylar foramen. Soon after it is closely bound to the vagus, and receives contributions from the loops between the first and second and the second and third cervical nerves. The nerve then passes downward and runs forward on the surface of the hyo-glossus to the muscles of the tongue. It gives off branches to many of the depressor muscles of the hyoid bone and larynx. All the true muscles of the tongue are supplied by the medullary part of the nerve.

For the embryology and comparative anatomy of the cranial nerves, *see* Nervous System.

SPINAL

The spinal nerves arise from each side of the spinal cord and are distributed to the trunk and limbs, though some of the upper ones supply the lower parts of the head and face. There are generally thirty-one pairs, eight cervical (abbreviated C.), twelve thoracic (Th.)—formerly called dorsal,—five lumbar (L.), five sacral (S.) and one coccygeal (Coc.). As the thoracic nerves are the simplest and most generalized in their arrangement, a typical one of these, say the fourth or fifth, will be first described.



FROM A. M. PATERSON, IN "CUNNINGHAM'S TEXTBOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 4.—THE DISTRIBUTION OF THE 10TH (PNEUMOGASTRIC OR VAGUS) NERVE

The nerve is attached to the spinal cord by two roots, of which the ventral is purely efferent or motor and the dorsal purely afferent or sensory. On the dorsal root is a fusiform ganglion which lies in the foramen between the vertebrae through which the nerve passes. The two roots then join together to form a mixed nerve (fig. 5), but very soon divide once more into anterior (ventral) and posterior (dorsal) primary divisions. These, however, each contain sensory and motor fibres. Just before it divides in this way the mixed nerve gives and receives its rami communicantes with the sympathetic (*see* NERVOUS SYSTEM).

The anterior primary division runs round the trunk, between the ribs, forming an intercostal nerve and giving off a lateral cutaneous branch, when the side of the body is reached, which divides into anterior and posterior secondary branches. The rest of the division runs forward, supplying the intercostal muscles, as far as the edge of the sternum, when it ends in an anterior cutaneous branch to the front of the chest. The dorsal primary division divides into an external (lateral) and internal (mesial) branch through which the skin and muscles of the back are supplied.

It will be seen from the foregoing that the thoracic nerves are almost completely segmental in their distribution, in other words, each supplies a slice of the body, but in the other regions this segmental character is masked by the development of the branchial skeleton and the limbs. In the cervical region the first cervical or *suboccipital nerve* comes out between the occiput and atlas and does not always have a posterior root. When it has not, it obviously can supply no skin. Its anterior primary division joins those of the second, third and fourth cervical nerves to form the *cervical plexus,* from which the skin of the side of the neck and lower part of the head and face are supplied by means of the *small occipital, great auricular, superficial cervical, suprasternal, supraclavicular* and *supraacromial* nerves (fig. 7), as well as those muscles of the neck which are not supplied by the cranial nerves. The *phrenic nerve,* which comes chiefly from the fourth cervical, runs down, through the thorax, to supply the greater part of the diaphragm. The explanation of this long course (*see* DIAPHRAGM) is that the diaphragm is formed in the neck region of the embryo. The posterior primary division of the second cervical nerve is large, and its inner (mesial) branch (*great occipital*) supplies most of the back of the scalp (fig. 7). The fifth, sixth, seventh and eighth anterior primary divisions of the cervical nerves as well as a large part of that of the first thoracic are prolonged into the arm, and in the lower part of the neck and armpit communicate with one another to form the *brachial plexus.* It will be seen from fig. 8 that each component nerve except the first thoracic divides into an anterior (ventral) and a posterior (dorsal) division which are best spoken of as secondary divisions in order to prevent confusion with the anterior and posterior primary divisions which all the spinal nerves undergo. In the diagram the anterior secondary divisions are white, while the posterior are shaded. Later on in the plexus three cords are formed of which the posterior is altogether made up of the posterior secondary divisions, while the anterior secondary divisions of the fifth, sixth and seventh cervical nerves form the external cord, and those of the eighth cervical and first thoracic the inner. As a general rule the nerves which rise from the ventral secondary divisions of the limb plexuses run only to that surface of the limb which was ventral in the embryo, while the

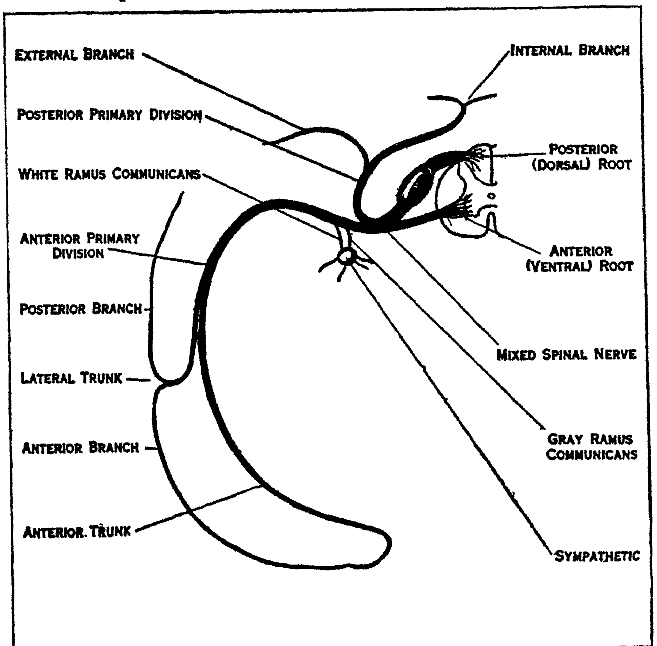


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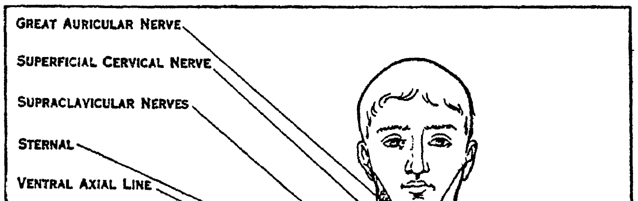
FIG. 5.—SCHEME OF THE DISTRIBUTION OF A TYPICAL SPINAL NERVE

dorsal secondary divisions are confined to the original dorsal area, but, in order to apply this to the human adult, it must be realized that the limbs are at one time flattened buds coming off at right angles from the side of the body and having dorsal and ventral surfaces, one (preaxial) border toward the head of the embryo, and one (postaxial) toward the tail.

Brachial Plexus.—With regard to the muscular supply of a limb the general rule is that each muscle is supplied by fibres



FROM A. M. PATERSON, "CUNNINGHAM'S TEXTBOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 6.—DISTRIBUTION OF THE CUTANEOUS NERVES ON THE FRONT OF THE TRUNK, SHOWING, ON THE LEFT SIDE OF THE FIGURE, THE DISTRIBUTION OF THE SEVERAL NERVES

derived from more than one spinal nerve; this is made possible by the redistribution of fibres in the plexuses. Moreover, the muscular supply does not necessarily correspond to that of the overlying skin, because (*see* MUSCULAR SYSTEM, ANATOMY OF) some of the primitive muscles have been suppressed, others have fused together, while others have shifted their position to a considerable distance. Bearing the foregoing facts in mind, the main distribution of the nerves of the brachial plexus may be surveyed. The outer cord of the plexus gives off the *external anterior thoracic nerve* (C. 5, 6, 7) to the pectoralis major, the *musculo-cutaneous* nerve (C. 5, 6) to the muscles on the front of the arm, and to the skin of the outer side of the forearm and the outer head of the *median nerve* (C. 5, 6, 7), which joins the inner head (C. 8, Th. 1) and supplies most of the flexor muscles of the front of the forearm as well as those of the ball of the thumb.

From the inner cord come the inner head of the median just mentioned, the *ulnar nerve* (C. 8, Th. 1), which passes down behind the internal condyle of the humerus, where it is popularly known as the "funny bone" and supplies the flexor carpi ulnaris, half the flexor profundus digitorum, and most of the muscles of the hand as well as the inner digit and a half on the palmar and dorsal aspects. Other branches of the inner cord are the *internal cutaneous* (C. 8, Th. 1) supplying the inner side of the forearm, the *lesser internal cutaneous* (Th. 1) which often joins the *intercosto-humeral* or lateral cutaneous branch of the second intercostal nerve to supply the skin on the inner side of the upper arm, and the *internal anterior thoracic nerve* (C. 8, Th. 1) to the pectoralis minor and major.

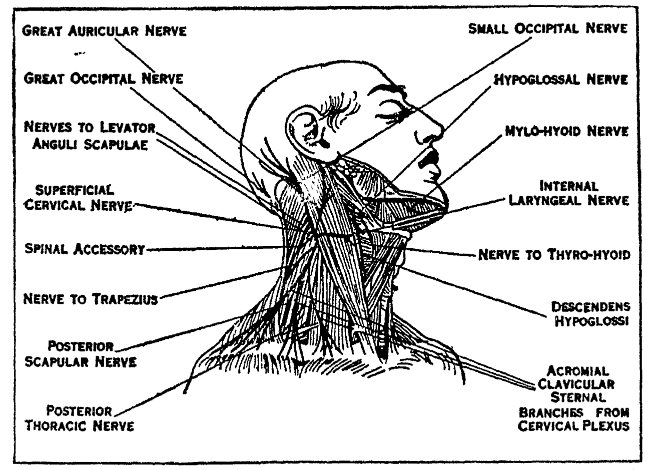
From the posterior cord are derived the three *subscapular nerves* (C. 5, 6, 7, 8) which supply the subscapularis, teres major and latissimus dorsi muscles, the *circumflex nerve* (C. 5, 6) supplying the deltoid and teres minor muscles, and the skin over the lower part of the deltoid, and the *musculo-spiral nerve* (C. 5, 6, 7, 8) which is the largest branch of the brachial plexus and gives off cutaneous twigs to the outer side and back of the arm and to the back of the forearm, as well as muscular twigs to the triceps and adjacent muscles. At the elbow this nerve divides into the *radial* and *posterior* interosseous. The radial is entirely sensory and supplies the skin of the outer side of the back of the hand, including three digits and a half, while the posterior interosseous is wholly muscular, supplying the muscles on the back of the forearm. It will be seen that the posterior cord is derived altogether from posterior secondary divisions of the plexus, but there are three other nerves derived from these which should be mentioned.

The *posterior thoracic* or respiratory nerve of Bell comes off the back of the fifth, sixth and seventh cervical nerves before the anterior and posterior secondary divisions separate, and runs down to supply the serratus magnus muscle.

The *posterior scapular* or nerve to the rhomboid muscles runs to those muscles from the fifth cervical.

The *suprascapular nerve* (C. 5, 6) passes through the suprascapular notch to supply the supraspinatus and infraspinatus muscles.

Lumbo-Sacral Plexus.—The spinal nerves which are distributed to the lower limbs first intercommunicate in the lumbar and sacral plexuses, which, with the perineal nerves, are sometimes spoken of together as the lumbo-sacral plexus. The *lumbar plexus* (fig. 9) is formed as a rule of the first four lumbar nerves, though the greater part of the first lumbar is segmental in its distribution and resembles one of the thoracic nerves. It early divides into an *ilio-hypogastric* and *ilio-inguinal* branch, which run round the abdominal wall in the substance of the muscles, and of which the former gives off an iliac branch, which is in

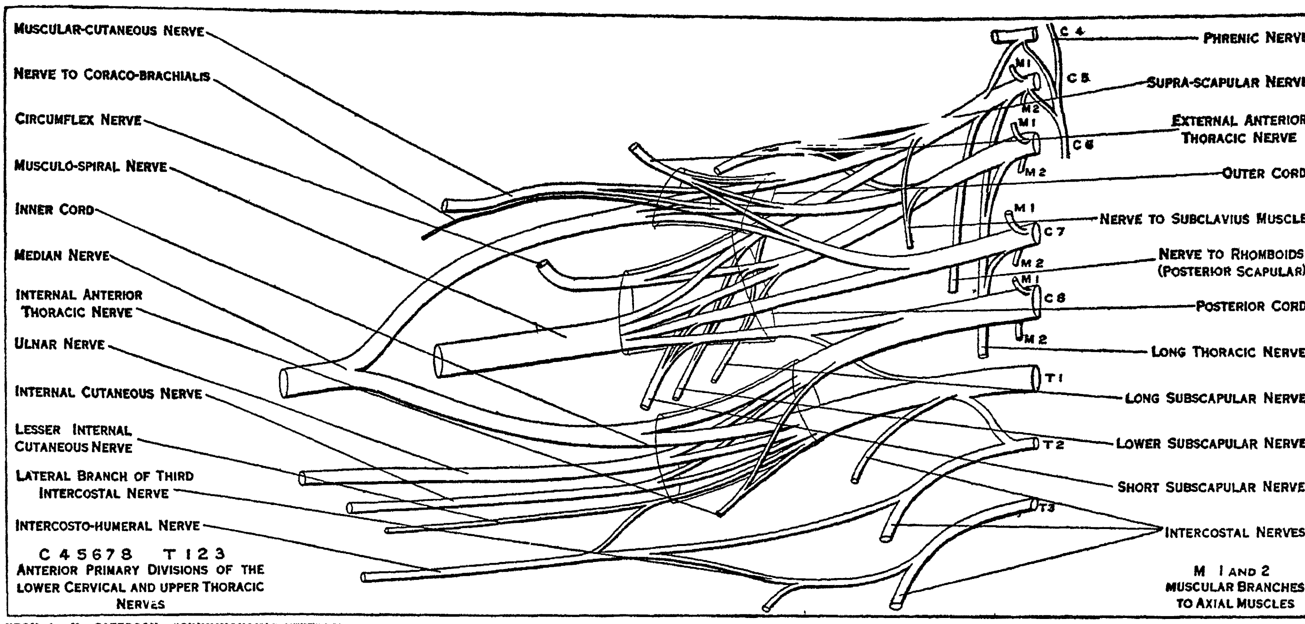


FROM A. M. PATERSON, "CUNNINGHAM'S TEXTBOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 7.—THE TRIANGLES OF THE NECK, SHOWING THE NERVES

series with the lateral cutaneous branches of the intercostal nerves and passes over the crest of the ilium to the gluteal region, while the hypogastric branch runs round to the skin of the pubic region.

The other anterior secondary division of the lumbar plexus is the obturator (fig. 9). The *obturator nerve* (L. 2, 3, 4) supplies the adductor group of muscles on the inner side of the thigh as well as the hip and knee joints; it occasionally has a cutaneous branch on the inner side of the thigh. The posterior secondary branches of the plexus are the genito-crural, the external cutaneous and the anterior crural. The genito-crural nerve (L. 1, 2)



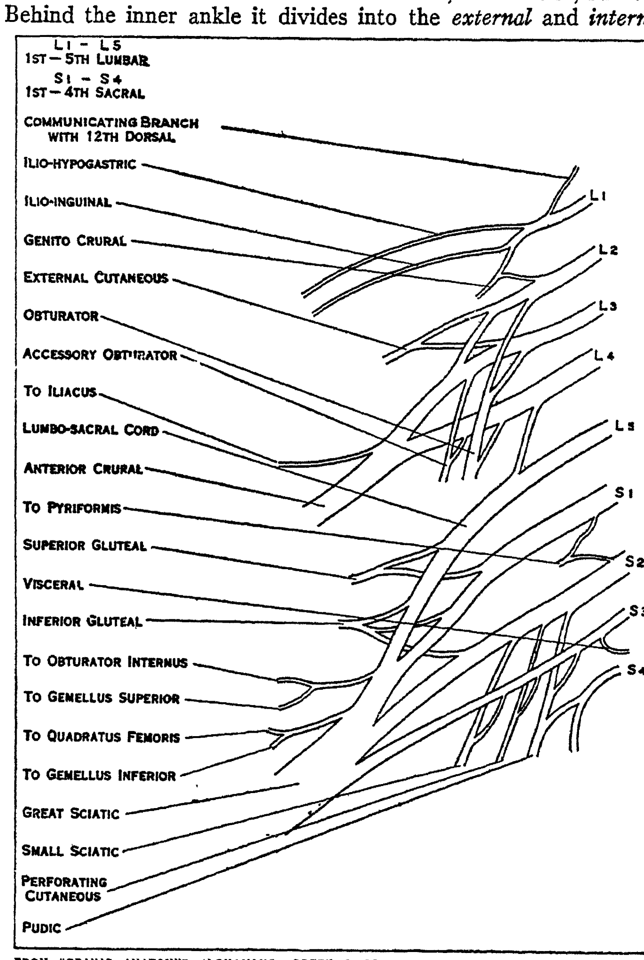
FROM A. M. PATERSON, "CUNNINGHAM'S TEXTBOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 8.—THE NERVES OF THE BRACHIAL PLEXUS

is partly anterior (ventral) and partly posterior (dorsal). It sends one anterior branch through the inguinal canal to supply the cremaster muscle, and another (posterior) to the skin of the thigh just below the groin.

The *external cutaneous nerve* (L.2, 3) supplies the skin of the outer side of the thigh, while the *anterior crural* (L.2, 3, 4) innervates the muscles on the front of the thigh, the skin on the front and inner side of the thigh, through its *middle* and *internal cutaneous* branches, and the skin of the inner side of the leg and foot through the *internal saphenous* branch. At first sight it is difficult to understand how the anterior crural nerve, which supplies the skin of the front of the thigh, is a posterior secondary division of the lumbar plexus, but the explanation is that the front of the human thigh was originally the dorsal surface of the limb bud, and the distribution of the nerve is quite easily understood if the position of the hind limb of a lizard or crocodile is glanced at. The fourth lumbar nerve is sometimes called the *nervus furcalis,* because, dividing, it partly goes to the lumbar, and partly to the sacral plexus (fig. 9), though, when the plexus is prefixed, the third lumbar may be the nervus furcalis, or, when it is postfixed, the fifth lumbar.

All the constituent nerves of the plexus run into one huge nerve, the *great sciatic,* which runs down the back of the thigh and, before reaching the knee, divides into *external* and *internal popliteal nerves.* These two nerves are sometimes separate from their first formation in the plexus, and may always be separated easily by the handle of a scalpel, since they are only bound together by loose connective tissue to form the great sciatic nerve. When they are separated in this way the external popliteal is made up entirely of posterior (dorsal) secondary divisions (fig. 9), and is derived from the fourth and fifth lumbar and first and second sacral nerves, while the internal popliteal is formed by the anterior (ventral) secondary divisions of the fourth and fifth lumbar and first, second and third sacral nerves. The *external popliteal nerve* supplies the short head of the biceps femoris (*see* MUSCULAR SYSTEM, ANATOMY OF), and, just below the knee, divides into anterior tibial and musculo-cutaneous branches, which supply the dorsal surface of the leg and foot. The *anterior tibial nerve* is chiefly muscular, innervating the muscles in front of the tibia and fibula as well as the extensor brevis digitorum pedis on the dorsum of the foot, though it gives one small cutaneous branch to the cleft between the first and second toes. The *musculo-cutaneous nerve* supplies the peroneus longus and brevis muscles, and the rest of the skin of the dorsum of the foot and lower part of the leg, while the skin of the upper part of the dorsum of the leg, below the knee, is supplied by the external popliteal before its division. The *internal popliteal nerve,* after supplying the hamstrings, is continued into the calf of the leg as the *posterior tibial* and innervates all the muscles on this, the ventral, surface. Behind the inner ankle it divides into the *external* and *internal*



FROM "GRAY'S ANATOMY" (LONGMANS, GREEN & CO.)

FIG. 9.—PLAN OF THE LUMBAR AND SACRAL PLEXUSES

plantar nerves, from which the muscles and skin of the sole are supplied. A little above the knee each popliteal nerve gives off a contribution to help form the *external* or *short saphenous nerve.* These join about the middle of the back of the calf, and the, now

formed, *short saphenous nerve* runs down behind the outer ankle to supply the outer side of the foot. Sometimes it encroaches on the dorsum of the foot, replacing part of the musculo-cutaneous. To return to the sacral plexus: branches are given off from the anterior secondary divisions to the short external rotator muscles of the hip (pyriformis, quadratus femoris, etc.), while from the posterior secondary divisions come the superior gluteal (L. 5, S. 1) and the inferior gluteal (L. 5, S. 1, 2) to the muscles of the buttocks.

In modern descriptions the lower branches of the lumbo-sacral plexus are grouped into a *pudendal plexus,* and the plan, though open to criticism on morphological grounds, has such descriptive advantages that it is followed here. Contributions from the first, second, third and fourth sacral, and the coccygeal nerve, form it, and these contributions are almost all anterior (ventral) secondary divisions. The branches of this plexus are the small sciatic, pudic, visceral, perforating cutaneous, muscular and sacro-coccygeal nerves. The *small sciatic* (S.1, 2, 3) is partly dorsal and partly ventral in its origin and distribution; it supplies the skin of the perineum, buttock and the back of the thigh. The *pudic nerve* (S.2, 3, 4) helps to supply the skin and muscles of the perineum and genital organs. The *visceral branches* form the pelvic stream of white rami communicantes (*see* NERVOUS SYSTEM); they run from the second and third or third and fourth sacral nerves to the pelvic plexuses of the sympathetic system. The *perforating cutaneous nerve* (S.2, 3) pierces the great sacro-sciatic ligament and supplies the skin over the lower internal part of the buttock. The *muscular branches* (S.3, 4) supply the external sphincter, levator ani and coccygeus.

The *sacro-coccygeal nerve* (S.4, 5; Coc.1) runs down on each side of the coccyx to supply the adjacent skin, and represents the ventro-lateral nerve of the tail of lower mammals.

(F. G. P.; X.)

The function of the nerves is to transmit messages from the sense organs to the central nervous system and from the central nervous system to the muscles and gland cells. The incoming (or "afferent") messages are decoded, so to speak, in the spinal cord and brain and the outgoing ("efferent") messages are elaborated there, the nerves acting merely as the conducting mechanism between the periphery and the central controlling station. A nerve appears to the naked eye as a long cord of whitish, translucent

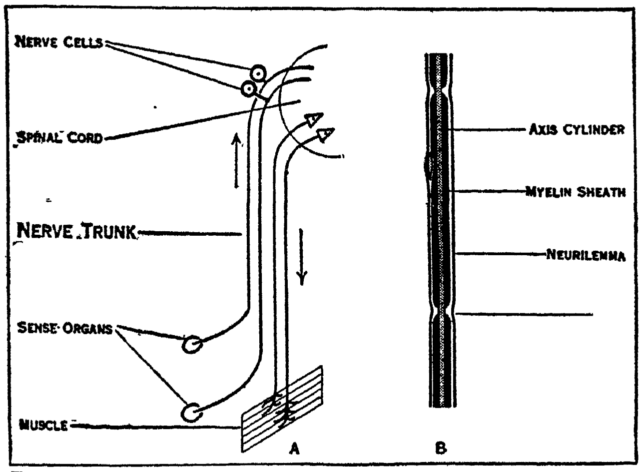


FIG. 10.—A PERIPHERAL NERVE AND ITS FIBRES. B. STRUCTURE OF NERVE FIBRE

material; the large nerve trunks like the sciatic (in man) may be half an inch in breadth, but the ultimate branches are so thin as to be scarcely visible. Microscopically the nerve is made up of a number of fibres, about $\frac{1}{100}$mm. in diameter, each of which acts as an independent conducting path: so that a nerve of medium size may contain several thousand fibres, some terminating in sense organs and some in muscles or glands.

The nerve fibre itself is made of a central core or "axis cylinder" of protoplasm arising from the body of a nerve cell which is generally stationed in or near the spinal cord: the axis cylinder runs from one end of the fibre to the other enclosed in a sheath of fatty material (myelin) interrupted by occasional constrictions or "nodes" and this in turn is enclosed in a membranous sheath called the neurilemma. Either or both sheaths may be absent in certain fibres. A diagram of the general structure of the nerve and its fibres is shown in fig. 10.

The impulse set up by an electric shock in an isolated nerve might have little connection with the normal working of the

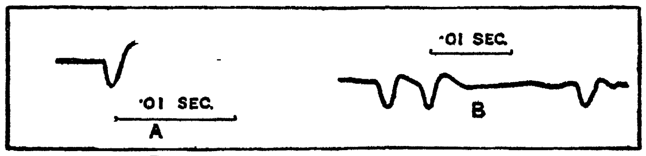


FIG. 11.—ELECTRIC RESPONSE OF NERVE
A. Record of "action current" in a frog's sciatic nerve, stimulated electrically. B. Action of currents in sensory nerve fibres, by light touch

nerve in the body, but there is now no doubt that the messages normally conveyed by the nerve fibres do consist of these impulses and of nothing else. To show this it is necessary to magnify the electric changes in the nerve trunk several thousand times by valve amplification; it is then possible to record the discharge of impulses travelling towards the central nervous system from the sense organs or away from it to the muscles. A portion of such a record is given in fig. 11. A sense organ has been stimulated by touching the skin and a series of impulses passes up the sensory fibres. Each impulse has the usual brief action current and all are of the same size whatever the strength of the stimulus. This does not prevent the nerve fibre from signalling the intensity of stimulation, for it is found that the frequency of the discharge (the number of impulses per second) depends on the stimulus, and the frequency may vary over a wide range (from 5 to 150 a second in the frog). The impulses from the different sense organs are not all exactly alike, for their rate of travel depends on the size of the fibre and the fibres from different organs are not all of the same diameter; but all impulses whether motor or sensory seem to be of the same type and up to the present we have no evidence of any kind of nervous conduction. (E. D. A.)

NERVI, a coast town of Liguria, Italy, province of Genoa, 7½ mi. S.E. of Genoa by rail (also electric tramway), 82 ft. above sea level. Pop. (1936), 4,002 (town), 8,769 (commune). It is a winter resort. It is surrounded with groves of olives, oranges and lemons, and its villas have beautiful gardens. At Quarto, 2½ mi. N.W., 1,000 Garibaldians embarked for Marsala in 1860.

NERVOUS SYSTEM. The nervous system forms an extremely complicated set of links between different parts of the body, and is divided into (A) the central nervous system, composed of (1) the brain, and (2) spinal cord; (B) the peripheral nervous system, consisting of (1) the cranial nerves, (2) the spinal nerves, (3) the various sense organs, such as the eye, ear, olfactory organ, taste organ and tactile organs, and (4) the motor end plates; (C) the sympathetic system. The anatomy and physiology of many of these parts are treated in separate articles (*see* BRAIN; SPINAL CORD; NERVE; EYE, HUMAN; EAR, ANATOMY OF; OLFACTORY SYSTEM; SMELL AND TASTE; TOUCH, SENSE OF; MUSCULAR SYSTEM, ANATOMY OF; and also SYMPATHETIC SYSTEM). The object here is to deal with anatomical points which are common to the whole system, or for which a place does not conveniently occur elsewhere.

HISTOLOGY OF THE NERVOUS SYSTEM

Three kinds of tissue are found in the nervous system, *nerve fibres, nerve cells* and a supporting tissue called *neuroglia.*

Nerve Fibres may be medullated or non-medullated, but, whichever they are, they consist of the long process or *axon* of a nerve cell; in a non-medullated nerve this process is either naked or enclosed in a delicate membrane called the *primitive sheath* or *neurilemma,* but in a medullated nerve the process or *axis cylinder* is encased by a white fatty substance called myelin, and so the term "myelinated" is often used instead of "medullated" for these nerves (fig. 1). Outside this white sheath the neurilemma is present in most nerves, but is lost when they are massed to form

the white matter of the central nervous system and in the optic nerve. At regular intervals the myelin is interrupted by some substance which stains deeply with silver nitrate, and these breaks are known as *nodes of Ranvier.* They do not, however, affect the axis cylinder. In a large nerve, *e.g.*, the median, the nerve fibres are collected into small bundles (*funiculi*), enclosed in a connective tissue sheath (*perineurium*), and separated from it by a lymph space. From this sheath delicate processes penetrate among the fibres (*endoneurium*). The funiculi are collected into bundles called *fasciculi*, and the whole nerve consists of a variable number of fasciculi surrounded by a dense fibrous sheath, the *epineurium*.

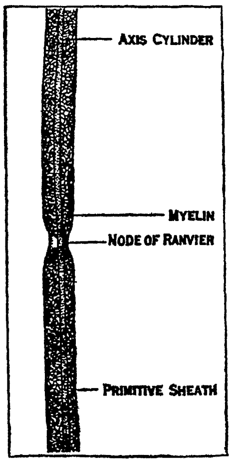
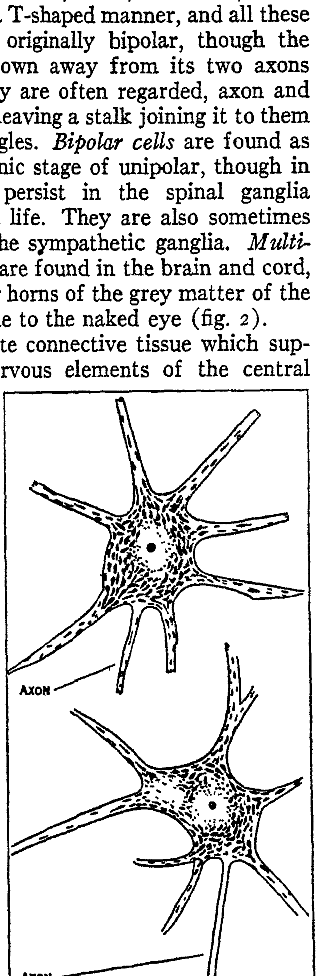


FIG. 1.—STRUCTURE OF A SINGLE NERVE FILAMENT

Nerve Cells are unipolar, bipolar or multipolar. *Unipolar cells* are found in the ganglia on the posterior roots of the spinal nerves, and only give off an axon or axis cylinder process; this, however, soon divides in a T-shaped manner, and all these cells were originally bipolar, though the cell has grown away from its two axons (or, as they are often regarded, axon and dendrite), leaving a stalk joining it to them at right angles. *Bipolar cells* are found as an embryonic stage of unipolar, though in fish they persist in the spinal ganglia throughout life. They are also sometimes found in the sympathetic ganglia. *Multipolar cells* are found in the brain and cord, and are best studied in the anterior horns of the grey matter of the latter, where they are nearly visible to the naked eye (fig. 2).

Neuroglia.—This is the delicate connective tissue which supports and binds together the nervous elements of the central nervous system. One part of it, which lines the central canal of the cord and ventricles of the brain, is formed of columnar cells (*ependyma*), while the rests consists of small cells with numerous processes which sometimes branch and sometimes do not.



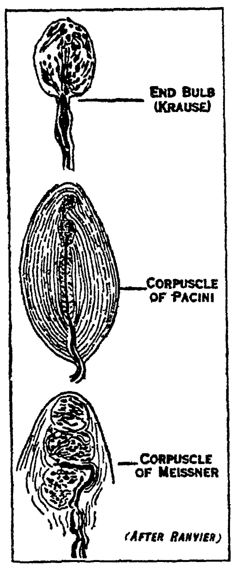
FROM "CUNNINGHAM'S TEXTBOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)
FIG. 2.—NERVE CELLS FROM THE ANTERIOR HORN OF GREY MATTER OF THE HUMAN SPINAL CORD

Nerve Endings.—Sensory nerves end by breaking up into fibrillae or by various tactile organs. In the former case the minute fibrils composing the axons or nerve fibres separate and end among epithelial cells of the mucous membrane or skin. In the latter case the nerve fibres lose their myelin sheath and end in one of the seven following organs:—

1. *End bulbs of Krause* (*see* fig. 3), oval bulbs composed of elongated cells among which the nerve fibrils end in knobs or coils; each is surrounded by a sheath of neurilemma, and the organs are found in the lips, tongue, conjunctiva, epineurium of nerves, synovial membranes of joints, and in the glans penis et clitoridis, where they have a mulberry-like appearance.

2. *Pacinian corpuscles* (fig. 3) are large enough to be seen by the naked eye, and are oval bodies made up of a series of concentric capsules of connective tissue rather resembling the structure of an onion; in the centre is a structureless core, at the distal extremity of which the nerve fibre ends in one or more knobs. These bodies are found in the palm and sole, in the mesentery, the genital organs and in joints.

3. *Tactile corpuscles of Meissner and Wagner* (fig. 3) are oval bodies found in certain of the skin papillae and mucous membrane, especially of very sensitive parts like the hand and foot, lips, tongue and nipple. They are oval and made of a connective tissue capsule from which septa enter the interior. The nerve fibre generally takes a spiral course through them, loses its myelin sheath, and ends by breaking up into its fibrils, which eventually become bulbous.



FROM R. HOWDEN, IN "CUNNINGHAM'S TEXTBOOK OF ANATOMY"
FIG. 3.—TACTILE CORPUSCLES

4. *Tactile corpuscles of Grandry* are found in the skin of those parts devoid of hair, and consist of a capsule containing two or more largish cells, between which the nerve fibre ends in the so-called tactile discs.

5. *Ruffini's endings* are flattened oval bodies with a thick connective tissue capsule, in which the nerve fibre divides into many varicose branches, form a rich plexus, and end in knobs. They are found between the true skin and subcutaneous tissues of the fingers.

6. *Organs of Golgi* occur in tendons. Nerve fibres penetrate the tendon bundles and divide in a tree-like manner to end in little disks and varicosities.

7. *Neuro-muscular spindles* are small fusiform bundles of embryonic muscle fibres, among which the nerve fibres end by encircling them and forming flattened disks. These are sensory endings, and must not be confused with the motor end plates.

Motor nerves end in striped muscle by *motor end plates.* These are formed by a nerve fibre approaching a muscle fibre and suddenly losing its myelin sheath while its neurilemma becomes continuous with the sarcolemma of the muscle fibre. The axis cylinder divides, and its ramifications are surrounded by a disk of granular matter containing many clear nuclei.

THE SYMPATHETIC SYSTEM

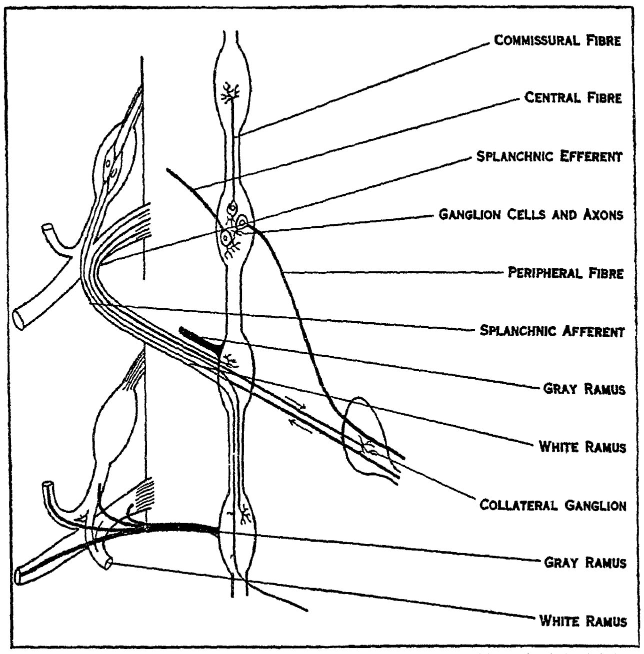
This system is made up of two gangliated cords running down one on each side of the vertebral column and ending below in the median coccygeal ganglion. In the neck the cords lie in front of the anterior tubercles of the transverse processes of the cervical vertebrae, in the thorax, in front of the heads of the ribs, while in the abdomen they lie in front of the sides of the bodies of the vertebrae. In addition to these cords there are numerous ganglia and plexuses through which the sympathetic nerves pass on their way to or from the viscera and blood-vessels.

A typical ganglion of the sympathetic chain is connected with its corresponding spinal nerve by two branches called *rami communicantes,* one of which is grey and the other white (fig. 4). The white consists of medullated fibres belonging to the central nervous system, and these are splanchnic afferent or centripetal, and efferent or centrifugal. The efferent fibres lie in the anterior roots of the spinal nerves, and, like all the fibres there, are either motor or secretory. They are the motor paths for the unstriped muscle of the vessels and viscera, and the secretory paths for the cells of the viscera. In the course of each fibre from the nerve cell in the spinal cord, of which it is an axon, to the vessel or viscus it supplies, there is always a break where it arborizes round a ganglion cell, and this may be in its own ganglion of the sympathetic chain, in a neighbouring ganglion above or below, or in one of the so-called collateral ganglia interposed between the sympathetic chain and the viscera.

The grey rami communicantes are found in connection with all the spinal nerves, though they are irregular in the paths by which they reach the sympathetic ganglia from the cells of which they spring; their fibres are mainly non-medullated, and pass into both roots of the spinal nerves and also into the anterior and posterior primary divisions of those nerves. In this way they reach the body wall and limbs, and are somatic vaso-motor, secretory and pilo-motor fibres, supplying the vessels, glands and hair muscles of the

skin and its glands.

In the gangliated chain there is a ganglion corresponding to nearly each spinal nerve, except in the neck, where only three are found; of these the superior cervical ganglion is more than an inch long, and is connected with the first four spinal nerves as well as with the ninth, tenth and twelfth cranial nerves (fig. 5). Branches of distribution pass from it to the pharyngeal plexus,



FROM A. M. PATERSON, "CUNNINGHAM'S TEXTBOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 4.—SCHEME OF THE CONSTITUTION AND CONNECTIONS OF THE GANGLIATED CORD OF THE SYMPATHETIC

the heart and the two carotid arteries. Of these the branch accompanying the internal carotid artery passes to the carotid and cavernous plexuses, and through these communicates with the spheno-maxillary, otic and ciliary ganglia, while the branch to the external carotid communicates with the submaxillary ganglion. The middle cervical ganglion (fig. 5), when it is present, gives rami communicantes to the fifth and sixth cervical nerves, as well as branches of distribution to the thyroid body and heart.

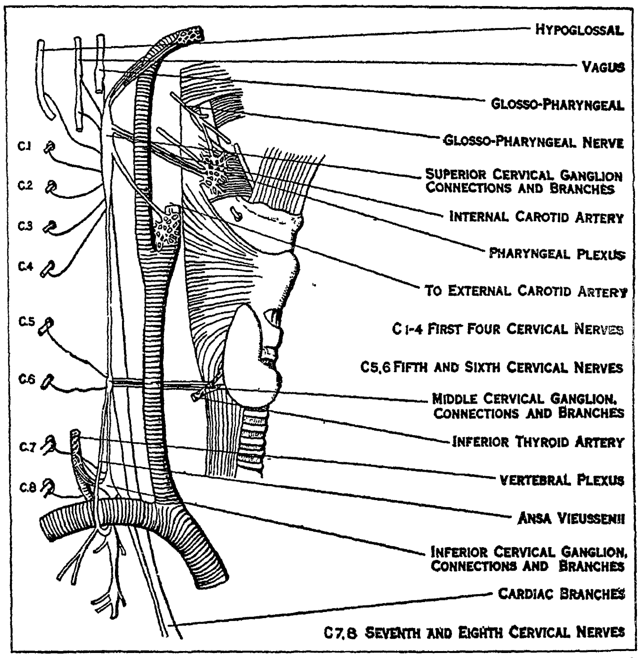
The inferior cervical ganglion (fig. 5) lies behind the subclavian artery, and, besides the main connective cord, has a loop (ansa Vieussenii) joining it to the middle cervical ganglion in front of that vessel. It communicates with the seventh and eighth spinal nerves, and gives branches of distribution to the heart and to the subclavian artery and its branches, especially the vertebral. The thoracic part of the sympathetic cord has usually eleven ganglia, which receive both white and grey rami communicantes from the spinal nerves (fig. 6); of the former the upper ones run up in the chain and come off from the cervical ganglia as already described, while the lower ones form the three abdominal splanchnics which pass through the diaphragm (*q.v.*) and join the abdominal plexuses.

The great splanchnic (fig. 6) comes from the sixth to the ninth ganglia, and ends in the semi-lunar ganglion of the solar plexus. The small splanchnic comes from the ninth and tenth, or tenth and eleventh ganglia, and ends in the aortico-renal ganglion of the solar plexus, while the smallest splanchnic comes from the last thoracic ganglion, whether it be the tenth or eleventh, and ends in the renal plexus.

In the lumbar region the gangliated cord is very irregular; there may be four or more ganglia, and these are often fused. Gray rami communicantes are given to all the lumbar spinal nerves, and white ones are received from the first two. Most of the branches of distribution pass to the aortic plexus. The sacral gangliated cord runs down just internal to the anterior sacral foramina; it usually has four small ganglia, and the two cords end by joining the coccygeal ganglion or ganglion impar, though the two-fourth sacral ganglia are united by transverse interfunicular commissures. The white rami communicantes, already mentioned as the pelvic stream, from the second to the fourth sacral spinal nerves, do not enter the ganglia but pass directly to the pelvic plexuses (fig. 6).

Sympathetic Plexuses.—In the thorax are the superficial and deep cardiac plexuses and the coronary plexuses; the former receives the left superior cervical cardiac of the vagus, and lies in the concavity of the arch of the aorta. The deep cardiac plexus is larger, and lies in front of the bifurcation of the trachea; it receives all the other cardiac nerves, and communicates with the anterior pulmonary plexuses of the vagus (*see* NERVE: *Cranial*).

In the abdomen the solar plexus is by far the most important. It lies behind the stomach and surrounds the coeliac axis; in it are situated the semilunar, aortico-renal and superior mesenteric ganglia, and from it are prolonged subsidiary plexuses along the main arteries, so that diaphragmatic, suprarenal, renal, spermatic, coeliac, superior mesenteric, aortic and inferior mesenteric plexuses, are recognized. The hypogastric plexus is the continuation downward of the aortic, and lies just below the bifurcation of the aorta (fig. 6); it divides into two branches, which accompany the internal iliac arteries and are joined by the pelvic stream of white rami communicantes from the sacral spinal nerves and some twigs from the ganglia of the sacral sympathetic to form the pelvic plexuses. These are prolonged to the viscera along the branches of the internal iliac artery, so that haemorrhoidal, vesical, prostatic, vaginal and uterine plexuses are found. By the side of the neck of the uterus in the last-named plexus several



FROM A. M. PATERSON, IN "CUNNINGHAM'S TEXTBOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

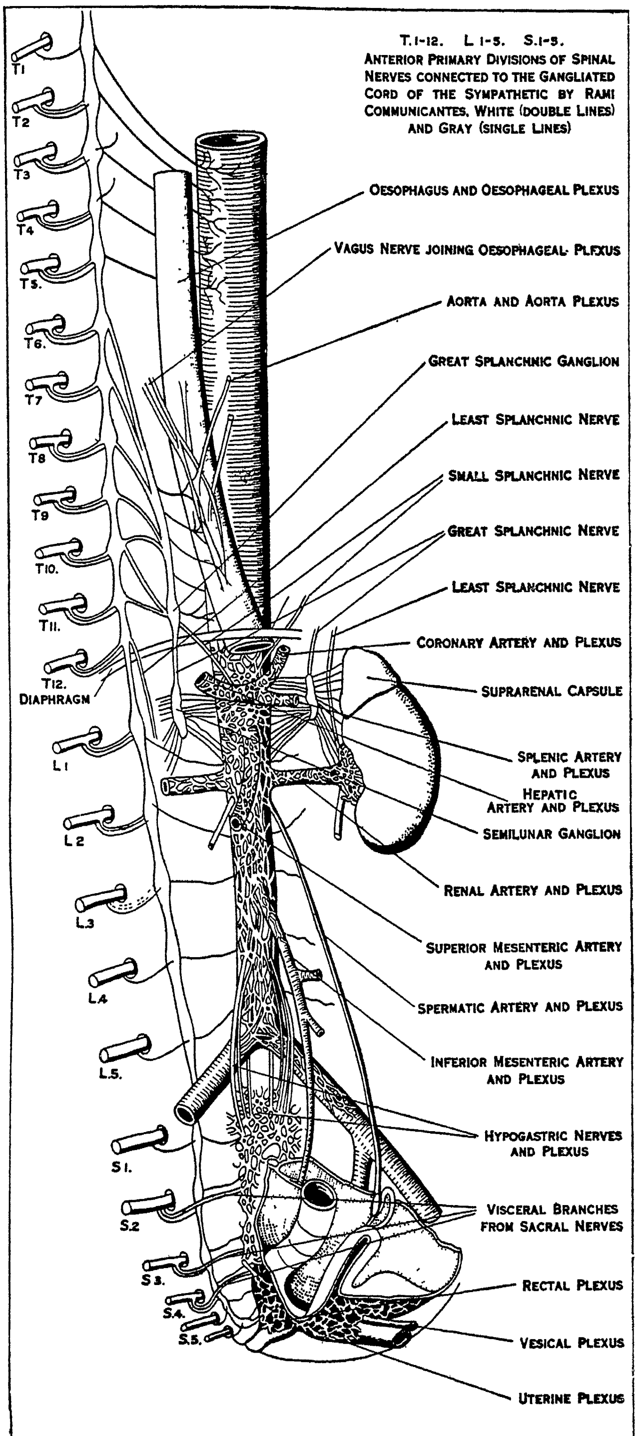
FIG. 5.—THE DISTRIBUTION OF THE SYMPATHETIC GANGLIATED CORD IN THE NECK

small ganglia are seen. (For the literature of the sympathetic system, *see* Quain, *Anatomy*, London.)

EMBRYOLOGY OF NERVOUS SYSTEM

The development of the brain, spinal cord and organs of special sense (eye, ear, tongue), will be found in separate articles. Here that of the cranial and spinal nerves and the sympathetic system is dealt with. The thoracic spinal nerves are the most typical, and one of them is the best to begin with. In fig. 7 the ganglion on the dorsal root is seen growing out from the neural crest, and the cells or neuroblasts of which it is composed become fusiform and grow in two directions as the ganglion recedes from the cord. Those which run toward the spinal cord are the axons, while those growing into the mesoderm are probably enlarged dendrites. The ventral roots rise as the axons of the large cells in the ventral

horn of the grey matter, and meet the fibres of the dorsal root on the distal side of the ganglion. As the two roots join each divides into an anterior (ventral) and a posterior (dorsal) primary division, the latter growing into the dorsal segment of its muscle plate and the skin of the back. The anterior primary division grows till it reaches the cardinal vein and dorsal limit of the coelom, and there forks into a somatic branch to the body

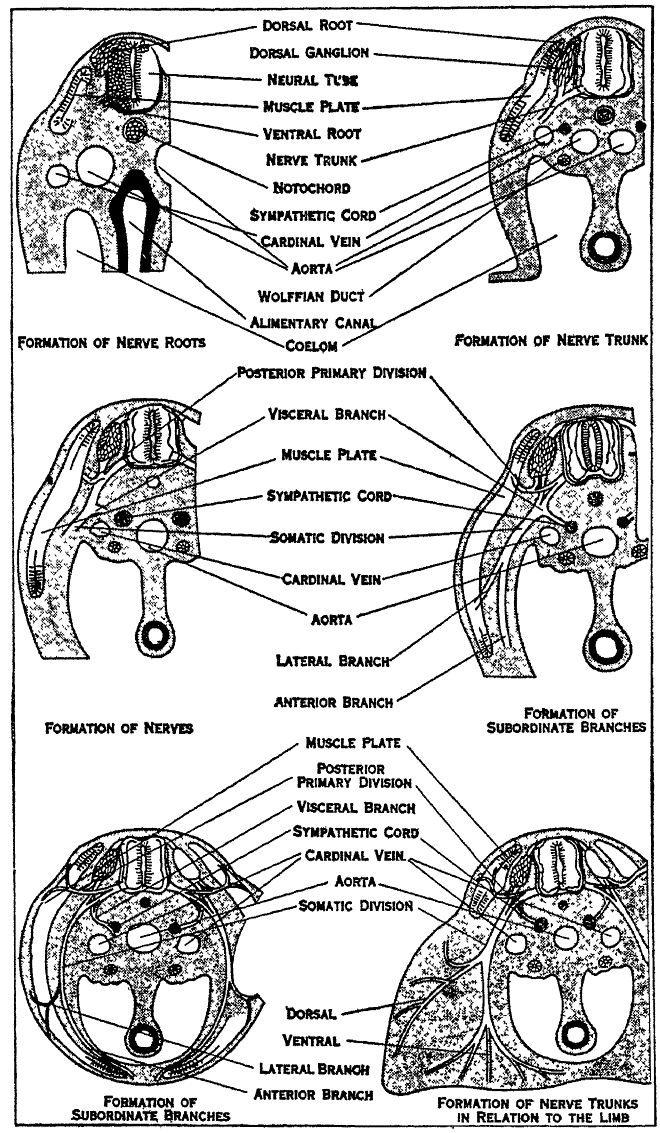


FROM A. M. PATERSON, IN "CUNNINGHAM'S TEXTBOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 6.—THE ARRANGEMENT OF THE SYMPATHETIC SYSTEM IN THE THORAX, ABDOMEN AND PELVIS

wall, and a splanchnic or visceral branch which joins the sympathetic and forms the white ramus communicans. The somatic branch grows round the body wall and gives off lateral and anterior branches.

The cranial nerves are developed in the same way as the spinal, so far as concerns the facts that the motor fibres are the axons of cells situated in the basal lamina of the mesencephalon and



FROM A. M. PATERSON, IN "CUNNINGHAM'S TEXTBOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 7.—DEVELOPMENT OF THE SPINAL NERVES

rhombencephalon (*see* BRAIN), and the sensory are the axons and dendrites of cells situated in ganglia which have budded off from the brain. The evidence of comparative anatomy, however, shows that the cranial nerves cannot be directly homologized with the spinal, nor can the fact of there being twelve of them justify us in assuming that the head contains the rudiments of twelve fused or unsegmented somites.

The sympathetic system is developed from the posterior root ganglia of the spinal nerves, by cells which in man migrate a few at a time. A. M. Paterson, however, believes that the sympathetic is developed, independently of the cerebro-spinal system, in the mesoderm (*Phil. Trans.*, B. clxxxi.).

COMPARATIVE ANATOMY

The comparative anatomy of the brain and spinal cord is dealt with in the separate articles devoted to them.

In *Amphioxus* the dorsal and ventral roots of the spinal nerves do not unite with one another but alternate, a dorsal root on one side being opposite a ventral on the other. The dorsal roots are both sensory and motor, the ventral only motor. In the Cyclostomata (*Petromyzon*) the arrangement is nearly the same, but in some regions there are two ventral roots to one dorsal. In the

fishes and higher vertebrates the dorsal and ventral roots unite, though in selachian (shark) embryos the dorsal and ventral roots alternate (F. M. Balfour, *The Development of Elasmobranch Fishes*, London, 1878).

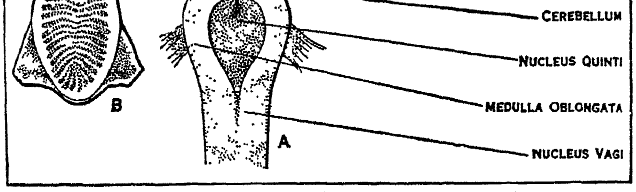
The cranial nerves are only represented by two pairs in *Amphioxus*. In the Cyclostomata, fishes and Amphibia, ten pairs of nerves are found, which in their distribution do not always agree with those of man. In the Amniota or reptiles, birds and mammals, the eleventh and twelfth nerves have been added. The cranial nerves are formed of at least five components: (1) ventral motor, (2) lateral motor, (3) somatic sensory, (4) visceral sensory, (5) lateral line nerves.

The *ventral motor components* are those which rise from cells situated close to the mid line, and probably correspond to the ventral roots of the spinal nerves. The nerves to the eye muscles (motor oculi, trochlearis and abducens) have this origin (*see* NERVE: *Cranial*), as also has the hypoglossal, which doubtless is a cephalized spinal nerve.

The *lateral motor components* rise from cells situated more laterally, and comprise the motor roots of the fifth (trigeminal), seventh (facial), and ninth, tenth and eleventh (glossopharyngeal, vagus and spinal accessory). These nerves supply muscles belonging to the branchial skeleton, instead of the muscles of the primitive cranium, of which the eye muscles are the remnants.

The *somatic sensory components* supply the skin, and end in cells which, among the cyclostomes and fishes, form a considerable elevation in the rhombencephalon, known as the nucleus quinti (fig. 8). These components, in the lower forms, are found in the fifth, seventh and tenth nerves, but in mammals practically only the fifth contains them. They correspond to the dorsal roots of the spinal nerves.

The *splanchnic sensory* or *viscero sensory components* end in the brain in the medullary cells known as the *fasciculus communis* in fishes, and named the *fasciculus solitarius* in mammals, as well as in the nucleus vagi (fig. 8). They are found in the fifth, seventh, ninth, tenth and eleventh nerves, and supply visceral surfaces. In mammals the lingual and palatine branches of the fifth, the chorda tympani and great superficial petrosal of the seventh, and all the sensory fibres of the ninth and tenth except Arnold's nerve, represent these. In fishes and Amphibians the palate is supplied by the seventh nerve instead of the fifth.



BY COURTESY OF THE MUSEUM OF THE ROYAL COLLEGE OF SURGEONS, ENGLAND

FIG. 8.—A. BRAIN. B. CHOROID PLEXUSES OF LAMPREY

The system of the lateral line or acustico-lateralis component is sometimes regarded merely as a subdivision of the somatic sensory. It is best developed in the fish, and may be divided into pre- and post-auditory and auditory. The pre-auditory part comprises the pit and canal end organs supplied by the seventh, and also probably the olfactory organ supplied by the first nerve. The auditory apparatus, supplied by the eighth nerve, is, according to modern opinion, undoubtedly a part of this system, while the tenth nerve sends a large branch along the lateral line supplying the special end organs of the post-auditory part.

The following table, slightly modified from the one drawn up by J. McMurrich, gives a fair idea of the present state of our knowledge of the nerve components in the Mammalia.

Nerve	Ventral motor	Lateral motor	Somatic sensory	Splanchnic sensory	Lateral line
I.	..	..	..	..	+(?)
II.*	..	..	..	..	..
III.	+	..	..	..	..
IV.	+	..	..	..	..
V.	..	+	+	+	..
VI.	+	..	..	..	..
VII.	..	+	..	+	..
VIII.	..	..	..	..	+
IX. X. XI.	..	+	+	+	+
XII.	+	..	..	..	..
Spinal	+	(?)	+	+	..

*A tract of the brain.

BIBLIOGRAPHY.—For further details and literature of the nervous system *see* Quain, *Anatomy* (latest edition); R. Wiedersheims, *Comp. Anat. of Vertebrates* (London, 1907); Bronn, *Classen und Ordnungen des Thierreichs*, McMurrich, *Development of the Human Body* (London, 1923). For the theory of nerve components *see* Onèra Merritt, *Journ. Anat. and Phys.*, vol. xxxix. A general discussion on the comparative anatomy and morphology of limb plexuses will be found in Miss C. W. Saberton's paper (1906), "Nerve Plexuses of *Troglodytes niger*," *Studies in Anatomy* (Manchester, 1906). She refers to most of the literature on the subject, but the papers of H. Braus, *Jena Zeitschr.* (1898), on fish, of M. Davidoff, *Morph: Jahrb.* (1879), on the pelvic plexuses of fish, and of M. Fürbringer, *Gegenb. Festschr.* (1897), on the spino-occipital nerves and brachial plexus of fish, are also important. *See* also S. W. Ransom, *The Anatomy of the Nervous System* (Philadelphia, 1927; bibl.); A. Pitres and L. Testut, *Les nerfs en schémas* (Paris, 1925); L. Bianchi, *The Mechanism of the Brain and the Function of the Frontal Lobes* (Edinburgh, 1922; bibl.); J. R. Whitaker, *Anatomy of the Brain and Spinal Cord* (Edinburgh, 1921); C. U. A. Kappers, *Die Vergleichende Anatomie des Nervensystems der Wirbelthiere und des Menschen* (Haarlem, 1920–21; bibl.). (F. G. P.)

NESFIELD, WILLIAM EDEN (1835–1888), British architect, one of the leaders of the Gothic revival in England, was born in Bath on April 2, 1835, and died in Brighton on March 25, 1888. His father, Maj. William Andrews Nesfield, a well-known landscape gardener, laid out Regent's park and St. James's park and remodelled Kew. Nesfield was educated at Eton and articled successively to William Burn, a classicist, and Anthony Salvin of the Gothic school. He then travelled for study in France, Italy and Greece. The volume of his *Sketches from France and Italy* (1862) became one of the text-books of the Gothic revival. In 1859 Nesfield settled in London and began in 1862 a nominal partnership with Norman Shaw, when they shared rooms, but never collaborated. Nesfield's principal work was in domestic architecture, wherein he showed a mastery of planning and construction and a conscientious regard for detail. As he progressed he forsook the early French style of his earlier work, as seen in Combe abbey and Cloverly hall (1864) and developed a purely English manner, coming at last to English renaissance, as at Kinmel park. Among his other notable works are the lodge at Regent's park (1864) and at Kew gardens (1866); Farnham Royal house, Leawood, Loughton hall, Westcombe park, the Rose and Crown hotel and the bank at Saffron Walden. Many of his sketches and measured drawings are in the library of the Royal Institute of British Architects.

NEST. Nidification or the practice of making nests concerns all that appertains to the preparation for the reception of eggs, or newly-born young, and the subsequent care thereof on emergence. Our conceptions of nidification are commonly derived from observations on birds; but mammals, reptiles, amphibia and fishes, as well as invertebrates, include species which make more or less elaborate preparation in advance for the reception of their young.

The first stage in this sequence commonly consists in the selection of a definite site whereon, with a few exceptions, a nest is built in, or on which the eggs, or young, are deposited. Two factors govern this preparation,—the conditions of the environment, and the state of the young on emergence.

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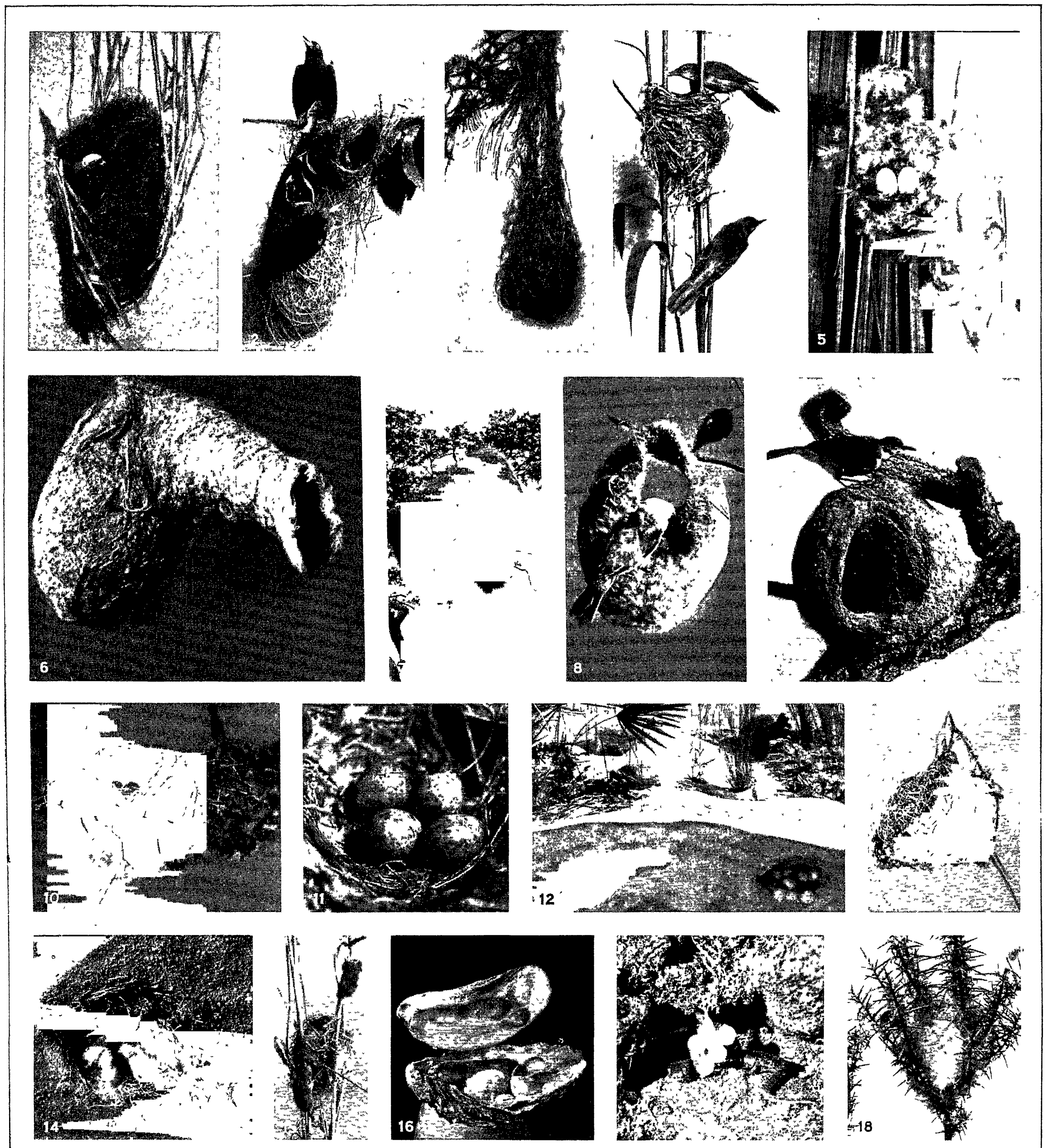
NESTS AND NESTING SITES OF VARIOUS BIRDS

1. Sparrow hawk in a nest of sticks, England. 2. Storks on a chimney top, France; the nest of sticks and reeds is added to year by year. 3. Nest of the golden eagle, built on a high mountain ledge. 4. Female kestrel about to feed her young in an abandoned crow's nest, England. 5. Community of brown pelicans showing nests, Florida. 6. Nest of American egret, Florida. 7. Community of flamingoes, Bahamas, showing mud nests 8. Neighbouring nests of an ibis and a little blue heron, Florida. 9. Sandhill crane approaching its nest built in a marsh, Florida. 10. Derby flycatchers in a loosely made nest, Texas. 11. Blackcap feeding her young, England. 12. American crow on a bulky nest of sticks placed high in a tree. 13. Edible nests of an East Indian swift, made of solidified saliva. 14. Nest of the North American hermit thrush, placed on the ground

NEST



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NESTING HABITS OF BIRDS, MAMMALS, INVERTEBRATES AND FISHES

1. Nest of the humming bird (*Panterpe insignis*), Costa Rica, made of moss and spiders' webs. 2. Amazonian caciques (*Cacicus cela*), with their nest of woven grass suspended from a tree branch. 3. Nest of the Mexican cacique (*Zarhynchus wagleri*), sometimes several feet in length, made of grass and strips of palm leaf. 4. Reed warbler (*Acrocephalus phragmitis*), England, and its cup-shaped nest of reed stems supported by several upright reeds. 5. The feathered nest of the palm swift (*Tachornis*), usually agglutinated to the under surfaces of palm leaves or grass roofs of huts. 6. Hanging nest of the Turkistan *Remera* (*Remiza caspia*), formed of dried grasses and feathers. The bottleneck entrance affords protection against intruders. 7. Nest of the social weaver bird (*Philetaerus socius*), Africa. It consists of an umbrella-shaped roof of grass sheltering an under surface honeycombed with numerous feather-lined cavities. 8. Hanging nest of the *Remera* (*Remiza pendulina*) of Rumania, constructed of lichens, mosses and grass, lined with feathers. 9. Clay nest of the red ovenbird (*Furnarius rufus*), South America, usually about a foot in diameter. 10. Nest of twigs lined with dry leaves built by a group of anis (*Crutophaga ani*), Mexico. It is large enough to accommodate all the females of the company who deposit their eggs in layers separated by leaves. 11. Nest of the woodcock (*Philohela minor*), a hollow scratched in the ground. 12. View of a gopher turtle habitat (*Gopherus polyphemus*) (Daudin) in a sand dune showing the pile in front of the burrow and the cavity where the turtle deposits its eggs. 13. Nest of the cape (African) weaver birds (*Sitagra capensis*), constructed of grass stems and vegetable fibres suspended by long "arms" from trees, bushes or eaves. 14. Underground burrow of the mole (*Talpa europaea*), lined with grass. 15. Nest of the harvest mouse (*Mus minutus*), woven of grass and leaves of corn and attached to cornstalks. 16. Butterfish (*Pholis gunnellis*) coiled around an egg mass in the reversed upper valve of an empty oyster shell. 17. Red backed salamander (*Plethodon cinereus*) guarding its eggs in the moist shadow of a cave nest. 18. Nest of the grass spider (*Agalena*)

Birds.—With the birds a nest is not invariably made, as for example with the auks and murres whose single eggs are deposited on bare ledges of rock projecting from the face of a cliff rising steeply from the sea. Species which haunt sandy wastes make little or no preparation by way of a nest. This receptacle seems originally to have been made for the purpose of keeping the incubating bird, and the eggs, from contact with cold, damp earth.

Much more elaborate are the nests of the smaller species. These, placed in hedgerows or bushes or even on the ground, are bowl-shaped structures made of fine grass stems interwoven with horsehair, and cunningly masked by moss or lichen, as in the case of the European long-tailed titmouse. Some, like the thrush, use a foundation of clay, and line the interior of the nest with a mixture of decayed wood and cow dung. Some of the African weaverbirds, and of the American hangnests, suspend the nest, which is made of long grass stems, and vegetable fibres, by a long "rope" attached to the bough of a tree. Toward the end this rope is enlarged to form a spherical chamber, with an entrance at the top or side in the hangnests; and at the end of a further extension of the rope beneath the nest in the weavers. Some of the flowerpeckers of Africa build a nest of felted cotton-down. A few species make a more or less extensive use of saliva as a cement for mud-built nests, as with the swallow tribe, the South American ovenbird and the flamingo. The use of salivary glands in nest building attains to its maximum with the swifts which glue small twigs to the inside of a chimney to form a tiny basket or, as in the case of the Asiatic edible swifts, use saliva alone. Such nests are used by the Chinese in making bird's nest soup.

Hollows in trees are used by many birds, such as the parrots and the woodpeckers, the eggs being deposited on the rotten wood at the bottom of the hole. Others, like the sand martin and the kingfisher drive long tunnels into the face of a sandbank, enlarging the end of the tunnel to form a nest chamber. The greatness of this achievement is commonly overlooked; for it would be difficult to find birds more apparently unsuited for such a task, since the sand martin has the feeblest of feet and an extremely short beak, while the short legs and syndactyle toes of the kingfisher, coupled with its long, pointed beak, seem less fitted for burrowing.

While there is general conformity of type characteristic of the nests of the different groups of birds, there are striking exceptions to the rule. Thus, the stork tribe are content with a simple platform of sticks; but the hammerhead (*Scopus umbretta*) builds a huge nest of mud and sticks, covered in by a roof so substantial as to bear easily the weight of a man. This roof may be as much as 6 ft. across. The flamingo, again, builds a steep pedestal of mud, the top of which is scooped out to receive the eggs. Parrots nest in hollow trees, but the quaker-parrot (*Myopsittacus*) of South America builds a large domed nest of sticks.

The Gallinaceous birds make little more than an apology for a nest, fashioned in a depression in the ground. But the megapodes of Celebes, New Guinea and Australia build a huge mound of decaying vegetable matter, and laying their eggs deep down in the fermenting mass leave them to hatch by the heat thus engendered.

One of the most remarkable cases of nidification among birds is furnished by the hornbills. The eggs are laid at the bottom of a cavity in a tree, and as soon as the female has started incubation, the entrance hole is closed by the male by means of clay; but a space is left open wide enough for his mate to push her beak through to receive food. (*See* Birds: *Bird Nesting.*)

NONAVIAN NEST-MAKERS

Mammals.—Few other animals have attained to the skill in weaving displayed by birds. The harvest mouse among the mammals is, however, the rival of most birds and many squirrels build bulky structures in treetops or vines. The rabbit builds a nest in her burrow, and lines it with the under-fur plucked from her body, forming a parallel to the case of the ducks, geese and swans, which line the nest with down similarly plucked from the breast for this purpose.

The only nest-building mammals which produce eggs are the *Tachyglossus*, or spiny anteater, and the duck-billed platypus or *Ornithorhynchus*. The nest is of the simplest character, placed in a chamber at the end of a long tunnel dug by the animal.

Reptiles.—Among the reptiles nest-building goes little or no further than digging a hole in the ground, and depositing the eggs within it, leaving them to their fate as in the case of the megapodes among the birds. The European pond tortoise, however, takes a little more trouble. She first prepares the ground by watering it from the bladder, and from special anal water sacs. Then, boring a hole with the tail, as one would use a stick, the feet are used to enlarge it. When about five inches deep the eggs are laid at the bottom, and the soil is put back again and beaten down flat. The crocodile digs a hole in the sand nearly two feet deep, laying her eggs therein and covering them up. But she returns periodically to sleep above her treasures. She is thus at hand to assist the young to escape at the time of hatching. She is warned of this by the noise they make in endeavouring to break through the shell: just as young birds announce their advent by cheeping before the shell is actually broken. When they have all emerged the mother escorts them to the water. The alligator, on the other hand, like the muskrat, builds a great mound of decaying vegetation in a marsh to a height of about 3 ft. and as much as 8 ft. in diameter. Some 8 in. from the surface the eggs, 20 to 30, white and hard-shelled, are laid.

The python, among the snakes, like *Ichthyophis* among the Amphibia coils her body around the eggs until they hatch, and guards her young for some time after.

Amphibia.—The Amphibia furnish instances of nidification of a very remarkable character, and at the same time, provide valuable material for the study of behaviour in regard to the parental instincts to serve as a standard of comparison with the higher vertebrates on the one hand, and the lower on the other.

The frogs of the genus *Phyllomedusa* build nests recalling that of the tailorbird. The process of this nest-making has been watched in *Phyllomedusa hypochondria,* the *Wollenkukk* of the Paraguayan Chaco. The female carries the male upon her back while searching for a suitable leaf—which must be of some tree overhanging the water. This found, both then seize it and hold the edges together with their hindfeet, while the female pours her eggs into the funnel thus formed, the male fertilizing them as they pass in. The gelatinous envelope of the eggs suffices to hold the leaf edges in position as they are brought together in the filling process which goes on until about 100 eggs are laid.

Fishes.—Among the fishes the fresh-water sticklebacks (*Gasterosteus*) and the marine 15-spine stickleback (*Spinachia*) build nests of weeds, the task being undertaken by the male, who uses, as a binding material, a secretion formed by the kidneys. He undertakes the sole charge of the eggs and young. The gourami (*Osphronemus*) of the Malay archipelago fashions a nest of air bubbles toughened by a kind of saliva, and mounts guard over both eggs and young. The Cichlid fishes both of America and the old world, as well as some of the Siluroid fishes, carry the young in the mouth; in some species both sexes do this, in others the male alone. The male pipefish carries the eggs and young in a pouch running along the belly. The Aspredo of the Guianas carries her eggs attached to the under surface of the head, belly and paired fins. For their accommodation the skin assumes a spongy condition so that each comes to lie within a deep depression, recalling the egg pits of the Surinam toad, but in the case of Aspredo the pits are shallow and the larvae are not retained there.

Invertebrates.—Among the insects the elaborate care for the eggs and young displayed by the ants, bees and wasps is too well known to need further mention. The scorpions and the wolf spiders carry their young about on their backs until they can fend for themselves; and some of the scorpions, again, like the wolf spiders, bear their eggs about closely packed within a spherical silken bag.

Among the Echinoderms we find an antarctic sea-slug (*Cucumaria crocea*) carrying the young on its back. One of the sea urchins (*Hemiaster philippi*), and a starfish (*Asterias spirabilis*) carry the young in brood pouches on the back in the case of the sea urchin, and around the mouth in the starfish. It would seem that only arctic and antarctic species behave after this fashion.

In all other cases the young leave the parent as minute, free-swimming larvae, undergoing a complicated metamorphosis before attaining to the adult form. Here, then, we must regard the care of the young as an entirely impersonal, unconscious act, determined by the physical peculiarities of the external environment. This is a factor to be borne in mind in considering the origin, and evolution, of nidification in animals of all grades. (W. P. P.; X.)

NESTOR (*c.* 1056–*c.* 1114), the reputed author of the earliest Russian chronicle, was a monk of the Pecherskiy cloister of Kiev from 1073. The only other known fact of his life is that he was commissioned with two other monks to find the relics of St. Theodosius, a mission which he succeeded in fulfilling. The chronicle begins with the deluge, as those of most chroniclers of the time did. The compiler appears to have been acquainted with the Byzantine historians; he makes use especially of John Malalas and George Hamartolus. He also had in all probability other Slavonic chronicles to compile from, which are now lost. Many legends are mixed up with Nestor's *Chronicle;* the style is occasionally so poetical that perhaps he incorporated *byliny* which are now lost. The early part is rich in these stories, among which are the arrival of the three Varangian brothers, the founding of Kiev, the murder of Askold and Dir, the death of Oleg, who was killed by a serpent concealed in the skeleton of his horse, and the vengeance taken by Olga, the wife of Igor, on the Drevlians, who had murdered her husband. The account of the labours of Cyril and Methodius among the Slavs is also very interesting, and to Nestor we owe the tale of the summary way in which Vladimir suppressed the worship of Perun and other idols at Kiev. As an eyewitness he could only describe the reigns of Vsevolod and Sviatopolk (1078–1112), but he gathered many interesting details from the lips of old men, two of whom were Giurata Rogovich of Novgorod, who gave him information concerning the north of Russia, Petchora, and other places, and Jan, a man ninety years of age, who died in 1106, and was son of Vishata the voivode of Yaroslavl and grandson of Ostromir the Posadnik, for whom the *Codex* was written. Many of the ethnological details given by Nestor of the various races of the Slavs are of the highest value.

The latest theory about Nestor is that the *Chronicle* is a patchwork of many fragments of chronicles, and that the name of Nestor was attached to it because he wrote the greater part or perhaps because he put the fragments together.

The Chronicle has come down to us in several manuscripts, but unfortunately no contemporary ones, the oldest being the so-called Lavrentievski of the 14th century (1377). It was named after the monk Lavrentii, who copied it out for Dimitri Constantinovich, the prince of Souzdal. The work, as contained in this manuscript, has had many additions made to it from previous and contemporary chronicles, such as those of Volinia and Novgorod. Soloviev, the Russian historian, remarks that Nestor cannot be called the earliest Russian chronicler, but he is the first writer who took a national point of view in his history, the others being merely local writers. The language of his work, as shown in the earliest manuscripts just mentioned, is Palaeo-Slavonic with many Russisms.

The *Chronicle* has been translated into Polish, Bohemian, German and French. The compiler cannot very well be the author of the lives of Boris and Gleb, the martyrs, and of the life of St. Theodosius, because they contradict many passages in the *Chronicle.* The work is of primary importance for early Russian history, and has amusing episodes of an Herodotean character. The reputed body of the ancient chronicler may be seen among the relics preserved in the Pecherskiy monastery at Kiev.

See Louis Leger, *Chronique dite de Nestor* (Paris, 1884); Bestuzhev Riumin, *On the Composition of the Russian Chronicles till the end of the 14th century* (in Russian) (St. Petersburg, 1869). (W. R. Mo.)

NESTOR, in Greek legend, son of Neleus and Chloris, king of Pylos (Kakovátos) in Elis. When all his brothers were slain by Heracles, in consequence of the refusal of Neleus to purify him for the murder of Iphitus, Nestor alone escaped. In the *Iliad,* he is about 70 years old, full of good advice and of stories of his early exploits. In the *Odyssey,* he is seen by Telemachus at Pylos. The name is used in modern times for any old man of ripe experience, or the oldest member of a class or corporation.

NESTOR, the name of a small group of parrots peculiar to New Zealand. The type is *Nestor meridionalis,* the kaka, an olive-brown bird about as big as a crow. The larger *N. notabilis,* the kea (*q.v.*) has developed the habit of attacking sheep to obtain the kidneys. It also eats carrion, grubs, fruits and seeds. A third, more brightly coloured species is said to have inhabited Norfolk Island and a fourth Phillip Island; both of these are now extinct and no specimens of the former are known to exist.

NESTORIANS. The present article deals not with the life and doctrine of Nestorius (*q.v.*) but with the Eastern Churches called by his name.

A christology of the kind usually called Nestorian was eagerly and successfully propagated in Syria and Persia by Ibas, bishop of Edessa (435) and Barsumas, bishop of Nisibis. In Persia the old churches were stimulated into vigour and new ones founded. Their centre was at Ctesiphon on the Tigris, a busy trading city. The church traced its doctrines to Theodore of Mopsuestia rather than to Nestorius, whose name at first they repudiated, not regarding themselves as having been proselytized to any new teaching. After the Mohammedan invasion of Persia early in the 7th century the Nestorians were able to come to terms with the invaders; and for five centuries the Nestorians were a recognized institution within the territory of Islam, though their treatment varied from kindly to harsh. But the barbaric invasions of the 13th and 14th centuries fell with crushing force on the Nestorians. In 1258 Hulagu Khan took Baghdad, and about 1400 Timur again seized and sacked the city. Though the Nestorians were numerous, their moral influence and their church life had greatly deteriorated. Those who escaped capture by Timur fled to the mountains of Kurdistan, and the community that had played so large a part in Mesopotamian history for a thousand years was thus shattered. Various attempts during the 16th century to promote union between the Nestorians and Rome proved fruitless, but the Roman Church has never ceased in its efforts to absorb this ancient community.

The Nestorians showed a zeal for evangelization which resulted in the establishment of their influence throughout Asia, as is seen from the bishoprics founded not only in Syria, Armenia, Arabia and Persia, but at Halavan in Media, Merv in Khurasan, Herat, Tashkent, Samarkand, Baluk, Kashgar, and even at Kambaluk (Pekin) and Singan fu (Hsi'en fu) in China, and Kaljana and Kranganore in India. Mongolian invasions and Mohammedan tyranny have, of course, long since swept away all traces of many of these. The 400,000 Syrian Christians ("Christians of St. Thomas," *see* THOMAS, ST.) who lived in Malabar no doubt owed their origin to Nestorian missionaries, the stories of the evangelization of India by the Apostles Thomas and Bartholomew having no real historical foundation, and the Indian activity of Pantaenus of Alexandria having proved fruitless, in whatever part of India it may have been exercised. The theology of the Indian Syrian Christians is of a Nestorian type, and Cosmas Indicopleustes (6th century) puts us on the right track when he says that the Christians whom he found in Ceylon and Malabar had come from Persia (probably as refugees from persecution, like the Huguenots in England and the Pilgrim Fathers in America). Pehlevi inscriptions found on crosses at St. Thomas's Mount near Madras and at Kottayam in Travancore, are evidence both of the antiquity of Christianity in these places (7th or 8th century), and for the semi-patri-passianism (the apparent identification of all three persons of the Trinity in the sufferer on the cross) which marked the Nestorian teaching. In 745 Thomas of Kana brought a new band of emigrants from Baghdad and Nineveh, and possibly the name "Christians of St. Thomas" arose from confusion between this man and the apostle. Other reinforcements came from Persia in 822, but the Malabar church never developed any intellectual vigour or missionary zeal. They had their own kings, lived as a close caste, and even imitated the Hindus in caste regulations of food and avoidance of pollution. In 1330 Pope John XXII. issued a bull appointing Jordanus, a French Dominican, bishop of Quilon, and inviting the Nestorians to enter "the Christian Church." The

invitation was declined, but in the 16th century the Syrian Christians sought the help of the Portuguese settlers against Mussulman oppression, only to find that before long they were subjected to the fiercer perils of Jesuit antagonism and the Inquisition. The Syrians submitted to Rome at the synod of Dampier in 1599, but it was a forced submission, and in 1653 when the Portuguese arrested the Syrian bishop just sent out by the catholicus of Babylon, the rebellion broke out. The renunciation was not quite thorough, one party adhering to the Roman Church as Romo-Syrians, the others reverting wholly to Syrian usages and forming to-day about three-fourths of the whole community.

WIDESPREAD MISSIONS

Early evidence of Nestorian missions in China is extant in the tablet found in 1625 at Chang'an in the district of Hsi'en-fu, province of Shensi. It commemorates "the introduction and propagation of the noble law of Ta t'sin in the Middle Kingdom," and beneath an incised cross sets out in Chinese and Syriac an abstract of Christian doctrine and the course of a Syrian mission in China beginning with the favourable reception of Olopan, who came from Judaea in 636. For two generations the little cause prospered, and again after persecutions in 699 and 813. Later on a second mission arrived, many churches were built and several emperors patronized the faith.

In the 10th century the Nestorians introduced Christianity into Tartary proper; in 1274 Marco Polo saw two of their churches. The legend of Prester John is based on the idea of the conversion of a Mongol tribe, the Karith, whose chieftain Ung Khan at baptism received the title Malek Juchana (King John). Their activity may well be said to have covered the continent. Their campaign was one of deliberate conquest, one of the greatest ever planned by Christian missionaries. Marco Polo is witness that there were Nestorian churches all along the trade routes from Baghdad to Pekin.

The Modern Nestorians.—The Nestorians or East Syrians (*Surayi*) of Turkey and Persia now inhabit a district bounded by Lake Urmia, or Urumia, on the east, stretching westwards into Kurdistan, to Mosul on the south, and nearly as far as Van on the north. It is only of late years, under the influence of the different missions, that education, ruined by centuries of persecution, has revived amongst the Nestorians; and even now the mountaineers, cut off from the outer world, are as a rule destitute of learning, and greatly resemble their neighbours, the wild and uncivilized Kurds. They are, however, extraordinarily tenacious of their ancient customs, and, almost totally isolated from the rest of Christendom since the 5th century, they afford an interesting study to the ecclesiastical student. Their churches are rude buildings, dimly lighted and destitute of pictures or images, save that of the Cross, which is treated with the deepest veneration. There are three liturgies—of the Holy Apostles, of Theodore and of Nestorius. The first is quite free from Nestorian influence, dates from some remote period, perhaps prior to 431, and is certainly the most ancient of those now in use in Christendom; the other two, though early, are undoubtedly of later date. The Nestorian canon of Scripture seems never to have been fully determined, nor is the sacramental system rigidly defined. Nestorian writers, however, generally reckon as sacraments the Priesthood, the Oil of Unction, the Offering of the Body and Blood of Christ, Absolution, the Holy Leaven and the Signation of the life-giving Cross. The "Holy Leaven" is reputed to be a part of the original bread of the first Eucharist, brought by Addai and Mari and maintained ever since in the Church; it is used in the confection of the Eucharistic wafers, which are rather thicker than those used in the Western Church. Communion is given in both kinds, as throughout the East; likewise, confirmation is administered directly after baptism. Sacramental confession is enjoined, but has recently become obsolete; prayers for the departed and invocation of saints form part of the services. The bishops are always celibates and are chosen from episcopal families. The service-books were wholly in ms. until the press of the archbishop of Canterbury's mission at Urmia issued the *Takhsa* (containing the liturgies, baptismal office, etc.) and several other liturgical texts.

The Nestorians commemorate Nestorius as a saint, and invoke his aid and that of his companions. They reject the Third Oecumenical Council, and though showing the greatest devotion to the Blessed Virgin, deny her the title of *Theotokos, i.e.,* the mother or bearer of God. Their theological teaching is misty and perplexing; but systematic or even consistent theological thinking is not their primary interest (*see* J. F. Bethune-Baker, *Nestorius and his Teaching*). The peculiar circumstances, both ecclesiastical and temporal, of the Nestorians have attracted much attention in western Christendom, and various missionary enterprises amongst them have resulted (*see* authorities named below).

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NESTORIUS (d. *c.* 451), Syrian ecclesiastic, patriarch of Constantinople from 428 to 431, was a native of Germanicia at the foot of Mount Taurus, in Syria. The year of his birth is unknown. He received his education at Antioch, probably under Theodore of Mopsuestia. As monk in the neighbouring monastery of Euprepius, and afterwards as presbyter, he became famous in the diocese for his asceticism, his orthodoxy and his eloquence. He was nominated by Theodosius II. patriarch of Constantinople, and was consecrated on April 10, 428. He immediately set to work to extirpate heresy in his diocese, beginning by the suppression of the assemblies of the Arians. These, by a bold stroke of policy, anticipated his action by themselves setting fire to their meeting-house, Nestorius being forthwith nicknamed "the incendiary." His repression of the Novatians and the Quartodecimans led to serious disturbances at Sardis and Miletus. The toleration the followers of Macedonius had long enjoyed was also broken, the recently settled Pelagians alone finding any respite. One of the practices assailed by Nestorius was the custom, which had become almost universal in Constantinople, of bestowing the epithet Θεοτόκος "Mother of God," upon Mary the mother of Jesus. From Antioch Nestorius had brought along with him to Constantinople a co-presbyter named Anastasius, who enjoyed his confidence and is called by Theophanes his "syncellus." This Anastasius, in a pulpit oration which the patriarch himself is said to have prepared for him, caused great scandal to the partisans of the cult of Mary by saying, "Let no one call Mary the mother of God, for Mary was a human being; and that God should be born of a human being is impossible."

Cyril (*q.v.*) of Alexandria seized his opportunity. He stirred up his own clergy, he encouraged the dissidents at Constantinople, he addressed himself to the sister and wife of the emperor, and he bribed the officials of the court. He also sent to Rome a careful selection of Nestorius's sayings and sermons. Nestorius himself, on the other hand, having occasion to write to Pope Celestine I. about the Pelagians (whom he was not inclined to regard as heretical), gave from his own point of view an account of the disputes which had recently arisen within his patriarchate. Celestine naturally resented any questioning of the Roman decision concerning the Pelagians, and was jealous of the growing power of the Constantinople see. In a synod which met in 430, he decided in favour of the title Θεοτόκος, bade Nestorius retract his erroneous teaching, on pain of instant excommunication, and entrusted the execution of this decision to the patriarch of Alexandria.

In this situation of affairs the demand for a general council became irresistible, and accordingly Theodosius and Valentinian III. issued letters summoning the metropolitans of the Catholic church to meet at Ephesus at Whitsuntide 431, each bringing with him some able suffragans. Nestorius, with sixteen bishops and an armed following, Cyril with fifty bishops, Juvenal of Jerusalem, and Flavian of Thessalonica arrived. John of Antioch was delayed on his journey, and wrote requesting that the opening of the

synod should not be delayed on his account. Cyril and his friends assembled in the church of the Theotokos on June 22, and summoned Nestorius to give an account of his doctrines. He replied that he would appear when all the bishops were assembled; and the imperial commissioner, Candidian, formally protested against the opening of the synod. Cyril and the 159 bishops who were with him nevertheless proceeded to read the imperial letter of convocation, and afterwards the letters which had passed between Nestorius and Cyril. The entire assembly then cried anathema on Nestorius and his doctrines, and the decree of his exclusion from the episcopate and from all priestly communion was solemnly read and signed by all present. The accused and his friends never had a hearing.

The populace accompanied the members with torches and censers to their lodgings, and there was a general illumination of the city. A few days afterwards (June 26th or 27th) John of Antioch arrived; whether inclined or not to the cause of his former copresbyter, he disapproved the precipitancy with which Cyril had acted, and at a *conciliabulum* of forty-three bishops held in his lodgings he was induced by Candidian, the friend of Nestorius, to depose the bishops of Alexandria and Ephesus on the spot. The Ephesians intervened to prevent the execution of this decision on the next Sunday. Meanwhile a letter from the emperor declared invalid the session at which Nestorius had been deposed unheard; numerous sessions and counter-sessions were afterwards held, the conflicting parties both seeking the imperial support. In the end Theodosius decided to confirm the depositions which had been pronounced on both sides, and Cyril and Memnon as well as Nestorius were by his orders laid under arrest. Representatives from each side were now summoned before him to Chalcedon, and at last, yielding to the sense of the evident majority, he gave a decision in favour of the "orthodox," and the council of Ephesus was dissolved. Maximian, one of the Constantinopolitan clergy, a native of Rome, was promoted to the vacant see, and Nestorius was henceforward represented in the capital only by one congregation, which presently became extinct.

But the Antiochenes maintained for some time an attitude of antagonism towards Cyril and his creed, and were not pacified until an understanding was reached in 433 on the basis of a new formula involving some concessions by him. The union even then was opposed by certain bishops, who were deposed from their sees. Their school at Edessa was closed by Zeno in 489. Immediately after his deposition Nestorius withdrew into private life in his old monastery of Euprepius, Antioch, until 435, when the emperor ordered his banishment to Petra in Arabia. A second decree, it would seem, sent him to Oasis, probably the city of the Great Oasis, in Upper Egypt, where he was still living in 439, at the time when Socrates wrote his *Church History*. He was taken prisoner by the Blemmyes, a nomad tribe that gave much trouble to the empire in Africa, and when they set him free in the Thebaid near Panopolis (Akhmim) *c.* 450, they exposed him to further persecution from Schenute, the hero of the Egyptian monks. There is some evidence that he was summoned to the Council of Chalcedon, though he could not attend it, and in the concluding portion of his book known as *The Bazaar of Heraclides* he not only gives a full account of the "Robber Synod" of Ephesus 449, but knows that Theodosius is dead (July 450) and seems aware of the proceedings of Chalcedon and the flight of Dioscurus, the unscrupulous successor of Cyril at Alexandria. Nestorius was already old and ailing and must have died very soon after. There are still Nestorians in Kurdistan, and the Syriac Church is Nestorian in theology, as are the churches in Asia founded by Nestorian missionaries in the middle ages.

Modern View.—Only recently has an attempt been made to judge Nestorius from some other evidence than that afforded by the accusations of Cyril and the inferences drawn therefrom. This other evidence consists partly of letters from Nestorius, preserved among the works of those to whom they were written, some sermons collected in a Latin translation by Marius Mercator, an African merchant who was doing business in Constantinople at the time of the dispute, and other material gathered from Syriac manuscripts. Since the helpful collection of *Nestoriana* published by Dr. F. Loofs in 1905 there has also come to our knowledge the most valuable evidence of all, Nestorius's own account of the whole difficulty, viz., *The Bazaar*[1] *of Heraclides of Damascus*. This pseudonym served to protect the book against the fate that overtook the writings of heretics, and in a Syriac version it was preserved in the Euphrates valley where the followers of Nestorius settled. Ebed Jesu in the 14th century mentions it together with *Letters* and *Homilies*, as well as the *Tragedy*, or a *Letter to Cosmas*, the *Theopaschites* (of which some fragments are still extant) and the *Liturgy*, which is still used by the Nestorian Church. The discovery of *The Bazaar*, which is the *Apologia* of Nestorius, was made public by Dr. H. Goussen (though members of the Archbishop of Canterbury's Mission to the Assyrian Christians had previously been acquainted with the book). The text has been edited by P. Paul Bedjan (Leipzig, 1910) and a French translation has been made by M. l'abbé F. Nau. A representative selection of extracts has been given to English readers in J. F. Bethune-Baker's *Nestorius and his Teaching* (Cambridge, 1908), chapter ii. of which describes the ms. and its accounts.

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NET. A fabric of thread, cord or wire, the intersections of which are knotted so as to form a mesh. The art of netting is intimately related to weaving, knitting, plaiting and lace-making, from all of which, however, it is distinguished by the knotting of the intersections of the cord. It is one of the most ancient and universal of arts, having been practised among the most primitive tribes, to whom the net is of great importance in hunting and fishing. Net is a common Teut. word, of which the origin is unknown; it is not to be connected with "knit" or "knot." The term "net," *i.e.*, remaining after all deductions, charges, etc., have been made, as in "net profit," is a variant of "neat," tidy, clean, Lat. *nitidus*, shining. Net-making, as a modern industry, is principally concerned with the manufacture of the numerous forms of net used in fisheries, but netting is also largely employed for many other purposes, as for the temporary division of fields, for protecting fruit in gardens, for screens and other furniture purposes, for bags, appliances used in various games, etc. Since the early part of the 19th century numerous machines have been invented for netting, and several of these have attained commercial success. Fishing nets were formerly made principally from hemp fibre —technically called "twine."

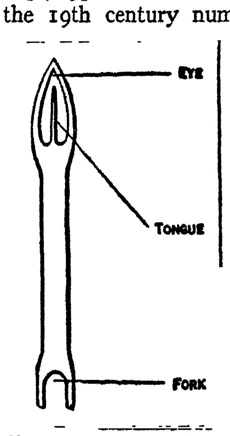


FIG. 1.—NEEDLE USED IN NET-MAKING

The forms of fishing nets vary according to the manner in which they are intended to act. This is either by entangling the fish in their complicated folds, as in the trammel; receiving them into pockets, as in the trawl; suspending them by the body in the meshes, as in the mackerel-net; imprisoning them within their labyrinth-like chambers, as in the stake-net; or drawing them to shore, as in the seine. The parts of a net are the head or upper margin, along which the corks are strung upon a rope called the head-rope; the foot is the opposite or lower margin, which carries the foot-rope, on which in many cases leaden plummets are made fast. The meshes are the squares composing the net. The width of a net is expressed by the term "over"; *e.g.*, a day-net is three fathoms long and one over or wide. The lever is the first row of a net. There are also accrues, false meshes or quarterings, which are loops inserted in any given row, by which the number of meshes is increased. To bread or breathe a net is to make a net.

[1]Syriac, *tēgūrtā*, lit. "merchandise." The Greek word may have been ἐμπορίον. Nothing is certainly known of any such Heraclides.

Hand Netting.—The tools used in hand netting are the needle, an instrument for holding and netting the material; it is made with an eye *E*, a tongue *T* and a fork *F* (fig. 1). The twine is wound on it by being passed alternately between the fork and round the tongue, so that the turns of the string lie parallel to the length of the needle, and are kept on by the tongue and fork. A spool, or mesh pin, is a piece of round or flat wood on which the loops are formed, the perimeter of the spool determining the size of the loops. Each loop contains two sides of the square mesh; therefore, supposing that it be required to make a mesh one inch square—

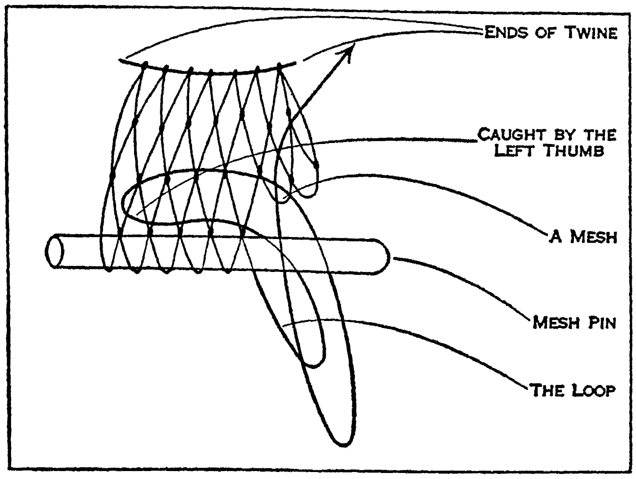


FIG. 2.—DIAGRAM SHOWING COURSE OF TWINE IN FORMING A FISHERMAN'S KNOT IN NETMAKING

that is, measuring one inch from knot to knot—a spool two inches in circumference must be used. Large meshes may be formed by giving the twine two or more turns round the spool, as occasion may require; or the spool may be made flat and of a sufficient width. The method of making the hand knot, known as the fisherman's knot, is more easily acquired by example than described in writing. Fig. 2 shows the course of the twine in forming a single knot. From the last-formed knot the twine passes over the front of the mesh pin and is caught behind by the little finger of the left hand, forming the loop, thence it passes to the front and is caught by the left thumb, then through the loop and mesh as sketch indicates, after which the twine is released by the thumb and the knot is drawn taut. Fig. 3 is a bend knot used for uniting two ends of twine.

Machine Netting.—In 1778 a netting machine was patented by William Horton, William Ross, Thomas Davies and John Golby. In 1802 the French government offered a reward of 10,000 fr. to the person who would invent an automatic machine for netmaking. Joseph Jacquard submitted a model of a machine which was brought under the notice of Napoleon I and Lazare Carnot, and he was summoned to Paris by the emperor, who asked—"Are you the man who pretends to do what God Almighty cannot—tie a knot in a stretched string?" Jacquard's model, which is incomplete, was deposited in the Conservatoire des Arts et Métiers; it was awarded a prize, and he himself received an appointment in the conservatoire, where he perfected his famous attachment to the common loom. In the United Kingdom, the first to succeed in inventing an efficient machine and in establishing the industry of machine netmaking was James Paterson of Musselburgh. Paterson, originally a cooper, served in the army through the Peninsular War, and was discharged after the battle of Waterloo. He established a net factory in Musselburgh about 1820; but the early form of machine was imperfect, the knots it formed slipped readily and, there being much prejudice against machine nets, the demand was small. Walter Ritchie, native of Musselburgh, devised a method for forming the ordinary hand knot on the machine nets, and the machine, patented in July 1835, became the foundation of an extensive and flourishing industry. The Paterson machine is very complex. It consists of an arrangement of hooks, needles and sinkers, one of each being required for every mesh in the breadth being made. The needles hold the meshes, while the hooks seize the lower part of each and twist it into a loop. Through the series of loops so formed a steel wire is shot, carrying with it twine for the next range of loops. This twine the sinkers successively catch and depress sufficiently to form the two sides and loop of the next mesh to be formed. The knot formed by threading the loops is now tightened up, the last-formed mesh is freed from the sinkers and transferred to the hooks and the process of looping, threading and knotting thus continues.

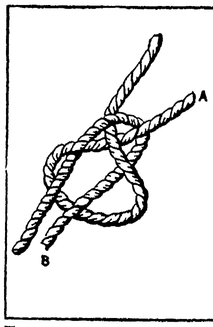


FIG. 3.—A BEND KNOT USED TO JOIN TWO ENDS, A AND B

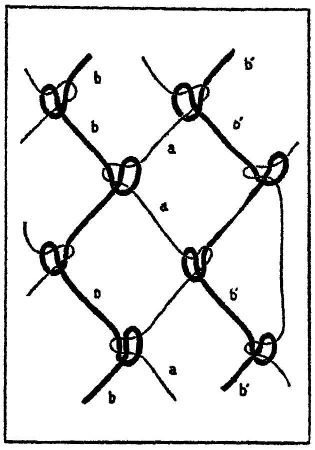


FIG. 4.—BAUDOUIN AND JOUANNIN'S NET LOOM, WHERE THE A SERIES IS DRAWN INTO LOOPS, OVER AND THROUGH WHICH THE B SERIES PASSES

Another form of net loom, working on a principle distinct from that of Paterson, was invented and patented in France by Onésiphore Pecqueur in 1840, and again in France and in Great Britain in 1849. This was improved by many subsequent inventors; especially by Baudouin and Jouannin.

Net Manufacture in the United States.—The manufacture of nets for the fisheries in the United States dates back to about 1844, being initiated by a manufacturer of cotton yarns at Canton, Mass. The popularity with which the first experimental cotton twines were received led the manufacturer to devote his whole time to their manufacture and improvement. In 1858 the first netting machine in the United States was seen. The limitations of this machine led to the development of new inventions, particularly those designed for handling heavy twines.

In view of the wholly inadequate supply of domestic flax and since but little of it is suitable for the manufacture of netting, domestic manufacturers are dependent upon imports for their raw materials. The use of cotton in the making of nets increased until the quantities used exceeded those for linen. Manilla is used by the domestic manufacturers in the making of trawls or other bag nets.

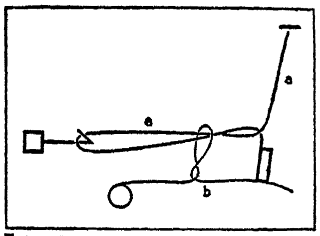


FIG. 5.—DIAGRAM SHOWING THE CONTINUATION OF THE PROCESS

Fishery apparatus employed in the fisheries of the United States and Alaska represents a large portion of the capital investment, a large part of which includes nets, nettings and lines, chiefly cotton, flax and hemp. Much of this material lasts but two years at best, so that the annual investment in new netting each year is an important factor in the fisheries.

NETHERLANDS. The Netherlands first became known to the Romans through the campaigns of Julius Caesar. He found the country peopled partly by tribes of Celtic (Gallic) stock, partly by tribes of Germanic, the river Rhine forming roughly the line of demarcation between the races. The Gallic tribes bore the general appellation of Belgae, and among these the Nervii, inhabiting the district between the Scheldt and the Sambre, were at the date of Caesar's invasion, 57 B.C., the most warlike and important. To the north of the Meuse and, more particularly, in the low-lying ground enclosed between the Waal and the Rhine (*insula Batavorum*) lived the Batavi. Beyond these were found the Frisians (*q.v.*), who gave their name to the territory between the Rhine and the Ems.

Julius Caesar, after a severe struggle with the Nervii and their confederates, was successful in bringing the Belgic tribes into

subjection to Rome. Under Augustus (15 B.C.), the conquered territory was formed into an imperial province, Gallia Belgica, and the frontier was strongly fortified. The Batavi were first brought under Roman rule in the governorship of Drusus (13 B.C.). They were not incorporated in the empire, but were ranked as allies. In 69 they revolted under a native leader, known only under his Roman name of Julius Civilis. After the rising, they returned to their position of *socii*. Their land became a recruiting ground for the Roman armies and they were henceforth faithful in their steady allegiance to Rome.

When at the end of the 3rd century the Franks (*q.v.*) began to swarm over the Rhine into the Roman lands, the names of the old tribes had disappeared. The branch of the Franks—who were a confederacy, not a people—that gradually overspread Gallia Belgica bore the name of Salii, from their position on the river Saale. In the days of their great king Clovis (481–511) they were in possession of the whole of the southern and central Netherlands.

The conversion of the Franks tended to facilitate fusion between them and the Gallo-Roman population and to accentuate the enmity between the Franks and their heathen neighbours, the Frisians in the northern and western strip of the coastal region and the Saxons in the eastern part of the country. In the south of the Netherlands bishoprics were set up at Cambrai, Tournai, Arras, Thérouanne and Liège. In the north, however, progress was much slower and success was the result as much of the arms of the Carolingian mayors of the palace and kings, as it was of the efforts of the missionaries Willibrord and Boniface. In 695 the bishopric of Utrecht was founded by Pippin II, and the Anglo-Saxon missionary Willibrord became the first archbishop among the Frisians. In the two following centuries the Frisians and Saxons, after an often severe struggle, finally surrendered to the authority of the Frankish empire and embraced Christianity.

The Duchy of Lower Lorraine.—The Verdun treaty (843) assigned the central part of the empire to the emperor Lothair, separating the kingdom of East Francia (the later Germany) from West Francia (the later France). This middle kingdom included the whole of the later Netherlands with the exception of the portion on the left bank of the Scheldt, which river was made the boundary of West Francia. On the death of the emperor in 855 his second son Lothair (825–869) received the northern part of his father's domain, known as Lotharii Regnum, corrupted later into Lotharingia and Lorraine. Lothair had no heir, and in 870 by the treaty of Merssen his territory was divided between the kings of East and West Francia. In 880 East Francia acquired the whole; from 912 to 924 it formed part of West Francia. In 925 Lorraine passed in the reign of Henry the Fowler under German overlordship. Henry's son, Otto the Great, placed it in 954 in the hands of his able brother, Bruno, archbishop of Cologne, for pacification. Bruno, who kept for himself the title of archduke, divided the territory into the two duchies of Upper and Lower Lorraine. Godfrey of Verdun was invested by him with the government of Lower Lorraine. The history of the Netherlands from that time forward—with the exception of Flanders, which continued to be a fief of the French kings—is the history of the various feudal states into which the duchy of Lower Lorraine was gradually broken up. (*See* BRABANT; FLANDERS; GELDERLAND; HOLLAND; LIÈGE; LIMBURG; LORRAINE; UTRECHT.)

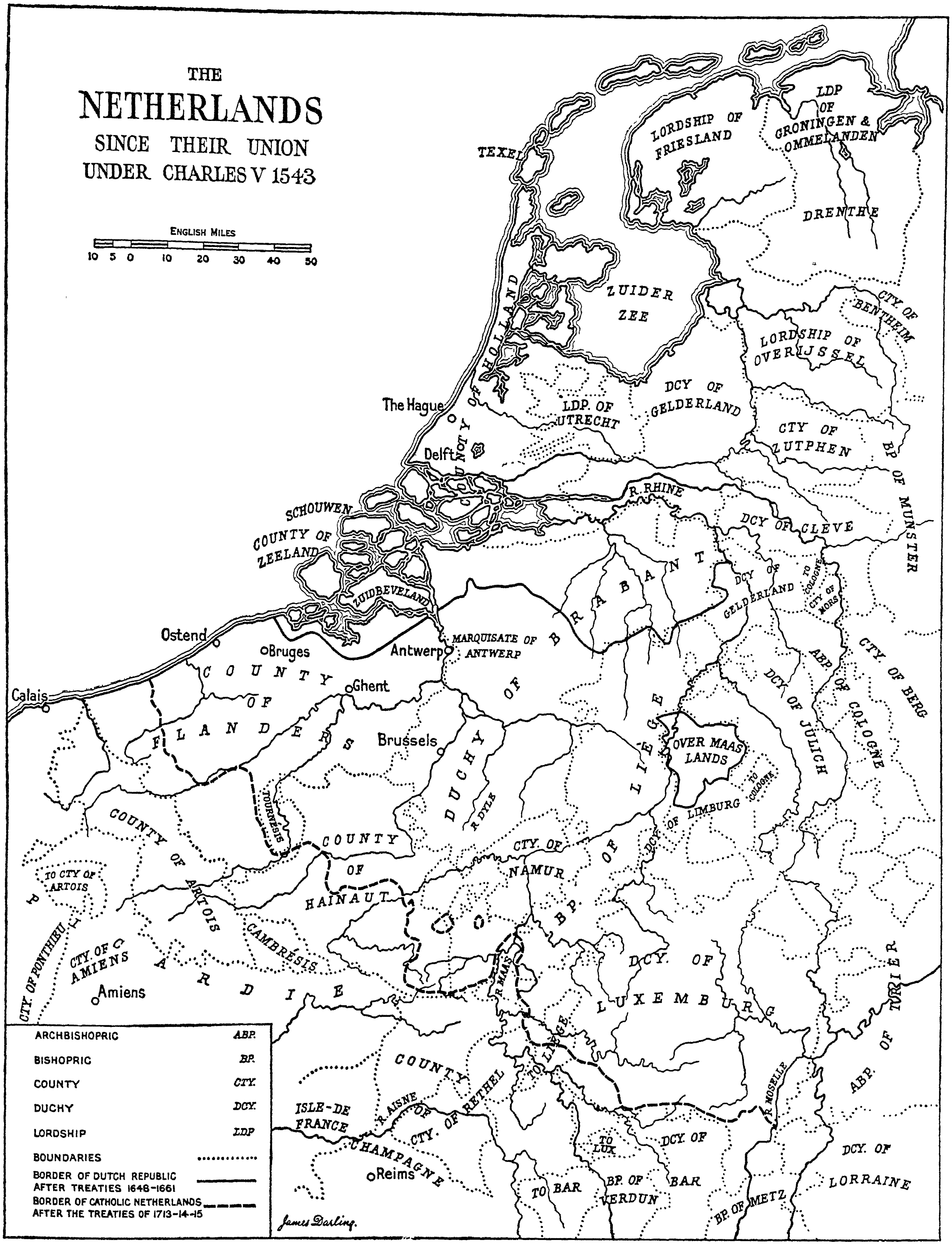
The development of feudalism in the Netherlands was largely caused by the necessity of protecting the land against the Scandinavian attacks of the 9th and 10th centuries. For a time near the middle of the 9th century the Northmen were masters of all Holland and Friesland, though they never established permanent settlements there. The remoteness of the Netherlands from the centres of either French or imperial power threw the burden of defense upon local magnates, and a great increase in their authority was the inevitable consequence. Long before the end of the 11th century the system of feudal states had been firmly established in the Netherlands.

The Rise of the Cities.—Little is known about the Netherlands towns before the 11th century. The earliest charters date from that period. The charters were of the nature of a treaty between the city and its feudal lord, and they differed much in character according to the importance of the place and the pressure that the citizens were able to put upon their lord. The extent of the rights which the charter conceded determined whether the town was a free town or a commune. In the case of a commune the concessions included generally the right of inheritance, justice, taxation, use of wood, water, etc. The lord's representative, entitled justiciary (*schout*) or bailiff (*baljuw*), presided over the administration of justice and took command of the town levies in war. The *gemeente*—consisting only of those bound by the communal oath for mutual help and defense—elected their own magistrates. These electors were often a small proportion of the whole body of inhabitants; sometimes a few influential families alone had the right, and it became hereditary. The magistrates bore the name of *scabini*, and at their head was the seigneurial official—the *schout* or *baljuw*.

The most powerful and flourishing of all were those of Flanders—Ghent, Bruges and Ypres. In the 13th century those towns had become the seat of large industrial populations employed in the weaving of cloth with its dependent industries and closely bound up by trade interests with England, whence they obtained the wool for their looms. Bruges, at that time connected with the sea by the river Zwijn, was the central mart and exchange of the world's commerce. In those Flemish cities the early oligarchic form of municipal government in the long run gave way to a more democratic one. The great mass of the townsmen, organized in trade guilds—weavers, fullers, dyers, smiths, leather-workers, brewers, butchers, bakers and others, of which by far the most powerful was that of the weavers—as soon as they became conscious of their strength rebelled against the exclusive privileges of the patricians and succeeded in ousting them from power. The patricians relied upon the support of the French crown, but the battle of Courtrai (battle of the Golden Spurs, 1302), in which the handicraftsmen laid low the chivalry of France, secured the triumph of the democracy. The power of the Flemish cities rose to its height during the ascendancy of Jacob van Artevelde (*c.* 1290–1345), the famous citizen-statesman of Ghent, but after his downfall the mutual jealousies of the cities undermined their strength, and with the crushing defeat of Roosebeke (1382), in which Jacob's son Philip van Artevelde perished, the political greatness of the municipalities entered upon its decline.

In Brabant—Antwerp, Louvain, Brussels, Malines (Mechelen)—and in the episcopal territory of Liège—Liège, Huy, Dinant—there was a more feeble repetition of the Flemish conditions. Flourishing communities were likewise to be found in Hainaut, Namur, Cambrai and the other southern districts of the Netherlands, but nowhere else the vigorous independence of Ghent, Bruges and Ypres, nor the splendour of their civic life. In the north also the 13th century was rich in municipal charters. Dordrecht, Leyden, Haarlem, Delft, Vlaardigen, Rotterdam in Holland and Middelburg and Zierikzee in Zeeland repeated with modifications the characteristics of the communes of Flanders and Brabant. But the growth and development of the northern communal movement, though strong and instinct with life, was slower and less tempestuous than the Flemish. In the bishopric of Utrecht, in Gelderland and in Friesland the privileges accorded to Utrecht, Groningen, Zutphen, Stavoren, Leeuwarden, followed on the model rather of those of the Rhenish "free cities" than of the Franco-Flemish commune.

The Dukes of Burgundy.—It was at that time that Flanders and gradually the other feudal states of the Netherlands, by marriage, purchase or force, fell under the dominion of the house of Burgundy. The foundation of the Burgundian rule in the Netherlands was laid by the succession of Philip the Bold to the counties of Flanders and Artois in 1384 in right of his wife, Margaret of Mâle. In 1406 Antony, Philip's second son (killed at Agincourt, 1415), became duke of Brabant by bequest of his maternal great-aunt Joan. The consolidation of the Burgundian power was effected by Philip the Good, grandson of Philip the Bold, in his long and successful reign of 48 years (1419–67). He inherited Flanders and Artois, purchased the county of Namur (1427) and compelled his cousin Jacqueline, the heiress of Holland, Zeeland, Hainaut and Friesland, to surrender her possessions to him in 1433,



FROM POOLE, "HISTORICAL ATLAS" (CLARENDON PRESS, OXFORD)

after his having become in 1428, by the Reconciliation of Delft, regent of Jacqueline's counties. On the death, in 1430, of his cousin Philip, duke of Brabant (Antony's younger son), he took possession of Brabant and Limburg; the duchy of Luxembourg he acquired by purchase in 1443. He made his bastard son David bishop of Utrecht, and from 1456 onward that see continued under Burgundian influence. The duchy of Gelderland too came temporarily under the Burgundian power during the reign of Charles the Bold.

This extension of the Burgundian dominion implied the establishment of a strong monarchical authority. The dukes had united under their sway a number of provinces with different histories, institutions and languages, and their aim was to centralize their government. The nobility and clergy were on the side of the ducal authority; its opponents were the municipalities, especially those of Flanders. Their strength had been seriously weakened by the overthrow of Roosebeke, but Philip the Good on his accession found them once more advancing rapidly in power and prosperity. He was quite aware that the industrial wealth of the great Flemish communes was financially the mainstay of his power, but their very prosperity made them the chief obstacle of his schemes of unifying into a solid dominion the loose aggregate of states over which he was the ruler. On this matter Philip would brook no opposition: Bruges was forced after strenuous resistance to submit to the loss of its most cherished privileges in 1438, and the revolt of Ghent was quenched in the "red sea" of Gavre in 1453. The splendour and luxury of the court of Philip surpassed that of any contemporary sovereign. A permanent memorial of it remains in the famous Order of the Golden Fleece, which was instituted by the duke at Bruges in 1430 on the occasion of his marriage with Isabella, daughter of John I of Portugal.

(C. D. J. B.; X.)

Before the accession in 1467 of Charles the Bold, Philip the Good's only son, two important steps had been taken toward unification. The first was the appointment of a grand council with supreme judicial and financial functions, whose seat was finally fixed at Malines in 1473; the other, the summoning of deputies of all the provincial "estates" of the Netherlands to a states-general at Brussels in 1465. At first all went well with Charles. By his ruthless suppression of revolts at Dinant and Liège he made his authority undisputed throughout the Netherlands. His campaigns against the French king Louis XI were conducted with success. His creation of a formidable standing army, the first of its kind in that age of transition from feudal conditions, gave to the Burgundian power all the outward semblance of stability and permanence. But Charles, though a brave soldier and good military organizer, was neither a capable statesman nor a skilful general. At the very height of his power all his schemes of aggrandisement came to sudden ruin through a succession of disastrous defeats at the hands of the Swiss. At Nancy, on Jan. 5, 1477, Charles was himself among the slain, leaving his only daughter, Mary (*q.v.*) of Burgundy, then in her 20th year, sole heiress to his possessions.

Mary of Burgundy.—The catastrophe of Nancy threatened the loosely knit Burgundian dominion with dissolution. Louis XI claimed the reversion of the French fiefs and seized Burgundy, Franche Comté and Artois. But the Netherland provinces, though not loving the Burgundian dynasty, had no desire to have a French master. Deputies representing Flanders, Brabant, Hainaut and Holland met at Ghent, where Mary was detained almost as a prisoner, and compelled her (Feb. 10, 1477) to sign the "Great Privilege." This charter provided that no war could be declared nor marriage concluded nor taxes raised by the sovereign without the assent of the estates, that natives were alone eligible for high office and that the national language should be used in public documents. The central court of justice at Malines was abolished, but the grand council was reorganized and made thoroughly representative. The Great Privilege was supplemented by provincial charters, the Flemish Privilege (Feb. 10), the Great Privilege of Holland and Zeeland (Feb. 17), the Great Privilege of Namur and the *Joyeuse Entrée* of Brabant, both in May, thus curtailing the sovereign's power of interference with local liberties. On these conditions Mary obtained the hearty support of the estates against France. Her marriage four months later to Maximilian of Austria was the beginning of the long domination of the house of Habsburg.

The Archduke Philip.—When Mary died from the effects of a fall from her horse (March 1482), Maximilian became regent (*mambourg*) for their son, Philip. The peace of Arras with France (March 1483) freed him to deal with the discords in the Netherland provinces, and more especially with the turbulent opposition in the Flemish cities. With the submission of Ghent (June 1485) the contest was decided in favour of Maximilian, who in 1494, on his election as emperor, was able to hand over the country to his son, Philip, in a comparatively tranquil and secure state. Philip was 15 years of age, and his accession was welcomed by the Netherlanders, with whom Maximilian had never been popular. Gelderland, however, which had revolted after Nancy, had Charles of Egmont for its duke, and the two bishoprics of Liège and Utrecht were no longer subject to Burgundian authority. In 1496 Philip married Joan of Aragon, who in 1500 became heiress apparent to Castile and Aragon. She gave birth at Ghent to a son, afterward the emperor Charles V. On the death of Queen Isabella, Philip and Joan succeeded to the crown of Castile and took up their residence in their new kingdom (Jan. 1506). A few months later Philip unexpectedly died at Burgos (Sept. 25). His Burgundian lands passed without opposition to his son Charles, then six years of age. (X.)

Charles V.—The emperor Maximilian, who was regent during the minority of his grandson, appointed his daughter, Margaret, widow of Philibert, duke of Savoy, as governor general, an office which she held with varying success for eight years. In 1515, at the instance of the states-general, the 15-year-old Charles was suddenly declared of age. Born and brought up in the Netherlands, he was personally popular there. The country was prosperous. The period of Burgundian rule had given it not only common constitutional organs but the unifying sentiment of a common loyalty. Unfortunately, however, the accession of Charles brought the Netherlands into the huge and incongruous collection of states which the wars and marriages of the Habsburgs had heaped together. By the time he was 20 Charles was king of Aragon and Castile, with their Italian and American possessions, head of the house of Austria and emperor. This meant first that he had to spend most of his life in his other dominions, leaving the Netherlands again to his aunt, Margaret, and after her death (Nov. 27, 1530) to his sister Mary, the widow of Louis II of Hungary. It meant also that he had to make large financial demands on these rich provinces for the purposes of his many wars. Opposition to the taxes led at last to one serious collision: the great city of Ghent resisted, and on Feb. 14, 1540, Charles entered it as a conqueror and humbled it by annulling its liberties and exacting a heavy fine. Another difficulty was the rapid growth of Protestantism. A series of severe edicts against heresy was issued and enforced; but though many heretics were executed, every form of Protestant belief continued to make converts. None of these dangers, however, came as yet to a head. The rule of Charles and the "governesses" was on the whole moderate and successful. He rounded off the dominions by the purchase and subjugation of Friesland (1524), the annexation of the lands of the bishops of Utrecht (1528) and the defeat of an opponent who tried to establish himself in the duchy of Gelderland (1538). By 1543 he ruled over the 17 provinces which are usually meant by the name Netherlands, though oddly enough there are several different ways of enumerating them. It is due not to any geographical or racial factors but simply to the subsequent course of political history that there was no further expansion of the frontiers to the east or south. In the task of welding these provinces together by constitutional links Charles made some headway, but not much. He made the rules of hereditary succession the same for all of them, so that they should never be divided among different heirs. He carried out a nominal, but in the result quite ineffective, incorporation of the provinces in the Holy Roman empire. He governed the provinces by executive councils of the type usual in the monarchies of the period and, in addition to the provincial estates, he liked to summon, when he needed grants of money, states-general

(produced in London in 1902). Miss Nethersole worked during World War I on various Red Cross organizations. She was the founder in 1917 of the People's League of Health. In 1936 she was created C.B.E. She died at Bournemouth, Eng., on Jan. 9, 1951.

NETHINIM, the name given to the members of a class of assistants in the service of the temple of Jerusalem. In the Old Testament they are specially mentioned, and thus designated, only by the compiler of Chronicles-Ezra-Nehemiah (3rd century B.C.). The name means "given" or "dedicated" (*i.e.,* to the temple); *cf.* Num. iii, 9; viii, 19, where the same term is applied to the Levites. In I Esdras and Josephus they are called ἱερόδουλοι, as are also the Levites in I Esdras i, 3. In the census lists compiled by the Chronicler, where a complete classification is desired, we find the order: Levites, singers, porters, Nethinim; *e.g.,* in Ezra ii. Of these classes, the first three are of equal rank; the singers and porters are Levites (I Chr. ix, 2; Neh. xi, 3, 15–18; xiii, 22, etc.), though sometimes expressly distinguished from them, when the special duties of the several orders are thought of (II Chr. xxxv, 15; Ezra ii, 70, etc.). In the time of the Chronicler the Nethinim were free men and members of the Israelite community. They were registered by families and were exempt from taxation. Like the priests and Levites they served in rotation, being assigned to a certain portion of Jerusalem (Ophel), and also to neighbouring Levitical cities or villages. In Neh. x, 29 *et seq.* they join in the solemn covenant, promising among other things not to intermarry with "the peoples of the land."

It is generally supposed, and not without good reason, that the Nethinim had their origin in a class of foreign menials (slaves) employed in the temple. In the time of the Chronicler it was customary to describe the Nethinim as "those given by David for the Levitical service" (Ezra viii, 20), and similar to this is the designation of one portion of them as the "children of Solomon's servants" (Ezra ii, 55; Neh. vii, 57; xi, 3). (C. C. T.)

NETLEY, a village in Hampshire, Eng., 3 mi. S.E. of Southampton, and on a branch of the Southern Region railway. A Cistercian abbey was founded in 1237 by Henry III; its ruins include a great part of the cruciform church, abbot's house, chapter house and domestic buildings. The style is Early English and Decorated The gatehouse was transformed into a fort in the time of Henry VIII. Netley hospital for wounded soldiers, built after the Crimean War, is one of the principal military hospitals in Great Britain.

NETSCHER, GASPAR (1639–1684), German portrait and genre painter, was born at Heidelberg in 1639. As a boy he was adopted by a physician named Tullekens, who placed him under an artist named De Koster, and afterward under Gerard ter Borch. He then went to Italy, but finally settled at Bordeaux, where he made a living by painting the small cabinet pictures which are now so highly valued because of their exquisite finish. After moving to The Hague, he turned his attention to portrait painting, which proved more lucrative, and he was soon able to gratify his own taste by depicting the musical and conversational pieces which fully displayed his genius. These possess easy yet delicate pencilling, brilliant and correct colouring and pleasing light and shade, although frequently their refinement passes into weakness. His sons, Constantyn (1668–1722) and Theodorus (1661–1732), were also painters, after their father's style but inferior in merit.

NETTLE, the common name for the plants of the botanical genus *Urtica,* which gives its name to the family Urticaceae. It contains about 30 species found in the temperate parts of both hemispheres. They are herbs covered with stinging hairs, and with very small, greenish, unisexual flowers on the same or on different plants. The stinging hairs consist of an elongated tubular cell the extremity of which is finely pointed. By this point the hair penetrates the skin, breaks off and its contents pass out. The fluid contains formic acid and has a temporary irritant effect. Nettle tops, or the very young shoots of the nettle, may be used as a vegetable like spinach; but from the abundance of crystals (*cystoliths*) they contain they are apt to be gritty. The fibre furnished by the stems of several species is used for cordage or papermaking. Three species of nettle are wild in the British Isles: the common or great nettle (*U. dioica*), which is a hairy perennial with staminate and pistillate flowers in distinct plants; the small nettle (*U. urens*), which is annual and, except for the stinging hairs, glabrous, and has staminate and pistillate flowers in the same panicle; and the Roman nettle (*U. pilulifera*), an annual with the pistillate flowers in rounded heads, which occurs in waste places in the east of England, chiefly near the sea—the most virulent British species.

In North America, where the small nettle has become naturalized locally and the great nettle from Newfoundland to Colorado and southward, there are several native nettles. Among these are the tall nettle (*U. gracilis*), found across the continent northward; the weak nettle (*U. chamaedrioides*), of the southeastern states; the hoary nettle (*U. holosericea*), found from Idaho and Washington to Lower California. Closely allied are the wood nettle (*Laportea canadensis*) of the eastern United States and the western nettle (*Hesperocnide tenella*) of California, both of which also produce stinging hairs.

NETTLE RASH: *see* URTICARIA.

NETTLESHIP, HENRY (1839–1893), English classical scholar, was born at Kettering on May 5, 1839. He was educated at Lancing, Durham and Charterhouse schools and Corpus Christi college, Oxford. He was a master at Harrow and later professor of Latin at Oxford, where he died on July 10, 1893. He specialized in the study of Virgil. After John Conington's death in 1869, he saw his edition of Virgil through the press, and revised and corrected subsequent editions. In 1887 he published some of the results of 12 years' labour on a Latin lexicon (never completed) in a volume entitled *Contributions to Latin Lexicography.* The second series of his *Lectures and Essays,* published in 1895 and edited by F. Haverfield, contains a memoir by Mrs. M. Nettleship, with full bibliography.

NETTLESHIP, RICHARD LEWIS (1846–1892), English philosopher, was born on Dec. 17, 1846, and educated at Uppingham and Balliol college, Oxford. He won the Hertford scholarship, the Ireland, the Gaisford Greek verse prize, a Craven scholarship and the Arnold prize, but took only a second class in Litterae Humaniores. He became fellow and tutor of his college and succeeded to the work of T. H. Green, whose writings he edited with a memoir (1880). His philosophy was idealistic and Hegelian. He died on Aug. 25, 1892, from the effects of exposure on Mont Blanc, and was buried at Chamonix.

Besides his edition of Green's works, Nettleship published *The Theory of Education in Plato's Republic* (1880). His *Philosophical Lectures and Remains* were edited by A. C. Bradley (1897; 2nd ed., 1901), the *Lectures on the Republic of Plato* being printed separately in 1898 (2nd ed., 1901).

NETTLE TREE, the name applied to certain trees of the genus *Celtis,* belonging to the elm family (Ulmaceae). The best-known species have usually obliquely ovate, or lanceolate leaves, serrate at the edge and marked by three prominent nerves. The flowers are inconspicuous, with a four- or five-parted perianth, as many stamens, a hairy disk and a one-celled ovary with a two-parted style. The fruit is succulent, drupelike, a character which serves to separate the genus alike from the nettles and the elms, to both of which it is allied.

C. australis is a common tree, both wild and planted, throughout the Mediterranean region extending to Afghanistan and the Himalaya; it is also cultivated in Great Britain. It is a rapidly growing tree, from 30 to 40 ft. high, with a remarkably sweet fruit, recalling a small black cherry, and was one of the plants to which the term "lotus" was applied by Dioscorides and the older authors. The wood, which is compact and hard, is used for a variety of purposes. *C. occidentalis,* a North American species, is the hackberry (*q.v.*).

NEUBER, FRIEDERIKE KAROLINE (1697–1760), German actress, was born in Reichenbach, Saxony, on March 9, 1697. She and her husband acted in travelling theatrical companies until they formed their own, in 1727, at Leipzig. In 1748 she introduced Gotthold Lessing's first play to the German public. She died in poverty in Laubegast, Saxony, 1760.

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NEU-BRANDENBURG, a town of Germany, in Mecklenburg, on the Tollense See at the mouth of the Tollense, 58 mi. W.N.W. of Stettin by rail. Pop. (1939) 22,275. Neu-Brandenburg was founded in 1248, and has belonged to Mecklenburg since 1292. It is partly surrounded with walls, and possesses four old Gothic gates, dating from about 1300. The principal buildings are the Marienkirche, a 13th-century Gothic building, the former grand ducal palace and the palace of Belvedere.

NEUBREISACH: *see* Neuf-Brisach.

NEUBURG, a town in the *Land* of Bavaria, situated on the Danube 12 mi. W. of Ingolstadt by rail. Pop. (1933) 7,670. Neuburg was originally an episcopal see. In the 10th century it passed to the counts of Scheyern, and through them to Bavaria, being ceded to the Rhenish Palatinate in 1507. From 1557 to 1742 it was the capital of a small principality ruled by a cadet branch of the family of the elector palatine of the Rhine. In 1742 it was united again with the Rhenish Palatinate, with which it passed in 1777 to Bavaria. Its most important building is the old residence of its princes, in 16th-century Renaissance style.

NEUCHÂTEL (Ger. Neuenburg), one of the cantons of western Switzerland, on the frontier toward France. It is the only Swiss canton that is situated entirely in the Jura, of which it occupies the central portion (its loftiest summit is Mont Racine, 4,731 ft., in the Tête de Rang range). The canton has a total area of 305 sq.mi., of which more than three-quarters is reckoned "productive." It consists, for the most part, of the longitudinal ridges and valleys characteristic of the Jura, while its drainage is very unequally divided between the Thièle or Zihl, and the Doubs, which forms part of the northwest boundary of the canton, and receives only the streams flowing from the Le Locle and La Chaux de Fonds valley. Three regions make up the territory. That stretching along the shore of the lake is called Le Vignoble (from its vineyards) and extends from about 1,500 ft. to 2,300 ft. above sea level. An intermediate region is named Les Vallées, for it consists of the two principal valleys of the canton (the Val de Ruz, watered by the Seyon, and the Val de Travers, watered by the Areuse), which lie at a height of about 2,300 ft. to 3,000 ft. above sea level. The highest region is known as Les Montagnes, and is mainly composed of the long valley in which stand the industrial centres of La Chaux de Fonds (*q.v.*) and Le Locle (*q.v.*), to which must be added those of La Sagne, Les Ponts and Les Verrières, the elevation of these upland valleys varying from 3,000 ft. to 3,445 ft. The canton is well supplied with railways, the direct line from Berne past Kerzers (Chiètres), Neuchâtel, the Val de Travers and Les Verrières to Pontarlier for Paris passing through it, while La Chaux de Fonds is connected by a line past Le Locle with Morteau in France. Other lines join the capital, Neuchâtel, to La Chaux de Fonds, as well as to Yverdon at the southwest extremity of the lake, and to St. Blaise at its northeast end.

The population declined in the 20th century: (1920) 131,349, (1930) 124,324; (1941) 117,994; (1950) 128,152. In 1930, 105,516 were French-speaking, 15,248 German-speaking and 2,888 Italian-speaking, while 100,548 were Protestants, 13,720 Roman Catholics and 436 Jews. There are three "established and state-endowed" churches, the National Evangelical, the Roman Catholic and the Old Catholic (this sect in La Chaux de Fonds only), while the pastors of the Free Evangelical Church and of the Jews (mostly in La Chaux de Fonds) receive special privileges.

Besides the capital, Neuchâtel (*q.v.*), the chief towns are La Chaux de Fonds, Le Locle and Fleurier, the latter the principal village in the Val de Travers.

The most valuable mineral product is asphalt, of which there is a large and rich deposit in the Val de Travers. The wine of the Vignoble region is plentiful. Absinthe is manufactured in the Val de Travers.

The most characteristic industry is that of watchmaking, which is chiefly carried on (since the early 18th century) in the highland valleys of La Chaux de Fonds and of Le Locle, as well as at Fleurier in the Val de Travers.

The canton is divided into 6 administrative districts, which comprise 63 communes.

The legislature or *grand conseil* consists of members elected in the proportion of population and holds office for three years.

The canton in 1941 sent six representatives (elected for a term of four years) to the *nationalrat,* lower chamber of the national parliament. It sends two members to the upper chamber.

History.—We first hear of the *novum castellum* (Neuchâtel) in the will (1011) of Rudolf III, the last king of Burgundy, on whose death (1032) that kingdom reverted to the empire. About 1034 the emperor Conrad II gave this castle to the lord of several neighbouring fiefs, his successors establishing themselves permanently there in the 12th century and taking the title of count. In 1288 the reigning count resigned his domains to the emperor Rudolf, who gave them to the lord of Châlon-sur-Saône, by whom they were restored to the count of Neuchâtel on his doing homage for them. This act decided the future history of Neuchâtel, for in 1393 the house of Châlon succeeded to the principality of Orange by virtue of a marriage contracted in 1388. The counts gradually increased their dominions, so that by 1373 they held practically all the present canton, with the exception of the lordship of Valangin which was held by a cadet line of the house till bought in 1592. In 1532 the title of prince was taken by the reigning count, while by the treaty of Westphalia (1648) the principality became sovereign and independent of the empire. In 1707 the Longueville house of Neuchâtel also became extinct, and a great struggle arose as to the succession. Finally the parliament (states) of Neuchâtel decided in favour of Frederic I, the first king of Prussia. The nominal rule of the Prussian king (for the country enjoyed practical independence) lasted till 1857, with a brief interval from 1806 to 1814, when the principality was held by Marshal P. A. Berthier, by virtue of a grant from Napoleon. In 1814 its admission into the Swiss confederation was proposed and was effected in 1815, the new canton being the only nonrepublican member, just as the hereditary rulers of Neuchâtel were the last to maintain their position in Switzerland. This anomaly led in 1848 to the establishment (attempted in 1831) of a republican form of government, brought about by a peaceful revolution led by A. M. Piaget. A royalist attempt to regain power in 1856 was defeated, and finally, after long negotiations, the king of Prussia renounced his claims to sovereignty, though retaining the right to bear the title of "prince of Neuchâtel." Thus in 1857 Neuchâtel became a full republican member of the Swiss confederation.

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NEUCHÂTEL, capital of the Swiss canton Neuchâtel, situated near the northeast corner of the lake of Neuchâtel. In 1950 it had 27,998 inhabitants, the greater portion of whom were French-speaking and Protestant, with a minority of German-speaking inhabitants and Roman Catholics, and a small number of Jews. It is the meeting point of several important railway lines. The older portion of the town is built on the steep slope of the Chaumont (3,855 ft.), and originally the waters of the lake bathed the foot of the slope. But the gradual growth of alluvial deposits, and later the artificial embankment of the shore of the lake, added much dry ground, and on that site the finest modern buildings were erected. The 16th-century castle and the 13th-century collegiate church of Notre Dame (now Protestant) stand close together, and were founded in the 12th century when the counts took up their permanent residence in the town, to which they granted a charter of liberties in 1214. Among the buildings on the quays are the Musée des Beaux Arts (modern Swiss paintings and various historical collections, including that

of Desor relating to the Lake Dwellings), the Gymnase (in which are also the museum of natural history, with the fine collections of Agassiz, and the town library), the university and the École de Commerce. The town owes much to the gifts of citizens.

NEUCHÂTEL, LAKE OF. The lakes of Neuchâtel, Bienne and Morat, connected by canals, are survivors of a former great lake of the lower Aar valley. It is the largest lake wholly in Switzerland. Its total area is 92½ sq.m. (36½ sq.m. are in the Canton of Neuchâtel over 33 sq.m. in Vaud, 20¾ sq.m. in Fribourg and in Berne 2 sq.m.). It is about 23½ m. long, from 3¾ to 5 m. wide, its greatest depth is 502 ft., while its surface is 1,427 ft. above sea level. The Thièle or Zihl river enters at its south-western end and issues from it at its north-eastern end, but it also receives the Areuse (N.W.), Seyon (N.W.) and the Broye (N.E.). On the south-eastern shore the picturesque and historic little town of Estavayer is the chief place. At the south-western extremity of the lake is Yverdon (the *Eburodunum* of the Romans and the residence of Pestalozzi, 1806–1825). Far more populated is the northwestern shore, where from southwest to northeast, we find Grandson, Cortaillod, Serrières and Neuchâtel itself. On the north shore is La Tène.

NEUENDORF: *see* NOWAWES.

NEUF-BRISACH or **NEUBREISACH,** a town of France in the department of Haut-Rhin on the Rhine-Rhone canal, 12 mi. E. from Colmar by the railway to Freiburg. Pop. (1936) 2,150. Neuf-Brisach is a garrisoned fortress town founded by Louis XIV in 1699 and fortified by Vauban. It was taken by the Germans on Nov. 10, 1870, and became French once more in 1918.

NEUFCHÂTEAU, a town of eastern France, in the department of Vosges at the confluence of the Meuse and the Mouzon, 49 mi. W.N.W. of Épinal by rail. Pop. (1936) 4,083. The town, which is said to occupy the site of the Roman *Neomagus,* belonged in the middle ages to the dukes of Lorraine, ruins of whose château are still to be seen. In 1641 it passed to France. The churches are those of St. Christopher (13th and 15th centuries) and St. Nicholas, the latter combining the Romanesque and Gothic styles and built above a Romanesque crypt.

NEUHOF, THEODORE STEPHEN, BARON VON (*c.* 1690–1756), German adventurer and for a short time nominal king of Corsica, was the son of a Westphalian nobleman and was born at Cologne. Educated at the court of France, he served first in the French army, and then in that of Sweden. Baron de Goertz, minister to Charles XII, realizing Neuhof's capacity for intrigue, sent him to England and Spain to negotiate with Cardinal Alberoni. He returned to Sweden and then went to Spain, where he was made colonel and married one of the queen's ladies-in-waiting. Deserting his wife soon afterwards he repaired to France and became mixed up in Law's financial affairs; then he wandered about Portugal, Holland and Italy, and at Genoa he made the acquaintance of some Corsican prisoners and exiles, whom he persuaded that he could free their country from Genoese tyranny if they made him king of the island. With their help and that of the bey of Tunis he landed in Corsica in March 1736, where the islanders, believing that he had the support of several of the powers, proclaimed him king. He assumed the style of Theodore I, issued edicts, instituted an order of knighthood and waged war on the Genoese, at first with some success. But he was eventually defeated, and civil broils soon broke out in the island; the Genoese having put a price on his head and published an account of his antecedents, he left Corsica in Nov. 1736, ostensibly for foreign assistance. He returned to the island in 1738, 1739 and 1743, but the combined Genoese and French forces drove him out. Arrested for debt in London he regained his freedom by mortgaging his "kingdom" of Corsica and subsisted on the charity of Horace Walpole and other friends until his death in London on Dec. 11, 1756.

See *Mémoires pour servir à l'histoire de la Corse,* by his son, Frederick, also an English translation, both published in London in 1768. In 1795 he published a new edition on *Description of Corsica with an account of its union to the crown of Great Britain. See* also Fitzgerald, *King Theodore of Corsica* (1890) and Le Glay, *Théodore de Corse* (1907).

NEUILLY, TREATY OF. The Bulgarian treaty was signed at Neuilly on Nov. 27 1919, and came into force on Aug. 9 1920. In the main it is the same as the Austrian treaty. But there were important differences in the military and naval clauses, and also in reference to reparation and finance.

The only serious territorial changes were to the west and south. The Serb-Croat-Slovene kingdom obtained several strategic ratifications. The two most important are that the Strumitsa salient in the extreme south-west has been flattened out, the western half being ceded to the Serbs; also, and more important, in the Nish-Pirot area the town of Tsaribrod has been taken from Bulgaria and a line drawn whereby an advance on Nish would be rendered more difficult. The frontier, however, confers no offensive advantage on the Serbs. A loss more serious in another sense is that to Greece of the district of Western Thrace, lying between Xanthi and the Maritsa river. This was ceded to Greece on her obtaining Eastern Thrace and Adrianople. Bulgaria, for ethnic reasons, received a slight extension of territory west of Adrianople. The expulsion of Greeks from Adrianople and East Thrace by the Turks did not, however, cause the Allies to change their minds about Western Thrace, which remains annexed to Greece and is denied to Bulgaria.

Bulgaria had always asserted claims to that part of Macedonia now in Serbian hands, and also to Eastern and Western Thrace. In the former area her ethnic pretensions are better founded than in the latter. But Serbian Macedonia is in the hands of a formidably armed and militarily strong nation. Greek Macedonia and Thrace are now populated by hundreds of thousands of Greek refugees from Asia, and contain over 80% of a purely Greek population. In population Bulgaria lost some 300,000 persons, of whom some are not Bulgars.

Part IV. The military, naval and air clauses have some special points. Bulgaria is allowed 20,000 regulars, 10,000 gendarmes and 3,000 frontier guards, or 33,000 in all. This number is insufficient to maintain order in a turbulent Balkan State, and the subsequent serious disturbances in Bulgaria are due directly to this fact. It is increased by the difficulty of applying the voluntary long-service system of 12 consecutive years to a nation of peasants. In an agricultural country it is practically impossible to get men to leave their farms for 12 years, and the army is always likely to be dangerously below strength, and the less regular formations dangerously above it. The naval clauses do not differ from those of the German or Austrian treaties. All Bulgaria's navy has now been destroyed, and she was left with four torpedo-boats, of which three were damaged, and six motor-boats, of which four were damaged.

Part V. (*Prisoners of War and Graves*) and

Part VI. (*Penalties*) are the same as in the Austrian treaty (*see* ST. GERMAIN, TREATY OF).

Part VII. (*Reparation.*) This contains the most novel and interesting feature of the treaty, and is, in fact, the only serious attempt to get reparation on to a business basis. It contained three features of great interest.

(*a*) Contrary to the practice in the German, Austrian and Hungarian treaties, there was no attempt made to seize or distribute the Bulgarian commercial fleet on the "ton-for-ton" or "class-for-class" principle.

(*b*) It fixed the amount to be paid at the lump sum of £90,000,000.

(*c*) It created a Reparation Commission consisting of French, British and Italian representatives with power to reduce this amount by a simple majority vote (not by unanimity as is the systematic rule), on the suggestion of the inter-allied Commission.

The general scope and powers of the Reparation Commission are drawn in such a manner as to control the finances of the country sufficiently to obtain reparation, without offensive interference. In the end, the Reparation Commission, after examining the question on the spot, has practically remitted three-quarters of the total of £90,000,000. The annual sum now required to meet the charges on the 550,000,000 gold francs of the debt is well within the capacity of the new Bulgarian State, and is being punctually paid. None of the remaining clauses of the Bulgarian treaty have any special features of interest or importance.

(*See* BULGARIA; PARIS, CONFERENCE OF; REPARATION, etc.).

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NEUILLY-SUR-SEINE, a suburb of Paris 8 kilometres northwest from Notre Dame, in the department of Seine. It is situated between the fortifications and the Seine. Pop. (1936) 56,938. A castle at Neuilly, built by the count of Argenson in the 18th century, ultimately became the property and favourite residence of the duke of Orléans (Louis Philippe), the birthplace

of nearly all his children and the scene of the offer of the crown in 1830. The buildings were pillaged and burned by the mob in 1848. The park, which extended from the fortifications to the river, as well as the neighbouring park of Villiers (also belonging to the princes of Orleans), was broken up into building lots, and is occupied by many small middle-class houses and a few fine villas. The fine bridge, designed in the 18th century by Perronet, is noteworthy as the first level bridge constructed in France. The Galignani institution, founded by the brothers Galignani for aged book-sellers, printers and others, has accommodation for 100 residents. The manufactures include perfumery, chocolate, colours, varnish, automobiles, carpets; Neuilly is an engineering centre.

NEUMANN, FRANZ ERNST (1798–1895), German mineralogist, physicist and mathematician, was born at Joachimstal on Sept. 11, 1798. Neumann's earlier papers on crystallography led to his appointment as Privatdozent at Königsberg, where in 1828 he became extraordinary, and in 1829 ordinary professor of mineralogy and physics. In 1831, from a study of the specific heats of compounds, he formulated "Neumann's law" (that "the molecular heat of a compound is equal to the sum of the atomic heats of its constituents"). Devoting himself next to optics, he produced memoirs which entitle him to a high place among the early searchers after a dynamical theory of light. In 1832, by the aid of a particular hypothesis as to the constitution of the ether, he reached results agreeing with those obtained by A. L. Cauchy, and succeeded in deducing laws of double refraction resembling those of A. J. Fresnel. He made contributions to the mathematical theory of electrodynamics, and in papers published in 1845 and 1847 established mathematically the laws of the induction of electric currents. His last publication was on spherical harmonics (*Beiträge zur Theorie der Kugelfunctionen*, 1878). He died at Königsberg on May 23, 1895.

NEUMANN (originally BAMBERGER), **KARL FRIEDRICH** (1793–1870), German orientalist, was born at Reichsmannsdorf, near Bamberg, on Dec. 28, 1793. He studied philosophy and philology at Heidelberg, Munich and Göttingen. From 1822 to 1825 he was a teacher at Spires; then he learned Armenian in Venice and visited Paris and London. In 1829 he went to China, where he amassed a library of about 12,000 valuable books and manuscripts, which he presented to the royal library at Munich. In 1831 Neumann became professor of Armenian and Chinese at Munich. In 1852 he was removed from his chair on account of his revolutionary views. He died in Berlin on March 17, 1870.

Neumann wrote *Geschichte des englischen Reichs in Asien* (Leipzig, 1851); *Geschichte der Vereinigten Staaten von Amerika* (Berlin, 1863–1866); *Versuch einer Geschichte der armenischen Literatur* (Leipzig, 1836); *Die Völker des südlichen Russland* (1846, and again 1855); and several translations from the Chinese. The journal of the Royal Asiatic Society (London, 1871) contains a full list of his works.

NEUMES, the signs employed in Western musical notation before the introduction of the staff. (Gr. νεῦμα, a sign). They were, in the first instance, merely rough expression marks placed over the words, to guide the singers of the plainsong melodies, the melodies themselves being learned by ear, and hence they gave no indication as to the pitch or time-relations of the notes. Gradually, however, they became more and more elaborate and precise, then their positions on the paper were varied to indicate pitch, though at first without the employment of lines; subsequently lines were introduced, and so, step by step, the whole present-day system was evolved. (*See* MUSICAL NOTATION.)

NEUMÜNSTER, a town in the Prussian province of Schleswig-Holstein, Germany, lies on the Schwale, 40 mi. N. of Altona-Hamburg by rail, and at the junction of lines to Kiel, Vamdrup (Denmark) and Tönning. Pop. (1939) 52,719. The name, which was originally Wipendorp, is derived from an Augustine monastery, founded in 1130, and is mentioned as *novum monasterium* in a document of 1136. Its industrial importance began in the 17th century, when the cloth-workers of Segeberg, a town to the south-east, migrated to it. It became a town in 1870. It is, after Altona, the most important industrial town in the province.

NEUNKIRCHEN or OBER-NEUNKIRCHEN, a town in the Saarland territory, Germany, on the Blies, 12 mi. N.E. of Saarbrücken. Pop. (1939) 39,866, consisting almost equally of Protestants and Roman Catholics. The town is first mentioned in 1280, and became important industrially during the 18th century. The principal industrial establishment is an iron-foundry. Around the town are important coal mines. The castle built in 1570 was destroyed in 1797.

NEUQUÉN, an inland territory of Argentina on the Chilean frontier, between the Colorado and Limay rivers, with the province of Mendoza on the north and the territory of Río Negro on the east and south. Area, 36,324 sq.mi. Population (1947 est.) 85,958. The greater part of the territory is mountainous, with fertile, well-watered valleys and valuable forests. The eastern part, however, contains large plains showing only stunted vegetation and having numerous saline deposits. The long droughts that prevail in this region have deterred agricultural settlement. Nevertheless, agriculture and stock raising provide the chief sources of wealth. The Neuquén, which unites with the Limay near the 68th meridian to form the Río Negro, is the principal river of the territory of Neuquén. The largest of a group of beautiful lakes in the higher Andean valleys is the celebrated Nahuel Huapí (Lion Grass), which has an area of 216 sq.mi. and which lies partly in the southwest angle of the territory, partly in Río Negro and partly in the republic of Chile. It is the source of the Río Limay and receives the overflow from two smaller neighbouring lakes.

The temperature of the Andean region is cold even in summer, but on the lower plains it is hot in summer. The territory is reached by a light-draught river steamer which ascends the Río Negro to Neuquén, the capital, at the confluence of the Limay and Neuquén, and by railway from Bahía Blanca to Zapala, via Neuquén. The population is concentrated in a few small towns on the rivers and in some colonies in the fertile districts of the Andes. The capital, founded Sept. 12, 1904, had a population (1940 est.) of about 7,500.

NEURALGIA. A symptom, not a disease, neuralgia is manifested by pain along the course of a nerve. Various forms are distinguished according to the nerve affected: suboccipital neuralgia when the pain is in the back of the head and neck, intercostal neuralgia when it is between the ribs, etc. Strictly speaking, the term is restricted to those nerve pains for which no specific cause and no evidence of impaired function of the nerve can be found. Actually the word is often employed for pain caused by local nerve damage when pain is the prominent symptom. Most sciatic neuralgia, for example, is attributable to mechanical compression and stretching of a sensory root of the sciatic nerve from displacement of an intervertebral disc within the spinal canal. One should realize, too, that neuralgic pain is frequently the forerunner of hidden organic disease and that the first consideration in treatment is the search for a definitive cause.

Characteristically the pain of neuralgia is sharp, acute, darting and paroxysmal. The attacks, commonly brief in themselves, may succeed each other without respite for hours or days, robbing the victim of appetite and sleep and reducing him to a state of exhaustion and mental depression. Neuralgia of a nonspecific kind is prone to occur during states of debility and malnutrition from any cause and in association with infections. Exposure, chilling and fatigue are sometimes precipitating causes.

Treatment for relief of symptoms is sometimes of little avail, many cases proving refractory to all measures. Pain is controlled, as well as can be, by ordinary analgesics, together with hypnotics if required for sleep, avoiding narcotics if at all possible. Hot or cold applications, diathermy or repeated local anaesthesia with novocaine may be beneficial. For extremely severe or prolonged attacks, palliative operations on sensory nerves, roots or their central connections have been resorted to with differing success.

The following types of neuralgia, all of common occurrence, deserve special mention.

Trigeminal Neuralgia (*tic douloureux*), so-called because the pain is strictly confined to one or all of the three divisions of the main sensory nerve of the face. Pain appears in the lower jaw, cheek, tongue and temple, in the upper jaw, cheek and side of the nose and in the forehead and eye, depending on the division affected. The flashing, stabbing, boring pains, usually lasting less

than a minute, are excruciating, and the sufferer commonly recoils from his agony with a spasmodic facial contortion. Characteristically, stimulation of circumscribed areas of the face or mouth, eating, talking or even the lightest touch may provoke an explosion of neuralgic pain. The victim sedulously avoids such contingencies. There is little, if any, discomfort during the intervals between paroxysms. The condition, for which no cause can usually be found, afflicts the elderly and may have spontaneous remissions. Medical therapy is of little help, but surgical treatment is effective. Injection of the affected branch with alcohol gives prompt relief but rarely for more than a year or two. Cutting of the sensory roots within the skull, an operation having a mortality rate of less than 1%, affords almost certain permanent freedom from pain.

Atypical Facial Neuralgia differs from trigeminal neuralgia in that the pain, although felt in the face, tends to be more diffuse, is duller in quality, persists for minutes or hours and is not ordinarily provoked by sensory stimulation. The nature of the condition is obscure but it seems probable that it is a disorder of the sympathetic nervous system and may be a variant of migraine. Some cases respond to a regime of treatment for migraine, but most are more intractable. All do poorly with surgical treatment.

A variety of paroxysmal, unilateral nocturnal neuralgic pain involving the eye and temple, often called histamine headache in the United States, is a closely related condition.

Postherpetic Neuralgia is merely the continuation for weeks, months or sometimes years of the nerve-root pain which is always present in the region of the skin eruption during the acute stage of an attack of shingles (*herpes zoster*). This distressing sequel of the disease affects mostly elderly persons. X-ray therapy appears to benefit some patients. Otherwise, once established, the pain stubbornly resists treatment.

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NEURASTHENIA, a term for a group of symptoms characterized chiefly by feelings of persistent weakness, chronic fatigue and irritability, loss of interest in external events and a depressive mood. The concept of neurasthenia underwent many modifications after 1869 when both George M. Beard and Edwin H. Van Deusen independently employed the term to designate a specific psychiatric syndrome. Its use as a substantive is obsolescent. When used in its adjectival form as *neurasthenic* reaction, syndrome, state, disturbance or symptom, reference is made to the fact that it is no longer regarded as a disease entity. Neurasthenic symptoms usually appear in combination with other psychoneurotic manifestations. Occasionally they represent precursors of a psychotic reaction (*see* PSYCHOSIS) in which there is a temporary or permanent degradation of personality functions as a result of failure of psychological adaptation. The symptoms may also emerge as an initial reaction to damage to the highest integrative centres of the central nervous system. Since the supply of certain metabolites are quickly exhausted in febrile illnesses and can be easily replenished, prolonged postinfectious neurasthenic reactions are no longer commonly encountered.

Beard grouped together almost 100 symptoms which he attributed to exhaustion of the nervous system in consequence of dephosphorization of nerve cells. In this large constellation he included loss of strength, generalized discomfort, recurrent aches and pains, inability to concentrate and sleep, poor appetite, persisting weakness of the spinal musculature, hysterical and hypochondriacal manifestations, sexual difficulties and numerous phobias. Van Deusen's description of the clinical picture was more circumscribed and, in all probability, derived from observations on patients in cachectic states which developed during prolonged febrile or psychotic episodes when the dietary intake was not adequate to sustain the metabolic needs of nervous tissue. Both investigators reported sequelae that suggest the symptomatology of advanced polyneuropathy associated with vitamin deficiency. Beard's writings stimulated many workers to attempt to separate from the large group of symptoms more clearly defined clinical patterns. For example, in 1894 Sigmund Freud suggested that anxiety neurosis be distinguished from neurasthenia. As psychoanalytical and psychobiological principles were extended into the field of medicine, many of the symptoms Beard described were regrouped as various psychoneurotic reactions. Beard's all-inclusive conception led to a confusion of the meaning of the term which persisted, so that some medical writers failed to distinguish neurasthenic symptoms and anxiety, hypochondriacal, hysterical and obsessional-compulsive states.

The chronic weakness and fatigue probably represents alterations in the muscular attitudes of people under certain emotional stresses which have not yet been correlated with the quantity of muscular effort expended. Neurasthenic symptoms may be understood as the end results of various psychological defensive manoeuvres designed to prevent the expression of feelings or desires that would not be acceptable to the conscious part of the personality. Treatment requires a comprehensive review of the personality development as well as an evaluation of the physiological status. Psychotherapeutic programs should be designed so that the doctor-patient relationship provides multiple opportunities to bring the unacceptable impulses to light. (*See* also PSYCHIATRY.)

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NEURITIS, a term denoting inflammation of nerve fibres. Two varieties are known, the localized and the multiple. The localized form frequently follows exposure to cold and may attack a single nerve. Facial paralysis (Bell's palsy) is commonly seen following a neuritis of the facial nerve. Neuritis may follow blows and wounds, stretching or long-continued pressure, as in a dislocation of the elbow joint, or the nerve may be involved in a neighbouring inflammation. The first symptom of a localized neuritis is boring pain along the course of a nerve and its distribution, the part being sensitive to pressure.

Multiple neuritis or polyneuritis may affect many of the peripheral nerves symmetrically and at the same time. For the pathological changes *see* NEUROPATHOLOGY. The causes may be divided as follows: (1) The toxins of acute infective diseases, such as diphtheria, influenza, typhoid fever, malaria, scarlet fever and septicaemia. (2) Acute or chronic poisoning by lead, arsenic, mercury, copper and phosphorous. (3) General disorders: gout, rheumatism, tubercle, carcinoma. (4) The local action of leprosy and syphilis. (5) Endemic disease: beri-beri (*q.v.*). (6) Alcohol, the most common. Alcoholic neuritis is a result of constant steady drinking, particularly of beer. It begins with numbness of the feet and later of the hands, then painful cramps in the legs appear and there is pain on moving the limbs, and superficial tenderness is occasionally present. In other cases the earliest symptoms are weakness of the legs and extreme fatigue, leading to a characteristic "steppage gait," or marked inco-ordination of movement may occur and the gait become ataxic. Trophic changes soon appear, early and rapid muscular wasting occurs, the skin becomes dry and glossy, the nails brittle and the hair thin. In time contractures take place, the hip and knee-joints become flexed and the foot dropped at the ankle. Should the case progress the patient may become bedridden and powerless, and degenerative mental changes may take place, loss of memory, irritability of temper and emotional instability. Early cases may recover completely under treatment. The galvanic and faradaic currents, combined with massage, are useful in helping to restore the wasted muscles, and hot-air baths and warm applications are appreciated.

Neuritis accompanying both beri-beri and alcoholism is the result of deficiency of vitamin B_1.

Arsenical neuritis mostly affects the lower extremities, as contrasted with lead, which mainly paralyzes the fingers and wrists; recovery is even slower than in alcoholic neuritis, the treatment being on the same lines, with the removal of the cause of the dis-

ease. In the neuritis of chronic lead poisoning a fine tremor of the hands is an early symptom and sensory symptoms are usually absent; the muscles affected are the extensors of the wrists, thumb and fingers (*see* LEAD POISONING). The course of the disease is long, and an attempt should be made to eliminate the lead from the system by purgatives and the administration of potassium iodide.

In diabetic neuritis paraesthesia is slight, and the legs are chiefly affected; weakness and ataxia may be present. Trophic sores on the feet are of frequent occurrence in this variety. The treatment is that of the disease. Postdiphtheric neuritis, formerly seen in about 10% of all cases of diphtheria, is now exceedingly rare. Acute polyneuritis with numbness and motor weakness has been noted after various infections, particularly with viruses, together with slight muscular wasting and electrical degeneration. Later, there is loss of sensation in the peripheral portion of the limbs, and the motor weakness may affect the muscles of the trunk and face. Such cases tend toward complete recovery.

In polyneuritis due to metallic poisons BAL (British anti-Lewisite) is helpful. Massage of weak muscles and passive movement of joints may speed recovery. Electric stimulation may also be helpful.

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NEUROPATHOLOGY, the general name for the science concerned with diseases of the nervous system. For the anatomy and physiology, *see* NERVE, NERVOUS SYSTEM, BRAIN, SPINAL CORD and SYMPATHETIC SYSTEM. The morbid processes affecting the nervous system are usually clinically divided into two great groups of (1) organic disease, (2) functional disturbance, depending on whether or not symptoms observed during life can be associated with recognizable changes after death. Knowledge of the first group is much more advanced than of the latter, for, given certain symptoms during life, we can, as a rule, predict not only the nature of the morbid process, but its particular locality.

The histological elements which make up the nervous system may also be divided into two groups: (1) the nervous units or neurones, (2) the supporting, protecting and nutrient tissues. Nervous diseases may start primarily in the neurones and cause their degeneration; such may bring about "diseases," or "syndromes" within the nervous system. The nervous units, however, may be affected secondarily by disease processes starting in the supporting, protecting and nutrient tissues within the nervous system; such include changes of the blood-vessels, lymphatics, membranes and the special nervous connective tissue, neuroglia (a residue of the embryonal structure from which the nervous system was developed). Tumours and new growths must also be included.

The causes of pathological processes occurring in the nervous units (neurones) may be divided into internal and external; in all cases except direct injury the two groups are generally more or less combined.

Internal Causes.—Of the factors involved in nervous disease *hereditary predisposition* may first be accented. In 70% of 150 cases of idiocy or imbecility in the London county asylums, Dr. Tredgold found a family history of insanity in some form or another. This predisposition may be convergent, paternal, maternal; from grandparents or even more remote ancestors. Moreover, no study of heredity is complete that does not take into consideration collaterals. Especially does this apply to functional neuroses, *e.g.*, epilepsy, migraine, hysteria and neurasthenia; and to psychoses, *e.g.*, delusional insanity, mania and melancholia, manic-depressive, recurrent or periodic insanity and dementia-praecox or adolescent insanity. Strictly speaking, it is the tendency to nervous disease rather than the disease itself that is inherited, and this is frequently spoken of as a neuropathic or psychopathic taint.

EXTERNAL CAUSES

The external causes producing morbid changes in the nervous elements are: I. Abnormal conditions of the blood and lymph. II. Excess or deficiency of normal stimulation, or existence of abnormal stimulation. III. Injury or diseases of supporting, enclosing or vascular tissues.

Abnormal Conditions of the Blood and Lymph.—The essential causes of change in environment of the nervous elements (neurones) are: (1) Deficiency or absence of blood-supply to the nervous system in general (as after severe haemorrhage), or to some particular portion, owing to local vascular disturbance or occlusion. (2) Alterations in the normal condition of the blood, due to (*a*) deficiency or absence of certain essential constituents, (*b*) excess of certain normal constituents, (*c*) the presence of certain abnormal constituents produced within the body, or entering it from without. All these act through the cerebro-spinal fluid, a special lymph secreted by the choroid plexus in the ventricles of the brain by which the neurones are bathed.

(1) *Quantity of Blood Supply.*—Syncope or fainting occurs when the blood supply suddenly fails to reach the higher centres of the brain; such may arise from sudden reflex arrest of the heart's action, or from localized spasms of the cerebral vessels. The effects of embolism and thrombosis are considered later.

(2) *Quality of Blood Supply.*—(*a*) Insufficiency of oxygen, as in anaemia, leads to functional depression, lassitude and mental fatigue. Impoverishment of the blood in women by frequent pregnancies and excessive lactation causes neuralgia, nervous exhaustion and may aid in the development of neurasthenic or hysterical reactions. The tendency of psychoneuroses and psychoses to occur and recur at menstrual and climacteric periods in women, indicates that these factors themselves are of periodic significance. These are connected with the reproduction functio· rather than with the blood however. The most striking examples of the effect of absence or "sub-minimal" deficiency of a normal constituent of the blood upon the development and functions of the nervous system are afforded by cretinous idiots, who are born without thyroid glands, and whose brains never develop in consequence; and by those people who suffer from myxoedema (*q.v.*) occasioned by the absence of thyroxin or other products of the internal secretion of the thyroid gland. The proof of this is shown by the disappearance of the nervous phenomena, slowness of thought, slowness of speech, etc., after thyroxin or a preparation of the gland has been continuously administered. This is an excellent example of a reversible process.

(*b*) Excess of certain Normal Constituents in the Blood.—Excess of carbonic acid causes drowsiness, and probably in asphyxia is one of the causes of the convulsions. All the nitrogenous waste products are normal constituents of the blood; but should oxidation be incomplete, from disease of the liver, or should these substances accumulate in the blood, owing to inadequate function of the kidneys, uraemia may supervene, the manifestations of which are headache, drowsiness, unconsciousness or coma, epileptiform convulsions and sometimes symptoms of polyneuritis. Again, in Graves's disease (hyperthyroidism), nervous phenomena, in the form of exophthalmos, fine tremors, palpitation and mental excitement have by some authorities been explained by the excess of thyroid internal secretion, due to the enlargement and increased functional activity of the gland.

(*c*). The presence of abnormal constituents in the blood is a most important cause of disease of the nervous elements. These are: Poisons produced within the body (α) by perverted function of organs or tissues, auto-intoxication; (β) by the action of micro-organisms, protozoa and bacteria, upon the living fluids and tissues of the body; (γ,) poisons introduced into the body from without.

(α) Poisons resulting from perverted Function of the Organs.—Nervous symptoms follow auto-intoxication by products of disordered digestion, fatigue products (*e.g.*, sarcolactic acid in prolonged muscular spasm), excess of uric acid, phosphates, oxalates, sugar, bile, hepatic products as in acute yellow atrophy. In pernicious and certain grave anaemias, the degenerative changes in

the spinal cord found in some cases is due, chiefly, to some neuro-toxin, which probably arises from imperfect metabolism or absorption from the alimentary canal. In auto-intoxication, disease of one organ or tissue is apt to establish a vicious circle which is constantly enlarging; therefore nervous symptoms manifesting themselves in the course of a disease add much to the gravity of the complaint.

(β). Poisons produced by infective Micro-organisms.—Some of these have a general devitalizing influence by altering the blood and producing fever. In acute infectious diseases, delirium is a frequent complication; in severe cases, stupor and coma may occur, and in this extreme stage the nerve cells undergo an acute morbid bio-chemical change. These particular poisons may have marked selective toxic action upon particular parts of the nervous system.

Poisons may have a *selective influence* upon some part of the nervous system. The syphilitic organism and its poisons are most important factors in the production of two progressive degenerations of the nervous system—one affecting especially the afferent conducting tracts of the spinal cord, namely, tabes dorsalis (locomotor ataxia), and the other affecting especially the frontal and central convolutions of the cerebral hemispheres, namely, general paresis (general paralysis of the insane). When syphilis attacks the supporting, enclosing and nutrient vascular tissues, a predilection to affect structures about the base of the brain occurs, and paralyses of the third nerve are frequent in this disease. Other examples occur in rabies, tetanus, diphtheria (*q.v.*).

Protozoa and Diseases of the Nervous System.—The relation of protozoa to the existence of widespread diseases affecting men and animals is becoming yearly of greater importance. Certain diseases in which the nervous system is profoundly affected are now explained by the invasion of the tissues of the body by these lowly organisms, for example, African sleeping sickness due to a special protozoan; Syphilis due to *Spirochaeta* or *Treponema pallida;* Malaria due to *Haematozoon malariae.*

The bacterial invasion of tissues is generally characterized by a migration of polymorpho-nuclear leucocytes, but protozoal invasion is characterized by a formative hyperplasia of the fixed cell tissues, endothelial, epithelial and conjunctival, and there is a close similarity in the defensive reaction of the tissues to all forms of protozoal invasion.

When the nervous system is affected a local or general chronic meningo-encephalitis is set up, characterized by a meningeal and perivascular infiltration with lymphocytes and plasma cells, occasioned by a chronic irritative process, presumably caused in the case of sleeping sickness for example by the presence of trypanosomes in the actual cerebro-spinal fluid. The same perivascular and meningeal infiltration with plasma cells and lymphocytes is found in syphilitic diseases of the nervous system.

Pathology of the Cerebro-spinal Fluid.—Pathological changes in the cerebro-spinal fluid are important in the diagnosis of nervous diseases. Normal cerebro-spinal fluid is clear like water; it has a specific gravity of 1·006 and resembles in its composition the blood *minus* its corpuscular and albuminous constituents. Being secreted by the choroid plexus, if any cause, such as tumour or meningitis, should interfere with its escape from the ventricles it gives rise by pressure to *internal hydrocephalus* and cerebral anaemia which may occasion epileptic convulsions and various degrees of drowsy stupor, lethargy, unconsciousness and even coma. Lumbar puncture has proved of some use in treatment, but is invaluable in the diagnosis of various diseases of the central nervous system. The fluid withdrawn should be centrifuged and the deposit examined microscopically if necessary after staining by suitable methods; the existence of cells indicates disease of the central nervous system. In general paresis, cerebro-spinal syphilis and tabes dorsalis even in early stages, the deposit consists almost entirely of lymphocytes. Some evidence of the progress of the disease and the effect of treatment may be obtained by counting the number of cells at different periods. In tuberculous meningitis there are also lymphocytes in abundance; tubercle bacilli cannot readily be found, but if the fluid be injected into a guinea pig, the animal will develop tubercle. In epidemic cerebro-spinal meningitis the cells in the deposit are polymorpho-nuclear leucocytes and in the leucocytes can be seen *Diplococcus intracellularis.* Septic, pneumonic and pyogenic organisms may also invade the central nervous system giving rise to meningitis, and in these cases the deposit will be polymorpho-nuclear leucocytes, and perhaps the specific organisms may be seen in stained preparations; but if not, they can be obtained by cultural methods.

Other formed elements which may be found are large cells, macrophages containing blood pigment; these cells indicate that haemorrhage has occurred. One of the most important uses of lumbar puncture has been the discovery of the cause of African sleeping sickness. The fluid withdrawn and centrifuged is found to contain large numbers of lymphocytes and plasma cells in addition to specimens of the actively moving organism *Trypanosoma gambiense,* a flagellate. In the forms of disease here described as containing cells in the centrifuged deposit, there is also in the fluid an appreciable amount of proteins. If pathological cerebro-spinal fluid be added to an equal quantity of saturated solution of sodium sulphate there will be a distinct turbidity indicating the presence of proteins in appreciable quantity. This appreciable quantity of proteins is especially significant in the case of fluid withdrawn from cases of general paralysis or tabes, for it goes *pari passu* in amount with the Wassermann *sero-diagnostic reaction for syphilis.*

African sleeping sickness is characterized by a progressive *lethargy,* paresis, tremors and the signs and symptoms of neural exhaustion without neural destruction; it comes on slowly and insidiously often years after infection and eventually terminates fatally by intercurrent disease or paralysis of the bulbar centres. Examination of the central nervous system explains the fatal lethargy; the perivascular and meningeal lymphatics are filled with lymphocytes and plasma cells and the neuroglia supporting cells have undergone a rapid proliferation. The effect of this morbid process is to deprive the neural elements of oxygen and nutrition; the neurones in consequence, although not destroyed, are nevertheless unable to function for more than a brief period.

Poisons Introduced into the Body.—The most widespread and potent cause of nervous and mental disease is the abuse of alcohol-containing liquids. At least 20 per cent of the inmates of the asylums of London are admitted with a history of alcoholism. Whether alcoholism is a cause or a result is still debatable. In not more than 10% is alcohol the efficient cause of the mental disease; in many it is only a contributory factor, and in not a few the lapse from moderation to intemperance is one sign of a mental disturbance. To people with unstable nervous systems a relatively small quantity of alcohol may act as a poison. Thus epileptics, imbeciles, criminals, potential lunatics, and the subjects of head injury are liable to become anti-social and dangerous to themselves and others by indulgence in quantities of alcohol which would have no harmful effect upon the mentally stable and sound individual. However, chronic alcoholics form a large proportion of those guilty of crimes of violence, homicide, suicide, and sexual offences. Another common effect of alcohol is *peripheral polyneuritis* (*see* NEURITIS), although frequently changes occur as well in the ganglion cells, from which the axis cylinders of the nerves have their origin. (*See* NERVOUS SYSTEM.) Alcoholic polyneuritic psychosis affecting women in many ways resembles delirium tremens (*see* DELIRIUM); the fact that neuritis occurs much more frequently in women is probably associated with the fact that when the female breaks through the resistance to her conflicts by the use of alcohol her regression is deeper and her indulgence greater. Many other poisons, notably lead and arsenic, the specific fevers before mentioned, syphilis and alterations of the blood due to imperfect metabolism, such as occur in diabetes and gout, may produce, or become important factors in producing, peripheral neuritis. The outbreak of arsenical neuritis from beer containing this poison in Manchester in 1900 is of interest from that fact that the symptoms closely resembled acute alcoholic neuritis. A distinctive feature, however, was the pigmentation of the skin and the severity of the nervous symptoms.

A disease, common in the East, termed beri-beri (*q.v.*),

is a form of neuritis. Anaesthetic leprosy is an interstitial inflammation of the nerves due to the *Lepra bacillus*. Among the nervous diseases caused by occupation may be cited lead poisoning (*q.v.*). Lead also produces a chronic inflammation of the cerebral cortex, *Encephalitis saturnina*, causing a complex of symptoms, namely dementia, loss of memory, weakened intellect, paresis and epileptiform seizures, hallucinations of sight and hearing, and mental exaltation or depression. Mirror-makers suffer with characteristic fine tremors, from the slow absorption of mercury into the system. Workmen at indiarubber factories may suffer from severe mental symptoms, owing to the inhalation of the fumes of carbon bisulphide. Serious nervous symptoms have followed carbon monoxide poisoning. Cases which have recovered from the immediate effects have suffered with dementia and symptoms of disseminated sclerosis, the result of multiple haemorrhagic softenings.

Certain other poisons, besides alcohol, act upon the nervous system when continually entering the body as the result of a *habit*, namely, absinthe, ether, cocaine, opium, morphin, hashish and tobacco. Each of these has a selective influence upon certain parts of the nervous system. In illustration thereof may be mentioned impairment of central vision in tobacco amblyopia. Other diseases of like kind are under pellagra (*q.v.*), ergot (*q.v.*), botulism (*see* MEDICAL RESEARCH).

Adequate and Pathological Stimulation.—The nervous system in the form of systems, groups and communities of neurones, each with special functions, yet all woven together in one harmonious whole, develops in a particular way in consequence of the awakening influence of stimuli from without and from accumulated instinct stimuli from within. Consequently nervous structures which are not used at all, or badly used are liable to undergo regressive metamorphosis and atrophy; thus amputation of a limb in early life causes atrophy of the nervous structures which dealt with the sensations and movements of the part. This may be seen in the grey (synapses) and white matter (conducting pathways) of the spinal cord; there may also be found an atrophy of the psycho-motor neurones of the brain functionally related to the sensory and motor terminal areas of the involved limb. The converse is also true; the longer a perverted function exists, the more unlikely it is to disappear and ultimately to bring about irreversible structural changes.

Mental pain in the form of grief, worry, anxiety, fright, shock, violent emotions (pleasurable or painful), disappointed love, and excessive intellectual work, frequently precede and determine various types (*a*) of psychoses, *e.g.*, manic-depressive, paranoid; (*b*) of neuroses, *e.g.*, compulsion neurosis, hysteria, epilepsy, hystero-epilepsy; (*c*) or gross brain disease, *e.g.*, apoplexy, thrombosis, arteriosclerotic degenerations.

Visceral reflex irritation affords many examples of organ neuroses, the symptoms of which may be set up by irritation of the viscera, *e.g.*, intestinal worms. Teething and indigestible food are often the exciting cause in infants and young children of convulsions and spasms of the glottis (spasmophilic). Some anomalies of the female reproductive organs act as exciting causes in the release of hysterical reactions. Paroxysmal exacerbations of emotional disturbances are liable to occur at the menstrual period or menopause. Here the stimulus proceeds from the reproductive instinct. The irritation of a carious tooth may produce spasmodic tic or trigeminal neuralgia. Wax in the ear may occasion vertigo and tinnitus; and grave errors of refraction in the eyes may be an accessory factor in the causation of attacks of migraine. Irritation of the receptors of the vagus in almost any part of its widespread visceral origin may lead to vomiting. The characteristic pain of angina pectoris, which radiates down the inner side of the left arm, is partly explained by the fact that the cardiac branches of the sympathetic follow the vascular supply of the arm, and the stimulus from the diseased aorta or coronary vessels radiates as pain in the vascular area. The entire explanation is extremely complex[1]. This is one example of a great number of *referred pains* studied so extensively by the English observers, Head and Mackenzie.

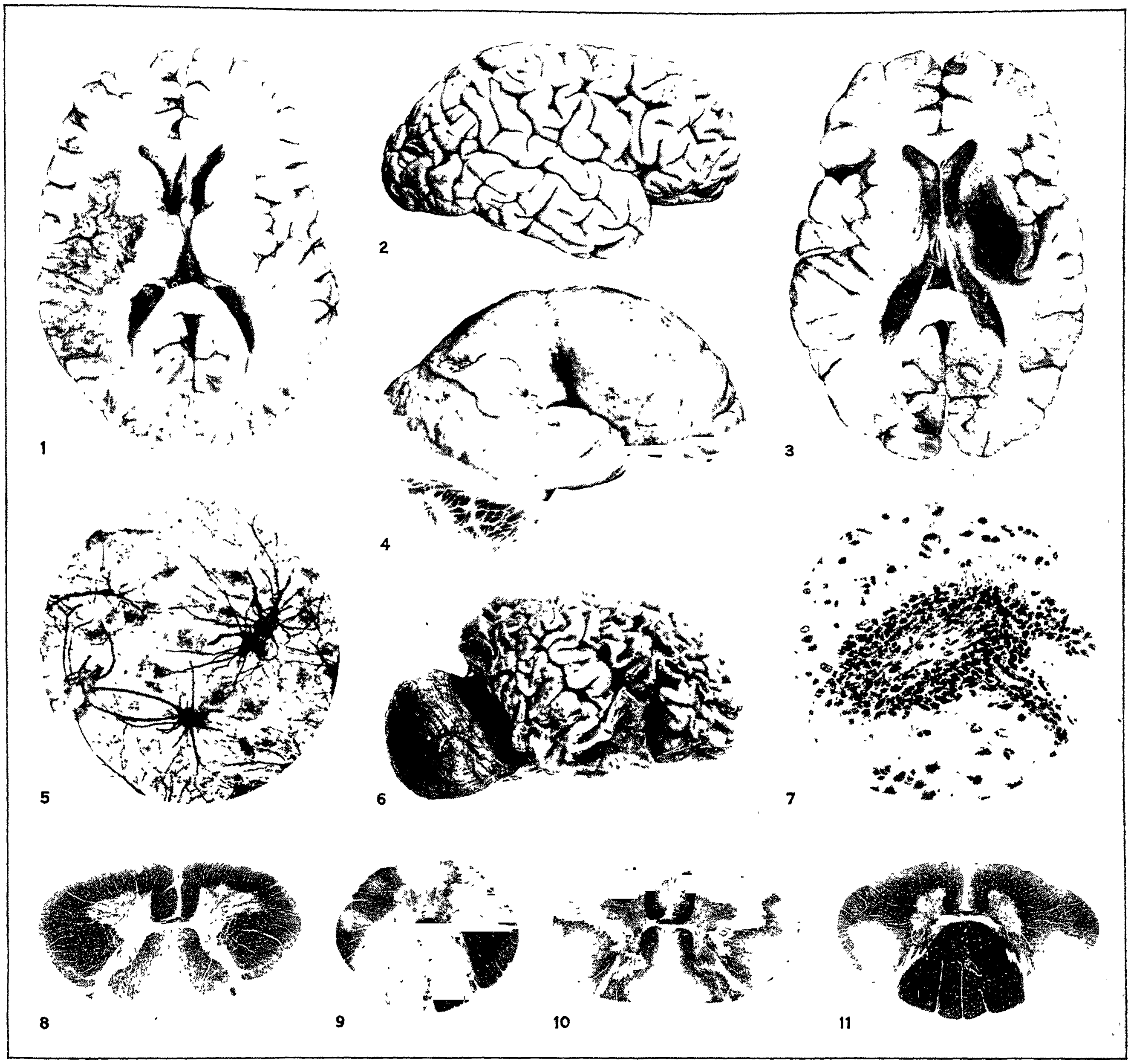
[1]Spiegel, Wien, Kl. Woch. 40, 1927, 853.

Injury or Disease of Enclosing or Supporting Structures may lead to paralytic or irritative lesions of the nervous system, or the two may be combined. Blows or wounds of the head and spine may damage or destroy the nervous structures by shock or direct injury. Concussion of the brain or spinal cord may occur, as a result of injury, without any recognizable damage of the enclosing structures or even the central nervous system. Shock, due to concussion, can thus be explained as resulting from molecular or bio-chemical changes in the nervous structures.

Direct injury may cause local destruction of the nervous tissue; but wounds and diseases of the enclosing and supporting structures, if non-infective, give rise only to such symptoms as accord with the nerve structure irritated or destroyed. Should, however, the wound or diseased structure become infected, the disease spreads and becomes generalized; likewise the symptoms. Of the many causes of infective inflammation of the brain itself, middle-ear disease is the most important. It is very liable, when neglected, to be followed by a septic meningitis, encephalitis and brain abscess, the most frequent seat of which is in the adjacent temporal lobe, but it may involve other parts of the brain as well, for example the cerebellum and frontal lobe. The peripheral nerves may be destroyed or irritated by direct injury, disease or new growth in adjacent tissues, or they may be involved in the callus thrown out round the seat of a fracture.

Diseases of the blood-vessels are among the most frequent causes of gross brain disease. Arteries or veins—more frequently the former—may become blocked or ruptured from various causes. The immediate effect is a disturbance or loss of consciousness, and the individual may be "struck down" (*see* APOPLEXY) and never regain consciousness (*see* COMA). Should consciousness return, more or less permanent loss or disturbance of function becomes obvious. Paralysis of some form, especially hemiplegia, is commonest. The cerebral arteries, usually the left middle cerebral may be occluded by embolism (*see* THROMBOSIS AND EMBOLISM). The area of brain supplied by that artery undergoes softening in consequence, resulting in paralysis of the opposite half of the body (hemiplegia) associated with aphasia when the paralysis affects the right side in a right-handed person (*see* Plate, fig. 1). When the embolus is infective, as in ulcerative endocarditis, it not only blocks the vessel but leads to an infective inflammation and softening of its coats, with the formation of an aneurism. The aneurism may suddenly rupture into the substance of the brain and produce apoplexy. Most cases of apoplexy from cerebral haemorrhage in young people are due to this cause. Softening may also arise from coagulation of the blood (thrombosis) in the arteries or veins. Many causes generally combine to produce thrombosis, viz., a weak acting heart and altered conditions of the blood. It is sometimes met with in the cachexia of phthisis and cancer, in typhus and pneumonia, after parturition and in marasmus at all periods of life, but especially in the very young and very old. But thickening, roughening, and a degenerated condition of the cerebral arteries known as atheroma, when associated with a weak acting heart is especially liable to give rise to thrombosis and softening, and is a very common cause of apoplexy, paralysis and mental deterioration in people who have passed middle life. General disease of the arteries of the body, with chronic Bright's disease and high arterial pressure, is frequently associated with the formation of minute aneurisms upon the cerebral arteries, which may rupture and cause apoplexy.

This is especially liable to occur in a vessel supplying the basal ganglia, the effused blood tearing through the motor efferent fibres (pyramidal tracts) lying between the optic thalamus and the corpus striatum (*see* Plate, fig. 3). The result is hemiplegia of the opposite side of the body. Disease of the arteries of the central nervous system, occurring in a person under 40, is generally due to syphilis, the virus of which produces an inflammation of the inner coats (*see* ARTERIES, DISEASES OF). The thickening and narrowing of the lumen with loss of elasticity of the arteries of the brain generally may suddenly or gradually set up cerebral anaemia and give rise to semi-comatose and comatose or even apoplectic states. Occlusion by the inflammatory proliferation or by the sudden clotting of blood in the diseased vessel may occur, the immedi-



BY COURTESY OF J C GREENFIELD

THE HUMAN BRAIN AND SPINAL CORD IN HEALTH AND DISEASE

1. Horizontal section across a brain showing a softening in the left hemisphere due to a blockage of a cerebral artery. This caused right sided hemiplegia and aphasia
2. Right cerebral hemisphere of an adult man; normal state of convolutions
3. Horizontal section across a brain in which a haemorrhage in the right hemisphere had damaged the motor path to the left arm and leg causing left hemiplegia
4. Right half of the brain of a microcephalic idiot. There is complete absence of any convolutional pattern in the cortex of the brain, which closely resembles that of the sheep. The cerebellum is normally developed
5. Microscopic section of a degenerated area of cerebral cortex overlying a tumour, showing enlarged neuroglia cells
6. Right half of the brain of a microcephalic idiot (walnut type). Here the convolutions have shrunk and a bag of fluid replaces the temporal pole. This is due to a vascular lesion before birth
7. Microscopic section of the cerebral cortex of a case of general paralysis showing inflammatory cells surrounding a small vessel

8–11. Sections across the spinal cord in different common forms of spinal paralysis (the undamaged nerve fibres are stained black): 8. "Locomotor ataxy" in which the ascending or sensory fibres in the posterior columns degenerate. 9. "Disseminated sclerosis," in which patches of degeneration (pale areas) are scattered haphazard, damaging both sensory and motor fibres. 10. "Subacute combined degeneration," usually associated with anaemia, in which both sensory and motor fibres are affected. 11. "Motor neuron disease," in which all the descending or motor fibres degenerate

ate effect of which may be an epileptic or apoplectic fit; the result is softening; and as any or all of the arteries of the brain may be affected successively, simultaneously, or at random, the symptoms may be manifold. They may be general or local, and are often associated with inflammation of the membranes. The disease, under treatment, may abate, and the paralytic or mental phenomena partially or completely disappear, indicating the restoration, or partial restoration, of the circulation in the diseased arteries; sometimes with the lapse of treatment, and sometimes without, new symptoms manifest themselves, showing that the disease has attacked a fresh set of arteries. *Disseminated sclerosis* (*insular*) is another progressive random, morbid process, the pathology of which is not fully understood, but is probably due to some toxic cause. Islands of nervous tissue undergo a morbid change, commencing in the myelin sheath and ending in an increase of the supporting neuroglia tissue at the expense of the true nervous tissue (*see* Plate, fig. 11).

Tumours and new growths in the central and peripheral nervous systems may be primary or secondary; the former arise in the supporting, enclosing or nutrient tissue elements; the latter are metastatic deposits from tumours originating elsewhere. Tumours may be single or multiple, the special symptoms occasioned depending upon the seat of the tumour and whether it destroys or only irritates the adjacent nervous tissue. Tumours situated within the cranial cavity cause general symptoms, namely, optic neuritis, severe headache and vomiting; these symptoms, which are caused by increased intracranial pressure, are more severe in rapidly growing vascular tumours, even though small, than in large slow-growing tumours. Some tumours are highly vascular and a large thin-walled vessel may suddenly rupture and cause an apoplectic fit. If the growth is situated in a portion of the cortex having some special localizing function, *e.g.*, the motor area, it is likely to give rise to epileptiform convulsions, starting in a limb or definite group of muscles; but the irritation usually spreads to the whole motor area of the same side, and even extends to the opposite hemisphere, by an overflow of the discharge through the corpus callosum. In such case there is loss of consciousness. If, however, the tumour destroys the cerebral cortex of a particular region, it may give rise to a paralytic lesion, *e.g.*, paralysis of the arm.

Diseases of the blood-vessels, or of supporting and enclosing tissues, produce secondary degenerations of the nervous system. The symptoms, like the lesion, are obtrusive; frequently arising suddenly, they may in a short time terminate fatally, or tend towards partial or complete recovery. Various forms of motor and sensory loss and disturbance of function may arise, indicating destruction or disturbance of particular regions of the central nervous system; and degenerations in certain tracts and systems of fibres arise, corresponding in histological character with those observed when a nerve fibre is separated from its cell of origin by section (secondary degeneration of Waller and Türck). This form of degeneration must be distinguished sharply from primary degeneration, which is due to an inherent nutritional defect of the nerve cell and all its processes (the neurone), in which a regressive metamorphosis occurs; it starts in the myelin sheath and the fine terminal twigs of the axis cylinder and dendrons, and proceeds back to the main branches and trunk, eventually destroying the trophic and genetic centre itself, the nerve cell. These *primary* degeneration processes are insidious in origin, progressive in character, and nearly always fatal; they, therefore, are associated with a progressive evolution of symptoms.

To cite some examples: (1) *Locomotor ataxy* (tabes dorsalis), is a primary degeneration affecting the *afferent* sensory system of neurones. (2) *Progressive spinal muscular atrophy* is a disease of the *efferent* motor system of neurones of the brain and spinal cord. Infantile paralysis (*Anterior poliomyelitis*), is an acute inflammation causing destruction chiefly of the spinal motor neurones of the ventral horn. It differs from the progressive spinal muscular atrophies in its sudden onset and non-progressive character; it resembles them in producing paralysis of muscles without sensory disturbance. (3) *General paralysis of the insane* (general paresis) is a degeneration which begins in the association system of neurones of the cerebral cortex, but frequently is associated with degeneration of the afferent or efferent systems.

The psychoneuroses and benign psychoses have not been satisfactorily explained by definite morphological changes in the actual brain substance. We know little or nothing accurately about the morbid histology of certain chronic psychoses, or defect states, except as regards the morphological changes met with in cases of amentia and dementia. The large and illy circumscribed groups, called idiocy and imbecility, are associated with arrest of development of the brain, the naked-eye evidence of which may be afforded by small size and simplicity of convolutions of the brain as a whole or in part (*see* Plate, figs. 2, 4 and 6); and the microscopical evidence by arrest, or imperfect development, of structures connected with the higher functions of the mind, namely, the association neurones in the more superficial layers of the cerebral cortex. Various degenerative processes, either primary or secondary, broadly termed dementics, are associated with progressive decay and atrophy of the superficial layers of the grey matter of the cortex, and naked-eye evidence thereof is afforded by partial or general wasting of the cerebral hemispheres, accompanied with thickening of the pia-arachnoid membrane, atrophy of the convolutions, and with deepening and widening of the intervening sulci. Since the modern studies on this subject of V. Economo, Jakob, the Vogt's Josephy, Fünfgeld, Spatz, Spielmeyer and others have given a definite architectonic and myelotectonic knowledge of the cortex as well as the striatum the older studies of a former generation are obsolete. A newer cortical and subcortical pathology is being written and is to be found in special articles in this edition. At the present time a generalized neuropathology cannot be written.

The cerebro-spinal fluid fills up the space in the cranial cavity caused by the atrophy of the brain; consequently there is a great excess of this fluid. This wasting so characteristic a finding in general paralysis is especially due to atrophy of the cells and fibres of the superficial grey matter of the cortex, sections of which, examined microscopically, after suitable staining, show great poverty, or complete loss, of three sets of delicate myelinated fibres, namely, tangential, super-radial and the inter-radial corresponding to the line of Baillarger. This degeneration of the superficial association fibres of the cerebral cortex affects especially the frontal and central convolutions, and is the earliest and most constant microscopical change in general paresis. It is accompanied usually by meningeal and vascular changes, atrophy of the nerve cells, the proliferation of the neuroglia (fig. 5); especially characteristic is the perivascular infiltration with lymphocytes and plasma cells (*see* Plate, fig. 7). It was, indeed, thought that this condition of the vessels was pathognomonic of general paresis; it certainly is not, for it is found throughout the central nervous system in cases of African sleeping sickness and the arterial types of neurosyphilis. It has sometimes been known to occur in the neighbourhood of cerebral tumours but it is not found in uraemia or lead encephalitis.

Microscopical Changes in Degeneration of the Neurone.—About 1850, Waller demonstrated that a nerve fibre undergoes degeneration to its termination when separated from its cell of origin; hence the term "Wallerian degeneration." Embryological researches by Prof. His showed that the axis-cylinder process (the essential conducting portion of the nerve fibre) is an outgrowth of the nerve cell. The cell, therefore, is the trophic and genetic centre of the nerve fibre. Acute alterations and death of the nerve cells may occur from toxic conditions of the blood; from high fever (107°–110° F); arrest of the blood supply, as in thrombosis and embolism; or actual destruction by injury, haemorrhage or inflammation. These morbid processes produce, as a general rule, bio-chemical as well as morphological changes in the nerve cell and its processes. When a nerve cell dies, the nerve fibre undergoes secondary degeneration and death; that is to say, the whole neurone dies, and regeneration, at any rate in the higher vertebrates, does not take place. Restoration, or partial restoration, of function is due to other structures taking on the function, and the more specialized that function is, the less likely is restoration to take place. If, however, a peripheral

nerve is divided, its component fibres are merely severed from their cells of origin. All that portion of the nerve which is in connection with the nerve cells of origin practically undergoes no change. The peripheral portion undergoes degeneration, but from the central end of the nerve new axis cylinders again grow out and a new nerve is formed. With this regeneration comes restoration of function, which may be hastened by suturing the ends of the cut nerve. A similar regeneration, however, does not occur after section of fibres of the white matter of the central nervous system, and this may be due to the fact that the nerve fibres of the white matter of the cerebrospinal axis possess no nucleated sheath of Schwann, which plays an important part in regeneration; in the present writer's opinion, the neurilemmal sheath of the old fibre forms a new protoplasmic basis, into which the axis cylinder from above grows, the passage of stimulus determining its function. The writer, working in conjunction with Prof. Halliburton, has shown that the characteristic microscopical changes in the myelin sheath which occur in the process of degeneration are due to a splitting up of the complex phosphoretted substance "protagon" into glycero-phosphoric acid, choline and oleic acid by a process of hydration. The Marchi reaction, so useful for demonstrating degeneration of the central and peripheral nervous systems, is dependent upon the fact that the myelin sheath, after hardening in a solution of bichromate of potash, does not turn black when acted upon by osmic acid, whereas the simpler non-phosphoretted fatty product of degeneration is stained black. When the Marchi reaction of degeneration is fully developed, it has been ascertained that the nerve yields no phosphorus. The degeneration resulting from section of a nerve is termed *secondary*, to distinguish it from another, *primary*, due to slow and progressive decay of the whole neurone, beginning usually at the terminal twigs and proceeding back towards the cell body with its contained nucleus. These primary degenerations involve systems of neurones, correlated by function rather than by anatomical situation. Examples have been given already. The cause of primary degenerations is probably a defect inherited or acquired in the *vita propria* of the neurones affected. They slowly atrophy and disappear, and their place is filled up by an overgrowth of the supporting neuroglia tissue (*see* Plate, fig. 9). This overgrowth of dense tissue is termed sclerosis and was erroneously considered to be the cause, instead of the effect, of the atrophy of the nervous tissue. (F. W. Mo.)

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NEUROPTERA, the term used in zoological classification for that order of insects which includes the alder flies, snake flies, ant-lion flies, lacewings and their allies. They comprise small to rather large soft-bodied insects with usually elongate feelers and two pairs of similar, net-veined, membranous wings; the wings are closed rooflike over the body when at rest and the hind pair are almost always without a plicated posterior lobe. The mouth parts are for biting, the tarsi are five-jointed and there are no cerci or tail feelers. All Neuroptera undergo complete metamorphosis and the larvae are active and predatory with well developed antennae, sense organs and legs; they are mostly terrestrial but some are aquatic. The pupae have the appendages free and are generally enclosed in silken cocoons.

Rather more than 2,000 species of Neuroptera were known by 1945, and of those only a little more than 60 occur in the British Isles while about 200 species are found in the United States.

Neuroptera are all insects of weak flight, they are rarely abundant in individuals and feed mostly upon soft-bodied insects or liquid matter such as honey dew. Most of the species have beautiful net-veined wings which often exhibit a complex reticulation owing to the presence of numerous accessory veins. There are numerous veinlets arising from the costal vein and vein Rs is generally pectinately branched. In their larval stages they are exclusively predaceous. The order is divided into two suborders, viz., the Megaloptera and the Planipennia as given below.

SUBORDER I. MEGALOPTERA

Veins with little or no tendency to fork at the margins of the wings; vein Rs with but few extra branches. Larvae with biting mouth parts; pupae not enclosed in a true cocoon.

This group includes a small number of archaic insects separable into two superfamilies comprising about 200 species throughout the world. (1) The Sialoidea, all with aquatic larvae, include the alder flies (*q.v.*) (family Sialidae), so-called because in England the adults often frequent alders along the banks of streams. Their larvae respire by means of seven or eight pairs of slender, jointed, abdominal gills. The genus *Sialis* is widely distributed with two British and many North American species. Also included are the large dobson-flies (*q.v.*), belonging to the family Corydalidae and found in North and South America and parts of the old world. Smaller members of the same family are often known in America as fish flies (*q.v.*). (2) The Raphidiodea or snake flies (*q.v.*) are distinguished by the elongate prothorax and by the very long ovipositor in the female. They are terrestrial insects whose larvae are found under the bark of trees. Twenty species are found in North America (1945) and four species of the genus *Raphidia* occur in Britain.

SUBORDER II. PLANIPENNIA

Veins with evident forking at the margins of the wings; vein Rs usually with numerous branches. Larvae with piercing mouth parts; pupae enclosed in a cocoon.

Included here are the major portion of the Neuroptera: they are nearly all terrestrial insects, only a small number being partially or truly aquatic in their larval stages. The Planipennia are divided into 16 families of which only the most important are mentioned.

The Ithonidae or moth-lacewings are confined to Australia: they are large, stoutly built, mothlike insects with primitive venation. Their larvae live in the soil where they prey upon those of chafer beetles, to which they bear a close general resemblance. The Hemerobiidae or brown lacewings are widely distributed and

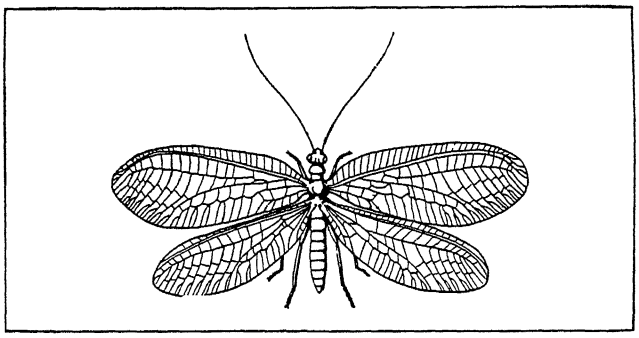

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FIG. 1.—A GREEN LACEWING (CHRYSOPIDAE)

fairly numerous in species. Their larvae along with those of the Chrysopidae or green lacewings (fig. 1) roam about vegetation preying upon aphides, mites, thrips and other soft-bodied insects (*see* Lacewing-fly). The Osmylidae and Sisyridae have aquatic larvae: the insects of the first mentioned family are medium to large-sized species which differ from the lacewings in certain venational characters. *Osmylus fulvicephalus* is the largest British neuropterous insect and occurs locally along the borders of streams where there is dense vegetation. The Sisyridae differ in having very few cross veins to the wings besides being much smaller in size. They are brown or fuscous insects found along

the borders of rivers which contain the fresh-water sponge upon which their larvae feed and live. Three species of *Sisyra* occur in Great Britain and this genus, along with *Climacia,* is found in the United States. The Mantispidae or mantis flies (*q.v.*) are easily distinguished by the elongate thorax and the prehensile fore legs which resemble in form those of the common mantis (*q.v.*) and are likewise used for seizing other insects which serve as their prey. The larvae of the European *Mantispa styriaca* are predacious upon young *Lycosa* spiders and during development they undergo striking changes of form constituting hypermetamorphosis. The family is mainly tropical but ranges into southern Europe and a few species occur in the United States. The Psychopsidae have very broad, rounded wings supported by a stout "mid-rib" and with a densely reticulated venation. Many are insects of striking beauty and their larvae have been found beneath bark of trees. The family has a wide discontinuous range occurring in South Africa, Tibet, China and Australia. The Nemopteridae (fig. 2) differ from all other Neuroptera in having very long threadlike or ribbonlike hind wings. Their larvae occur in caves on the floors of buildings among debris, etc., where they prey upon smaller forms of insect life. The family occurs in many of the warmer parts of the world including southern Europe but is absent from North America. The Myrmeliontidae or ant-lion flies (*q.v.*) bear a general resemblance to dragon-flies and have short knobbed feelers. Although most abundant in the warmer parts of the world, several species occur in Europe, one being found as far north as Sweden, but none are found in the British Isles: about 65 species inhabit the United States. Their larvae live on the ground where some make pitlike snares for entrapping their prey, while others hide away under stones or debris. The Ascalaphidae are closely related to the preceding family but can easily be separated by their much longer antennae as well as by venational differences. Their larvae either hide away on the ground or live concealed on the bark of trees. They are chiefly tropical insects, only a few species occurring in southern Europe and North America. The Coniopterygidae, or mealywings (*q.v.*), number about 50 species and are the smallest and most aberrant of all Neuroptera. They are covered with a white powdery secretion, their wings have comparatively few veins and the hind wings are much reduced in size. Their larvae roam about plants, preying upon aphides, scale insects and mites. Rather more than half a dozen species are found in Great Britain and a similar number occur in the United States.

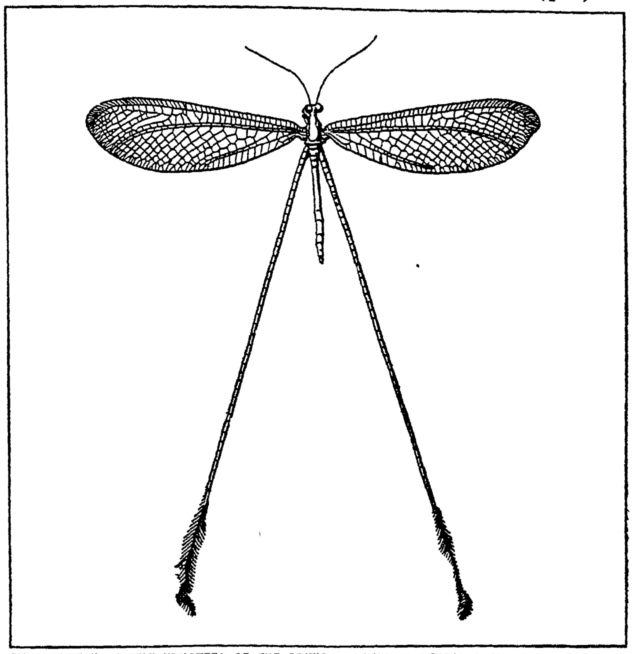

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FIG. 2.—NEMOPISTHA IMPERATRIX (NEMOPTERIDAE)

Natural History (fig. 3).—The eggs of Neuroptera are ovoid and in several families, including the green lacewings, the female exudes a sticky secretion which she draws out into a hairlike stalk upon which the egg is laid for safety. The larvae, with few exceptions, are terrestrial or arboreal and in the Planipennia they are all characterized by the greatly drawn out mandibles and maxillae which are used for seizing and perforating the prey. The mandibles are grooved along their ventral surface and the maxillae, which closely resemble them in form, fit one into each groove: in this way the two sets of appendages function as a pair of tubes through which the body juices of their victims are sucked out. Larvae of the Planipennia are further remarkable for the fact that six out of their eight Malpighian tubes become transformed into silk glands, the silk being emitted through an anal spinneret. The larvae of all Neuroptera are carnivorous and mostly prey upon other forms of insect life. When fully fed those of the Planipennia construct silken cocoons and, prior to the emergence of the perfect insect, the pupa cuts open the cocoon with its mandibles and, being mobile, often travels some little distance before the imago emerges. Little is definitely known respecting the specific nature of the food of the perfect insects: many are nocturnal in habits and are attracted to lights, while most of the day-flying species are rarely seen on the wing.

Geographical Distribution.—Certain families of Neuroptera are nearly world-wide in their distribution, the Chrysopidae, for example, being found in almost all extensive areas of land excepting New Zealand: the Sialidae have an almost world-wide though discontinuous range, while the Raphidiidae are mainly restricted to the northern hemisphere. Several families, on the other hand, are almost confined to Australia which has a more complete and diverse fauna of Planipennia than any other region of the globe, although the Megaloptera are only represented there by a few species. Only 7 families of Neuroptera occur in the British Isles and 13 families are found in the United States.

Geological Distribution.—The Megaloptera are evidently an archaic group but their fossil remains, unless very perfect, are difficult to identify. The earliest undoubted remains of this suborder have been found in the Permian rocks of Russia. The Planipennia first appear as fossils in Lower Permian beds of Kansas, where they are represented by the genus *Permoberotha.* They also occur in Upper Permian strata of the U.S.S.R. and Australia.

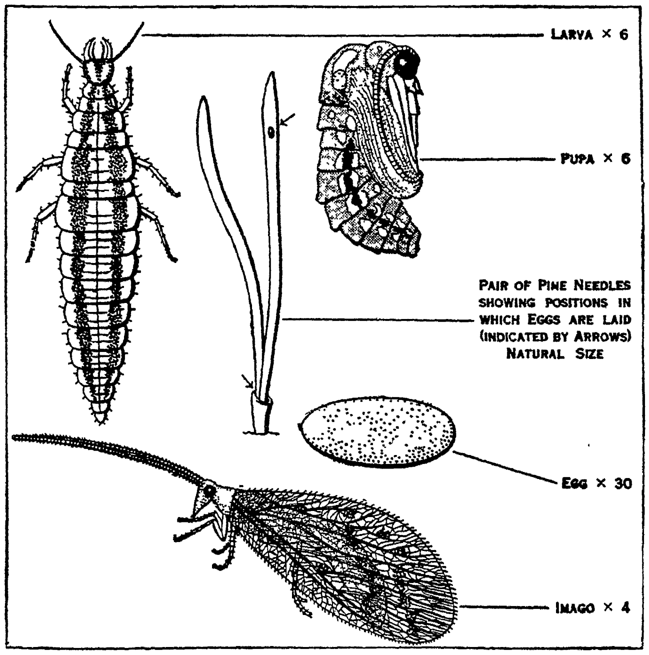

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FIG. 3.—LIFE CYCLE OF BROWN LACEWING (HEMEROBIUS STIGMA)

Economic Importance.—Neuroptera as a whole are distinctly beneficial to man in their larval stages. Larvae of the Sialidae form food for trout and other fishes, while those of the Planipennia prey upon many soft-bodied noxious insects. In Europe and North America the most beneficial families are the Hemerobiidae, Chrysopidae and Coniopterygidae, and in Australia larvae of the

Ithonidae destroy numbers of Scarabaeid grubs in the soil.

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NEUSALZ, a town in the Prussian province of Silesia, Germany, on the Oder, 20 mi. by rail N.W. of Glogau. Pop. (1939) 17,108. Neusalz became a town in 1743. Its largest industry is, perhaps, the manufacture of thread; there are also in the town ironworks, breweries, shipbuilding yards and electrical works. Lignite is mined in the neighbourhood and chemicals manufactured.

It developed trade because of its numerous rail and river connections.

NEUSS, a town in the Prussian Rhine province, Germany, 4 mi. W. of Düsseldorf and 1½ mi. from the west bank of the Rhine, with which it is connected by the Erft canal. It lies at the junction of lines to Cologne, Viersen, Zevenaar (the Netherlands), Düsseldorf, Düren and Rheydt. Pop. (1939) 60,506, of whom the majority were Catholics. Neuss, the *Novaesium* of the Romans, mentioned by Tacitus, formerly lay close to the Rhine. Drusus, brother of the emperor Tiberius, threw a bridge across the Rhine here, and his name is preserved in the Drusustor, the lower half of which is of Roman masonry. In 1474–75 Charles the Bold besieged the town in vain for 11 months, but it was taken and sacked by Alexander Farnese in 1586. Extensive excavations have been made and many Roman treasures have been unearthed.

The church of St. Quirinus is a fine example of the transition from the Round to the Pointed style. The town hall was built in the 17th and altered in the 18th century.

NEUSTADT (Polish, *Prudnik*), a town in the Prussian province of Silesia, Germany, on the river Prudnik, 60 mi. by rail S.E. of Breslau. Pop. (1939) 17,244.

NEUSTADT-AN-DER-HAARDT, a town of Germany, in the Bavarian Palatinate, situated under the eastern slope of the Haardt mountains and at the mouth of the valley of the Speyerbach, 14 mi. W. of Speyer, and at the junction of railway lines to Worms, Weissenburg and Kaiserslautern. Pop. (1939) 24,481. Neustadt is one of the centres of the Rhenish grape cure. It does a large trade in wines and is often called Neustadt-an-der-Weinstrasse.

NEU-STETTIN, a town in the Prussian province of Pomerania, Germany, on the small Streitzig lake, 90 mi. by rail E.N.E. of Stettin, at the junction of railways to Belgard, Posen and Stolpmünde. Pop. (1939) 19,946. Neu-Stettin was founded in 1313 by Wratislaus, duke of Pomerania, and is commercially important.

NEU-STRELITZ, capital of the former German republic of Mecklenburg-Strelitz, situated between the Zierker See and the Glambecker See, 60 mi. N. of Berlin, on the railway to Stralsund, at the junction of lines to Warnemünde and Wittstock. Pop. (1939) 26,225. Neu-Strelitz was not founded till 1726. The former ducal residence is a pseudoclassical edifice, with a library.

About 1½ mi. to the south lies Alt-Strelitz (pop. 4,820), the former capital of the duchy.

NEUSTRIA, the old name for the western kingdom of the Franks, as opposed to the eastern kingdom, Austrasia (*q.v.*). The most ancient form of the word is *Niuster,* from *niust,* which would make the word signify the "most recent" conquests of the Franks. The word Neustria does not appear in Gregory of Tours, but is found for the first time in Fredegarius. Under the later Merovingian kings the princes reigning in the west were called kings of Neustria, and those reigning in the east, kings of Austrasia. Under the new Carolingian dynasty, the word Neustria was restricted to the district between the Loire and the Seine, together with part of the diocese of Rouen north of the Seine; while Austrasia comprised only the Frankish dominions beyond the Rhine, together, apparently, with Mainz, Worms and Spires on the left bank. The districts between Neustria and Austrasia were called *Media Francia* or simply *Francia.* In 843 Brittany took from Neustria the countships of Rennes and Nantes; and gradually the term Neustria came to be restricted to the district which was later called Normandy. By a similar usage, the term Neustria was applied in Italy in the 8th century to western Lombardy.

See F. Bourquelet, "Sens des mots France et Neustrie sous le régime mérovingien," in the *Bibliothèque de l'école des chartes,* vol. xxvi, pp. 566–574; A. Longnon, *Atlas historique de la France.*

NEUTRALITY has been defined as the legal status arising from the abstention of a state from all participation in a war between other states, the maintenance by it of an attitude of impartiality in its dealings with the belligerent states, and the recognition by the latter of this abstention and impartiality. From this legal status arise the rights and duties of neutral and belligerent states respectively. Under the conception of absolute sovereignty prevalent before World War I one state might go to war with another for a good or bad reason, or for no reason at all, and a violation of international law by one state was regarded as no concern of any other, except that immediately affected by such violation. With the creation of the League of Nations and the ratification in 1928 of the Paris pact for the renunciation of war, the concept of permissive sanctions or nonbelligerency arose. States asserted a privilege to manifest varying degrees of partiality toward the warring parties, stopping short of war, and ceased to observe the duty of impartiality. Though the United Nations charter sought to change the privilege of neutrality to a duty to support collective sanctions against aggressor states, it seemed likely that the legal status of neutrality would remain an important problem in international law.

Rights and Duties of Neutrals.—These may be subdivided into the rights and the duties of neutrals; and the rights and liabilities of trade. A neutral state is entitled to have the integrity of its territory and territorial waters respected by all the belligerents. Consequently, belligerents may not use a neutral's territory as a base of operations or engage in hostilities therein. The privilege of the inviolability of its territory is accompanied by a duty to prevent therein acts by belligerents in derogation of its sovereignty. It is entitled to use, and must use, the means at its disposal, including measures of force if necessary, to prevent within its territory the commission of any act which, if tolerated, would constitute a nonfulfilment of its neutral duty. It is also entitled to exact compliance by belligerents with its own municipal regulations, designed to maintain its neutrality and to perform its international obligations. If such regulations are enforced equally upon all the belligerents, they are not to be regarded as hostile or unfriendly. It is entitled to maintain its diplomatic intercourse with other neutral states and with the belligerents alike, except for such temporary interruptions as may be demanded by military necessity. It is entitled to offer its good offices or mediation to the belligerents with a view to the cessation of hostilities without the exercise of this right being regarded as an unfriendly act (*Hague Convention, I,* 1907). Finally it is entitled to require belligerents not to interfere with the commercial intercourse of its subjects, unless such interference is warranted by international law.

Duties of Neutral States.—The primary duty of a neutral state is strict impartiality in its relations with both belligerents, whether such impartial conduct is obligatory or discretionary. There must not be any discrimination or preference. Even a favour granted to one must be extended to the other. A neutral state must not allow a belligerent to move troops, munitions of war or supplies across its territory or to erect or use therein wireless or other telegraphic apparatus for military purposes. It must intern belligerent forces which have taken refuge in its territory, but may leave at liberty escaped prisoners of war and permit the passage of the sick and wounded belonging to the belligerent forces (*Hague Convention, V,* 1907). It must not allow any act of war, including the exercise of visit and search or

capture, to be committed by a belligerent within its territorial waters. It must release a prize so captured with its officers and crew and intern the prize crew. It must not allow a prize court to be established on its territory nor on a vessel within its territorial waters. It must not allow either belligerent to use territory or territorial waters as a base of military operations against its adversary, nor may it furnish either belligerent with troops, ships, munitions of war, money or with commodities of direct or indirect use in the war. It must use due diligence in preventing the fitting out or arming of vessels within its jurisdiction and the departure of vessels intended to engage in hostile operations; the issue of commissions by either belligerent or the enlistment of men (*Hague Convention, XIII*, 1907).

Rights and Liabilities of Neutral Trade.—Restraint on neutral trade with belligerents rests upon a compromise between two conflicting principles. On the one hand the subjects of a neutral state contend that they are entitled to carry on their normal trade with either belligerent, provided such trade is not directly calculated to prejudice the military operations of one belligerent, nor to promote those of the other. On the other hand a belligerent state claims that the subjects of a neutral state are not entitled to supply his enemy with commodities which are of direct and indirect use to his enemy in the conduct of the war. Between these two contentions there have been great divergencies both in theory and practice. A state is apt to take a different view when belligerent from that which it maintained as a neutral. But upon one matter there is no difference of opinion. It is generally recognized that it is for the belligerent and not for the neutral state to enforce the restraints on neutral trade; that it is the duty of the neutral state to acquiesce in such restraints in so far as they are not unwarrantable; and that the violation of such restraints by the subjects of a neutral state are not criminal and only involve the perpetrators in the seizure and loss of their property. The most important restraints on neutral trade are those imposed by the rules relating to blockade (*q.v.*), pacific blockade (*q.v.*), contraband (*q.v.*), continuous voyage, convoy (*q.v.*), unneutral service, and visit and search (*q.v.*).

Neutrality in World War I.—At the outbreak of World War I the warring powers qualifiedly announced their acceptance of the rules of naval warfare as laid down in the Declaration of London of 1909 but subsequent modifications of the declaration in practice eventually rendered it insignificant. The U.S. government accordingly took the position that it would in any event demand that its rights under existing rules of international law and treaties be respected. Resort by the German government to the laying of mines and submarine warfare and by the British government to a system of blockade, rationing, requisitioning and black lists resulted in a vast disruption of neutral rights of trade. The loss of life as well as of property caused by Germany's methods of naval warfare finally led to U.S. intervention on behalf of the Allies.

Basic Concepts of Neutrality.—The developments in neutrality occurring between World War I and World War II were concerned with what had hitherto been regarded as two essential characteristics of neutrality, its voluntary and its absolute quality. First, it was conceived to be a voluntary status in the sense that each state had the sovereign right to abstain or to take part in the hostilities as it might see fit. Second, it was conceived to be absolute in the sense that the neutral state must refrain from any form of participation in the hostilities and any manner of assistance to one of the belligerents.

Neutrality as a Voluntary Status.—In his war message of April 2, 1917, Pres. Woodrow Wilson declared that "neutrality is no longer possible or desirable when the peace of the world is involved and the freedom of its peoples." The council of the League of Nations amplified this thought in Sept. 1920, when it said: "The idea of neutrality of members of the League of Nations is not compatible with the other principle that all the members of the League will have to act in common to cause their covenants to be respected." The members, subject to certain qualifications, solemnly agreed not to resort to war. From this fact arose the question as to whether the obligation to apply sanctions to a member who had resorted to war in disregard of its covenants made the status of neutrality impossible for League members. The assembly concluded on Oct. 4, 1921, after a study of the question, that "the unilateral action of the defaulting state cannot create a state of war; it merely entitles the other Members of the League to resort to acts of war" against the covenant-breaker. The members were not compelled to take such action; each member could "decide for itself whether a breach of the Covenant has been committed." The Pact of Paris of 1928 raised the problem whether non-League members who had signed or adhered to the treaty were thereby precluded from assuming the status of neutrality upon a violation of the treaty by another state party thereto. It was generally felt, however, that the pact did not eliminate neutrality and that each state was privileged to decide for itself whether or not it would ignore a breach of the treaty.

Doctrine of Permissive Sanctions.—A group of jurists, sometimes referred to as the sanctionist school, developed the view that the covenant of the League and the principles of the Pact of Paris, if they did not create the duty, at least created the privilege to discriminate against aggressors. It was advanced that those states who had resorted to war in breach of their treaty obligations were no longer entitled to claim the benefits of impartial conduct as against third parties. Nonbelligerents who had suffered such a breach of treaty obligations were permitted to apply sanctions short of war against the aggressor; the former obligation to be neutral, *i.e.*, impartial, no longer applied. The International Law association, meeting in Budapest, Hungary, in 1934, suggested that a state resorting to war in violation of the pact could not require from other parties thereto observance of the traditional obligations of neutrality. In other words, as between parties to the pact, a nonbelligerent was free, though not obliged, to refuse to a violator of the pact the benefits of impartial treatment.

U.S. Neutrality Legislation Prior to World War II.—The obligations of a neutral state under international law are the same for all nations. A number of nations, including Great Britain, the United States and France, have endeavoured to enforce their obligations under international law through their municipal statutory penal law. This statutory law in the United States is known as the "neutrality laws." In Great Britain the statutory provisions are found in the Foreign Enlistment acts. Such domestic legislation may impose more stringent obligations than those required by international law. In the neutrality legislation of the United States in 1935 and 1937, and to a lesser extent in 1939, a more severe standard of neutral conduct was imposed.

The United States neutrality legislation of the 1930s was a complex of the views of three schools of thought. It was the view of the noninterventionist or isolationist school that war could be avoided by avoiding economic and other contacts with those engaged in hostilities. This view resulted in the embargo and cash-and-carry provisions of the 1937 act whereby (1) the president was empowered, through proclamation, to make it unlawful to export arms, ammunition and implements of war, as determined by him, to the belligerent states named by him, and (2) other trade with the belligerents could be prohibited by the president unless title to the goods was first transferred to the belligerent and the belligerent transported such goods in other than U.S. ships.

The sanctionist school, with its view that impartiality was no longer obligatory as against an aggressor, succeeded to a certain extent in granting discretionary power to the president in enforcing the act by making its operation dependent on a finding that a state of war existed, a discretion which Pres. Franklin D. Roosevelt used in the Chinese-Japanese conflict by failing to make such a finding.

The traditional school of neutrality sought to preserve the requirement of equal and impartial treatment to both belligerents. The Neutrality act approved Nov. 4, 1939, relaxed the embargo on arms, ammunition and implements of war and permitted any foreign transferee of title to remove its own acquisitions of such munitions from U.S. territory. It also empowered the president

to proclaim the existence of combat areas into which U.S. citizens or vessels might not enter. The cash-and-carry and the combat area provisions were eliminated by an act approved Nov. 17, 1941, just prior to Pearl Harbor.

Transfer of Destroyers to Great Britain.—With the German occupation of France and the Low Countries in 1940, the entry of Italy into the war as a belligerent, and the success of German naval warfare over wide areas adjacent to the English channel and the North sea, the United States was confronted with the question of whether maintenance of its traditional neutral attitude of impartiality would not result in the fall of Great Britain and impair the ability of the United States successfully to defend itself. Accordingly, pursuant to an executive agreement of Sept. 2, 1940, 50 over-age U.S. destroyers were transferred to Great Britain in exchange for leases of valuable naval and air bases on British territory in the western hemisphere. Though some opinion sought to justify the transfer as a permissive sanction against an aggressor, other U.S. authorities considered it clearly to be "a violation of our neutral status, a violation of our national law, and a violation of international law."

Lend-Lease Act.—The continuing successes of the axis powers in World War II led to the enactment by the United States on March 11, 1941, of the Lend-Lease act, whereby the president was given full discretion to determine that the defense of any specific country was vital to that of the United States. The president was authorized to manufacture in government arsenals, factories and shipyards, or otherwise procure, defense articles for the government of any such country, "and to sell, transfer title to, exchange, lease, lend or otherwise dispose of, to any such government any defense article." The requirements of self-defense and the doctrine of permissive sanctions were used to justify this otherwise manifest departure from traditional neutrality.

Freezing and Export Controls.—Beginning April 10, 1940, the freezing control of assets of countries invaded and occupied by the axis was begun as a protective measure for such countries. On June 14, 1941, freezing control was extended to the remaining countries of Europe, including Germany and Italy, and on July 26, 1941, to Japan, thereby frankly becoming another instance of application of sanctions. This control involved the prohibition of all transactions in the property of such countries subject to U.S. jurisdiction except under licence. The freezing control was used in conjunction with a system of export controls, including successively the "moral embargo" of 1938 on shipments of aircraft, etc., to countries bombing civilian populations, the Export Control act of July 2, 1940, under which aviation gasoline, steel and iron scrap were embargoed to Japan, and the black-listing, beginning July 17, 1941, of persons and firms in American republics whose activities were believed to be unfriendly to American interests.

Seizure of Foreign Ships in U.S. Ports.—By act of June 6, 1941, the president was authorized to requisition any foreign merchant vessel lying idle in U.S. waters. Italian, Danish and Finnish vessels were the most numerous of those seized under this act. The effect of all the foregoing measures was an abandonment by the United States of its traditional principles of neutrality prior to World War II and an acceptance in its place of the emerging doctrine of nonbelligerency or permissive sanctions. From the standpoint of Germany and Italy, however, they could be regarded as *causae belli,* and were mentioned in the German declaration of war as a violation of the rules of neutrality.

Declaration of Panama.—The Declaration of Panamá signed Oct. 3, 1939, by the representatives of the 21 American republics proclaimed a noncombat zone extending to nearly 300 mi. of the high seas adjacent to the western hemisphere. The measure was sought to be justified as an exercise of protective jurisdiction to protect their neutrality. The declaration was put to the test in the British victory over the "Admiral Graf Spee" off Montevideo, Uruguay. Though the American republics protested this action in a joint statement of Jan. 1940, Great Britain replied that it could not be deprived of its belligerent rights by unilateral action and that it had clearly acted within such rights when they were exercised beyond the three-mile limit.

Neutrality During and After World War II.—World War II presented sufficient instances involving the discharge of neutral duties by Sweden, Spain, Turkey and Argentina, and as between Japan and Russia, that the utility of the traditional rules of neutrality was shown not to be outmoded. They did furnish a standard by which the relations between a weak neutral and a relatively powerful belligerent could be judged. But with the acceleration of the world to a bipolar power system after World War II, the United States and the U.S.S.R. being the respective centres thereof, the possibilities of the abstention of any state from any further major war seemed slight and the value of neutrality as a means of localizing the infections of war remote. It seemed probable that the alignment of interests thus brought about would manifest itself either in direct participation in wars, or in the assumption of the status of nonbelligerency (partiality) with regard thereto, instead of classic neutrality (impartiality). Such policies would profess to be given legal justification on the basis of a collective imposition of sanctions but, in the absence of the universality of the application of such a system through world-wide support of the United Nations, it might be questioned whether any such regional or limited system of collective interference would become international law, in the correct sense of that term.

In so far as the United Nations was concerned, the powers of the Security council, coupled with the agreement of the members to accept and carry out its decisions, represented a long step toward the compulsory imposition of collective sanctions against aggressors. However, decisions of the Security council in this respect were subject to the veto, which might prevent the obligation from ever arising, and were further subject to the working out of special agreements for the furnishing of military aid under article 43. (*See* also BLACK LIST.)

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NEUTRON, a particle in the atomic nucleus (*q.v.*) which has no electric charge. The neutron has a mass very nearly equal to that of a proton, the nucleus of the hydrogen atom. The neutron and the proton are believed to be the fundamental building stones of which all atomic nuclei are composed.

History.—The neutron was discovered only recently, even by standards of atomic physics. Its existence was first postulated by Lord Rutherford in 1920 as a helpful concept in understanding the structure of atomic nuclei. It was experimentally discovered in 1932 by Sir James Chadwick at the Cavendish laboratory in Cambridge, Eng. Earlier in the same year, Frédéric Joliot and Mme. Irène Joliot-Curie in Paris had investigated a certain radiation emitted by beryllium when bombarded by alpha particles from radioactive substances. They found that this radiation which had previously been interpreted as a gamma radiation (*see* RADIOACTIVITY, ARTIFICIAL), was capable of propelling hydrogen nuclei (protons) with very high speed which was incompatible with its supposed nature. Chadwick, after a very thorough experimental investigation of all the properties of the new radiation, came to the conclusion that it must consist of neutral particles of a mass very nearly equal to that of the proton. The major argument in this conclusion was the speed given by the newly discovered particle to various atomic nuclei in collisions. This new particle was named neutron.

It was soon found that neutrons are particularly effective in causing nuclear transformations (*see* ATOM; NUCLEUS); this is because of their lack of electric charge. In 1934 Enrico Fermi and his collaborators showed that nearly every element in the periodic table will undergo a nuclear transformation when bombarded by neutrons. In very many cases, radioactive isotopes (*q.v.*) of the elements are formed in this way. Slow neutrons were found particularly effective in producing many of these transformations.

Among the elements in which neutron bombardment induced

radioactivity Fermi found also uranium. This element was investigated in greater detail by Lise Meitner and Otto Hahn in Berlin in subsequent years. Their results were very difficult to interpret, until late in 1938 Hahn and F. Strassmann found that at least one of the radioactive elements formed in uranium was an isotope of barium. This was immediately interpreted by Otto Frisch and Meitner (also two weeks later and independently, by Hahn and Strassmann themselves) as indicating that the uranium nucleus had been split into two almost equal parts, a process which they called fission. The important technical developments resulting from this discovery will be described in the last section of this article.

Properties of Free Neutrons.—It is most appropriate to discuss the properties of the neutron by comparing them with those of its counterpart in the atomic nucleus, the proton.

The neutron, as already mentioned, has no electric charge, whereas the proton has one positive elementary charge (4.8×10^{-10} electrostatic units). This causes great differences in the passage of the two particles through matter: the proton ejects electrons from atoms which it encounters, and thereby produces heavy ionization along its path. Because of this, the track of a proton can easily be observed in a cloud chamber. The neutron, having no electric charge, can not produce ions but can only make direct collisions with atomic nuclei. Its track can, therefore, not be observed; but the presence of neutrons can only be deduced from the recoil nuclei which have been set in motion by collisions with neutrons. The tracks of these nuclei, which are electrically charged, can be observed in a cloud chamber (see *Detection of Neutrons* below).

Another consequence of the absence of ionization is that neutrons do not lose any of their velocity so long as they do not collide with atomic nuclei. Since such collisions are very rare, a neutron will travel very far before losing its speed. Protons, on the other hand, can travel only very short distances because they lose their energy by ionization. For instance, a proton with a velocity of 3×10^9 cm./sec., which is the order of magnitude of the velocities common in nuclear physics, will travel about 0.005 cm. in a material such as iron or copper. A neutron of the same velocity will travel about 5 cm. before it makes its first collision with a nucleus; and since it loses only a fraction of its energy in this collision, it will continue to travel for 10 to 100 times this distance before it is finally captured by a nucleus. Neutrons are, therefore, very penetrating.

Mass.—The mass of the neutron is very nearly the same as that of the proton. In the physical scale of atomic weights (in which the isotope O^{16} has a mass of exactly 16), the mass of the neutron is 1.00898. On the same scale, the mass of the hydrogen atom is 1.00814 and that of the proton 1.00759. The neutron is, therefore, slightly heavier than the proton and even slightly heavier than the hydrogen atom.

This fact has two important consequences. First of all it makes the neutron unstable against beta disintegration (*see* below). If the neutron were lighter than the hydrogen atom, the latter would be unstable. Since this is in contradiction with the known existence of hydrogen on earth and elsewhere, it follows that the neutron must be heavier than the hydrogen atom.

The second consequence is that the neutron can not be considered as a proton and an electron bound together in some way. If two particles are bound together, then, according to the Einstein relation, $E=mc^2$, the mass of the combination must be less than the sum of the masses of the parts (see *Neutrons as Building Blocks of Nuclei*, below). Therefore, the neutron and the proton have to be regarded as fundamental particles which are closely related to each other in a manner whose details are still unknown.

Spin, Magnetic Moment and Statistics.—Just like the more familiar fundamental particles, the electron and the proton, the neutron has a "spin"; *i.e.*, it has properties which are analogous to those of a spinning top. The value of the spin measured in units of Planck's constant is one-half, just as for proton and electron. It also shares with proton and electron the property of obeying Fermi's statistics, which makes it impossible for two neutrons to be in the same quantum state. The value of the spin and the fact that neutrons obey Fermi statistics are further arguments against the interpretation of the neutron as a combination of electron and proton.

The neutron also has a magnetic moment whose direction is opposite to that of its spin, as if a negative electric charge were revolving in the rotation of the spinning top. The value of the magnetic moment has been measured with great accuracy and is 1.9128 nuclear magnetons. The proton has a positive magnetic moment (as if a positive charge were revolving) whose value is 2.7928 nuclear magnetons. The magnetic moment of the electron is negative and is one Bohr magneton (1,840 nuclear magnetons), as predicted by Paul A. M. Dirac's theory. No theory had been developed by 1953 which explained the magnitude of the magnetic moments of neutron and proton.

Beta Decay.—According to the theory of radioactive beta decay (*see* RADIOACTIVITY, NATURAL), the fundamental process taking place in every beta decay is the transformation of a neutron into a proton plus an electron plus a hypothetical particle without charge, the neutrino. This fundamental process was first observed in 1949. A. H. Snell and collaborators at the Oak Ridge, Tenn., National laboratories detected the simultaneous occurrence of a proton and an electron coming from the decay of neutrons in a high intensity beam issuing from the chain-reacting pile (see *Atomic Energy* below). In 1950 John M. Robson at the Chalk River Atomic Energy project in Canada observed the decay of the neutron and the half life (time after which the original number has decreased to one-half) and also measured the energy spectrum of the decay electrons. He observed the heavy particles resulting from the decays in a sensitive mass spectrometer and showed that they were protons. The negative particles in coincidence with the protons were detected in an electron spectrometer which measured the electron energy. The spectrum obtained in this manner is in good agreement with the predictions of beta-decay theory. The observed maximum energy of the decay electrons gives a value for the mass of the neutron which compares very well with the more accurate measurements (*see* above) made from observations on nuclear transmutations in which all the masses and energies, except the neutron's mass, are known.

Free neutrons decay according to the usual laws of radioactive decay. Robson's measurements enabled him to deduce a value for the half life of the neutron decay of 13 min. This is also in excellent agreement with the value estimated from the theory of beta decay.

Neutrons as Building Blocks of Nuclei.—According to present theory, any nucleus is composed of neutrons and protons. This theory has replaced the older one, held until 1932, that protons and electrons were the building stones of the nucleus. This older theory had encountered grave difficulties. The most striking, perhaps, was that electrons never come out of atomic nuclei in collisions. Moreover, according to quantum mechanics, electrons cannot be compressed into such a small space as the inside of a nucleus. Additional arguments were the spin and the statistics of atomic nuclei, and the peculiar phenomena connected with beta radioactivity. The electron-proton hypothesis has been completely discarded.

The proton-neutron hypothesis has however met with considerable success and has been used to explain a number of fundamental properties of atomic nuclei. It is fairly well established that protons and neutrons can be treated inside the nucleus by the ordinary laws of quantum mechanics.

According to the proton-neutron hypothesis the atomic number Z (charge) of a nucleus is equal to the number of protons contained in it. The mass number A, *i.e.*, the integer nearest to the atomic weight, is the sum of the numbers of protons and neutrons since each of these particles contributes about one unit of atomic weight. The isotopes of a given element, therefore, all contain the same number of protons but varying numbers of neutrons; for instance, any isotope of the element carbon contains 6 protons, the most abundant isotope C^{12} contains in addition 6 neutrons, whereas the less abundant stable isotope C^{13} contains 7 neutrons.

Perhaps the most important information about a nucleus is provided by its exact weight. From it the binding energy of the nucleus can be deduced, with the help of Einstein's relation, $E=mc^2$. For instance, the helium nucleus has a mass of 4.00285. Since its atomic number is 2 and its mass number 4, it contains 2 neutrons and 2 protons; the combined weight of these 4 particles is 4.03314. The difference between this and the weight of the helium nucleus represents the force (more precisely, the energy) with which the 4 particles are held together in the nucleus. Because of the large value of the velocity of light, *c*, the energy represented by this mass difference is tremendous. The formation of 4 gr. of helium from 2 gr. of hydrogen and 2 gr. of neutrons releases as much energy as the burning of about 100 tons of coal.

A binding of this tremendous strength can not be because of electric forces; moreover, no such forces could act on neutrons anyway, because of the absence of electric charge. Gravitational forces are even more inadequate to account for the tight binding. A new force must therefore be assumed which is known as nuclear force. The exact character of nuclear forces is not known; but it is known that they act only over very short distances, having a range of about 3×10^{-13} cm. and being negligible outside this range. The exploration of nuclear forces is the prime objective of nuclear physics, and neutrons have proved to be most valuable tools in this research. The scattering of neutrons of various velocities by protons has given the most fundamental information about nuclear forces.

Neutron Production.—Since the neutron is not stable (see *Properties of Free Neutrons*, above, and *Nuclear Reactions Produced by Neutrons*, below), no neutrons are found in nature in the free state, *i.e.*, outside of atomic nuclei. Therefore, if an experimenter wishes to work with neutrons, he must produce them in his laboratory by means of nuclear reactions. These reactions fall into three types: (a) reactions initiated by a light nucleus, such as the nucleus of light or heavy hydrogen or helium, commonly called proton, deuteron and alpha particle, respectively; (b) reactions initiated by gamma-rays (electromagnetic radiation); (c) nuclear fission.

Reactions Produced by Charged Particles.—This type of reaction was historically the first method to produce neutrons and, until 1942, the only way to produce them in quantity. It is still the most versatile method, being capable of producing neutrons of specified kinetic energy. Chadwick, in his first experiments, obtained neutrons by bombarding beryllium or boron with alpha particles. Nowadays, neutrons are mostly produced by bombarding various atomic nuclei with deuterons and sometimes with protons which are accelerated in a cyclotron or some similar device. This has the advantage that the number of particles obtainable from accelerating devices is very much greater than the number of alpha particles emitted by available amounts of radioactive material. Particular nuclear reactions useful for the production of neutrons will be discussed below.

Yield.—One of the prime considerations for choosing a particular nuclear reaction for the production of neutrons is the yield. This depends sensitively on the kinetic energy (velocity) of the bombarding particle, and on the nature of the bombarding particle as well as of the target nucleus. The bombardment of beryllium with deuterons gives in general a higher yield than any other combination of nuclei. However, even for this reaction, the yield is very small and changes rapidly with the energy of the deuterons: At 1 Mev. (million electron volts) deuteron energy, it is about 1 neutron for 100,000 deuterons; at 10 Mev., about 1 in 1,000, and further increase of the deuteron energy to 40 Mev. is expected to increase the yield to about 1 in 100. The yields are so small because the deuteron loses kinetic energy continuously by ionizing the atoms of beryllium through which it passes, and in general it will have lost all its energy before it has had a chance to hit a beryllium nucleus and disintegrate it. A good cyclotron may give a current of deuterons of about 100 microamperes; if the deuteron energy is 10 Mev., this will produce about 10^{12} neutrons per second.

The yield from the bombardment of beryllium with alpha particles is about 1 neutron for 4,000 alpha particles (if the alpha particles come from radon). One curie of radon (*i.e.*, the amount which is in radioactive equilibrium with 1 gr. of radium), intimately mixed with beryllium will give about 10,000,000 neutrons per second. An average cyclotron is equivalent in neutron production to about 100,000 curies, *i.e.*, to the radioactive rays from 100 kg. of radium.

At very low energy the yield decreases rapidly. The reason is that the incident particle (deuteron or alpha particle) can not come close to the beryllium nucleus because there is a strong electrostatic repulsion between them, because of their positive electric charges, and there is not sufficient kinetic energy to overcome this repulsion. For instance, the yield for deuterons of 500,000 electron volts (ev.) on beryllium is only 1 neutron per 2,000,000 deuterons, and at 250,000 ev. it is immeasurably small. At these low deuteron energies the yield is greater when the target nucleus has a smaller electric charge; for instance, if deuterons are used for the target as well as in the bombarding beam. If the target contains deuterium in the form of heavy ice, the neutron yield for deuterons of 500,000 ev. is about 1 in 200,000, 10 times greater than for a beryllium target, and even at 100,000 ev. it is still 1 in 10,000,000, which, though small, is easily measurable.

Neutrons can also be produced by deuteron bombardment of other light nuclei such as lithium, boron, nitrogen, etc. The yields are usually smaller by a factor between two and ten than the yields from beryllium at the same energy.

Heavy nuclei do not give appreciable numbers of neutrons when bombarded by deuterons of moderate energy because the electrostatic repulsion does not permit deuterons to enter the heavy nucleus. This makes it possible to prevent the emission of neutrons from places where it is not desired, like the top and bottom of a cyclotron tank, by lining these places with substances of high atomic weight. This device fails for deuterons of energies of about 10 Mev. or higher.

Energy Release.—In any nuclear reaction energy is either released or absorbed. When neutrons are produced from deuterons, there is normally an energy release because the proton is not very strongly bound to the neutron in the deuteron and can be bound more strongly to the target nucleus. For instance, with a beryllium target, the energy release is 4 Mev., with a deuterium target, 3 Mev. Higher energy releases are obtained from lithium or boron targets, namely 15 and 13 Mev., respectively. These targets can, therefore, be used to produce very high energy neutrons from deuterons of quite low kinetic energy, which can be accelerated by apparatus of only moderate size and cost. Still higher energy neutrons can be obtained by deuteron bombardment of the hydrogen isotope of mass 3, with an energy release of 18 Mev.; this reaction is also useful because of its high yield at deuteron energies of a few hundred thousand volts.

An important problem in experiments on fast neutrons is the obtaining of neutrons of a well-defined energy (monochromatic neutrons). In general, a nuclear reaction will give neutrons of many different energies because the residual nucleus (which remains after emission of the neutron) can be left in several different quantum states. Thus, the deuteron bombardment of boron gives, besides the fast neutron group with 13 Mev. energy release, at least 3 other groups with energy releases of 9, 6 and 4 Mev., respectively; the reaction with lithium gives neutrons of all energies below the maximum, and that with beryllium gives also many energy groups.

On the other hand, the reaction between two deuterons is satisfactory because in this case the residual nucleus (helium 3) does not have any excited quantum states. The deuteron-deuteron reaction has, therefore, been the standard reaction for producing monochromatic neutrons. The reaction between the deuteron and the hydrogen isotope of mass 3 also fulfils this criterion and does at the same time give very high energy neutrons, in contrast to the deuteron-deuteron reaction.

Neutrons can also be produced by bombarding a nucleus with protons. In this case energy is always absorbed and the reaction, therefore, begins to take place only above a certain kinetic energy of the proton, the threshold energy. Measurement of this thresh-

old energy is most valuable in making accurate comparisons between the masses of atomic nuclei and has given an accurate value of the mass of the neutron. The reaction between lithium 7 and a proton gives monochromatic neutrons with high yield, and is very valuable for the accurate study of neutrons of moderately low kinetic energy.

Neutron Production by Gamma-Rays.—Neutrons can be released from nuclei by gamma-rays, *i.e.*, by electromagnetic radiation of extremely short wave length. The energy of one quantum of gamma radiation, $h\nu$, must be greater than the energy with which the neutron is bound to the rest of the nucleus. In most nuclei this binding energy is about 10 Mev.; notable exceptions are beryllium and deuterium for which the binding energies are 1.67 and 2.23 Mev., respectively.

The yield of neutrons is very small, even for gamma-rays of high energy. This is because it is much more likely for the gamma-rays to be absorbed by producing a pair of electrons (*see* QUANTUM MECHANICS) than to be absorbed in the nucleus. Average yields are about 1 neutron for 1,000 gamma-rays if sufficient material is provided to absorb the gamma-rays completely (this requires a thickness of several centimetres of iron or about a metre of beryllium); in thin layers, the yield is proportionally less. The efficiency of gamma-rays in producing neutrons usually rises with increasing gamma-ray energy and reaches a maximum at a gamma-ray energy of about 15 to 20 Mev. per quantum.

Neutron Production by Fission.—In the fission of uranium and other heavy nuclei, neutrons are emitted. This is the basis of the nuclear chain reaction which is the most economic means of producing large quantities of neutrons.

The fission of uranium can be induced by neutrons; in each fission one neutron is absorbed whereas more than one neutron is emitted. Each of the emitted neutrons can in turn produce fission in another uranium nucleus provided (1) the neutrons are not absorbed by other nuclei, and (2) a sufficient amount of uranium is used to prevent escape of the neutrons. In this way a nuclear chain reaction is obtained in which neutrons are continuously produced in fissions and in turn cause fission in other nuclei.

There is virtually no limitation on the number of neutrons that can be produced in this way. The only practical limitation comes from the considerable amount of energy released in fission which must be dissipated. If 100,000 kw. can be dissipated, more than 10^{18} neutrons per second are produced; one such machine thus gives a neutron production equivalent to 1,000,000 cyclotrons. For experimentation one has to consider that the neutrons will be distributed over a larger area which makes their density not so much larger than that from a cyclotron. Moreover, in working with large numbers of neutrons, the health hazards must be considered.

Nuclear Reactions Produced by Neutrons.—The most important physical property of neutrons is the absence of electric charge. This enables them to approach an atomic nucleus without being repelled by its positive charge. Therefore, a neutron can enter an atomic nucleus no matter whether it is fast or slow. On the other hand, a charged nuclear particle like a proton or deuteron can enter a nucleus only when it has a sufficiently high velocity to overcome the electric repulsion; the usefulness of such a particle for producing nuclear reactions is exhausted after it has been slowed down. Accordingly, the yield of nuclear reactions produced by a charged nuclear particle is only of the order of 1 in 1,000 or less (see *Reactions Produced by Charged Particles*, above); on the other hand, the yield of nuclear reactions from neutrons is nearly 100%; almost every neutron which is produced will ultimately be captured by a nucleus and will produce some nuclear reaction.

Several types of reactions between neutrons and atomic nuclei will be discussed in the following. Which of these reactions takes place in any given collision between neutron and nucleus is a matter of chance; the probability of any given type of reaction depends on the particular nucleus with which the neutron collides, and on the velocity of the neutron. Some reactions, notably the capture of neutrons with the emission of gamma radiation, are enhanced by reducing the velocity of the neutrons while others can be initiated only by fast neutrons.

Scattering of Neutrons.—The simplest process which may occur when a neutron hits an atomic nucleus is scattering, *i.e.*, a change of the direction in which the neutron moves. This scattering may be elastic like the collision between two billiard balls; in this case, the kinetic energies of the neutron and the nucleus after the collision add up to the kinetic energy of the neutron before the collision; or the scattering may be inelastic; *i.e.*, kinetic energy may be lost and transformed into internal energy of the nucleus.

Only elastic scattering is possible in collisions between neutrons and protons (nuclei of ordinary hydrogen). In collisions with other nuclei, in general both types of scattering may occur; but if the kinetic energy of the neutron is small, again only elastic collisions are possible, because then the energy will not be sufficient to excite any of the higher energy levels of the nucleus. Depending on the particular nucleus involved, the neutron must have a minimum energy of from 0.1 to about 10 Mev. in order to make inelastic scattering possible. Once the neutron energy is above this limit, inelastic scattering becomes rapidly more important and predominates over elastic scattering when fast neutrons collide with heavy nuclei. In the majority of cases, a very large fraction of the kinetic energy is lost in inelastic collisions, so that the neutrons emerge after the collisions with an average kinetic energy of about one-quarter of their initial energy or less. The remainder of the energy has been transformed into excitation energy of the nucleus and usually appears afterward in the form of gamma-rays.

Collisions between neutrons and atomic nuclei are, of course, relatively rare because of the very small size of the atomic nucleus. This size can be determined from the frequency of collisions with fast neutrons. The frequency of collisions is commonly measured in terms of the effective cross section, *i.e.*, the target area which the nucleus appears to present to the neutron. If the cross section is σ, a thin slab of material, of thickness t and containing N nuclei per unit volume, will scatter (or absorb) a fraction

$$f = N\sigma t$$

of the neutrons incident upon it. The cross section σ is conveniently determined by measuring the fraction $1-f$, of neutrons which penetrate the slab without being deflected.

The cross sections of nuclei for collisions with fast neutrons are all of the order 10^{-24} sq.cm. This corresponds to a radius of the nucleus of about 10^{-12} cm. which confirms the result obtained from other experiments (the figure 10^{-12} is correct for the heaviest nuclei). Neutron scattering experiments further confirm that the volume of nuclei is roughly proportional to the number of particles contained in them, *i.e.*, to the atomic weight. The most important deviation from this rule is that the lightest nuclei tend to present a relatively greater cross section to neutrons of moderate energy (a few million electron volts). In solid materials neutrons travel on the average about 2 to 10 cm. between two collisions.

For the theory of nuclear forces, the scattering of neutrons by protons is particularly important. The effective cross section of the proton for slow neutrons is unusually large, namely about 20×10^{-24} sq.cm., whereas that of nuclei such as Al, Si, etc., is only about 2×10^{-24} sq.cm. The large cross section of the proton has been explained in terms of a resonance effect. At higher neutron energy, the proton cross section decreases but it is still 3×10^{-24} sq.cm. for neutrons of 2 Mev. and falls in line with heavier nuclei only at extremely high neutron energy.

Whether the scattering is elastic or inelastic, some kinetic energy will be transferred from the neutron to the nucleus. The scattering is, therefore, connected with a slowing of the neutron which will be discussed in more detail under *Neutron Diffusion*, below.

Nuclear Reactions Leading to the Emission of Charged Particles.—In many cases the collision between a neutron and a nucleus leads to a true nuclear reaction in which a nuclear particle other than a neutron is emitted. These reactions are the inverse

of the reactions in which neutrons are produced by an incident-charged particle.

Many reactions have been observed in which a proton or an alpha particle is emitted when a nucleus is bombarded by a neutron. Reactions in which a proton is produced in general absorb energy and can, therefore, be caused only by neutrons of considerable kinetic energy. There are some exceptions, the most important being the reaction $n+N^{14}\rightarrow H+C^{14}$ which releases an energy of 0.6 Mev.; this reaction is caused with considerable probability by very slow neutrons.

The reactions in which alpha particles are emitted often release energy. The most important ones of this type are the reactions of neutrons with lithium 6 and with boron 10; the cross section for these reactions is extremely great, especially for slow neutrons ($4{,}000 \times 10^{-24}$ for boron 10, 900×10^{-24} for lithium 6).

Many neutron-induced nuclear reactions lead to the formation of a radioactive nucleus, which subsequently emits a beta-ray (electron). An example is the nucleus C^{14} which results from neutron bombardment of nitrogen, and it can be shown from general arguments about nuclear stability that all reactions caused by a neutron in which a proton is emitted lead to a radioactive nucleus. If an alpha particle is emitted in the reaction, the resulting nucleus may or may not be radioactive; for instance, the reaction between neutrons and lithium 6 leads to the important radioactive isotope of hydrogen of mass 3, whereas the reaction with boron 10 gives the stable nucleus lithium 7.

Nuclear reactions can be used to detect neutrons (see *Detection of Neutrons*, below) and it is particularly useful that some reactions can be caused only by fast neutrons while others are primarily initiated by slow ones. One can observe either the charged particle (proton or alpha particle) which is emitted in the reaction itself, or one can observe the (possible) radioactivity of the nucleus formed in the reaction.

Reactions Leading to the Emission of Several Neutrons.—When a neutron of very high energy (more than 10 Mev.) hits a nucleus, 2 or more neutrons are frequently emitted from the nucleus. In the case of heavy nuclei and of neutrons of sufficiently high energy, theory shows that this is the most likely process to occur. If two neutrons are emitted, the bombarded nucleus loses one unit of weight; this results frequently in a radioactive nucleus. Reactions of this type are often useful because they provide specific detectors for neutrons of high energy.

Capture of Neutrons.—Neutrons colliding with an atomic nucleus may simply be captured and incorporated into the nucleus, the energy of binding and the kinetic energy of the neutron being transformed into the energy of one or several gamma-rays. This simple capture process can occur with any nucleus except helium 4. In many instances, neutron capture leads to the formation of a radioactive nucleus which subsequently emits beta-rays; this makes the capture easily observable and makes it possible to use this process for the detection of neutrons. The probability of capture varies greatly; it is generally greater for slow than for fast neutrons, and greater for heavy than for light nuclei. For fast neutrons and light nuclei the capture probability is immeasurably small, for heavy nuclei about 1 collision in 20 to 200 leads to capture. For slow neutrons and heavy nuclei, capture is often more probable than scattering (for instance, for one isotope of cadmium about 10,000 times!). For slow neutrons and light nuclei, scattering still predominates over capture, *e.g.*, in ordinary hydrogen in the ratio 200 to 1, and in heavy hydrogen or carbon even more strongly.

Accordingly, neutrons have very different lifetimes in different substances, the lifetime being the average time from the production of the neutron until it is captured (or causes a nuclear reaction). In solid boron, this time is about $\frac{1}{10{,}000{,}000}$ sec., in most solids of high atomic weight about $\frac{1}{10{,}000}$ sec., in such special substances as graphite it becomes more than $\frac{1}{100}$, while in gases it ranges from about $\frac{1}{10}$ sec. for air to many seconds in pure heavy hydrogen. Even the longest of these times is short compared with the time required for the neutron to emit a radioactive beta particle (13 min.) which made the latter process very hard to observe.

The capture of slow neutrons shows the interesting phenomenon of resonance. For each nucleus there exist certain characteristic values of the kinetic energy of the neutron which make the capture of the neutron very likely. For instance, cadmium absorbs very strongly all neutrons less than 0.4 ev., indium absorbs neutrons of 1.4, 4 and 9 ev., gold those of 5 ev., whereas iodine has resonances at about 20, 30 and 40 ev. and some at higher energies. The resonances are very sharp; *e.g.*, indium absorbs strongly only neutrons between 1.2 and 1.7 ev., and its capture cross section at 1.44 ev. is more than 100 times as large as that at 2.5 ev. To study these neutron resonance levels, special devices, known as velocity selectors, have been built which measure the time of flight of the neutron from its source to a detector. Studies of resonances give important information on the structure of nuclei; in fact, the resonance effects in the capture of slow neutrons gave rise to the modern theory of the compound nucleus, first developed by Niels Bohr, which forms the basis for the general understanding of reactions involving heavy nuclei.

Fission.—Neutrons can produce fission in heavy nuclei, especially in uranium, thorium and plutonium. Fission consists in the splitting of the heavy nucleus into two parts of almost equal weight. This is possible because the stored energy in the heavy nucleus is considerably greater than the sum of the stored energies in the two nuclei of medium weight which are produced by the fission. The difference in stored energy is released in the process of fission; it is approximately 200 Mev. per fission. In a plant in which 1 gr. of uranium undergoes fission per day, about 1,000 kw. of power are developed.

The use of fission for practical purposes is based on the fact that neutrons are emitted in the fission process and that more than one neutron is emitted per fission. This makes it possible to have a nuclear chain reaction in which the neutrons emitted in fission in turn produce fission. As was pointed out in *Neutron Production by Fission*, above, this process is the most suitable one for the practical production of neutrons in large quantities.

Detection of Neutrons.—One of the most important problems in neutron experiments is the detection of the neutrons. Since the neutron produces no direct ionization, it can be detected only through its interactions with other nuclei. Three types of effects may be used for the detection of neutrons, viz.:

(1) The recoil of a nucleus which has collided with a neutron; (2) the charged particles emitted in a nuclear reaction produced by a neutron and (3) the production of a radioactive nucleus by any nuclear reaction caused by the neutron (this reaction may be simple capture).

The first effect will occur only with fast neutrons and can, therefore, be used only to detect these neutrons; on the other hand, it has the advantage that it permits the determination of the energy of the neutron. The second and third effect can be used for the detection of slow as well as fast neutrons; different nuclear reactions are used in the two cases.

Fast Neutron Detectors.—Recoil Detectors.—In an elastic collision between a neutron of mass m and a nucleus of mass M the latter receives the kinetic energy

$$E' = \frac{4mM}{(M+m)^2} E \cos^2 \theta \qquad (1)$$

where E is the kinetic energy of the neutron before the collision and θ is the angle between the direction of motion of the incident neutron and the recoil nucleus. For ease of observation, a large kinetic energy of the recoil nucleus is usually desirable; therefore, protons are preferred because their mass M is practically equal to that of the neutron. If the recoil proton goes in the same direction as the incident neutron, it will receive the entire kinetic energy of the latter.

Protons are also favourable because the probability of their collision with a neutron is particularly large and can be calculated with great accuracy on theoretical ground. Furthermore, the recoil protons produced by neutrons of a given energy E are distributed uniformly in kinetic energy from 0 to E, which simplifies the determination of the energy of neutrons.

The most important types of proton recoil detectors are cloud

chambers filled with hydrogen or a gaseous hydrogen compound, photographic emulsions and ionization chambers with linear pulse amplifiers. The cloud chamber or emulsion is then exposed to neutrons coming from a definite direction and the direction as well as the length of the proton tracks is observed. From the length of the track the energy of the proton can be deduced. In an ionization chamber the energy is measured by the number of ions formed (by a single proton). The ionization chamber can be filled with hydrogen or provided with a layer of paraffin or some other solid material containing hydrogen. For the observation of large numbers of neutrons and determination of their energy, the ionization chamber is the most satisfactory instrument.

The efficiency of neutron counters is low, because of the small probability of collision between neutrons and nuclei. A proton recoil counter containing a thick layer of paraffin in an ionization chamber is the most efficient counter known for fast neutrons. If the neutron energy is E Mev., the counter will give about $2E$ pulses for every 10,000 neutrons incident upon it. Thin paraffin layers, of course, give even smaller efficiency but are more convenient for measuring the neutron energy. "Thick" and "thin" are to be understood in comparison with the range of the recoil protons.

Deuterons and alpha particles have also been used successfully for the observation of neutrons by the recoil method; in these cases, however, the energy distribution of the recoil nuclei is not uniform as it is in the case of protons. The recoil of still heavier nuclei, such as carbon, comes in mainly as a disturbing effect when compounds such as paraffin are used in a recoil detector.

Nuclear Reactions.—The reaction of neutrons with boron 10, giving alpha particles, can be used for the detection of fast neutrons. An unsatisfactory feature of this detector is that the reaction is produced with much higher probability by slow neutrons than by fast ones.

Fission is a very convenient means of detecting neutrons, because it gives rise to very large pulses of ionization which can easily be distinguished from any disturbing effect. It is usually desirable that the detector respond only to fast not to slow neutrons; this can be accomplished by using uranium 238 or thorium, rather than U^{235} or plutonium. The detection efficiency is about 100 times lower than for a proton recoil counter.

Radioactivity.—Many nuclear reactions produced by neutrons lead to radioactive nuclei. These can be observed after the end of the irradiation with neutrons, a fact which is often an advantage. For the detection of fast neutrons, reactions are preferable which can be produced only by fast neutrons. The reaction $n+Al^{27}=Mg^{27}+\mathrm{H}$ is a good example; Mg^{27} is a radioactive nucleus emitting beta-rays with a lifetime of about 10 min. The reaction can be produced only by neutrons of more than 2 Mev. kinetic energy and increases in probability with increasing neutron energy. Similar threshold detectors can be obtained by using Mg, Si, P, etc.

Of particular interest are threshold detectors sensitive to neutrons of extremely high energy. Such detectors are provided by nuclear reactions in which one neutron enters the nucleus and two neutrons are ejected. A very useful reaction of this type occurs with copper, leading to the formation of the radioactive nucleus Cu^{62} of 10 min. half-life; it occurs with neutrons of more than about 11 Mev. energy. For still higher neutron energy carbon is a good detector; a reaction of the same type leads to the formation of C^{11}, a radioactive nucleus of 20 min. half-life. The minimum neutron energy required in this case is about 20 Mev.

Detectors for Slow Neutrons.—The recoil type detector is not usable in this case, which leaves only two types:

Nuclear Reactions.—The most generally useful detector of slow neutrons is based on the reaction $n+B^{10}=Li^7+He^4$. This reaction has an extremely high probability for slow neutrons (cross section, 4,000 x 10^{-24} sq.cm.). The alpha particles have an energy of about 1.5 Mev. and are easily observed. The most commonly used detector consists of an ionization chamber filled with boron trifluoride gas; the ionization pulses are detected with the help of a linear amplifier. Moderate size chambers of this type (about 10 cm. long) at atmospheric pressure will detect about 10% of the neutrons of thermal velocity (2 km. per second) incident upon them. Increase in the pressure and size, and use of separated boron 10, will increase the efficiency. It is obvious that the detection of slow neutrons is much more efficient than that of fast ones.

Boron can also be used in the form of thin foils of boron metal or boron carbide, the alpha particles being detected in some neutral gas. Lithium 6 may be used instead of boron 10 but the detection efficiency in this case is about ten times smaller.

Fission is a very convenient means of detecting slow neutrons because of the large pulses of ionization. Uranium 235 or plutonium must be used because only these nuclei undergo fission when bombarded with slow neutrons.

Radioactivity.—There are many ways of observing slow neutrons by using the formation of radioactive nuclei. The most useful type of nuclear reaction for this purpose is the simple capture of neutrons (with emission of gamma-rays), which is generally much more probable for slow neutrons than for fast ones and thus provides a specific detector for slow neutrons. As has been mentioned before, neutron capture leads often, although not always, to the formation of a radioactive nucleus. Indium foils have been found especially useful as detectors of slow neutrons but also silver, gold, rhodium, bromine, iodine and other substances have been used successfully. The radioactivity is observed after the end of the irradiation by neutrons.

Detectors of this type can be selected so as to indicate slow neutrons of fairly definite velocities by making use of the resonance effects. In order to measure the number of very slow neutrons (less than 0.4 ev., thermal neutrons) one uses the fact that cadmium absorbs these neutrons very strongly while it is transparent for neutrons of higher energy. If one measures the radioactivity produced, for instance, in an indium foil with and without a shield of cadmium around the foil, the difference indicates the number of thermal neutrons incident upon the foil. On the other hand, the radioactivity observed with the foil covered by cadmium, is almost entirely because of neutrons whose kinetic energy corresponds to a resonance in the indium nucleus (see *Capture of Neutrons*, above). By using different detectors with different resonance energies, one can observe the properties of neutrons of various energies.

Neutron Diffusion.—For many experiments, it is desirable to reduce the velocities of the neutrons. This can be done by permitting the neutrons to collide with nuclei; in each collision some kinetic energy is transferred from the neutron to the nucleus. If this process is continued for a sufficient number of collisions, the velocity of the neutrons will be reduced until they come into equilibrium with the thermal motion of the atoms with which they collide.

In this manner so-called thermal neutrons are produced. The thermal neutrons have a velocity distribution similar to that of molecules in a gas; their mean velocity at room temperature is 2.2 km. per second. The thermal neutrons continue to make collisions with atomic nuclei; but since they are now in thermal equilibrium, these collisions no longer slow the neutrons down, there being equally many collisions in which the neutron gains and in which it loses energy. Ultimately, the neutron will be captured by a nucleus. This happens in most substances only after the neutrons have been slowed down to thermal energy because the capture probability is usually quite small compared to the probability of scattering. Only in some substances, like boron, capture will take place while the neutrons are still fast.

The production of slow neutrons, and of thermal neutrons in particular, is important from the scientific as well as from the practical point of view. The investigation of thermal neutrons has yielded most of the information about the radioactive nuclei formed by neutron capture. The investigation of neutrons of somewhat higher energy showed the existence of resonance levels in nuclei and thus laid the foundation for the modern theory of the compound nucleus (see *Capture of Neutrons*, above). For chain-reacting piles in which natural uranium is used, slow neu-

trons are important in order that the fission of uranium 235 predominates over the capture of neutrons in uranium 238. Whatever the purpose of the slowing down, it is important that not many neutrons are lost by capture during the process.

The most commonly used moderator for the slowing of neutrons is hydrogen in the form of paraffin or of water. Hydrogen has the advantage that the neutron loses a large fraction of its energy in each collision (see *Fast Neutron Detectors,* above) and that the effective cross section is large. Neutrons of an initial energy of 2 Mev. become thermal at an average distance of about 10 cm. from the source, in paraffin or water. However, a paraffin block of at least 50 cm. radius is required to prevent a sizable fraction of the neutrons from escaping. If the neutrons are emitted from the source with higher kinetic energy, larger amounts of paraffin are needed to slow them down and vice versa.

For atomic energy piles, hydrogen-containing substances are not suitable because protons capture neutrons with considerable probability. In this case, either heavy water or graphite are commonly used. The energy transfer in a collision is in this case much less than in the case of protons, and the effective cross sections are also smaller. Therefore, much larger amounts of material are required to slow the neutrons down to thermal energy; this is one of the reasons for the large size of atomic energy piles. On the other hand, there is practically no capture in either graphite or heavy water until the neutrons have been slowed to thermal energy, and even at thermal energy they will make hundreds of collisions before being captured.

The mathematical treatment of neutron diffusion is usually done in two stages; namely, first the slowing down to thermal energy and then the diffusion of the thermal neutrons. The second stage can be treated according to the ordinary methods of diffusion theory, using the diffusion equation

$$\tfrac{1}{3}\, lv\nabla^2 n - \frac{n}{\tau} + q = 0$$

where n is the density of neutrons (number per cubic centimetre), q the strength of the neutron source (number produced per cubic centimetre and second), l is the mean free path of the neutrons between two collisions, v their mean velocity and τ their mean lifetime, that is, the mean time which elapses before they are captured.

The mathematical treatment of the first stage, the slowing process, is quite difficult because the mean free path of the neutron changes with its velocity. A very useful although not exact concept in this theory is the age of the neutron, defined as one-sixth of the mean square distance travelled by the neutrons from the source to the point at which their energy drops below a certain arbitrary energy, E. The age η can be calculated as a function of E from experimental data and the density of neutrons of energy E at the distance r from the source in a homogeneous medium is given approximately by

$$n\,(\eta, r) = (4\pi\eta)^{-3/2} \exp(-r^2/4\eta).$$

Atomic Energy.—The basis for the practical release of the energy of atomic nuclei is the fission of uranium. As was mentioned already, fission can be caused by neutrons, and in each fission a certain number of neutrons, ν, is released. For uranium 235, for example, ν has the value 2.5. This is the basis of the nuclear chain reaction in which each of the neutrons produced in fission is again permitted to react with a uranium nucleus and can cause another fission.

Conditions are simplest in the rare isotope uranium 235, or in plutonium 239. These substances can be made to undergo fission by neutrons of any velocity; in fact, slow neutrons are most effective. Therefore, the slowing down of the neutrons by their unavoidable collisions with the uranium nuclei does not diminish their effectiveness. In a large mass of uranium 235, every neutron which has been released in a fission will in turn cause fission. Since the number of neutrons released in each fission is greater than one, the total number of neutrons will increase in this process. The increase is very rapid because very little time elapses between the production of a neutron and its causing fission in another nucleus. With large amounts of uranium 235 or plutonium, therefore, one obtains an explosive multiplication of the neutrons and an explosive release of fission energy. This is the principle of the atomic bomb.

If the amount of uranium 235 is reduced, a fraction of the neutrons produced in it will escape and, thus, not produce further fission. If the amount of uranium is made small enough, so that only one neutron out of every ν neutrons produced will stay in the uranium, whereas the remaining $\nu-1$ escape, the reaction will cease to lead to a multiplication of the number of neutrons but will merely be self-sustaining. This is the principle of the chain-reacting pile for the production of atomic energy without explosion. It is ordinarily desirable to keep the amount of the expensive material, uranium 235 or plutonium, to a minimum. This is accomplished both in the chain-reacting pile and in the bomb by surrounding the active material with a reflector, *i.e.,* any substance which can scatter neutrons back to the active material, and thus minimizes the number of escaping neutrons. Conditions are somewhat more complicated if ordinary uranium is used instead of the separated isotope 235. In this case the abundant isotope of uranium, 238, undergoes fission only when bombarded by fast neutrons, whereas slower neutrons will simply be captured, leading to the formation of uranium 239. In this capture the incident neutron disappears and no new neutron is emitted. Only the rare isotope uranium 235, which comprises about 0.7% of natural uranium, undergoes fission with slow neutrons, and thus can keep the chain reaction going. But in general the fission in 235 is much weaker than the capture in 238; only for neutrons of very low velocity, less than 1 ev., is the ratio reversed. Since it is not possible to avoid nuclear collisions and thus keep the neutrons at very high energies (at which they could produce fission in 238), it is necessary to slow them down completely, *i.e.,* to energies less than 1 ev., so that they can cause fission in 235 with high probability.

On the basis of these considerations atomic energy piles are designed to include a moderator, usually graphite or heavy water (see *Neutron Diffusion,* above), which serves to slow the neutrons down to thermal energies. The neutrons produced by fission have kinetic energies of several million electron volts; they are then permitted to diffuse in the moderator and come back as thermal neutrons to the uranium. Then some of them will cause fission in 235 and thus produce new neutrons to sustain the chain reaction. Other neutrons returning to the uranium will be captured in 238 and produce uranium 239. This is a radioactive nucleus which decays successively into neptunium and then into plutonium 239. The plutonium can be separated chemically from the uranium and can be used in its turn for atomic energy production. The production of plutonium in a chain-reacting pile is the first instance in which one chemical element has been transmuted into another in large quantities by man.

The chain-reacting pile is very useful for the production of neutrons in large quantity. By letting the emerging neutrons diffuse through large additional amounts of moderator, it is possible to obtain thermal neutrons which are almost entirely free of fast neutrons, for experimental purposes. Another use of chain-reacting piles is the production, by the capture of neutrons in various natural nuclei, of a great variety of radioactive nuclei which are useful as tracers in biology, chemistry and for industrial research.

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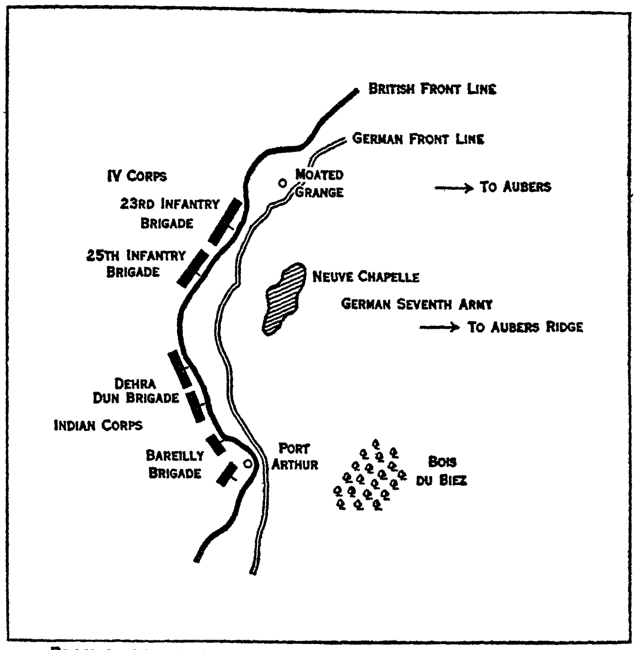
NEU-ULM, a town in Bavaria, Germany. Pop. 14,866 (1951). The town is situated on the Danube, opposite Ulm, and is a railway centre. It was incorporated as a town in 1857.

NEUVE CHAPELLE, BATTLE OF (March 10–13, 1915). Neuve Chapelle is a village in Pas de Calais west of Lille. Pop. (1946) 419. To understand the tactical idea upon which the battle of Neuve Chapelle was founded (the first of the siege warfare battles undertaken by the British army in France) it must be clearly kept in view that the British higher command had not grasped the fact that the war which now confronted them was an engineer-artillery war, and not a cavalry-infantry one. They considered that infantry could "open a door for an inroad of horsemen against the enemy's rear," and in spite of the failure of Neuve Chapelle, this quite impossible idea governed the tactics of Sir John French and Sir Douglas Haig up to the end of the war.

Plan of Attack.—On Feb. 12, General Haig recommended an offensive towards the Aubers ridge on a frontage of 2,000 yards between Port Arthur and the Moated Grange. Neuve Chapelle was to be the first objective, then a line east of the village, and finally the Aubers ridge, the occupation of which would threaten the enemy's communications between La Bassée and Lille. Sir John French, the commander-in-chief, approved of this plan, and fixed its date as soon after March 9 as weather would permit. The attack, or rather assault, was to be carried out by two corps, the Indian corps on the right and the IV corps on the left. It was to be made after an intense artillery bombardment of 35 minutes' duration. Having broken the enemy's front, it was proposed to extend the attack to five miles in width, and so make room for the cavalry corps to pass through and pursue. The bombardment was to be carried out by 530 guns and howitzers, and the ammunition available was approximately 216,380 rounds.

Operations of March 10.—At 4.30 A.M. the assaulting battalions were in position. The morning was cold and misty, and visibility was bad. Sunrise was at 6.30 A.M., and exactly one hour

later the general bombardment was opened. At 8.5 A.M. the attack was launched, and its first phase was carried out with considerable success. At 8.50 A.M. Neuve Chapelle was entered, but here the advance of the right was brought to a standstill by the British artillery barrage which had lifted, and was now falling between the village and the Bois de Biez. The first real trouble was experienced on the two flanks, on the right from the Bois de Biez, and on the



PLAN OF THE BATTLE OF NEUVE CHAPELLE, MARCH 10–13, 1915

left from Manquissart, from both of which a heavy fire was directed on the attackers rendering it impossible for them to extend their front rapidly. By 1 P.M. the whole of the first objective, except part of the Port Arthur salient, was in British hands. Then came a delay. Sir Douglas Haig proposed to advance on the Aubers ridge at 2 P.M., but this attack had to be postponed. This enabled the Germans to push forward reserves to their second line position east of the village, which was only partially dug. From this line an effective cross fire was brought to bear on the north of Neuve Chapelle.

Operations of March 11.—During the night the Germans strengthened their new front line. The main attack was carried out by the IV. corps, and was directed on Aubers, the Indian Corps supporting it on the right. It was launched at 7 A.M., but was at once crushed by heavy machine gun fire opened from the concave position now held by the enemy. A little after noon the attack had to be abandoned. It was then clear that until the infantry assault could be prepared by an effective bombardment, to continue the action would lead to unprofitable slaughter.

Operations of March 12.—At 5 A.M. on the 12th the Germans made a strong counter-attack which, however, failed in its object. This was followed by an order from Sir Douglas Haig to continue the attack. It was ordered and then postponed with the inevitable confusion resulting. The IV. Corps was instructed to "push through the barrage of fire regardless of loss." The Bois de Biez was to be taken "at all costs." The 7th and 8th Divisions were to push on "regardless of the enemy's fire," with the inevitable result that hundreds of men were at once shot down. By nightfall it became obvious that the battle could not be continued, and early on the 13th Sir John French, having lost 12,892 officers and men, wired to Lord Kitchener: "Cessation of the forward movement is necessitated . . . above all by want of ammunition."

Comments.—The true reason for the failure was lack of understanding. An attempt was made to attack a fortress as if it were a deployed army in the field. The conception of surprise was admirable, but it was useless to expect to capture the Aubers ridge from a frontage of 2,000 yards. To do so the frontage should have been at least 12,000 yards, because the ridge was some 6,000 yards distant, and because in siege-warfare the normal depth of penetration is half the length of the initial base. Nevertheless, in this battle, the first of the British grand attacks, and the first in which the "barrage" was used, more common sense was shown in restricting the artillery bombardment to the shortest possible time than in any subsequent battle up to that of Cambrai in November 1917. The German defences were but half a mile deep, and it was possible to fracture them by artillery fire if the bombardment were rapid, for rapidity carried with it surprise.

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NEUVILLE, ALPHONSE MARIE DE (1836–1885), French painter, was born at Saint-Omer, France, on May 31, 1836. From school he went to college, where he took his degree of *bachelier ès lettres*. He first took up painting in 1856, after passing through the Naval College at Lorient. For a time he worked in Picot's studio, but was painting independently when he produced his first picture, "The Fifth Battalion of Chasseurs at the Gervais Battery (Malakoff)." In 1861 he exhibited "The Light Horse Guards in the Trenches of the Mamelon Vert," at the Salon. His pictures of military life showed peculiar insight, but his full power was not reached till after the war of 1870, episodes in which he depicted in a famous series, including the "Bivouac before Le Bourget" (1872), "The Last Cartridges" (1873), the "Surprise at Daybreak" (1878), and a considerable number of drawings. He also exhibited in London some episodes of the Zulu War. In 1881 he was made an officer of the Legion of Honour for "The Cemetery of Saint-Privat" and "The Despatch-bearer." He also collaborated with Detaille in "The Panorama of Rézonville." De Neuville died on May 18, 1885.

See Montrosier, *Les Peintres militaires* (1881), and "De Neuville" in *Gazette des beaux arts* (1885).

NEUWIED, a town in the Prussian Rhine province, Germany, on the Rhine, 8 mi. below Coblenz, on the railway from Frankfort-on-Main to Cologne. Pop. (1939) 21,593. Neuwied was founded by Count Frederick of Wied in 1662, on the site of the village of Langendorf. Among those who sought refuge here was a colony of Moravian Brethren; occupying a separate quarter of the town, they carried on manufactures of porcelain stoves. Near Neuwied one of the largest Roman *castra* on the Rhine has been excavated. The principal building is the château, which contains a collection of Roman antiquities.

NEVA, a river of Russia, which carries off into the Gulf of Finland the waters of Lakes Ladoga, Onega, Ilmen and many smaller basins. It issues from the south-west corner of Lake Ladoga in two channels, which are obstructed by sandstone reefs, so that the better of the two has a depth of only 7 to 16 feet. A little farther down it becomes completely navigable, and attains a breadth of 4,200 ft.; but between the village of Ostrovki and that of Ust-Tosna it passes over a limestone bed, which produces a series of rapids, and reduces the width of the river from 1,050 to 840 and that of the navigable passage from 350 to 175 feet. Nine or ten miles before reaching its outfall the river enters Leningrad, and 5 or 6 m. lower down breaks up into the Great Neva (850 to 1,700 ft. wide), the Little Neva (945 to 1,365), and the Great Nevka (280 to 1,205), this last, 2 m. farther on, sending off the Little Nevka (370 to 1,130 ft.). Its total length is only 40 miles. In front of the delta are sandbanks and rocks which prevent the passage of vessels except by a canal, 18 m. long, 124 to 226 ft. wide, and admitting vessels with a draught of 18½ ft., from Kronstadt to Leningrad. When Lake Ladoga sends down its vast accumulations of block-ice, inundations of a dangerous kind occur, as in 1777, 1824, 1879, 1903, and especially in 1924.

According to observations extending from 1706 to 1899, the mean day of the freezing of the Neva is Nov. 25, the earliest Oct. 28, the latest Jan. 9, and the next latest Dec. 26. The mean day of opening is April 21, the earliest March 18, the latest May 12.

NEVADA, popularly known as the "Sagebrush state," is one of the far western states of the U.S. It lies between approximately 35° and 42° N. and 114° 2′ and 120° W., and is

bounded north by Oregon and Idaho, east by Utah and Arizona, south and west by California. The Colorado river separating it in part from Arizona is the only natural boundary the state possesses, the others being arbitrary lines of geodetic measurement. Nevada ranks sixth among the states in size, having an area of 110,540 sq.mi., 751 sq.mi. of which are water surface. Its exreme length north and south is 483 mi., and its extreme width east and west is 320 mi. Its name, a Spanish word meaning "snow-clad," was originally applied to the snow-capped Sierra Nevada range on the Pacific slope.

Physical Features.—With the exception of its northeast and southeast corners, the state lies wholly within the Great Basin, the floor of which is really a vast tableland between 4,000 and 5,000 ft. above the sea.

This plateau, however, is not a plain, but contains many buttes, mesas and isolated mountain ranges, the latter running generally in a north and south direction and rising 1,000 to 7,000 ft. above the level of the plain. These ranges are from 5 to 20 mi. wide at their bases, and the valleys between are about the same width as the bases.

The total area of the valleys is about equal to that of mountainous land. In the northeast an unnamed range of highlands, broken and ill-defined, with a general east and west trend, forms the water parting between tributaries of the Humboldt river in the Great Basin region and those rivers that flow to the Snake river in Idaho and Oregon and thence via the Columbia river to the Pacific ocean. This drainage area of the Snake amounts to about 5,000 sq.mi. the Owyhee, Little Owyhee, Salmon and Bruneau rivers being the principal streams. In the southeast corner is the third drainage system. Here the Virgin river from Utah, after crossing the northwest corner of Arizona, enters the state and flows southwest for 60 mi. until it joins the Colorado river.

The latter stream flows for 150 mi. along the southeast boundary toward the Gulf of California. The Colorado leaves Nevada at an altitude of but 470 ft. above sea level, the lowest point in the state. The mean elevation of the state is 5,500 ft. and, with the exception of the dip to the Colorado in the southeast, the entire state lies above the 2,000 ft. line.

The Sierra Nevada range, which forms the western rim of the basin, sends into the state a single lofty spur, the Washoe mountains. At the foot of this range there is, relatively speaking, a depression, with an altitude of about 3,850 ft. above the sea, which receives the drainage of the eastern slopes of the Sierra, and what little drainage there is in the northern half of Nevada. From this depression eastward the general level of the plateau rises to an elevation of 6,000 ft. near the eastern borders of the state.

The mountain ranges also increase in height and importance as far as the East Humboldt range, a lofty mass about 60 mi. west of the Utah boundary. This range is the water parting for nearly all the westward-flowing streams of the state, and is by far the steepest and most rugged within Nevada, a number of its peaks attaining a height of 11,000 or 12,000 ft. On its eastern slope the waters soon disappear within the bed of narrow canyons, but break out again at the foot in ice-cold springs that form the source of the Ruby and Franklin lakes; on its western side the descent is more gentle, and the waters form the south fork of the Humboldt river.

The Humboldt is the most important of the basin streams. Rising in the northeast it flows in a tortuous channel in a general southwest direction for 290 mi. and drains 7,000 or 8,000 sq.mi. It empties into Humboldt lake, the overflow from which goes into the so-called Carson sink. At no part of its course is it a large river and near its mouth its waters are subalkaline. The Truckee, Carson and Walker rivers flow with more vigour, receiving their waters from the eastern slopes of the Sierra Nevada range and discharging them into alkaline lakes. Of these lakes Pyramid is the largest, being about 30 mi. long and 4 to 13 mi. wide. Walker lake is as long but only six or seven miles in width. These larger lakes always contain water, varying only in area and depth, but the smaller lakes usually evaporate in the course of the summer. The latter are formed by waters that fall on barren mountainsides and rush down in torrents, forming in the valleys shallow bodies of water yellow with mud held in suspension.

Excepting the "alkali flats" no portion of the desert is devoid of vegetation, even in the driest seasons. In the Washoe mountains there is a heavy growth of conifers extending down into the valleys; but in many places these mountains have been almost deforested to provide timber for the mines. In other places these areas have been incorporated into national forests, in the endeavour to protect and foster the growth of timber and vegetation so as to regulate the drainage of the state. On all but the lowest ranges of the basin the piñon and juniper are found, but these rarely grow to a height of more than 15 ft.; and on the principal ranges above 6,800 ft. is the stunted mountain mahogany. But except for these infrequent wooded areas, the mountains are even more bare than the valleys, because their shrubs are dwarfed from exposure. The valleys are covered with typical desert shrubs, greasewood, creosote bushes and sagebrush, and with bunch grass, which is valuable for grazing.

The skies of Nevada are clear nearly every day in the year. The mean annual precipitation varies from 3 in. in the southwest (Esmeralda county) to 12 in. in the east (White Pine county), and varies also according to altitude. Snow rarely lies on the ground in the valleys.

History.—The first recorded person of European descent to enter the limits of Nevada was Francisco Garcés of the Order of St. Francis, who set out from Sonora in 1775 and passed through what is now the extreme southern corner of the state on his way to California.

Half a century later trappers of the Hudson's Bay company led by Peter Skene Ogden entered Nevada from the north and discovered the Humboldt river. In 1827 Jedediah S. Smith, an American trader from St. Louis, crossed the state from west to east on his return from California after the first recorded journey from the Mississippi to the Pacific by the central route. In 1833 Capt. Benjamin Bonneville's men were on the Humboldt, and during 1843–45 John C. Frémont made a series of explorations in the region. The first recorded emigrant train to California crossed the state in 1841. By the treaty of Guadalupe Hidalgo, negotiated in 1848 at the close of the war with Mexico, Nevada became U.S. territory. It was then a part of California known as the Washoe country, and so remained until 1850, when most of the present state was included in the newly organized territory of Utah. One of the first settlements was made in 1849 by Mormons at Genoa in the valley of the Carson river. Here in 1851 the earliest recorded public meeting in the state was held to frame a government for the settlers since the seat of the territorial government of Utah was considered too remote to afford protection to life and property. But the Utah authorities intervened and in 1854 the Utah legislature created the county of Carson to include all settlements in western Utah.

In 1858 Carson City was laid out, and in the following year the people of Carson county chose delegates to a constitutional convention which met at Genoa and drafted a constitution. It was adopted by vote of the people, but this attempt to create a new state government proved abortive, and it was not until the mineral wealth of the Washoe country became generally known that congress took action.

In 1861 the territory of Utah was divided at 39° W. of Washington, D.C., and the western portion was called Nevada. The Comstock lode, one of the richest deposits of precious metal known in the world, was discovered in 1859, and Nevada ceased to be merely a highway for gold seekers on the way to California and became a stopping place. Virginia City became the most famous of all the mining camps of the far west.

An attempt to win statehood in 1863 was defeated, but in 1864 when it became evident that two more Republican votes were needed in the U.S. senate for reconstruction purposes, party leaders at Washington urged the people of Nevada to adopt a constitution and enter the union as a patriotic duty. The third constitutional convention in its history met at Carson City and drew up a constitution which was duly ratified, and in October of that year, Pres. Abraham Lincoln proclaimed the new state. The eastern boundary was pushed eastward to its present location on the

37th meridian west of Washington, D.C., in 1866, and the southern boundary was also fixed in that year. Being "battle-born," Nevada was loyal to the union throughout the Civil War, and furnished a company of troops in 1861 which was joined to a California regiment. In 1863 the territory raised six companies of infantry and six of cavalry (about 1,000 men), which saw no actual service against the Confederates but were useful in subduing hostile Indians.

The history of the state since its organization has been largely a history of its mines. From 1864 to 1868 there was a general reaction in the industry caused by unwarranted speculation and inflated values. After 1868 there came a period of consolidation, of more systematic workings, and of deeper development. In 1873 came the discovery of the "big bonanza" by John Mackay, James Fair, William O'Brien and Flood, who became the four "bonanza kings" of Nevada. In 1873, $21,000,000 was taken from the Comstock and production increased until a maximum of $36,000,000 was reached in 1878. The Sutro tunnel intersected the lode in the latter year, and drained the mines. But the richer workings soon proved below the tunnel level and the shafts were sent deeper. In 1882 an immense flow of hot water was struck which flooded the principal mines up to the Sutro tunnel level. The miners were forced to return to the upper levels and work the lower grade ores. Production decreased and with the end in sight the market slumped. Also, the national government had abandoned its artificial maintenance of the price of silver. The period of depression lasted until about 1900 when the discovery of a new mineral belt in southern Nevada brought renewed prosperity. Tonopah, 60 mi. from the railroad, became the new Mecca, and fast upon the heels of its discovery came that at Goldfield. A railway was completed to the new camps in 1904 and Tonopah proved to be one of the largest and steadiest producing districts of the state. Copper ores of vast extent were discovered at Ely at about the same time and the Nevada Northern railway was completed to this camp in 1907.

The depression immediately before 1900 served a good purpose in turning attention to the agricultural and livestock possibilities of the state. The river valleys under irrigation proved most fertile and these were soon settled by large-scale ranchers. On the river bottoms the ranchers raised their hay and controlled a still larger acreage of the upland grazing ground. Private irrigation systems were supplemented by federal undertakings, the most notable being the Truckee-Carson project. Many beautiful valley towns now have their prosperity founded on the permanent basis of agriculture rather than the uncertain one of mining.

Until the silver agitation of the '90s Nevada was safely Republican. The state's politics in the early period were replete with corruption, and many of its rich mine owners were accused of buying their seats in the United States senate. For four state elections the Silver party swept the state. After the issue subsided the old parties came into control. In the national elections of 1932-48 the state returned the Democratic ticket. After the legalization of gambling in 1931 and the reduction to six weeks of the residence requirement for divorce Nevada became a marriage, divorce and resort centre; during the period 1949–50 there were 9,342 divorces granted and 45,864 marriages solemnized in the state.

In 1936 Hoover dam was built across the Colorado river, situated 31 mi. from Las Vegas. This great dam attracts hundreds of thousands of tourists yearly, bringing $2,000,000 to Nevada.

Government.—Nevada is governed under its original constitution, adopted in 1864, and since amended in important respects. Proposed amendments must be passed by a majority in both houses of two consecutive legislatures before they can be submitted to the people.

The legislature, composed of a senate and assembly, meets regularly in January of every odd-numbered year, its sessions being limited to 60 days. The constitution requires that the number of senators shall be not less than one-third nor more than one-half the number of members in the assembly, and that the membership of both houses shall not exceed 75. In 1951 there were 17 senators and 43 assemblymen. Senators are elected for four years—one-half the membership retiring every two years; assemblymen are elected biennially. The initiative and referendum were adopted by amendment in 1904.

The principal administrative officers are the governor, lieutenant governor, secretary of state, attorney general, controller, treasurer, inspector of mines, surveyor general and superintendent of public instruction, all elected for four-year terms. The governor does not possess the usual sole pardoning power but serves together with the justices of the supreme court, the clerk of the supreme court and the attorney general on the board of pardons. There are many administrative boards and commissions, the most important of them being the board of welfare, board of examiners, Nevada tax commission, industrial commission, department of highways, Colorado river commission, fish and game commission, board of education, board of health and public service commission.

The judicial department consists of a supreme court with a chief justice and two associate justices, chosen for six years, and eight district courts, the 2nd with three judges and seven with one judge, elected for four years. Each township has a justice of the peace chosen biennially by its voters. The statutes provide that only three-fourths of the jurors may be required to agree to a verdict in civil cases. Nevada was the first state in the world to execute condemned men painlessly by means of odourless lethal gas. In 1931 a residence of six weeks in the state became necessary for divorce.

The county is the principal unit of local government. There are 17 counties in the state, some as large as several eastern states put together.

Population.—The population of Nevada in 1860 was 6,857; in 1880 it was 62,266; in 1910, 81,875; in 1940, 110,247; and in 1950, 160,083. This last figure represented an increase of 45.2% over the population in 1940. The population per square mile in 1950 was 1.5, as compared with 1.0 in 1940 and with 50.7 for the U.S. in 1950.

Of the 1950 population, 84,079, or 52.5%, lived in incorporated places of 2,500 or more, as compared with 39.3% in 1940, when these places constituted the urban area.

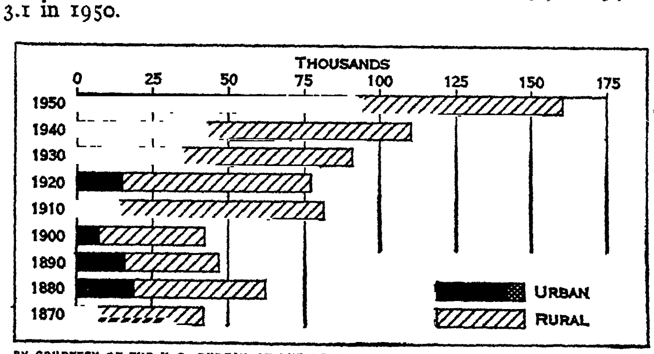
The entire urban population, under a new definition set up for 1950, which included also two unincorporated places of 2,500 or more, amounted to 91,625, or 57.2% of the state total.

TABLE I.—*Population of Nevada and Its Principal Cities*

Area	Population			Per cent of increase	
	1950	1940	1930	1940–50	1930–40
The state	160,083	110,247	91,058	45.2	21.1
Urban*	91,625	43,291	34,464	111.6	25.6
Rural*	68,458	66,956	56,594	2.2	18.3
Per cent urban	57.2	39.3	37.8	..	..
Principal cities					
Reno	32,497	21,317	18,529	52.4	15.0
Las Vegas	24,624	8,422	5,165	192.4	63.1
Carson City	3,082	2,478	1,596	24.4	55.3

*Final figures based on *new* definition. *See* comment in text.

The number of occupied dwelling units (or households) in 1950 was approximately 52,000, as compared with 33,000 in 1940. The average population per household had declined from 3.3 in 1940 to 3.1 in 1950.



BY COURTESY OF THE U.S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF NEVADA: 1870 TO 1950

The crosshatched part of the 1950 bar represents the population of the additional areas counted as urban under the new 1950 definition

The population of the state was distributed by colour and nativity in 1950 as follows: 87.1% native white; 6.6% foreign-born white; and 6.3% nonwhite, mainly Indians. There were 113.4 males per 100 females in the native white population and 159.9 in the foreign-born. Seven per cent of the population were 65 years old or over; 58.8% of the population 14 years old and over were in the labour force. Of the total number of employed males, 13.1% were engaged in agriculture, 6.8% in mining, 11.2% in construction, 6.1% in manufacturing, 11.0% in transportation and 17.5% in wholesale and retail trade.

Finance.—The state legislature authorizes all expenditures, and in turn fixes a tax levy which shall produce revenue enough to meet these expenditures. The supervision of the assessment and collection of taxes is in the hands of the Nevada tax commission consisting of the governor, acting as chairman, and six commissioners appointed by him. The director of the budget prepares the annual state budget, and exercises control of departmental spending. The director and the state board of examiners scrutinize every expenditure item. The post audit function is performed by the legislative auditor responsible to the legislature and the legislative counsel bureau

The credits of the state for the fiscal year ending June 30, 1950, amounted to $26,581,680, the debits to $25,797,769. There was a treasury balance of $5,587,310. As in most states, a large share of the receipts is derived from property taxation.

The state had bonds outstanding July 1, 1950, in the amount of $785,000, for construction of office and institutional buildings. This amount was more than offset by bonds and securities held by the state, income from which was $155,570.

On July 1, 1950, there were 26 individual banking institutions in the state, of which 19 were branches, 5 were national banks and 3 were state banks. The resources of Nevada banks totalled $179,204,871, and deposits were listed as $167,425,005. The 1950 assessment for tax purposes amounted to $312,536,414.

Education.—The state board of education is composed of the governor, the state superintendent of public instruction and five members elected one from each of the educational supervision districts of the state. There were in 1950 29,490 pupils enrolled in the public schools in the state, as against 20,746 in 1941. Of the total 1950 enrolment, 6,416 were in the public high schools. There were 15 kindergartens, 166 elementary schools and 38 high schools, staffed by 35 kindergarten teachers, 846 elementary teachers and 365 high school teachers.

The only institution of college rank is the University of Nevada, located on an eminence overlooking the city of Reno. Its enrolment during the regular session, 1950–51, was 1,466, composed of 996 men and 470 women. The Mackay School of Mines, founded and endowed by the family of John W. Mackay, one of the "bonanza kings" of the Comstock lode, is an outstanding department. A meteorological observatory is maintained at the top of Mount Rose.

Libraries.—The state library at Carson City, established in 1861, contained 184,682 volumes in 1950, including 55,229 volumes on law. Because of the completeness of its early-day statutes of every state in the union, it is one of the leading law libraries in the United States. The university library, housed in the Alice MacManus Clark building, contained 90,700 bound volumes in 1950. Other libraries at the university are the agricultural library, the Mackay research library and the mining library. A total of 18 libraries served every section of the state at mid-20th century.

Charities and Corrections.—A state orphans' home is located at Carson City, a state hospital for mental diseases at Reno, and a home for male juvenile delinquents at Elko. The state penitentiary is at Carson City.

Agriculture and Livestock.—Nevada is the most arid state of the United States because the high Sierra Nevada range interrupts the moisture-laden clouds from the Pacific. East of these mountains, the valleys, however rich their soils, are covered with sagebrush and appear like monotonous desert wastes, except where some stream annually overflows its banks to create natural meadows, or where the land has been cleared of sagebrush and artificially watered. Agriculture is dependent almost entirely upon irrigation; how much so is shown by the fact that while there were approximately 546,000 ac. of improved farmland in the state in 1944, 674,204 were under irrigation. During the period 1939–44 a decrease in the acreage of irrigated lands was caused by a number of dry years. The hay crop in 1948 was still of first importance, amounting to 647,000 tons valued at $12,293,000 while the estimated value of all Nevada's farm products was but $36,000,000. In southern Nevada hay and forage, wheat, tomato plants and barley are the principal crops, with berries, apples and other orchard fruits growing on both irrigated and unirrigated lands.

The total number of all cattle increased from 342,213 in 1937 to 546,000 in 1949; most of these were raised for beef purposes. The number of milch cows was 22,000 in 1949. Sheep numbered 473,000, horses 36,000 and swine 28,000. The 1948 wool clip yielded 3,689,000 lb.

The farm population in Nevada, similar to the trend in most of the mountain states, fell from 16,441 in 1930 to 15,852 in 1940, a decrease of 3.6%. Between 1940 and 1945 the number of farms decreased from 3,696 to 3,429, but the harvested acreage of Nevada's 46 crops totalled 487,000 in 1944.

TABLE II.—*Harvested Area and Production of Principal Crops in Nevada*

1948	Acreage harvested in 1,000 ac.	Production in 1,000 bu.
Corn	2	54
Wheat	22	652
Oats	9	369
Barley	22	814
All hay	438	647 tons
Potatoes	2	300

Mining.—From 1907 metal production steadily increased until it reached its peak in 1917, in which year gold, silver, copper, lead and zinc were produced to the value of $54,424,580. The years 1918–21 were years of swift decline, the production in 1919 being less than half that of 1918, and that of 1921 only 50% that of 1919. An upward turn came in 1923 when the gross production of all minerals rose to $28,598,627. From then through 1929 production of metals continued to rise steadily; in the latter year output was valued at $36,776,000. The economic depression which set in at the close of 1929 caused a tremendous decline in mineral production; in 1932 it was only $6,568,000. By 1940 it had risen to $42,571,000; and by 1947 to $42,639,000.

Gold and silver were first to recover from the depression because of the revaluation of the gold dollar and the passage of the Silver Purchase act in 1934. As a result of the government action the production of gold, amounting to 98,590 fine ounces in 1933, rose to 380,000 fine ounces in 1940. Its value rose from $2,519,968 in 1933 to $13,300,000 in 1940. Silver production increased from 1,148,621 fine ounces in 1933 to 5,102,000 fine ounces in 1940; with corresponding values of $402,017 and $3,628,032. During World War II production declined to approximately one-fourth of the 1940 production, but later increased to 111,532 fine ounces of gold and 1,790,020 fine ounces of silver in 1948, with corresponding values of $3,903,620 and $1,620,058. The production of lead increased from 880,896 lb. in 1932 to 14,998,000 lb. in 1940 and 19,554,000 lb. in 1948. The value in the latter year was $3,500,166. Zinc production, which amounted to 23,666,000 lb. in 1940, increased to 40,576,000 lb. in 1948; the value increased from $1,490,958 in 1940 to $5,396,608 in 1948. Almost all of the lead-zinc ore mined in Nevada contains substantial quantities of silver and gold, and mines in the Pioche district were the largest producers.

Copper was especially hard hit by the economic depression which began in 1929 because of the sudden, sharp falling off of demand together with the large inventories of ore the companies accumulated in the next two years. Production fell from 84,475,000 lb. in 1930 to 28,490,000 lb. in 1933. It rose to 151,820,000 lb. in 1940, but decreased to 90,484,000 lb. in 1948, production being stimulated by defense needs during World War II but declining after the war. However, the value of copper production increased from $1,823,335 in 1933 to $17,155,660 in 1940 and $19,635,028 in 1948, by far the largest share of the output in

Nevada coming from the Ely district in White Pine county.

After World War II Nevada continued to be an outstanding producer of mercury, tungsten, antimony and gypsum, although production of these minerals had declined from previous years, except gypsum which had a steady increase. Other minerals are barite, fluorspar, magnetite, sulphur and magnesium. Considerable magnesium is ordinarily produced at Gabbs valley and shipped out of the state. In 1948 the state acquired the huge magnesium plant at Henderson from the federal government, and chemicals, caustic soda, chlorine and various strategic fuels and metals were produced at the plant. Some turquoise was mined at Battle Mountain and Tonopah in 1948, but the production of gem stones in Nevada was on a reduced scale.

Manufactures.—The manufacturing interests of Nevada are unimportant. There were in 1947 only 126 establishments employing 2,667 workers, paying $8,409,000 in wages and manufacturing goods to the value of $27,777,000, an amount less than that of any other state. This represented a decrease in value of manufactures from the $33,717,000 produced in the peak year of 1929.

Transportation.—Nevada is crossed east and west by three main lines of railway, the Southern Pacific and the Western Pacific in the northern part and the Union Pacific system in the southern. Branch lines connect the more important mining towns with these lines. Railway mileage in the state reached a peak in 1915 when it amounted to 2,332 mi.; by 1947 it had decreased to 1,704 mi. In 1950 there were 3,560 mi. of road in the designated state highway system, of which 3,278 mi. were of dustless paved surface and 282 mi. improved state highways. During 1950, 211 mi. were constructed or reconstructed, with 165 mi. under construction at the end of the fiscal year; total disbursements for highways were $8,305,523. Motor vehicle registrations in 1949 totalled 71,990, of which 71,588 were privately owned and 402 were publicly owned.

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NEVADA, a city of southwestern Missouri, U.S., 90 mi. S. of Kansas City, at an altitude of 860 ft.; the county seat of Vernon county. It is on federal highways 54 and 71 and is served by the Missouri-Kansas-Texas and the Missouri Pacific railways. Pop. (1950) 7,986. It is the seat of a state hospital for the insane and of Cottey Junior college for girls (1884). The national guard of Missouri has a camping ground nearby. There are chalybeate and sulphur springs in one of the city's parks. Coal is mined in the vicinity, and the city has flour and planing mills, galvanized iron works and other manufacturing industries. Nevada was platted in 1855, incorporated as a town in 1869 and chartered as a city in 1880. During the Civil War it was burned to the ground (1863).

NEVADA CITY, a city of eastern California, U.S.A., on Deer creek, at an altitude of 2,525 ft., 63 mi. N.N.E. of Sacramento; the county seat of Nevada county.

The population was 2,487 in 1950, 2,445 in 1940 and 1,701 in 1930 by the federal census. It is a summer resort and a supply centre for the neighbouring mining camps. The county is a large producer of gold, first discovered there in the summer of 1849 by James W. Marshall, who in the preceding year had picked up the first nugget in California, near Coloma. The gold output was at its peak in 1850–51.

Nevada City was incorporated in 1851 under a special act of the legislature (repealed in 1852).

Nevada City was reincorporated in 1856 and again in 1878.

NÉVÉ or **FIRN,** masses of compacted snow formed from the accumulated snow in the catchment area of a glacier, by processes of alternate thawing and freezing. The névé is the feeding ground for the valley-glaciers. (*See* Glacier.)

NEVERS, a town of France, capital of the department of Nièvre, 159 mi. S.S.E. of Paris by the P.L.M. railway to Nîmes. Pop. (1934) 34,036. *Noviodunum,* the early name of Nevers, was later altered to *Nebirnum.* Many medals and Roman antiquities found there show its importance when Caesar chose it as a military depôt. In 52 B.C. the town was the first place siezed by the revolting Aedui. It became the seat of a bishopric at the end of the 5th century.

Having formed part of the duchy of Burgundy, the county of Nevers (Nivernais) was given by Duke Henry I in 987 to his stepson, Otto Williams, afterwards count of Mâcon, from whom it passed to his son-in-law, Landri. The first house of the hereditary counts of Nevers originated in Landri, and was brought to an end in 1192 by the death of Agnes, countess of Nevers, wife of Pierre de Courtenay (d. 1217).

The county subsequently passed into the houses of Donzy, Châtillon and Bourbon. Nevers is on the Loire where it joins the Nièvre. Narrow winding streets lead from the quay through the town, with many old houses (14th to the 17th centuries). The cathedral of St. Cyr is a combination of two churches, one Romanesque (11th century), the other Gothic (14th century). There is a fine square (16th century) tower on the south side. The church of St. Étienne is 11th century Romanesque. The ducal palace at Nevers (now occupied by the courts of justice and an important ceramic museum) was built in the 15th and 16th centuries and is one of the chief feudal buildings in central France.

An octagonal middle tower contains the great staircase, and its windows are adorned by sculptures relating to the history of the house of Clèves. The Porte du Croux, a square tower, with corner turrets (14th century) is among the remnants of the old fortifications.

Nevers is the seat of a bishopric under the archbishop of Sens, of tribunals of first instance and of commerce and of a court of assizes and has a chamber of commerce.

NEVILLE or Nevill, the family name of a famous English noble house, descended from Dolfin, son of Uchtred, who had a grant from the prior of Durham in 1131 of "Staindropshire," Co. Durham, a territory which remained in the hands of his descendants for over four centuries, and in which stood Raby castle, their chief seat.

His grandson, Robert, son of Meldred, married the heiress of Geoffrey de Neville (d. 1192–93), who inherited from her mother the Bulmer lordship of Brancepeth near Durham. Henceforth Brancepeth castle became the other seat of the house, of which the bull's head crest commemorates the Bulmers; but it adopted the Norman surname of Neville (*Neuville*). Robert's grandson, another Robert (d. 1282), held high position in Northumbria, and sided with Henry III in the Barons' War, as did his younger brother, Geoffrey (d. 1285), ancestor of the Nevills of Hornby. This Robert's son, Robert (d. 1271), extended the possessions of the family into Yorkshire by his marriage with the heiress of Middleham. The summons of their son, Ranulf (d. 1331), to parliament as a baron (1294) did but recognize the position of the Nevills as mighty in the north country. Ralph (d. 1367), the second baron—whose elder brother "the Peacock of the North" was slain by the Douglas in 1318—was employed by Edward III as a commander against the Scots and had a leading part in the victory of Nevill's Cross (1346), where David Bruce was captured, and by which Durham was saved. His active career as head of his house (1331–67) made the name of Nevill a power on the Scottish march.

Of his younger sons, Alexander became archbishop of York (1374–88) and was a supporter of Richard II, attending him closely and encouraging his absolutist policy; he was one of those "appealed of treason" by the opposition in 1388 and was outlawed. He died abroad in 1392.

His younger brother, William, a naval commander, was a leading Lollard and a friend of Wycliffe, and in 1388–89 acted with the lords appellant.

John, the 3rd baron (d. 1388), a warden of the Scottish marches

and lieutenant of Aquitaine, a follower of John of Gaunt and a famous soldier in the French wars of Edward III., continued the policy of strengthening the family's position by marriage; his sisters and daughters became the wives of great northern lords; his first wife was a Percy, and his second Lord Latimer's heiress; and his younger son, Thomas, became Lord Furnival in right of his wife, while his son by his second wife became Lord Latimer. His eldest son Ralph (1364–1425), 1st earl of Westmorland (*see* WESTMORLAND, EARLS OF), married as his second wife a daughter of John of Gaunt and secured heiresses for five of his sons, four of the younger ones becoming peers, while a fifth, Robert, was made bishop of Durham (1438–1457). Among his daughters were the duchesses of Norfolk, Buckingham and York (mother of Edward IV. and Richard III.) and an abbess of Barking. The Nevills were thus closely connected with the houses of Lancaster and York, and had themselves become the most important family in the realm. Of the earl's sons by his second marriage, Richard, earl of Salisbury (and three of his sons) and William, earl of Kent, are the subjects of separate notices.

The greatness of the Nevills centred in the "kingmaker" (Richard's son) and the heads of his house, after the 1st earl, were of small account in history, till Charles, the 6th earl, at the instigation of his wife, Surrey's daughter, joined Northumberland in the fatal northern rising of 1569 to the ruin of his house. His estates, with the noble castles of Brancepeth and Raby, were forfeited; Middleham, with the Yorkshire lands, had been settled by the 1st earl on the heirs of his second marriage.

Although the senior line became extinct on the earl's death abroad (1601), there were male descendants of the 1st earl remaining, sprung from George and Edward, sons of his second marriage. George, who was Lord Latimer, was father of Sir Henry, slain at Edgcote fight, and grandfather of Richard, 2nd lord (1469–1530), a soldier who distinguished himself in the north, especially at Flodden Field. His grandson (d. 1577) was the last lord, but there were male descendants of his younger sons, one of whom, Edmund, claimed the barony, and after 1601 the earldom of Westmorland, but vainly, owing to its attainder.

The heirs male of Edward, Lord "Bergavenny" (now "Abergavenny" co. Monmouth), who died in 1476, have retained their place in the peerage under that style to the present day. In 1784 the then Lord Abergavenny received an earldom, and the next lord erected at Eridge, Sussex, the present seat of the family, on which the marquisate of Abergavenny and earldom of Lewes were conferred in 1876. Its Sussex estates are derived through the Beauchamps, from the Fitz Alans, heirs of the Warennes.

See Rowland's *Historical and Genealogical Account of the Family of Nevill* (1830); Drummond's *Noble British Families* (1846); Swallow's *De Nova Villa* (1885); and Barron's sketch in *The Ancestor*, No. 6 (1903). Also Dugdale's *Baronage;* G. E. C[okayne]'s *Complete Peerage;* J. H. Round's *Feudal England;* and for the Nevill castles Mackenzie's *Castles of England.* For the Kingmaker, *see* Oman's monograph (1891).

NEVILLE'S CROSS, BATTLE OF. This battle of Oct. 17, 1346, took place after Crécy (*q.v.*) and while Edward III. was still abroad, besieging Calais. It foiled the opportunist Scottish invasion, and assured Edward's freedom to continue his French projects. But its main interest in military history is that it affords an example of the offensive power of the new tactical combination of archers and spearmen, in contrast to Dupplin, Halidon Hill, Crécy, Poitiers and Agincourt, which were all won by awaiting the enemy's onslaught. After crossing the border, King David Bruce was surprised by the quickness with which the English, under William de la Zouch, archbishop of York, concentrated to meet him. Driven to accept battle near Durham, the Scottish king took up his position to resist attack, his pikemen formed in three great "schiltrons." The English advanced, with their left leading, and the archers on this wing overlapped and swarmed round the Scottish right flank "schiltron." When this broke under the arrow-storm, they closed on the centre "schiltron" —already attacked in front. Its collapse, in turn, under the converging pressure, led to the capture of the king and the hurried retreat of the remaining left division of pikemen. Thus the archers proved their power against an immobile foe to pave the way for a successful assault by knights and men-at-arms.

NEVIN, ETHELBERT (1862–1901), American composer, was born at Edgeworth, Pa., Nov. 25, 1862. His musical talent displayed itself in childhood. He studied in Boston, 1884, before going to Berlin to continue work under Klindworth and Von Buelow, who encouraged his ability as composer. After teaching in Boston (1887–93), he returned to Europe residing for a time in Paris, Berlin, Florence and Venice as well as in Algiers. In 1900 he went back to the United States, becoming associated with Horatio Parker in the department of music at Yale university. He died at New Haven, Conn., Feb. 17, 1901. Ranked with the foremost of American song-writers, he was also the composer of many instrumental pieces, mostly in miniature form, marked by a delicate, melodious originality. Among his compositions were *Water Scenes* for the piano, including the favourite *Narcissus;* a piano suite, *In Tuscany;* the song cycles, *In Arcady* and *The Quest of the Heart's Desire,* the latter posthumously published as was also *Tempo di Valse;* a *Sketch Book* of songs and piano music; and *The Rosary,* the song that became instantly popular at a concert at Madison Square Garden, New York, Feb. 15, 1898.

See J. T. Howard, *Ethelbert Nevin* (1935).

NEVIS, an island in the British West Indies, forming with St. Kitts one of the four presidencies in the colony of the Leeward Islands. Pop. (1946) 11,388. It lies in 17° 14′ N. and 62° 33′ W., and is separated from St. Kitts by a shallow channel 2 mi. wide at its narrowest point. The island is almost circular, and from the sea has the appearance of a perfect cone, rising gradually to a height of 3,596 ft. Total area, 50 sq.mi. Average temperature, 82° F. Sea-island cotton is the chief crop, and some sugar is raised. Agriculture is almost entirely in the hands of small proprietors. Charlestown, the chief town and port, lies on the southwest coast. Alexander Hamilton, drafter of the U.S. constitution, was born there in 1757. Discovered by Columbus in 1493, Nevis was first colonized by the English in 1628; captured by the French in 1782, it was restored to Britain the next year.

NEW ACADEMY. Plato's school is known as the Academy, or the older Academy. For some time after Plato's death the school continued true to his teaching. But in the third century B.C., when Arcesilaus (316–241 B.C.) was head of the Academy, there came a great change. Arcesilaus developed a sceptical philosophy in opposition mainly to the Stoics. To mark this change in the trend of its teaching the school became known as the New Academy. (*See* PLATO; ACADEMY, GREEK.)

NEW ALBANY, a city of southern Indiana, U.S., on the Ohio river, opposite Louisville, Ky.; county seat of Floyd county. It is on federal highways 31 and 150, and is served by the Baltimore and Ohio, the Chicago, Indianapolis and Louisville, the Pennsylvania and the Southern railways and river steamers. Pop. (1950) 29,297; (1940) 25,414. The city is on a plateau above the river and is surrounded by hills rising more than 600 ft. above the river. It has 48 manufacturing industries with an output of about $45,000,000; the leading products are plywood, furniture, iron and steel, edge tools, engines and boilers, men's clothing, leather, fertilizers and flour. Agriculturally, New Albany and vicinity produce more than $500,000 worth of strawberries annually. Dairy products are second in volume. A state tuberculosis sanatorium, Silvercrest, was completed in 1940. New Albany was platted in 1813 and chartered as a city in 1839.

NEW AMSTERDAM, a town of British Guiana, situated in 6° 20′ N. and 57° 30′ W. on the east bank of the Berbice river, about 4 mi. from the mouth. Formerly the capital of the colony of Berbice, it is now the capital of the county of that name. It is composed almost entirely of wooden houses, having a population of 9,567 (1946 census). Colony house, standing in handsome grounds beside the botanical gardens, formerly the residence of the governor and seat of the legislature, now contains the treasury and supreme courts. New Amsterdam is connected by ferry, rail and a biweekly steamer service with Georgetown.

NEWARK, DAVID LESLIE, LORD (1601–1682), Scottish general, fifth son of Sir Patrick Leslie of Pitcairly, Fifeshire, commendator of Lindores, and Lady Jean Stuart, daughter of the

1st earl of Orkney. In his early life he served in the army of Gustavus Adolphus, where he rose to the rank of colonel of cavalry. In 1640 he returned to Scotland. He was major general under Alexander Leslie, earl of Leven, at Marston Moor. He was then sent into the northwestern counties, and besieged and took Carlisle. When, after the battle of Kilsyth, Scotland was at the mercy of the earl of Montrose and his army, Leslie was recalled from England in 1645, and made lieutenant general of horse. In September he surprised and routed Montrose at Philiphaugh near Selkirk. He was then declared lieutenant general of the forces. After a short period of service in England he returned to Scotland, and reduced several of the Highland clans.

In 1650 Newark was sent against Montrose, who was defeated and captured by Maj. Archibald Strachan, Leslie's advance guard commander; and later in the year, all parties having for the moment combined to support Charles II, Leslie was appointed to the chief command of the new army levied on behalf of Charles II. The result, though disastrous, abundantly demonstrated Leslie's capacity as a soldier, and it might be claimed for him that Oliver Cromwell and the English regulars proved no match for him until his movements were interfered with and his army reduced to indiscipline by the representatives of the Kirk party that accompanied his headquarters. After Dunbar Leslie fought a stubborn defensive campaign up to the crossing of the Forth by Cromwell, and then accompanied Charles to Worcester, where he was lieutenant general under the king. On the defeat of the royal army Leslie was committed to the Tower, where he remained till the Restoration in 1660. In 1661 he was created Lord Newark, and received a pension of £500 per annum. He died in 1682. The title became extinct in 1790.

NEWARK, a town of New Castle county in northwestern Delaware, U.S.; the altitude is 135 ft. It is served by the Baltimore and Ohio and the Pennsylvania railroads, and is on state highway 2. The population was 6,701 in 1950, 4,502 in 1940 and 3,899 in 1930 by the federal census. Newark was one of the first intersections between the Chesapeake and Delaware rivers where white travellers met, exchanged supplies and secured fresh horses. In 1758 it was licensed to hold fairs twice a year, and markets weekly, for the exchange of local agricultural produce. The Revolutionary army passed through the town in 1781 during Gen. George Washington's drive on Yorktown. The first sizable industry, a paper mill, was founded there before 1798 and the first local church was erected by Methodists in 1812. By 1836 the line of the present Pennsylvania railroad reached Newark and in 1852 the town received its charter; it was reincorporated in 1887. Newark is the seat of the University of Delaware, the state university, which had its origins in a small colonial school founded near New London, Pa., in 1743. The school was later removed to Newark and became the Newark academy. There is a public library in the town, and also the University of Delaware Memorial library, which specializes in chemistry and has a collection of Delawareana. The chief manufactures include fibre and fibre products, paper and chemical containers. Agricultural products include corn, wheat and apples. A newspaper, founded in 1910, is issued weekly.

NEWARK, a municipal borough in the Newark parliamentary division of Nottinghamshire, England. Pop. (1938) 20,330. Area 5.3 sq.mi. It lies on the Devon near its junction with the Trent and is connected with the Trent navigation by a canal 1½ mi. in length. It is 120 mi. N.N.W. from London by the L.N.E.R. Newark owed its origin, possibly in Roman times, to its position on the great road called the Fosse Way, in the Trent valley. Granted to the monastery of Stow by Godiva, it remained in the hands of the bishops of Lincoln until the reign of Edward VI. The castle was erected by Bishop Alexander in 1123, and the bridge about the same time. It was incorporated in 1549, and the charter was confirmed and extended by Elizabeth.

A weekly market on Wednesdays, and a fair on the eve, day and morrow of the Invention of the Holy Cross, are still held; another fair at St. Mary Magdalene and the four preceding days was granted by Henry III and is probably represented by the fair now held on May 14. A market for corn and cattle is still held on Wednesdays, and another on Tuesdays for fat stock has been added. The church of St. Mary Magdalene is notable for its tower and octagonal spire (223 ft. high). Its central piers, dating from the 11th or 12th century, remain, and the lower part of the tower is Early English. The upper parts of the tower and spire are Decorated, completed about 1350; the nave dates from between 1384 and 1393 and the chancel from 1489. There are a few old monuments and a 14th-century brass. The castle is supposed to have been founded by Egbert, king of the West Saxons. It was known as the "key of the North." The Norman stronghold still shows a gatehouse, a crypt and the lofty tower. The building seems to have been reconstructed in the early part of the 13th century. During the Great Rebellion it was garrisoned for Charles I and endured three sieges. A late 15th-century cross (the "Beaumond" cross) is in the town. A grammar and song school was founded in the reign of Henry VIII.

The town trades in malt, coal, corn and cattle. There are iron and brass foundries, boilerworks, agricultural implement manufactories and breweries. Gypsum and limestone are obtained in the neighborhood.

NEWARK, the largest city of New Jersey, U.S., a port of entry and the county seat of Essex county; on the Passaic river and Newark bay, 8 mi. W. of lower Manhattan (New York city). It is served by the Central of New Jersey, the Erie, the Lackawanna, the Lehigh Valley and the Pennsylvania railways; steamship lines operating to Atlantic, Gulf and Pacific ports; by trolleys entering the city's business centre via subway, motor bus and truck lines in all directions; and the Hudson and Manhattan railway, which provides 178 trains daily to and from New York via tubes under the Hudson river; federal highway 1 and state highway 25 (over a high-level super bridge structure known as the Pulaski skyway).

The Newark Metropolitan airport was one of the pioneer U.S. airports. It was opened in 1928 and together with Port Newark is leased and operated by the Port of New York authority.

Population in 1950, according to the federal census, was 437,857. This is more than doubled by the adjacent cities and suburbs, including the Oranges, Belleville, Nutley, Bloomfield, Montclair, Irvington, Maplewood, Elizabeth, Kearny, Arlington, Harrison and Bayonne. The city has an area of 23.6 sq.mi.; 13 mi. of water front, 375 mi. of streets (357 mi. paved). The site, bordered on the east by the Passaic river, is generally level, but rises gradually toward the west.

Port of Newark faces Newark bay at the mouth of the river. The city is laid out in an irregular pattern. It is closely built up in the business sections, largely with tall structures of modern type. Many of the older buildings are of a native brown sandstone. Broad street (120 ft. wide) and Market street (90 ft.) are the principal thoroughfares, and their intersection (the "Four Corners") is one of the busiest traffic points in the world. Near by is Military park (an irregular plaza used in colonial days as a drill ground), surrounded by public and semipublic buildings (including the Public Service terminal, completed in 1916). In this park is a magnificent bronze group of 48 figures on a gigantic scale, "The Wars of America," by Gutzon Borglum.

Facing Washington park, also near the heart of the city, are the public library and the Newark Museum of Industry, Art and Science (opened 1926). Conspicuous among the city's business structures are the buildings of the Prudential and various other insurance companies as well as that of the New Jersey Bell Telephone company. The county courthouse, designed by Cass Gilbert, has mural decorations by well-known American artists, and in front of it is Gutzon Borglum's seated statue of Abraham Lincoln (in bronze). The hall of records, opposite the courthouse, was completed in 1928. Completion of a union railway and trolley station in 1937 enabled abolition of Manhattan Transfer in the New Jersey meadows and involved the construction of Newark's first subway. Among the noteworthy old buildings are the Trinity Episcopal cathedral, near Military park, built in 1743 and used as a hospital during the Revolution; the House of Prayer with its stone rectory, more than 200 years old; and the Old First Presbyterian church, founded 1666.

There are 44 playgrounds, with a combined area of 42 ac., and the parks within the city limits cover 951 ac., of which 912 ac. are part of the Essex county park system aggregating 3,833 ac.

In 1917 the city adopted a commission form of government. Five commissioners, elected at large every four years, constitute the governing body. Each commissioner is the director of one of the five departments of the city's business (public affairs, public works, revenue and finance, public safety, parks and public property). The commissioners elect one of their own number as mayor. The public schools are administered by a nonpartisan board of nine members (appointed). The city's water supply from the Pequannock river watershed (57,000,000 gal. daily) in recent years has been increased by the development of the Wanaque watershed (a joint project of eight north Jersey municipalities), which supplies a total of 100,000,000 gal. a day, of which 40,500,000 are allotted to Newark.

The quality of water supplied is equalled by that of but very few large cities. The sewage from Newark and 21 other municipalities is disposed of through trunk sewers (operated by the Passaic Valley Sewerage commission) into strong tidal currents well out into New York bay.

The public school system comprises 49 elementary, 7 senior and 3 junior high schools, 1 continuation school and 11 evening schools. There are 2 vocational schools under county direction in the city; 27 parochial schools and several private academies, including Newark academy, founded in 1774. The public library and museum have been pioneers in developing unconventional methods of serving the people.

The library has 621,966 volumes and an annual circulation of 2,314,977. The museum has exhibits valued at more than $1,200,000. The New Jersey Historical society, with its exhibits and records, adds to the city's cultural assets. There are several special libraries in the city, including the Prudential Insurance company's valuable collection on vital statistics. Newark is the seat of the Newark College of Engineering (1885); the New Jersey College of Pharmacy (1891), now affiliated with Rutgers university, the state university of New Jersey. The Newark colleges of Rutgers university include facilities of the former University of Newark. There is also a state teachers college. There are about 300 churches and congregations and Newark is the see of both a Roman Catholic and a Protestant Episcopal bishop. The philanthropic institutions and agencies are united in a welfare federation, financed by an annual community chest campaign. Daily newspapers are: *Newark Evening News* and *Star-Ledger* (morning). Sunday newspapers are the *Sunday Call* and *Star-Ledger*.

Newark has long been one of the leading manufacturing centres of the country. The industries are highly diversified. Among the principal products are paints, pigments and varnishes; electrical apparatus, machinery and supplies; malt liquors; bread and other bakery products; meat packing, wholesale; chemicals; leather; machinery; jewellery. Newark is one of the important retail trade and wholesale trade centres as well. As an insurance centre also it has been long important. The ten large life, fire and casualty companies having their home offices there employ about 14,000 persons in Newark and have assets aggregating more than $5,115,000,000. It is an important transportation centre by rail, highway, air and sea and it is a prominent distributing point for many of the nation's leading products. Its development as a seaport is comparatively recent. In 1914 the city began the creation of the Port of Newark, later leased and operated by the Port of New York authority, as a shipping terminal and industrial centre. With aid from the federal government the channel was deepened to 30 ft. and widened to 400 ft. More than 2,000 ac. have been prepared on reclaimed land for industrial sites, 10 public and 133 private docks and piers have been built.

In 1666 (following the union of the towns of the New Haven jurisdiction with Connecticut in 1664, and the consequent secularization of the franchise) a band of about 30 Puritans from Milford, Conn., led by Capt. Robert Treat, settled at "Four Corners," and the next year they were joined by an equal number from Branford and Guilford, Conn. They bought practically all of what now is Essex county from the Indians for "fifty double hands of powder, one hundred bars of lead, twenty axes, twenty coats, ten guns, twenty pistols, ten kettles, ten swords, four blankets, four barrels of beer, ten pairs of breeches, fifty knives, twenty horses, 1850 fathoms of wampum, six ankers of liquor (or something equivalent), and three troopers' coats." The name was chosen in honour of their pastor, the Rev. Abraham Pierson (1608–78), who came from Newark-on-Trent, England. For 50 years or more the town remained essentially Puritan and was governed largely according to the Mosaic law. About 1730 Presbyterianism superseded Congregationalism. and in 1734 Col. Josiah Ogden (who had caused a schism by saving his wheat one dry Sunday in a wet season) led in founding the first Episcopal church (Trinity). Newark was incorporated as a township in 1693 and was chartered as a city in 1836. The townships of Orange and Bloomfield were set off from it in 1806 and 1812, respectively. From 1747 to 1756 the College of New Jersey (now Princeton university) was carried on there, under the presidency after the first few months of the Rev. Aaron Burr, who published in 1752 his famous textbook, the *Newark Grammar*. The manufacture of leather (especially patent leather) and shoes early became an important industry. There was a tannery there in 1770 and by 1837 there were 155 curriers and patent-leather makers. The jewellery industry dates from about 1830. Newark was the home of Seth Boyden (1788–1870), called by Thomas A. Edison "one of America's greatest inventors," who invented the processes for making patent leather (1818) and malleable cast iron (1826), besides many new machines and many improvements on older apparatus; of the Rev. Hannibal Goodwin, who in 1887, in the attic of the rectory of the House of Prayer, invented the flexible film which made the motion picture possible; and of Edward Weston, inventor of electrical measuring instruments. The city's population was 38,894 in 1850; 71,941 in 1860; 136,508 in 1880; and 246,070 in 1900. Between 1900 and 1910 it increased 41%; between 1910 and 1920, 19%; and between 1920 and 1930, 6.7%. Between 1930 and 1940, it decreased 2.8%. (R. W. Bt.; X.)

NEWARK, a village of Wayne county, New York, U.S., 30 mi. E. of Rochester on the state barge canal, and served by the Marion, the New York Central, the Pennsylvania and the West Shore railways. Pop. (1950) 10,275; in 1940 it was 9,646 by federal census. Twenty miles north are the summer resorts on Sodus bay (Lake Ontario), and Lakes Seneca and Canandaigua lie 15 mi. and 18 mi. respectively to the south. Newark has extensive nurseries (it is the rose centre of the U.S.) and a great variety of manufacturing industries with an aggregate business of $16,000,000 annually at mid-20th century. It is the seat of a state school for mental defectives.

The village was founded about the time of the opening of the Erie canal (1825) and was incorporated in 1839.

NEWARK, a city of central Ohio, U.S., 33 mi. E. by N. of Columbus, at the confluence of the north and south forks of the Licking river; the county seat of Licking county. It is served by the Baltimore and Ohio, Pennsylvania and New York Central railways. Pop. (1950) 34,178; (1940) 31,487; in 1930 it was 30,596 by the federal census. The city lies 820 ft. above sea level, in a broad, fertile valley, surrounded on three sides by low hills. It is an important industrial centre, manufacturing spun glass, electric ranges, glassware, aluminum wire and cable, petroleum products, rope and fabricated steel. In Newark and its vicinity are some of the most extensive and best preserved earthworks of prehistoric mound builders. When first observed (about 1800) by white settlers, the mounds were covered with dense forests containing trees more than 500 years old. Newark was first settled about 1801, its original plat was recorded in 1803 and the community was incorporated in 1826.

Denison university (Baptist, 1831) is located 6 mi. W. of Newark in Granville. Ten miles S. is Buckeye lake, and 5 mi. E. is Flint Ridge State park, in which flint pits used by many North American Indians are preserved. (*See* also Newark Works.)

NEWARK WORKS. An elaborate and complicated group of prehistoric works at the junction of two branches of Licking river, near Newark, Licking county, Ohio. Situated on a plain

30 to 50 ft. above the bottom land, the works consist of a series of square, circular, and octagonal enclosures, with mounds, ditches and connecting avenues spreading over nearly 4 sq.mi. They are composed of two groups, nearly 2 mi. apart, connected by two walled avenues averaging 200 ft. wide. The western group consists of a large circle, 3 to 14 ft. high and with a mean diameter of 1,054 ft., connected with a symmetrical octagon by an avenue 300 ft. long and 80 ft. wide. Outside the octagon are two small circles, and at each corner of the octagon is a gateway, opposite which and 60 ft. within is a small mound 3 to 6 ft. in height.

The length of the walls between the centres of the gateways averages 621 ft., from which the greatest variation is only four ft., except in one wall that falls 8 ft. short of the average. From the south side of the octagon a walled avenue stretches southward 2 mi. or more, and from near its east side two similar avenues extend eastward with a low wall on each side, one connecting with the square of the eastern group, the other running east to the descent to the lowland north of the square. Disposed along these avenues are circles.

The eastern group of the works consists of a large circle connected with the square mentioned by a broad avenue and several adjoining lines of walls. The wall of the circle is accompanied with an inside ditch 28 to 40 ft. wide and 8 to 13 ft. deep, while the wall itself is 35 to 55 ft. wide at the base and from 5 to 14 ft. high.

There is a gateway at the northeast with flanking extensions of the wall into the walled avenue leading to the square, the sides of which are 926 to 951 ft., yet the angles at the corners do not vary from the right angle more than one degree.

NEW BEDFORD, a city of Massachusetts, U.S., 56 mi. S. of Boston at the mouth of the Acushnet river, on an arm of Buzzards bay; a port of entry and one of the county seats of Bristol county.

It is on federal highway 6 and is served by the New York, New Haven and Hartford railroad, by Northeast Airlines and by motorbus lines and steamboats. Pop. in 1950 was 109,189; and in 1940 was 110,341.

The city occupies 19.1 sq.mi. along the west side of the river and harbour, opposite Fairhaven, with which it is connected by two highway bridges.

It is in the heart of the summer resort region of southern New England and is the port of sailing for the islands of Nantucket and Martha's Vineyard. The harbour is a tidal estuary, with a 30-ft. channel 350 ft. wide and a 14-ac. turning basin above the bridge.

Boulevards almost encircle the city, including a broad drive along the shore of the harbour to Clark's point, where Ft. Rodman (erected during the Civil War) guards the entrance. There are some handsome modern buildings, including the post office, the municipal building, the library and the high school. The library, established by a private society in 1802 and taken over by the city in 1853, was one of the first free public libraries in America. It has a fine collection of whaling prints and other material relating to the industry and much historical material relating to the Quakers.

The Bourne Whaling museum contains, among other exhibits, a half-size reproduction of Jonathan Bourne's favourite full-rigged whaling bark "Lagoda"; the walls are adorned with harpoons, darting guns and lances.

In the Seamen's Bethel (1831) just across the street are the black-bordered marble memorial tablets engraved in terms of bitter and hopeless grief which Herman Melville described in *Moby Dick.*

Free educational opportunities, in addition to those provided by the public-school system, are offered by a state textile school, the New Bedford vocational school and the Swain Free School of Design. Daily papers are published in French and in Portuguese.

New Bedford has long been one of the principal centres for the manufacture of fine cotton goods. It is the spot cotton market of the north, and its warehouses have a large storage capacity. The traffic of the harbour in 1949 aggregated 605,751 net tons, the bulk of which was receipts. In addition there are large shipments of fish.

The city's assessed valuation for 1948 was $112,000,000.

The site of New Bedford was visited in 1602 by Bartholomew Gosnold, who traded with the Indians at the mouth of the Acushnet. It was originally part of the town of Dartmouth, settled in 1652 by colonists from Plymouth who purchased the land from Massasoit. About 1665 there was a considerable influx of Quakers, who have ever since been an important and influential element in the population. There was no village on the site of the present city until 1760.

In 1787 New Bedford was set off from Dartmouth and incorporated as a town, and in 1847 it was chartered as a city. Fairhaven was separated from it in 1812.

The town was at first called Bedford (the family name of Joseph Russell, one of the founders), and later New was prefixed to distinguish the town from Bedford in Middlesex county. On May 14, 1775, a local ship captured two armed British sloops just outside the New Bedford harbour.

During the Revolution the harbour was a rendezvous of American privateers, and this led to an attack (Sept. 5, 1778) by a fleet and armed force under Earl Grey, which burned 70 ships and almost destroyed the town.

The whaling industry became established there after Joseph Rotch, a Nantucket merchant, built wharves and warehouses on the west side of the harbour in 1765, and New Bedford was long the principal whaling port of the world.

For more than a century the industry flourished, with interruptions due to the Revolution, the embargo, the War of 1812 and the Civil War, reaching its peak in 1857 when 329 whaling ships were registered, representing an investment of $12,000,000 and employing 10,000 men ashore and afloat. The hunting grounds shifted after 1791 from off the Virginia and Carolina coast to the Pacific, and after 1848 to the arctic waters.

The first cotton mill was built in 1847 by Joseph Grinnell (1789–1885) and his associates, and began operation in 1848 with 15,000 spindles and 200 looms.

NEW BERN, a city of eastern North Carolina, U.S., at the mouth of the Trent river, on the Neuse river estuary; a port of entry and the county seat of Craven county. It is on federal highways 17 and 70; is connected by a 12-ft. channel with the inland waterway from Boston, Mass., to Miami, Fla.; and is served by the Atlantic Coast Line, the Norfolk Southern and the Atlantic and East Carolina railways; by the National and the Piedmont airlines and by coastwise steamers. Pop. 15,812 in 1950, and in 1940, 11,815 by the federal census.

The Neuse river is 1½ mi. wide there, and it widens gradually to 7 mi. at its entrance into Pamlico sound, 30 mi. east. New Bern is a picturesque old city, on the peninsula formed by the two rivers, surrounded by forests of cypress and pines. It is the supply depot and commercial centre of the rich surrounding farm lands and of the numerous fishing and hunting resorts of the region (Ocracoke, Morehead, Beaufort, Jacksonville, Havelock, Nags Head and Cape Lookout).

The city's manufacturing industries include the largest lumber mill in the southeast, boat building, needle trades, chemicals and wood products.

New Bern was founded in 1710 by a company of Germans and Bernese Swiss in search of religious freedom, under the leadership of Baron Christopher de Graffenried, and was incorporated as a city in 1723. The general assembly met there in 1738. In 1749 a printing press (the first in North Carolina) was set up, and the first academy in the province was established. For some years the city was the capital of the province, and it was the leading seaport until the Revolution. Many beautiful old buildings still stand, including one wing of "Tryon's Palace" (the residence of the royal governor, built in 1767–70, and reputed the finest structure in America at the time), the Presbyterian church (1822), and Christ church, which has a communion service presented by George II in 1752.

The city was strongly fortified early in the Civil War, but was captured by Federal troops on March 14, 1862, and subsequent

attempts by the Confederates to retake it (March 14, 1863, and Feb. 1 and 5, 1864) were unsuccessful.

NEWBERRY, JOHN STRONG (1822–1892), U. S. geologist, was born at Windsor, Conn., on Dec. 22, 1822. He was graduated from Western Reserve university at Cleveland, O., in 1846 and from Cleveland Medical college in 1848, and completed his medical studies in Paris.

In 1851 he began the practice of medicine in Cleveland, but abandoned it to accept an appointment as surgeon and geologist with an exploring party in northern California and Oregon. His reports on the geology, botany and zoology of the expedition were published in 1857.

For the next four years he was employed on similar work in the region of the Colorado river, his researches extending over a large area in Utah, Arizona and New Mexico. In 1866 he was appointed professor of geology and palaeontology at the Columbia School of Mines, New York, where he commenced the formation of a magnificent collection of specimens. In 1869 he was made state geologist of Ohio and director of the second geological survey of that state, and in 1884 palaeontologist to the U.S. geological survey.

He devoted much study to Triassic, Cretaceous and Tertiary plants, and in particular to those of the Larami stage. He also carried on researches among the Palaeozoic and Triassic fishes of North America.

Among his other publications may be mentioned *The Origin and Classification of Ore Deposits* (1880). He died at New Haven, Conn., on Dec. 7, 1892.

See a bibliography of his publications in *Bulletin of Geol. Soc. of America*, vol. iv. p. 393 and "Memoir" (with portrait) by J. J. Stevenson in *American Geologist* (July, 1893).

NEWBERRY, a town of South Carolina, U.S., the county seat of Newberry county; on federal highways 76 and 176, 43 mi. N.W. of Columbia.

It is served by the Columbia, Newberry and Laurens and the Southern railways. Pop. (1950) 7,546. It is a cotton market and cotton-manufacturing centre, with more than 200,000 spindles in its mills. The lumber industry, livestock and pulpwood are important.

It is the seat of Newberry college (1856). The town was settled in 1832 and was incorporated in 1894.

NEWBOLT, SIR HENRY JOHN (1862–1938), English author and poet, was born on June 6, 1862, the son of H. F. Newbolt, vicar of St. Mary's, Bilston. He was educated at Clifton college, and at Corpus Christi college, Oxford. He was called to the bar at Lincoln's Inn in 1887 and practised until 1899. His first book was a story, *Taken from the Enemy* (1892), and in 1895 he published a tragedy, *Mordred;* but the publication of his ballads, *Admirals All* (1897), created his literary reputation. These were followed by other volumes of stirring verse, *The Island Race* (1898), *The Sailing of the Long-ships* (1902), *Songs of the Sea* (1904). From 1900 to 1905 he was editor of the *Monthly Review.* His novels *The Old Country* (1916) and *The New June* (1909), attracted attention. During the World War he was controller of wireless and cables. He was knighted in 1915. In 1914 appeared *Drake's Drum and other Sea Songs,* and *Aladore;* his chief contribution to war poetry was *St. George's Day and Other Poems* (1918). In 1920 he published his *Naval History of the Great War.*

His other works include:—*Tales of the Great War* (1916), *The Book of the Happy Warrior* (1917), and *Submarine and Anti-Submarine* (1918), written primarily for the young; *A New Study of English Poetry* (1917); *Poetry and Time* (1919); *An English Anthology* (1921); *Studies Green and Gray* (1926); *New Paths on Helicon* (1927); and *Naval Operations—1917 to the Armistice.*

NEW BRIGHTON, a community on the northeast shore of Richmond borough (Staten island), part of New York city, U.S.A., since 1898. It is at the northeastern end of Staten island, about 6 mi. S.W. of the borough of Manhattan. At New Brighton is the Sailors' Snug Harbour, founded under the will of Robert Richard Randall (*c.* 1740–1801), who in 1771 became a member of the Marine Society of New York (an organization for the relief of indigent masters of vessels and their families), and in 1790 bought from Baron Poelnitz the "Minto farm," about 21 ac. of land in what is now the borough of Manhattan. This tract, with four lots, also in what is now Manhattan, and cash and stocks to the value of about $10,000 Randall bequeathed to a board of trustees, directing that the income should be used "for the purpose of maintaining and supporting aged, decrepit and worn-out sailors," who had served at least five years under the American flag, and that the institution established for this purpose should be called "the Sailors' Snug Harbour." The Sailors' Snug Harbour was incorporated in 1806, and its charter was amended in 1828 to permit the building of the institution on Staten island rather than on the Randall estate, which had already greatly increased in value. In 1833 the institution, with lands covering 160 ac., was opened in New Brighton with about 50 inmates. Randall's body was removed to the grounds in 1834, and in 1884 a life-size bronze statue of him, by Augustus Saint-Gaudens, was placed in front of the main building. At New Brighton are located Curtis and St. Peter's high schools, Staten Island academy, the Staten island branch of Manhattan college, Staten Island hospital, and the Staten Island Institute of Arts and Sciences museum.

See I. K. Morris, *Memorial History of Staten Island* (1900); C. G. Kolff, *A Short History of Staten Island* (1926); and Leng and Davis, *Staten Island and Its People* (1930).

NEW BRITAIN, an island of the Bismarck archipelago, lying east of New Guinea, in the Pacific ocean, between 5° and 6° S., and 150° E. (German, *Neu Pommern;* native, *Birara*). It formed part of the colony of German New Guinea from 1884 (when the German protectorate was declared), until 1914, when it was occupied by Australian troops, and in 1919 it was mandated by the League of Nations to the commonwealth of Australia, until its occupation by the Japanese in Jan. 1942. Rabaul, the administrative centre and principal town, became a major Japanese base in the naval and air war between the Japanese and the U.S. and Australian forces under the command of General Douglas MacArthur (*q.v.*). It was a frequent scene of concentrations of Japanese shipping and of United Nations air attacks. It is long and narrow, almost crescent in shape, about 300 mi. long, with a width varying between 28 and 50 mi. The largest island in the archipelago, its total area is about 10,000 sq.mi. The population of the patrolled areas in 1940 was 90,349.

Little explored and little developed, New Britain, despite its narrowness, had never been crossed by a white man by the time of World War II except at its northern extremity, because it is bisected from east to west by rugged mountain chains. The highest peak on the island, the Father (7,546 ft.), is an active volcano. There are no rivers of any importance, only a few swift streams.

Although the location of Rabaul (non-native population 4,674 in 1940) is open to some criticism (it is on a swamp in an earthquake zone and against an active volcano), the town was built with rather typical German solidity and possesses an excellent harbour, a consideration which doubtless induced the Japanese to select it as a major base. Most of the white population lives in the neighbourhood of Rabaul.

Coco-nut plantations represent the principal agricultural activity of the island. The largest cultivated area (83,913 ac. in 1940) is on the Gazelle peninsula, on the northern shore of the island. Other plantations are located on the southern shore. There are several excellent harbours and anchorages along the shores of the island, Simpson harbour, in Blanche bay, being most frequently used. Copra is the principal product of New Britain, with shell fishing an important subsidiary industry. Most of the copra is shipped from Rabaul, which is ordinarily a port of call for ships from Australia, the Solomons and other regions of the southwest Pacific.

The island is divided into four administrative districts: Rabaul, Kokopo (the former Herbertshöhe, seat of the German administration of New Guinea), Gasmata and Talasea. While the interior has been largely left to the aborigines, roads are gradually extending the area where travel is safe. A good deal of communication is by steamer, and in normal times there is regular service between Rabaul and the smaller ports of New Britain and the ports of New Guinea and Australia.

The natives of New Britain are Melanesians, with dark skins and

frizzy hair. They are akin to the natives of New Guinea (*q.v.*) in customs and language. Old practices of cannibalism and headhunting are to be found in the remote interior districts, but have largely disappeared in the coastal areas with the building of roads and the establishment of a more settled administration. A curious kind of pidgin English developed for communication between the Europeans and the natives, who can be trained as workers and sometimes show considerable intelligence.

Vulcan Island, with an area of several acres, appeared on the south side of Blanche bay during an eruption of a volcano known as Mount Mother.

An eruption of the Matupi and Vulcan volcanoes, near Rabaul, on May 29, 1937, killed 263. (W. H. Ch.)

NEW BRITAIN, a city of Hartford county, Conn., U.S., 9 mi. S.W. of Hartford; served by the New York, New Haven and Hartford railway. The population was 73,726 in 1950 and 68,685 in 1940 by the federal census.

The seat of the Teachers College of Connecticut (chartered 1849) and a state trade school, the city is an important manufacturing centre, with an output in 1952 valued at about $250,000,000. Wages paid in that year totalled more than $90,000,000. Hardware, ball bearings, electrical appliances, hand tools, automatic machines, cutlery and edge tools, metal cabinets, suits, buckles, zippers, air conditioning units and machine-shop products are the leading manufactures.

Settlement within the territory occupied by New Britain began in 1687. The town of New Britain was incorporated in 1850, and the city was incorporated in 1871. In 1905 the two were consolidated.

NEW BRUNSWICK, a province of Canada, lying between approximately 44° 37′ and 48° 3′ N. and 63° 46′ and 69° 3′ W. Its length from north to south is 230 mi.; its greatest breadth, 190 mi.; and it has a seaboard of about 550 mi.

Geological and Physical Features.—The geological aspect of New Brunswick is fully treated in the article CANADA. Geographically, the province represents the land area of the eastern coast of Canada surrounded by the Bay of Fundy, Northumberland strait, the Gulf of St. Lawrence and the Baie des Chaleurs. It comprises the entire basin of the river St. John, a river 399 mi. long, flowing into the Bay of Fundy and navigable for 88 mi. to Fredericton, and for small boats for 65 mi. farther. The province includes also the basin of the Miramichi and lesser rivers entering the Gulf of St. Lawrence and the southern half of the basin of the Restigouche entering the Baie des Chaleurs. The upland areas thus drained reach in places a height of 2,000 ft. above sea level and form in the centre of the province an unbroken forest country, little occupied or reached by railways or highways as late as mid-20th century. All the lower valley of the St. John and many coastal parts of the province represent first-class agricultural land; and the coast line, especially along the Bay of Fundy, is well settled and offers a chain of commodious harbours. The high tides of the bay, reaching to 70 ft., occasion the peculiar phenomenon of the reversible waterfall at the mouth of the St. John and the rush of the tidal bore at the head of the Bay of Fundy. Only on its western side has New Brunswick in part a nongeographical boundary, the 69° 3′ meridian, a compromise line (Ashburton treaty, 1842) resulting from the search to find the "northwest angle" of Nova Scotia supposed (1783) to separate Nova Scotia from Massachusetts (later Nova Scotia from Maine).

Climate.—The cold air of the northern interior frequently flows over the province in winter. The average rainfall is 40 to 45 in. The snowfall is very heavy in the north of the province, where it exceeds 100 in. The harbour of Saint John is open throughout the year.

History.—Until 1784 New Brunswick formed part, first of the French province of Acadia, later of the British province of Nova Scotia. The first settlement within its borders was made in 1604 by Pierre de Guast, sieur de Monts, with whom was Samuel de Champlain. Their colony at the mouth of the St. Croix river was soon abandoned, but throughout the French regime the district was frequented by bands of fur traders. In 1762 the first English settlement was made at Maugerville, on the St. John river, and in 1764 a body of Scottish farmers and labourers took up land along the Miramichi.

Scattered French settlers located themselves on the mainland side of the Bay of Fundy. They numbered about 4,500 at the time of the expulsion of their kindred across the bay, and their numbers were increased by about 500 of these as refugees.

After the American Revolution the great influx of loyalists into the valley of the St. John led to the separation of New Brunswick from Nova Scotia in 1784. The close of the Napoleonic wars in 1815 brought a constant influx of immigration from Great Britain. The province had 74,000 inhabitants by 1824.

New Brunswick shared with Nova Scotia, in the middle period (1815–67), the prosperous development that arose from lumbering, shipbuilding and the fisheries, and (until 1849) from the preference of the British market for colonial timber and the effect of the Navigation acts (till 1849) in giving the maritime provinces the West Indian trade denied the United States. This occasioned a relative neglect of agriculture and led many immigrants to prefer settlement in upper Canada. The landmarks in the provincial history include the long diplomatic struggle between Britain and the United States over the delimitation of the boundary according to the cryptic terms of the treaty of 1783 which ended in the compromise of the Ashburton treaty of 1842. Provincial history turned also on the question of responsible government, granted after its adoption in Canada (1841–49) and then on reciprocity of trade with the United States (1854). The 1864 plan of confederation for British North America, urged by Canada as a remedy for deadlock, and by Great Britain after the warning of the American Civil War, found little favour in the province but in 1866 was voted by the legislature as a reaction from the Fenian raids. The 1867 union with Canada, by removing customs revenue and blocking British trade, proved highly unpopular. Hence, the postconfederation history of New Brunswick, as of Nova Scotia, turns on the unsatisfactory relations of the federal and provincial governments: the agitation for repeal, or maritime union, and for economic compensation to offset the dominance of central Canada.

Area and Population.—The area of the province is 27,985 sq.mi., of which 512 sq.mi. are fresh water. The population in 1951 was 515,697. In 1941, 63% of the people were of British descent, descendants of the loyalists who founded the colony or immigrants during the prosperous period of the middle 19th century; and the French numbered about 33%. The French population of the Chignecto isthmus represents, in the main, the original mainland Nova Scotia Acadians who were not included in the expulsion of the Acadians from the Nova Scotia peninsula in 1755. The aboriginal element of Algonkin stock is represented by the remnants of two tribes, the Malicites and the Micmac Indians, whose numbers increased (1871: 1,403; 1941: 1,939).

In 1941 the religion of the population was classified as follows: 46% Roman Catholic, 20% Baptist, 15% United Church, 12% Anglican and 4% Presbyterian. The chief towns (1951 pop.) are Fredericton, the capital, 16,018; Saint John, 50,779, and Moncton, 27,334.

Government.—The British North America act of 1867 and amendments assigned representation at Ottawa as 12 senators until 1873 (10 in 1951), and representation in the house of commons on the proportion of the population to that of Quebec, which has a fixed representation of 65. But the number of members by the British North America act of 1915 must not fall by decline of population below the number of senators, and stood at ten in the elections of 1949.

For the provincial government (capital, Fredericton) there is a lieutenant governor, appointed and paid by the federal government, a legislative assembly of 52 members elected for five years unless sooner dissolved, a premier and ministry on the British constitutional tenure and a fixed civil service nonpolitical tenure.

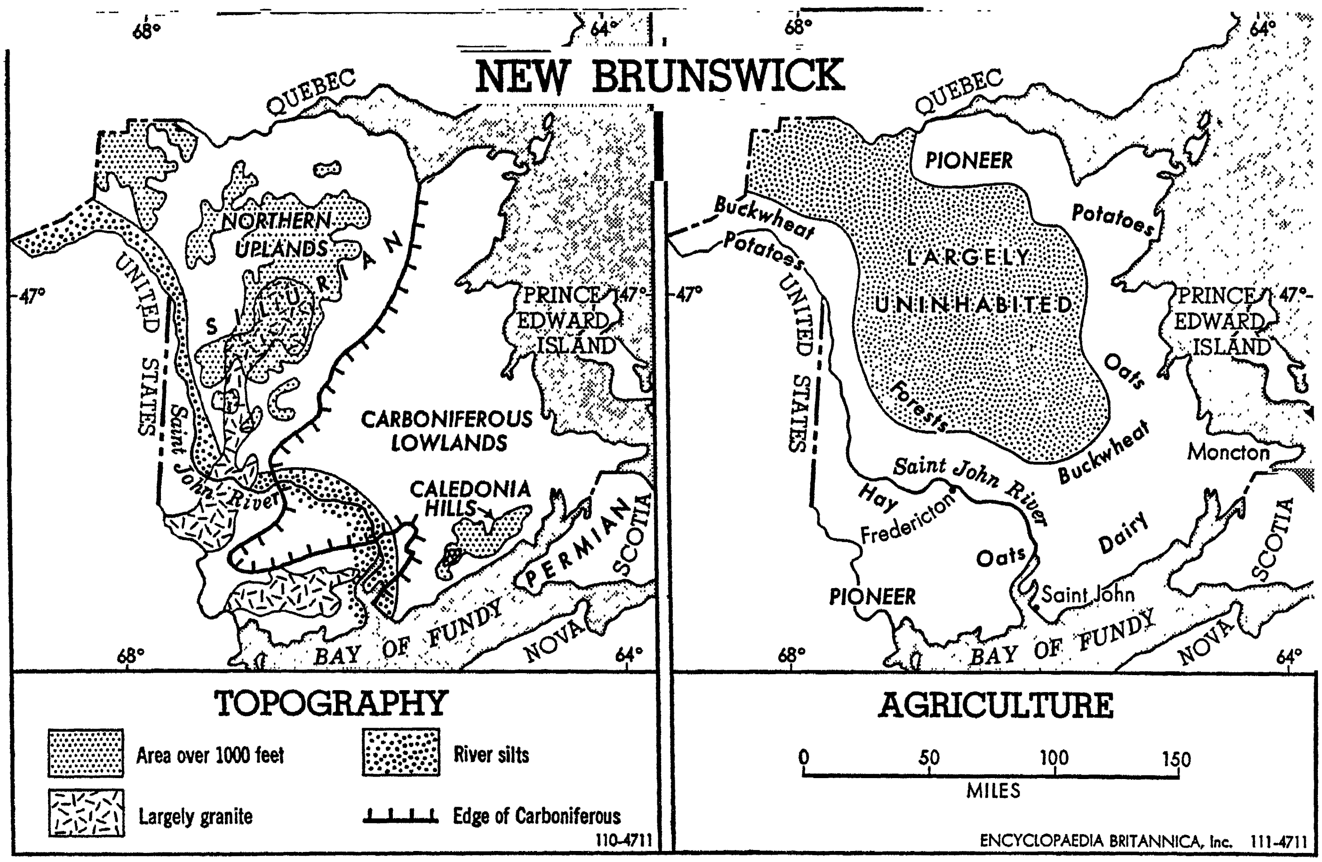
Education.—Almost all primary education is in public schools, nondenominational, compulsory and free of charge. In 1948 the enrolment was 98,331 in public day schools, 2,341 in private day schools and 958 in business colleges. University and college work is carried on in the (Provincial) University of New Brunswick at Fredericton, founded in 1800 and reorganized in 1859; the (Methodist) University of Mount Allison at Sackville; and the Roman Catholic college at Memramcook.

Agriculture.—The province contains a great deal of agricultural land, but by 1951 the larger part of it, 13,300 sq.mi. in a total of 16,750 sq.mi., remained uncleared of forest. The occupied fields and pastures covered only 2,690 sq.mi., and in 1948 there were 31,900 farms which created 22% of that year's total provincial production. In 1951 agriculture was the second ranking producer, being exceeded by forestry. To improve agriculture's position, the provincial government was active in the 1941–51 decade in promoting potato, creamery, poultry, pork and field-crop production. Comparative statistics revealed the consequent trend—field crop acreages: (1941) 871,000, (1949) 934,000; field crop values: (1941) $26,806,000, (1949) $32,129,000. Despite such increases, agricultural production of the province was far below that of Saskatchewan.

Forests.—The most valuable and most widely spread tree is the black spruce (*Abies nigra*), from which is made wood pulp for papermaking. The hemlock (*Abies canadensis*), the cedar, birch, beech, oak, ash and many other valuable trees are also widely spread. The chief ports for shipping are Saint John, at the mouth of the St. John river, and Chatham, at the mouth of the Miramichi.

The great forests, through which flow numerous rivers with excellent harbours at or near their mouths, have long made New Brunswick a centre of lumbering.

The forested land of New Brunswick, including land fit to clear for agriculture and land only of forest utility (lumber, pulpwood), covers about 21,770 sq.mi. of the total 27,473 sq.mi. of land area. Only about 190 sq.mi. of forest are classed as without commercial value. In 1950 the federal government created the 80-sq.mi. Fundy national park.



TOPOGRAPHY: THE RUGGED UPLANDS ARE PRIMARILY IN THE NORTH, WHILE THE LOWLANDS ARE IN THE EAST AND IN THE WEST ALONG THE SAINT JOHN RIVER. AGRICULTURE: FARMING AREAS CORRESPOND RATHER CLOSELY TO THE TOPOGRAPHY WITH THE BEST FARMS IN THE SAINT JOHN VALLEY AND IN THE CARBONIFEROUS LOWLANDS

Statistics (1950) of forest and forest industries in New Brunswick showed accessible standing merchantable timber (conifers and broad-leaved) as 8,950,000 cu.ft., to compare with 63,701,000,000 cu.ft. for Quebec, and 189,051,000,000 cu.ft. for Canada (exclusive of Newfoundland). The lumber production (1948) was 290,434,000 ft. b.m. worth $15,131,000. In 1949 total forest products were worth $113,000,000, of which $68,000,000 was for pulp and paper.

Minerals.—Until 1950 the mineral wealth of the province was small. At various times gold, copper, lead and zinc were worked on a small scale, but in 1950 commercial quantities of those minerals, plus silver, were found in Gloucester county. Iron and plumbago are mined in a limited way. Coal, of which New Brunswick has 11.3% of Canada's total reserves, is actively recovered; and the Hillsborough gypsum deposits are third largest in Canada and high grade. Natural gas with oil is obtained near Moncton.

In 1939 New Brunswick produced about $4,000,000 worth of minerals. A decade later the figure was $7,386,000, highest on record. Coal and gypsum accounted for most of the production.

Environment and Settlement.—The relation of the settlement to the environment is fairly close in New Brunswick. Structurally, the province lies in the western portion of a geological basin, with the oldest Silurian and Ordovician rocks forming uplands more than 1,000 ft. high in the north. These give rise to rather sterile soils, and in consequence the region is forested and almost as empty of settlers as in the earliest days of the province. The southeast half of the area consists of younger rocks belonging to the Carboniferous era (*see* figure), and some coal is worked in beds near Moncton. In the southwest are oval areas of granite which are mostly of Devonian Age and which burst up through the older Silurian deposits. The Caledonia hills are also formed of granite. They give rise to poor soils. The best soils are found along the St. John valley, where river silts to considerable depths are being extensively farmed.

The farmlands correspond fairly closely to the topography. The best farms occur in the St. John valley and in the lowlands formed of the Carboniferous rocks. Excellent potatoes are grown in the northwest in the county of Madawaska, and also by the French fisherman along the northeast coast. The lowlands are given over chiefly to hay and oats, associated with the dairy economy, especially in the region between Saint John and Moncton. As late as mid-20th century there was pioneer farming in the north and southwest (*see* map). Buckwheat is often widely grown in those areas.

Fisheries.—The fisheries of New Brunswick are extensive, though less so than those of Nova Scotia. This industry centres in the counties of Charlotte and Gloucester, herring, salmon, lobsters, sardines and cod forming the chief catch. The Restigouche and other rivers near the northern border are much frequented by anglers in search of trout and salmon.

Federal legislation after 1942 encouraged fishing production by subsidizing construction of small and medium-sized trawlers called draggers, and by financing provision of facilities for freezing and storing bait. In the same period the provincial government set up a special division of fisheries to modernize the industry through a fisheries loan board. Fishery production at market value climbed from $5,000,000 in 1939 to $20,000,000 in 1950.

Manufactures.—The manufactures, apart from the shipping of Saint John, are connected with lumbering and with agriculture. The making of pulp and paper, sawmill production and fish curing and packing were the three leading industries in the 1945–50 period, in that order of gross value of products. Co-operation in the manufacture of butter and cheese produced excellent results, and numerous cheese and butter factories are scattered through the province. To assist manufacturing, the provincial electric power commission undertook an expansion program, developing 141,000 h.p. by 1951.

New Brunswick in 1948 had 1,067 manufacturing establishments out of 33,447 in all Canada, with about 24,325 employees out of 1,156,006. Nearly half of these provincial workers were in the pulp and paper industry and in sawmills, about one-eighth in fish curing and packing and the same in vegetable processing. The rest were scattered, but many were in textile production and iron fabrication.

Communications.—The trunk lines of railway communications are the Canadian National Railways system (the former Intercolonial), the seashore route from Quebec province to Moncton, with an inland route via Edmundston, and the Canadian Pacific "short line" from Montreal, Que., to Saint John and Fredericton via the state of Maine. Trans-Canada Air Lines was established on a regular basis from Montreal to Moncton (Jan. 1, 1940), and six months later to Halifax, N.S. In 1948–49 direct T.C.A. operations commenced between Sydney, N.S., and Moncton. The Maritime Central Airways began flying on Dec. 8, 1941, with flights between Saint John and Charlottetown, P.E.I., via Moncton, and later branched into Nova Scotia and to the Magdalen Islands.

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Jessie I. Lawson and Jean M. Sweet, *This Is New Brunswick* (1951); Lillian Maxwell, *Round New Brunswick Roads* (1951.)

(S. LEA.; G. TR.; C. CY.)

NEW BRUNSWICK, a city of New Jersey, U.S., is the county seat of Middlesex county. It is on the Raritan river and federal highway 1, 30 mi. S.W. of New York city and 60 mi. N.E. of Philadelphia. It is served by the Pennsylvania and the Raritan River railways and by motorbus and motor freight lines. Pop., by federal census, (1950) 38,811; (1940) 33,180. The city rises from the river to high bluffs on the east and the west, commanding wide and picturesque views. It is the seat of Rutgers university, the state university of New Jersey, and New Brunswick Theological seminary, a school of the Reformed Church of America and the oldest theological school in the United States, founded in New York city in 1784 and situated in New Brunswick since 1810. New Brunswick is one of the oldest cities of New Jersey and has many buildings dating from the 18th century. The Buccleuch mansion, in a 60-ac. park, presented to the city by Anthony Dey, is one of the best preserved colonial houses in the state. In the city, and in the townships immediately surrounding, there are located many large industries manufacturing surgical supplies, pharmaceuticals, wire and cable, batteries, chemicals, needles, automobiles, paints, paper and leather products. New Brunswick's business district serves as a shopping centre for more than 150,000 people living within a radius of 10 mi. The assessed valuation in 1950 was $46,296,379. In 1906 the city adopted a commission form of government.

A settlement was established there in 1681. It was at first called Prigmore's Swamp, later Inian's Ferry, until the present name was adopted in honour of the House of Brunswick. A city charter was granted by the royal governor in 1730 and by the state legislature in 1784. Washington entered New Brunswick on Nov. 28, 1776, but evacuated it on the approach of the enemy, and from Dec. 3 to April 13, 1777, it was occupied by the British under Lord Howe.

NEWBURGH, a royal and small burgh, Fifeshire, Scot., on the Firth of Tay, 7 mi. N.W. of Ladybank junction by the North-Eastern Region railway system. Pop. (1951) 2,367. Its industries chiefly consist of the making of linen and oilskin goods, and there is a floorcloth factory. The trade in corn, fruit and potatoes, and the fisheries are important. About 1 mi. S.W. of the town stand the remains of Macduff's cross, which mark the spot where the clan Macduff was granted rights and sanctuary and composition for murder done in hot blood. Lindores abbey on the Tay is close to Newburgh. Of the Benedictine abbey, founded in 1178 by David, earl of Huntingdon, brother of William the Lion, there remain only the groined arch of the principal entrance, a portion of the west tower and other fragments. At Blackearnside, a forest of alders east of the village, Sir William Wallace defeated the earl of Pembroke in 1298.

NEWBURGH, a city of Orange county, N.Y., U.S., on the west bank of the Hudson river, opposite Beacon, 60 mi. N. of New York city. It is on federal highway 9W; is served by the Erie and the West Shore railways, motorbus and truck lines; and is connected by ferry with the New York Central at Beacon. The population of Newburgh in 1950 was 31,956; in 1940 it was 31,883 by the federal census. The Hudson widens at that point into Newburgh bay.

The city has two miles of water front, with a channel deep enough for ocean-going vessels. It occupies a commanding position on terraces rising abruptly from the river, and from the higher points the view embraces many miles of the Hudson and reaches to the Catskills on the northwest. Newburgh has a retail trade amounting to $49,000,000 annually; a large shipping trade in orchard, farm and dairy products; and a variety of manufacturing industries, with an output in 1949 valued at $95,000,000. In 1916 the city adopted a commission-manager form of government.

Newburgh was settled in 1709 by 53 Germans from the Rhenish Palatinate, led by their minister, Joshua Kockethal. Toward the middle of the century many of the Germans moved to Pennsylvania, and their lands were taken up by Scottish and English settlers, who in 1752 named the town after Newburgh, Scot., from which some of them had come. George Washington made his headquarters there from the spring of 1782 until Aug. 1783, in the Dutch farmhouse built by Jonathan Hasbrouck in 1750 (still standing in Washington park). There he wrote his letter of May 27, 1782, rebuking Col. Lewis Nicola for the suggestion that he assume the title of king; there he made his reply to the "Newburgh Addresses" calling for action by the army to force congress to redress its grievances; and there the arrangements were completed for demobilizing the continental army. Newburgh was incorporated as a village in 1800 and as a city in 1865.

NEWBURN, urban district, Northumberland, Eng., on the Tyne, 5½ mi. W. of Newcastle by a branch of the North-Eastern Region railway. Pop. (1951) 21,940. Area 7.3 sq.mi. It has collieries and iron, steel, engineering, tool and fire-clay works; and there is a large industrial population. Roman remains have been discovered near Hadrian's wall. The name of Scotswood, a manufacturing village between Newburn and the city, commemorates its occupation by the Scottish Covenanters in 1640. Newburn shared in the Tyneside depression of the 1930s, nearly 21% of the insured population being unemployed in June 1934.

NEWBURY, a municipal borough of Berkshire, Eng., 53 mi. W. by S. of Reading by the Western Region railway. Pop. (1951) 14,147. Area about 4 sq.mi. Newbury ("new town" or "borough") is first mentioned by Odericus Vitalis; it is probable, however, that the manor of Uluritone, entered in Domesday as held by Ernulph de Hesdain, covered a large part of the site. The manor subsequently passed to the crown and was held by Elizabeth before her accession. In 1627 it was granted by Charles I as a fee-farm to the corporation. Newbury was a borough by prescription; in 1187 its inhabitants were called "burgesses" and a document of the time of Edward I speaks of it as *burgus*. The borough was incorporated by a charter of Elizabeth (1596). It was extended in 1934. Newbury sent two representatives to the parliament of 1302.

The woollen industry declined early in the 17th century. The Weavers' company, which still exists, was incorporated in 1601. Newbury castle, of which traces remained until the 17th century, is said to have been besieged by Stephen in 1152. An important woollen market, established in 1862, is held annually.

Newbury is situated on the Kennet, which is followed by the Kennet and Avon canal. The church of St. Nicholas is an early 16th-century Perpendicular building. It is said to have been built mainly at the charge of John Winchcombe or Smalwoode (Jack of Newbury), an eminent clothier. A part of John Winchcombe's (Jack of Newbury's) house and the Jacobean cloth hall, now a public museum, still exist. The almshouses called King John's Court are supported by a foundation known as St. Bartholomew's Hospital, to which in 1215 King John granted by charter the profits of a fair on St. Bartholomew's day. Shaw house, on the outskirts, is an Elizabethan mansion; to the north is Donnington castle, retaining a Perpendicular gateway and other fragments. The suburb of Speenhamland was formerly an important posting station on the Bath road. At Sandleford priory, to the south of Newbury, the site and part of the buildings of an Augustinian priory (*c.* 1200) were utilized in the erection of a mansion in 1781. The householders of Newbury have the right to elect boys and girls to the educational foundation of Christ's hospital. Trade is agricultural and there are breweries and flour mills.

Battles of Newbury (1643 and 1644).—These two important battles during the English Civil War, more commonly called the Great Rebellion, are described under the latter heading. The first, on Sept. 20, 1643, arose out of the attempt of the royal army to bar the path of the parliamentary forces under the earl of Essex, which was returning to its base at Reading after raising the siege of Gloucester. Although Essex's army failed to break the royalist line, it had made so strong a moral and material impression that the royalists opened the road to it. The situation was reversed in the second battle, Oct. 26, 1644, when the parliamentary army had headed off Charles I on his way back to Oxford from Basingstoke. This was the first great manoeuvre battle of the war.

NEWBURYPORT, a city of northeastern Massachusetts, U.S., one of the county seats of Essex county, 38 mi. N.N.E. of Boston, on the southern bank of the Merrimack river, 3 mi. from the ocean. It is on federal highway 1 and is served by

the Boston and Maine railroad. Pop. (1950) 14,111; in 1940, 13,916 by federal census. It is an important manufacturing city with a diversified output, shoes, boots, radio and electrical parts. Shipping, distilling and jewellery making were established industries in the town at the close of the American Revolution. There are statues of George Washington and of William Lloyd Garrison (by J. Q. A. Ward and by David M. French, respectively) and many houses dating back to the 17th century, among them the stone "garrison" house in the form of a cross, with walls four feet thick. Other houses of interest are the birthplace of William Lloyd Garrison, the homes of "Lord" Timothy Dexter and Caleb Cushing and the Tracy mansion (1771), now part of the public library building. Indian Hill farm, birthplace of the journalist Ben Perley Poore, is 3 mi. W. of the city. The Putnam Free school, now part of the public-school system, was founded early in the 19th century by an endowment from Oliver Putnam. The high school for girls (opened in 1843) was a pioneer institution. Newbury, including the site of Newburyport, was settled in 1635 under the leadership of the Rev. Thomas Parker (1595–1677), who had lived in Newbury, Eng. In 1764 a tract of 647 ac. was set off and incorporated as the town of Newburyport, which (with enlarged boundaries) was chartered as a city in 1851. In the early part of the 19th century Newburyport was one of the most flourishing commercial centres of New England. Fishing, whaling and shipbuilding were the principal interests until the Civil War, and its clipper ships were among the fastest and the best known on the seas. During the Revolution and the War of 1812 it sent out many privateers.

NEW CALEDONIA: *see* Pacific Islands.

NEWCASTLE, DUKES OF. Within the space of a century there were no less than four successive creations of dukes of Newcastle in the British peerage. William Cavendish (*see* below), nephew of the 1st earl of Devonshire, was raised to the dignity of duke of Newcastle-upon-Tyne in 1665. His son and successor, Henry (1630–91), died leaving daughters only, and one of these married John Holles (1662–1711), earl of Clare, who was created duke in 1694. This duke died also without male issue, leaving his estates to his sister's son, Thomas Pelham (*see* below), who, with other dignities, had the title of duke of Newcastle-upon-Tyne conferred on him in 1715, and a second and similar ducal title (that of Newcastle-under-Lyme) in 1756. The first dukedom became extinct at his death, but the second title was granted him with remainder to Henry Fiennes Clinton, earl of Lincoln, at once his nephew and nephew-in-law. From that time the dukedom has remained in the Clinton family. The two principal dukes are more fully noticed below.

1. William Cavendish, duke of Newcastle (1592–1676), eldest surviving son of Sir Charles Cavendish and of Catherine, daughter of Cuthbert, Lord Ogle, and grandson of Sir William Cavendish and "Bess of Hardwick," was born in 1592 and educated at St. John's college, Cambridge. On the occasion of the creation of Prince Henry as prince of Wales in 1610 he was made a knight of the Bath, subsequently travelled with Sir Henry Wotton, then ambassador to the duke of Savoy, and on his return married his first wife, Elizabeth, daughter of William Basset of Blore, Staffordshire, and widow of Henry Howard, 3rd son of the earl of Suffolk. His fortune was immense, and he several times entertained James I and Charles I with great magnificence at Welbeck and Bolsover. In 1620 he was created Viscount Mansfield; in 1628, earl of Newcastle; and in 1629 the barony of Ogle was restored to his mother, this title, together with an estate of £3,000 per annum, descending to him. In 1638 he was made governor of the prince of Wales, and in 1639 a privy councillor. When the Scottish war broke out he assisted the king with a loan of £10,000 and a troop of volunteer horse, consisting of 120 knights and gentlemen. In 1641 he was implicated in the Army Plot, and in consequence withdrew for a time from the court. He was sent by Charles on Jan. 11, 1642, to seize Hull, but was refused admittance. When the king declared open war, Newcastle was given the command of the four northern counties, and had the power conferred on him of making knights. He maintained troops at his own expense, and having occupied Newcastle kept open communications with the queen, and dispatched to the king his foreign supplies. In Nov. 1642 he advanced into Yorkshire, raised the siege of York and compelled Lord Fairfax to retire after attacking him at Tadcaster. Subsequently his plans were checked by the latter's recapture of Leeds in Jan. 1643, and he retired to York. He escorted the queen, who returned from abroad in February, to York, and subsequently captured Wakefield, Rotherham and Sheffield, though failing at Leeds, but his successes were once more ravished from him by Fairfax. In June he advanced again, defeated the Fairfaxes at Adwalton Moor on June 30, and obtained possession of all Yorkshire except Hull and Wressel castle. He might now have joined the king against Essex, but continued his campaign in the north, advancing into Lincolnshire to attack the eastern association, and taking Gainsborough and Lincoln.

Thence he returned to besiege Hull, and in his absence the force which he had left in Lincolnshire was defeated at Winceby by Oliver Cromwell on Oct. 11, 1643, which caused the loss of the whole county. On Oct. 27, 1643 he was created a marquis. Next year his position was further threatened by the advance of the Scots. Against prevailing numbers he could do little but harass and cut off supplies. He retreated to York, where the three armies of the Scots, Fairfax and Manchester surrounded him. On July 1, Prince Rupert raised the siege, but on the next day threw away his success by engaging the three armies in battle, contrary to Newcastle's desire, at Marston Moor. After this disaster, notwithstanding the entreaties of the king and the remonstrances of Prince Rupert, Newcastle immediately announced his intention of abandoning the cause and of quitting England. He sailed from Scarborough accompanied by a considerable following, including his two sons and his brother, resided at Hamburg from July 1644 to Feb. 1645 and moved in April to Paris, where he lived for three years. There he married as his second wife Margaret (*see* below), daughter of Sir Thomas Lucas of St. John's, Colchester. He left in 1648 for Rotterdam with the intention of joining the prince of Wales in command of the revolted navy, and finally took up his abode at Antwerp, where he remained till the Restoration. In April 1650 he was appointed a member of Charles II's privy council, and in opposition to Edward Hyde, earl of Clarendon, advocated the agreement with the Scots. In Antwerp he established his famous riding school, exercised "the art of manage" and published his first work on horsemanship, *Méthode et invention nouvelle de dresser les chevaux* (1658; 2nd ed., 1747; translated as *A General System of Horsemanship*, 1743).

At the Restoration Newcastle returned to England, and succeeded in regaining the greater part of his estates, though burdened with debts, his wife estimating his total losses in the war at £941,303. He was reinstated in the offices he had filled under Charles I; was invested in 1661 with the Garter, which had been bestowed upon him in 1650; and was advanced to a dukedom on March 16, 1665. He retired, however, from public life and occupied himself with his estate and with his favourite pursuit of training horses. He established a racecourse near Welbeck, and published another work on horsemanship, *A New Method and Extraordinary Invention to Dress Horses and Work them According to Nature* . . . (1667). He wrote also several comedies, *The Country Captain and The Varietie* (1649), *The Humorous Lovers* and *The Triumphant Widow* (1677). With John Dryden's assistance he translated Molière's *L'Étourdi* as *Sir Martin Mar-All* (1688). He contributed scenes to his wife's plays, and poems of his composition are to be found among her works; and he was the patron of Ben Jonson, James Shirley, Sir William Davenant, Dryden, Thomas Shadwell and Richard Flecknoe, and of Thomas Hobbes, Pierre Gassendi and René Descartes. He died on Dec. 25, 1676, and was buried in Westminster abbey. By his first wife he had ten children, of whom one son, Henry, survived him, and became 2nd duke of Newcastle, dying in 1691 without male issue; the title then became extinct.

His second wife, Margaret, duchess of Newcastle (*c.* 1625–73), had been maid of honour to Henrietta Maria. The duchess cultivated literary composition with exuberant fervour, and kept a bevy of maids of honour obliged to be ready at all hours "to register her Grace's conceptions." Horace Walpole speaks of her as a "fertile pedant." She published, among others, *Philosophical Fancies* (1653); *Poems and Fancies* (1653); *The World's Olio* (1655); *Nature's Picture Drawn by Fancie's Pencil to the Life*, which includes an autobiography (1656); *Philosophical and Physical Opinions* (1655); *Orations of Divers Sorts* (1662); *Playes* (1662); *Sociable Letters* (1664); *Observations upon Experimental Philosophy* (1666); *Letters and Poems* (1676).

The Life of William Cavendish, Duke Marquis and Earl of Newcastle. . . , by Margaret, duchess of Newcastle, has been edited by C. H. Firth (1886); it was criticized by Samuel Pepys as "the ridiculous history of my Lord Newcastle writ by his wife, which shows her to be a mad, conceited, ridiculous woman, and he an ass to suffer her to write what she writes to him and of him," but on the other hand eulogized by Charles Lamb as a work for which "no casket is rich enough, no case sufficiently durable to honour and keep soft such a jewel." *See* also *La Duchesse et le Duc de Newcastle*, by Émile Montégut (1895). The duchess's *Select Poems* were edited by Brydges in 1813, and her *Autobiography* in 1814. The latter, edited by M. A. Lower, was published with her *Life of the Duke of Newcastle* in 1872.

2. Thomas Pelham Holles, duke of Newcastle (1693–1768), whose official life extended throughout the Whig supremacy of the 18th century, was the elder son of Thomas, first Lord Pelham, by his second wife, Lady Grace Holles, younger sister of John Holles, duke of Newcastle-on-Tyne, who died in 1711, and left the whole of his vast estates to him. In 1712 he also succeeded his father in his peerage and estates, and in 1714, when he came of age, was one of the greatest landowners in the kingdom. He vigorously sustained the Whig party at Queen Anne's death, and had much influence in making the Londoners accept King George. His services were too great to be neglected, and in 1714 he was created earl of Clare, and in 1715 duke of Newcastle-on-Tyne. He also became lord-lieutenant of the counties of

Middlesex and Nottingham and a knight of the Garter in 1718, in which year he increased his Whig connection by marrying Lady Henrietta Godolphin, granddaughter of the great duke of Marlborough. In 1717 he first held political office as lord chamberlain of the household, and in 1724 was chosen by Sir Robert Walpole to be secretary of state in place of Lord Carteret. This office he held continuously for 30 years (1724–54), and changed it only for the premiership on his brother's death. His long tenure of office was mainly because of his great Whig connections and his wealth, but praise must also be given to his inexhaustible activity and great powers of debate. He continued in office on Walpole's fall in 1742, and became more powerful on his younger brother Henry's becoming prime minister in 1743. On Henry Pelham's death in March 1754, Newcastle succeeded him as premier; but people who had been accustomed to him as secretary of state would not stand him as premier, and in Nov. 1756 he gave place to the duke of Devonshire. For his long services he was created duke of Newcastle-under-Lyme, with remainder to Henry Fiennes Clinton, 9th earl of Lincoln, who had married his niece Catherine Pelham. In July 1757 he again became prime minister—for William Pitt, though a great statesman, was a bad party leader—on the understanding, according to Horace Walpole, that "Mr. Pitt does everything, the duke gives everything." Under this ministry England became famous abroad, but it gradually fell before the young king's affection for Lord Bute, who, after supplanting Pitt, became prime minister in the room of Newcastle in May 1762. The duke went into strong opposition, and lost his two lord-lieutenancies for opposing the peace of 1763. In 1765 he became lord privy seal for a few months, but his health was fast giving way, and he died in Nov. 1768. The duke was not a great man, but he was industrious and energetic. He worked tirelessly, though vainly, to hold the Whig party together in the face of the determination of George III to destroy it. In this if in nothing else Newcastle was statesmanlike for it seems as though he alone clearly foresaw that calamity to the party which only union and organization could have averted.

See W. Coxe, *Memoirs of the Administration of the Right Hon. H. Pelham* (1829).

NEWCASTLE, a city and port of New South Wales, Australia, on the southern shore of the estuary of the Hunter river, where it enters the Pacific ocean, and 104 mi. by rail from Sydney. Pop. (1952 census) 137,590 including suburbs. The city is built at the foot of, and up, a steeply rising hill which backs the harbour, with a well-developed suburban area of 38 sq.mi. Its average annual temperature is 72°–55° F. and its average annual rainfall is 42 in With a large and fertile hinterland (Hunter valley, northern tablelands and Liverpool plains) and abundant coal resources at its doors, Newcastle was early a notable centre for the export of coal and primary produce. The possession of fuel, water, food supply and a good commercial position, and access to raw materials, have steadily attracted manufacturing industries and Newcastle has become one of the leading industrial areas in the southern hemisphere. Its iron and steel industries, established in 1915 by the Broken Hill Proprietary Company Limited (*q.v.*), have expanded to proportions rivalling its renowned coal trade. The black coal produced on the Newcastle-Cessnock field (9,343,900 tons for the year ended June 30, 1952) and iron and steel output (1,000,000 tons a year) represent 50% of Australia's total annual production. The establishment since 1950 of a large-scale rayon yarn and cord factory near Newcastle and the setting-up of cotton mills and a wool processing plant are indicative of textile manufacture becoming the city's third major industrial development. Newcastle's industries may be generally classified as metallurgical and metal-working; constructional engineering and shipbuilding; coke and chemical industries; textile manufacture; the making of fertilizer, cement, firebrick, pottery and woodworking. There are also flour and food product industries. These are conducted in Newcastle itself or in one of the numerous centres within easy reach of the port. The harbour (comprising North harbour, the Basin and Port Waratah) has ample accommodation, is well-sheltered and has modern installation for handling cargo and especially for loading coal and bulk wheat. The entrance is by a channel (500–450 yd. in width; average depth of 25½ ft. to a rock bottom) between breakwaters. Breaking of the rock bar across the entrance is projected to a depth of 32 ft. Its three miles of wharfage can be extended and it has a floating dock with a lifting capacity of 15,000 tons. Newcastle is the third port of Australia and the second of New South Wales in respect of trade which at mid-20th century normally amounted to £3,500,000 a year. Its exports (4,500,000 tons annually) are coal, coke, tar, etc.; frozen meat; butter, eggs; timber; pig iron, steel rails and plates, etc.; and fertilizers; and they usually exceed the imports (2,500,000 tons annually). About 6,000,000 tons of shipping, of which 2,000,000 tons are "overseas" vessels (*i.e.*, other than interstate or coastwise), use the port annually. Newcastle has railway and highway connections to the south with Sydney and to the rich dairy pastures of the north coast, and across the Hunter valley to the wheat, wool and cattle hinterland of the northwest. (W. Bs.)

NEWCASTLE, a seaside resort and urban district in County Down, Northern Ireland, on the west side of Dundrum bay, and 31 mi. S. of Belfast by road. Pop. (1951) 3,076. Area 2 sq.mi. Newcastle lies at the foot of Slieve Donard (2,796 ft.), the highest of the Mourne mountains. Electrical goods are manufactured. In the mountains is the Silent Valley reservoir, completed in 1933 for the supply of Belfast, with a capacity of 3,000,000,000 gal.

NEW CASTLE, a city of New Castle county, Del., U.S., at the head of Delaware bay, 6 mi. S. of Wilmington. It is on federal highway 40 and is served by the Pennsylvania railroad and steamship lines. Pop. (1950) 5,396. It has a good harbour, airports and manufacturing industries. New Castle played an important part in the territorial disputes of the Swedes, the Dutch and the English, from 1651, when Peter Stuyvesant built Ft. Casimir in the vicinity; and it was the capital of Delaware until 1777. The courthouse is one of the oldest public buildings in the U.S.; the Immanuel Protestant Episcopal church dates from 1689; and there are Dutch and English colonial dwellings still standing. The city was chartered in 1875.

NEW CASTLE, a city of eastern Indiana, U.S., 45 mi. N.E. of Indianapolis; county seat of Henry county. It is served by the New York Central, the Nickel Plate and the Pennsylvania railways. The population of New Castle in 1950 was 18,271; in 1940 it was 16,620 by the federal census. The city is the trade centre of a rich farming area, has important manufacturing industries (with an output in 1949 valued at $43,889,000), and is the seat of the Indiana Village for Epileptics. New Castle was founded in 1819 and incorporated in 1839.

NEW CASTLE, a city of western Pennsylvania, U.S., the county seat of Lawrence county; 50 mi. N.N.W. of Pittsburgh and 20 mi. S.E. of Youngstown, O., on the Shenango river and federal highways 224 and 422. It is served by the Baltimore and Ohio, the Erie, the Pennsylvania and the Pittsburgh and Lake Erie railroads. The population was 48,834 in 1950 and 47,638 in 1940 by the federal census. New Castle is an important commercial and industrial centre; its manufactures include steel, heavy rolling mill equipment, tin cans, glass, castings, chemicals and pottery. New Castle was founded in 1802. It was incorporated as a borough in 1869 and as a city in 1875.

NEWCASTLE-UNDER-LYME, a market town, municipal and parliamentary borough of Staffordshire, Eng., bounded on three sides by the city of Stoke-on-Trent. Pop. (1951) 70,028. Area 13.9 sq.mi. It takes its name from the "new castle" erected by the earl of Chester, the feudal overlord in the reign of Stephen, for the greater protection of his fief lying under what was during the Roman occupation the *Limes Britannica,* separating the provinces of Flavia Caesarensis, on the east, from Britannia Secunda, on the west. The castle served as a bastion during the long war against Wales. The fortification, being low-lying, became obsolete in Tudor times, and fell into decay. The town received its first royal charter of incorporation from Henry II in 1173, and the liberties and privileges were confirmed and extended by succeeding monarchs down to James II. In 1267 the borough and manor were granted by Henry III to his youngest son, Edmund Crouchback, and ever since then it has formed part of the duchy of Lancaster. The borough has sent representatives to parliament at least since 1354.

The parish church of St. Giles, the fourth or fifth on the same site, was rebuilt, with the exception of the tower, by Sir Gilbert Scott (1876). The University College of North Staffordshire was founded in 1949 and opened in 1950 at Keele hall, about 3 mi. west. In 1932 the borough was enlarged by the inclusion of Wolstanton (with a fine old church), Clayton and part of Keele. Chesterton (the site of a Roman camp), Knutton and Silverdale

also lie within the borough. The industries of Newcastle-under-Lyme are many and varied, and include collieries, brick and tile works, a cotton mill, a uniform-clothing factory and light engineering. (H. G. Ss.)

NEWCASTLE UPON TYNE, a city and county, parliamentary borough and port, standing on the River Tyne, England, 8 mi. from the mouth of the river and 272 mi. N. of London by road. Pop. (1951) 291,723. Area 17.3 sq.mi. It is the metropolis of the shipbuilding and industrial area of Tyneside.

One of England's principal railway stations, Newcastle is an important centre for rail communications with London, northwestern England and Scotland. Five principal bridges over the Tyne link Newcastle and Gateshead: the Tyne bridge (1928), taking traffic to the Great North road; the King Edward High Level bridge (1906), for the railway; the hydraulic swing bridge (1876), for foot passengers and vehicles; the Redheugh bridge (1900), for general traffic; and the old High Level bridge (1849) for the railway, road and foot passengers. The municipal airport was opened at Woolsington, 6 mi. N.W. of Newcastle, in 1935.

Municipal and commercial offices, the main shopping centre and principal places of entertainment in the city are concentrated in the square mile between the Tyne and the Town Moor. There broad, well-planned thoroughfares were introduced by Richard Grainger (1798–1861) and John Dobson (1787–1865) in place of the maze of narrow streets which had formed the old town centre. Grey street in particular is a superb example of town planning. Beyond lie pleasant, modern residential suburbs—Jesmond, the oldest, to the north, Walker, Walkergate and Heaton to the east, Denton, Fenham and Kenton to the west and northwest. There are 535 ac. of public parks in addition to the Town Moor (825 ac.).

History.—Newcastle was originally the site of a Roman station known as Pons Aelii. Its takes its name from the Norman castle, built in 1080 by Robert, eldest son of William the Conqueror and replaced between 1172 and 1177 by the impressive stone-built keep still standing today. Noteworthy features include the wellshaft, almost 100 ft. deep and surrounded by masonry 28 ft. thick at its broadest. The chapel is a fine example of late Norman architecture. In the Black gate adjoining the museum of the Society of Antiquaries houses the best-known collection of inscribed and sculptured stone illustrating the Roman occupation of Britain. The best remaining portion of the town walls lies between Westgate road and Gallowgate. A fragment of the Roman wall is visible on the south side of Denton bank. The guildhall, rebuilt in 1655–58, stands in the Sandhill.

The diocese of Newcastle, covering Northumberland, Berwick and small areas of Cumberland and Durham, was instituted in 1882. The church of St. Nicholas, adopted as the cathedral, is mainly 14th-century in date, though there is documentary evidence of a church on that site as early as 1123. The tower and steeple, added in the 15th century, are particularly beautiful examples of early Perpendicular. In particular the steeple is the finest known work in the style termed "Scottish Crown." The church of St. John the Baptist disputes with St. Andrew's the honour of being the city's oldest church though the building is mainly 14th and 15th century work. St. Andrew's is mainly 14th century but interesting earlier work remains, including the 12th century chevron-decorated chancel arch. This church was extensively damaged during the Civil War when Newcastle was twice occupied by the Scots and Charles I held prisoner by the army in 1646.

Administration.—Newcastle upon Tyne was a borough with its own written constitutions before the reign of Henry II. One of its most important charters was that of King John, granted in 1216, which authorized the burgesses to have a guild merchant. This association of traders, whose chief concern was to establish their monopoly of the town's trades, speedily assumed responsibility for town government. Thus, for example, the first reference to the office of mayor occurs in 1216. Henry IV by his charter of 1400 created Newcastle upon Tyne a county separate from and independent of the county of Northumberland. Accordingly it held its own court of quarter sessions, confirmed by William IV in 1836, and its own court of assize. Newcastle has been represented in parliament since 1283 when Edward I summoned two burgesses to his parliament at Shrewsbury. Since 1918 the parliamentary borough has been divided into four divisions of central, east, north and west, each returning one member of parliament. Since 1948 the constituency of West Newcastle has included Newburn urban district.

Education and Culture.—Of the independent schools in the city, the most famous are the royal grammar school, since 1907 occupying premises at Jesmond, which was founded by Thomas Horsley in the time of Henry VIII and incorporated by Queen Elizabeth I in 1600, and Dame Allan's school, since 1935 established at Fenham, which was endowed in 1705. The Municipal College of Commerce and Rutherford College of Technology provide both full and part-time further education. University education is provided by King's college which was founded in 1937 by the merging of Armstrong college and the University of Durham college of medicine. The former was founded in 1871 as a branch of the University of Durham and was the first university college to establish a department of mining. The latter, founded as the Newcastle School of Medicine and Surgery in 1834, was incorporated in Durham university in 1852.

The Municipal Museum of Science and Industry is devoted to the development and history of engineering, electrical engineering, mining, shipbuilding, transport and other industries with special reference to those of Tyneside; its exhibits include George Stephenson's locomotive. The Hancock Museum, named after the John Hancock collection of British birds, houses the collections of the Natural History Society of Northumberland, Durham and Newcastle upon Tyne, founded in 1892. Both water colours and oils by British artists are shown at the Laing art gallery; in particular there are water colours illustrating the development of the art in England from the 17th century onward. The public library has an extensive local history collection which includes local newspapers from the early 18th century onward, a fine series of works illustrated by Thomas Bewick, the wood engraver, family papers and other manuscripts. The Literary and Philosophical society, founded in 1793, also maintains a library, reading and lecture room.

Industry and Transport.—Coal, the basic element in industrial development, is Tyneside's most important natural resource. Mining began in the 13th century though coal exports were of little importance until the 17th century and industrial expansion proceeded slowly prior to 1800. Tyneside's achievements in shipbuilding are world-famous while its yards constitute one of the largest ship-repairing centres in the world. The Tyne itself has been navigated since Roman times. The conservancy of the river was originally vested in the corporation of Newcastle upon Tyne but in 1850 control passed to the Tyne Improvement commission. The commissioners accelerated development by undertaking large-scale dredging operations and providing improved docking facilities. The corporation owns the quayside at Newcastle almost 1½ mi. long which accommodates even the largest cargo ships. Exports include iron and steel products, coke and its by-products and chemicals. Tyneside is one of the principal wheat-importing centres in England and flour is milled locally. (E. M. Hw.)

NEWCHWANG, a Chinese port city in the province of Liaotung, Manchuria (40° 41′ N.; 122° 15′ E.), some 30 mi. above the mouth of the Liao river which enters the Gulf of Liao Tung. At the Treaty of Tientsin (1858), Newchwang was chosen as one of the ports to be opened to foreign trade, but it was Yingtze (or Yinkow) near the mouth of the Liao river which actually became the centre of foreign settlements and was opened to trade in 1864. In recent years there has been a tendency to designate the port correctly as Yinkow, but Newchwang remained the official name of the Treaty port. The town was in 1895 occupied by and later ceded to Japan, only to be retroceded to China under foreign pressure. During the Russo-Japanese War, it was first in Russian and later in Japanese hands, but was finally restored to China at the end of the war. The outlet of the Liao river is obstructed by a bar and the port is closed by ice for three or four winter months. It has railway connection with Peking and with the main Mukden-Dairen line of the South Manchuria railway by means of a short branch. Until 1907 Newchwang was the only treaty port of Manchuria and it shared in the rising prosperity of south Manchuria; but in more recent years its development has been checked owing to the remarkable rise of Dairen, though "prosperity" was returning with the new "Manchukuo" industrial development. With the Japanese occupation of Manchuria Newchwang was included in the puppet state of Manchukuo. The last full Chinese customs return for 1931 was St$5,919,428.

The chief imports were foreign cotton piece goods, cotton yarn, native cottons, aniline dyes; exports, mainly beans, bean oil, bean

cake, maize, cotton seed and coal. Until 1908 Newchwang was the centre of the bean oil and bean cake industry of Manchuria and of the export trade in these and other Manchurian products, but it has since been supplanted by Dairen. Before the outbreak of the war it was, however, the main Manchurian port for China trade, especially in bean cake for south China and bean oil for Shanghai. The main product of Newchwang is salt for industrial use (64% of all Manchuria). The reed of the neighbourhood is used for reed sacks (3,000,000 annually) and reed plants produce pulp material. Tashihchiao, 22 mi. east, is an important centre of magnesite mining. Cotton cloth weaving factories work for local consumption. Other products are hosiery, ribbons, towels, matches, soap, glass, knitting needles, bricks and dyes, etc. The sea fisheries of the neighbourhood are very important and employ about 3,000 fishermen and 550 boats, the annual yield of fishery products being worth more than 500,000 yen. The population in June 1938 was 159,470, of which 5,612 were Japanese, 1,611 Koreans, the remainder being Chinese; 1940 census, 180,871.

NEWCOMB, SIMON (1835–1909), American astronomer, was born in Wallace, Nova Scotia, on March 12, 1835. He became a resident of the United States in 1853, and graduated at the Lawrence scientific school of Harvard university in 1858. He was an assistant in the American *Nautical Almanac* office 1857–61. In 1861 he became professor of mathematics in the United States navy, and was assigned to duty at the United States Naval Observatory. For more than ten years he worked with the various meridian instruments, and when the 26in. equatorial was erected in 1873 he was put in charge of that instrument. In 1877 he was assigned to duty in charge of the American *Nautical Almanac* office, a post which he held until March 1897. In 1884 he became professor of mathematics and astronomy at the Johns Hopkins university, continuing, however, to reside at Washington. He was also editor of the *American Journal of Mathematics* for many years. In view of the wide extent and importance of his labours, the variety of subjects of which he treats, and the unity of purpose which guided him throughout, Simon Newcomb must be considered one of the most distinguished astronomers of his time. A study of his works reveals an unusual combination of skill and originality in the mathematical treatment of many of the most difficult problems of astronomy, an unfailing patience and sagacity in dealing with immense masses of numerical results, and a talent for observation of the highest order. On taking charge of the *Nautical Almanac* office, he became very strongly impressed with the diversity existing in the values of the elements and constants of astronomy adopted by different astronomers, and the injurious effect which it exercised on the precision and symmetry of much astronomical work. Accordingly he resolved to "devote all the force which he could spare to the work of deriving improved values of the fundamental elements and embodying them in new tables of the celestial motions." The formation of the tables of a planet has been described by Cayley as "the culminating achievement of astronomy," but the gigantic task which Newcomb laid out for himself, and which he carried on for more than 20 years, was the building up, on an absolutely homogeneous basis, of the theory and tables of the whole planetary system. The results of these investigations have, for the most part, appeared in the *Astronomical Papers of the American Ephemeris,* and have been more or less completely adopted for use in the nautical almanacs of all countries. A valuable summary of a considerable part of this work was published in 1895, as *The Elements of the Four Inner Planets and the Fundamental Constants of Astronomy.* In 1866 Newcomb had published an important memoir on the orbit of Neptune, which was followed in 1873 by a similar investigation of the orbit of Uranus (*Smithsonian Contributions to Knowledge,* vols. xv. and xix.). About 25 years later new tables of these planets were issued by him (*Astronomical Papers of the American Ephemeris,* vol. vii., pts. 3 and 4) based on unpublished investigations in which the elements were determined from the best available observations up to that time. In the meantime the theory of Jupiter and Saturn had been thoroughly worked out by G. W. Hill, Newcomb's distinguished collaborator in the *Nautical Almanac* office, and thus was completed one important section of the work projected by Newcomb in 1877.

NOTABLE ACHIEVEMENTS

Among Newcomb's most notable achievements are his researches in connection with the theory of the moon's motion. His first work on this abstruse subject, entitled *Théorie des perturbations de la lune, qui sont dues á l'action des planètes,* is remarkable for the boldness of its conception, and constitutes an important addition to celestial dynamics. For some years after the publication of Hansen's tables of the moon in 1857 it was generally believed that the theory of that body was at last complete, and that its motion could be predicted as accurately as that of the other heavenly bodies. Newcomb showed that this belief was unfounded, and that as a matter of fact the moon was falling rapidly behind the tabular positions. With the view of examining this question, he undertook the reduction of every observation made before 1750 which appeared to be worthy of confidence. The results of this work were published in 1878. The discussion of the observations made after 1750 was interrupted by his work on the planetary tables carried on during his connection with the *Nautical Almanac* office. After his retirement from active service in the navy he was enabled, due to a grant from the Carnegie Institution of Washington, to secure the necessary assistance from 1903 to 1909 to bring to completion the work of his great programme on the motion of the moon. This was finished less than a month before his death. The observations used in his work covered an extreme range in time of about 2,600 years and seemed, as he himself said, "to prove beyond serious doubt the actuality of the large unexplained fluctuations in the moon's mean motion."

On taking charge of the 26in. equatorial at the United States Naval Observatory, Newcomb devoted it almost exclusively for the first two years to observations of the satellites of Uranus and Neptune. The results of these skilfully conducted observations were published in a memoir on *The Uranian and Neptunian Systems.*

As early as 1860 Newcomb communicated an important memoir to the American Academy, *On the Secular Variations and Mutual Relation of the Orbits of the Asteroids,* in which he discussed the two principal hypotheses to account for the origin of these bodies—one, that they are the shattered fragments of a single planet (Olbers's hypothesis), the other, that they have been formed by the breaking up of a revolving ring of nebulous matter.

In the *Astronomical Papers of the American Ephemeris* will be found a large number of contributions from Newcomb's pen on some fundamental and most important questions of astronomy. Among these are papers on *The Recurrence of Solar Eclipses, A Transformation of Hansen's Lunar Theory, Development of the Perturbative Function and its Derivatives.* His memoir *On the Motion of Hyperion, a New Case in Celestial Mechanics,* is in some respects one of his most original researches. He discussed the transits of Venus of 1761 and 1769, and those of Mercury from 1677 to 1881. At the international conference, which met at Paris in 1896 for the purpose of elaborating a common system of constants and fundamental stars to be employed in the various national ephemerides, Newcomb took a leading part, and at its suggestion undertook the task of determining a definite value of the constant of precession, and of compiling a new catalogue of standard stars. The results of these investigations were published in 1899, and were in general use for a quarter of a century. In the intervals of these immense labours, on which his reputation as an astronomer rests, he found leisure for works of a lighter character; *e.g.,* his *Popular Astronomy* (1878), his *Astronomy for Schools and Colleges* (1880), written in conjunction with E. S. Holden, and *Astronomy for Everybody* (1903). After his retirement from official life he published an excellent popular treatise on *The Stars* (1901). Several of these books have been translated into one or more of seven different foreign languages. A more recondite work is his *Compendium of Spherical Astronomy* (1906). He also wrote on questions of finance and economics, as well as in the field of fiction.

He received honorary degrees from ten European and seven American universities. He was a member of 45 foreign societies. He was awarded the gold medal of the Royal Astronomical society in 1874, the Huyghens gold medal of the Holland Society of Science in 1878, the Copley medal of the Royal society in 1890, the Bruce gold medal of the Astronomical Society of the Pacific in 1897, the Schubert prize of the Imperial Academy of Sciences, St. Petersburg, in 1897, and the Sylvester prize of Johns Hopkins university in 1901. He died at Washington on July 11, 1909, and was given a military funeral befitting his rank as a rear admiral in the United States navy.

An autobiography, *Reminiscences of an Astronomer,* appeared in 1903; and a bibliography of his life and works containing 541 titles is given by R. C. Archibald in *Memoirs of the National Academy of Sciences,* xvii, "First Memoir," pp. 19–69. This also contains, pp. 1–18, "Biographical Memoir" by W. W. Campbell. (W. S. E.)

NEWCOMEN, THOMAS (1663–1729), English engineer, one of the inventors of the steam engine, was born at Dartmouth. While employed as ironmonger in his native town, he corresponded with Robert Hooke about the possibility of obtaining motive power by exhausting the air from a cylinder provided with a piston, Denis Papin and the marquis of Worcester having already made investigations on this subject. In 1698 he entered into partnership with Thomas Savery (*c.* 1650–1715), who had patented a method for raising water from mines. Newcomen's improvements on Savery's invention were so successful that they produced together a pumping-engine which served as a model for nearly three-quarters of a century. For a description of the "atmospheric steam-engine," then known as a "fire-engine," which they constructed in 1705, *see* STEAM ENGINE. John Cawley (or Calley) was also associated with them in this invention. Newcomen died in 1729, probably in London.

NEWDIGATE, SIR ROGER (1719–1806), English antiquary, was born on May 30, 1719. He was the 5th baronet of Harefield (in Middlesex) and Arbury (in Warwickshire), and grandson of Sir Richard Newdigate, an English chief justice during the time of Richard Cromwell's protectorate. He had an active political career, but is chiefly remembered for his collection of antiquities including marbles, casts of statues and vases. Two marble candelabra found in Hadrian's villa at Rome he purchased for £1,800 and presented them to the Radcliffe library at Oxford. Among his other generosities to the university were a chimney piece, for the hall of University college, and the sum of £2,000 for the removal by Flaxman of the Arundel collection of marbles to the Radcliffe library. The "Newdigate" prize of 21 guineas for English verse, which is open for competition each year to the undergraduates of Oxford university, was founded by him and was first awarded in the year of his death. He died at Arbury on Nov. 23, 1806.

NEWEL, in architecture, originally the central shaft around which a spiral or semi-circular staircase winds. Now more commonly any post at the intersection of a stair with a landing, in which case it is a vertical post which receives the rail and is framed into the supporting strings or beams of the stair construction. By extension, the term is also applied to any post in the railing larger than the other posts or balusters.

NEW ENGLAND. That portion of the eastern coast of North America lying between the 41st and 45th degrees of north latitude received its name of New England in 1614 from Capt. John Smith, who explored those shores on behalf of the Virginia company of English merchants.

Physiographically, New England possesses great variety and also a unity derived from isolation. Such physical isolation and unity is, however, deceptive, for New England faces on three fronts. The long and deeply indented coast line from its easternmost point on the Bay of Fundy to the tip of Cape Cod turns New England toward the maritime provinces of Canada, toward the fishing grounds of the Newfoundland banks and toward the ports of northern Europe, from which it is some hundreds of miles less distant than are its rival ports in the middle states. New England's southern shore from Cape Cod to the Hudson river invites close relations with the states to the south, that part lying west of the Connecticut river especially falling within the area of the metropolitan influence of New York rather than any New England centre. The northwestern region, on the other hand, turns its back on the rest of New England and finds its outside connection through Lake Champlain and the Richelieu river or through Lake Memphramagog with the Canadian province of Quebec.

Although parts of the coast of New England had been known to European fishermen early in the 16th century and it is certain that outlying islands and capes were visited frequently after 1560, no permanent settlement was achieved until the next century. That New England remained open so long after its exploration as a refuge for minority groups seeking homes rather than adventure was due to the fact that its inhospitable climate, stubborn soil and lack of profitable natural products did not invite capitalistic exploitation. That the early settlements of Pilgrims and Puritans remained undisturbed was due to the fact that this area was not a gateway to the interior; its rivers afforded access to no regions where settlers or capital were needed.

Surprising freedom from Indian opposition during the critical first decades of settlement is explained by the decimation of the native population by plague in the years 1610–20. By the time the Indians rallied for a concerted attempt (called King Philip's War) to expel the white intruders, the colonists were barely able to survive the attack. In that struggle the systematic land allotments and close village social structure clearly vindicated itself as a military advantage. On the social side also it proved its worth in affording opportunity for early district elementary schools, a college (Harvard, 1636) and, in the larger settlements, a few of the amenities of an urban civilization.

While substantial financial resources assured the success of the Puritan colony of the Massachusetts Bay company, the survival of the feeble and ill-supported settlement of the Pilgrims at Plymouth proved that a living could be won from the wilderness by extraordinary effort and self-discipline. Both examples prompted other undertakings. Roger Williams and Ann Hutchinson, refugees from the theocracy of Boston, with no backing from the home government, made tiny settlements on Narragansett bay south of the jurisdiction of the Massachusetts Bay colony, and secured recognition as a separate colony of Rhode Island with a charter from the crown. On the other hand, new immigrant groups enlarged by malcontents from Massachusetts established strong settlements on the southern coast and secured royal recognition as the colony of Connecticut in 1661. In four directions colonial attempts of a distinctly different type were attempted. Based on Champlain's discovery in 1609 of the lake which bears his name, the French government in Canada attempted to establish *seigneuries* on the slopes of the Green mountains bordering that lake. On the coast of Maine, Sieur de Monts in 1604 and a band of Jesuits in 1613 tried to found colonies. North of the Merrimac river Capt. John Mason received a grant from the crown and sent settlers to the mouth of the Piscataqua (Portsmouth). His plans for an aristocratic domain modelled on the mediaeval County Palatine as well as his appointment as royal governor-general of all New England came to naught with his death in 1637. His settlers fell under the rule of the Massachusetts Bay company until created into a royal province in 1679. Farther northeast another royal proprietor, Gorges, planned to colonize but failed in competition with the Puritan settlers. His heirs sold their claims to Massachusetts in 1674 and the region under the name of the District of Maine remained a part of Massachusetts until erected into an independent state in 1820.

The New England colonies had attracted little attention from the restored Stuarts until complaints of the independent attitude of the Massachusetts authorities in the persecution and exclusion of Quakers and Anglicans and a disregard of the Navigation acts drew down the royal displeasure. James II attempted to systematize his northern colonies by consolidating all the New England colonies with New York and New Jersey under a single royal governor. From an administrative point of view the scheme was sound. This new "Dominion of New England" would also have

enabled the English to oppose the threatened aggressions of the French more effectively, but the methods of James's agent, Randolph, and his governor, Andros, roused bitter opposition in New England. The cancellation of their charters the colonists regarded as a destruction of their constitutional rights. When the news of the glorious revolution in England reached Boston, Andros was overthrown, Connecticut and Rhode Island quietly resumed their old charter governments and Massachusetts obtained at the court of the new sovereigns, William and Mary, a restoration of many of her old rights under a new "province" charter (1691). By 1800 every acre of the land in the three southern New England states had been parcelled out in townships, and the frontier of almost contiguous settled communities pushed up to the 45th parallel—viz., a line from Vergennes on Lake Champlain to Bangor on the Penobscot. The qualities and characteristics which have distinguished the New Englanders and the institutions which New England has given to America were developed in the colonial period. At first, the most pronounced characteristic was the capacity for co-operative action. From this sprang the public school system, the town government, the Congregational Church organization. By the Revolution, however, the individualism which appeared sporadically in the early years came to be general and reached its height in Jonathan Mayhew, William Bentley, the Adamses, Thoreau and Emerson and in the educational theories of Charles William Eliot. Much has been said of the spiritual heritage of the Puritans and Pilgrims, and ideals with which they came to New England; but economic conditions may explain many peculiar features of New England life. Unquestionably the New England colonists suffered from lack of division of labour. The nature of the soil, the lack of easily accessible markets, the difficulty of securing a surplus of any great staple to exchange for other necessities forced each family to provide for its own wants. This produced a people of singular ingenuity and resourcefulness but without specialized skills. It offered no premium for systematic development of agriculture or industries except the few in which New England had a natural advantage both in production and in marketing. Of these the greatest was shipbuilding. This industry began almost at once with Winthrop's "Blessing of the Bay" launched on the Mystic river in 1631. On nearly every navigable stream in close proximity to the supply of timber arose small shipyards where the neighbouring farmers, trappers or fishermen employed their time in off-seasons in turning out vessels. For these they found a ready sale, because the English Navigation acts admitted colonial-built vessels to the status of English ships in the monopoly of the carrying trade of the expanding empire.

To the mother country New England seemed, until well into the 18th century, one of the least valuable of her overseas possessions. The area had not lived up to the expectations of the statesmen and merchant-capitalists who had encouraged its settlement, even as a source of ship-timber and furs. As a market for English products New England's slow growth of population, after the initial Puritan exodus, was disappointing. Its self-sufficiency contrasted markedly with the constant reliance placed by other settlements upon the board of trade for financial aid and political direction. As a result New England was ruled under a policy of "salutary neglect." The leadership of New England in American colonial resistance to the Acts of Parliament from 1763 to 1774 was due largely to three factors—first, the fact that the natural course of New England economy contravened the principles of mercantilism on which British imperial policy was based. Second, the attempt to enforce the application of those principles in the Sugar act and other acts of trade had precipitated a serious reaction from the prosperity which New England had enjoyed during the French Wars from 1689 to 1763. Just at that time, by the Stamp act, Grenville attempted to force the colonies to pay some portion of the cost of maintaining the newly won empire. Finally, New England town meetings afforded a unique sounding board for such men as Samuel Adams; and her colonial assemblies, accustomed to represent the mercantile element against the royal governors, gave a pseudoconstitutional appearance to action for intercolonial "congresses" to bring pressure by boycotting British goods.

New England played her chief part in the Revolution during the years 1765–77 in defining the issues and in precipitating actual hostilities. Though these centred in Boston, sentiment for and against rebellion and independence was fairly evenly distributed throughout New England, the line of cleavage being one of class and occupation rather than of locality. After the British evacuated Boston on March 17, 1776, New England saw little of active hostilities, except for the part played by her militia in checking Burgoyne's advance at Bennington, Vt., and in the struggles over the possession of Newport, R.I. Her irreconcilable temper convinced the British that attempts at conciliation or subjugation had greater chance of success elsewhere. The revolt against the mother country brought less of the civil war between rebels and Tories in New England than occurred farther south, chiefly because the Tory oligarchy had a very narrow basis in New England, was early overthrown and retired with the Red Coats to exile in Nova Scotia, New Brunswick and the West Indies. Control of the new state governments which were almost immediately formed fell into the hands of conservative elements who assumed the political offices and social leadership vacated by the fugitive loyalists.

The period of disorganization which followed the cessation of hostilities brought great suffering to many communities and certain classes in New England. The utter disruption of the old courses of commerce within the British empire no longer supplemented by privateering and wartime trade with other countries caused a lack of specie. Every state fell a prey to a greater or less degree to the paper money craze. Rhode Island, in particular, suffered so heavily that civil war threatened. The refusal of the Massachusetts legislature to relieve the pressure of debts and taxes by stay laws and further issues of paper money led to a rebellion under the leadership of Daniel Shays. Although New England leaders played prominent parts in the federal convention, the actual ratification of the new constitution proved a difficult matter in Massachusetts and New Hampshire and was rejected in Rhode Island until 1790. Such sentiment as turned New England toward the creation of "a more perfect union" came mainly from the creditor and mercantile classes and sections; chiefly it was due to the hope for a stable national currency and credit and for a national tariff system which could be used as a lever to pry from reluctant European governments the opening of their home and colonial posts to American trade.

For nearly a decade after the inauguration of the new government under Washington the superior organization of the dominant commercial interests committed New England as a whole to the Federalist party, but Jefferson gradually organized the latent anti-Federalist and Democratic elements until in the election of 1800 he was able to carry several representative districts.

The basis of New England's prosperity in the Federalist period seems to lie in the application of Yankee energy and resourcefulness to the exploitation of the peculiar advantages of New England in foreign trade. Her ships, restricted in their enterprises in the older fields under control of the British crown, turned to the Mediterranean and to the Pacific and Indian oceans. In 1786 Samuel Shaw established in Canton the first American mercantile house in China. In 1787 the "Grand Turk" brought to Salem the first of the many oriental cargoes which made that port famous. In 1792 Capt. Robert Gray's "Columbia" carried the Stars and Stripes around the world for the first time and laid the foundations not only for the American claim to Oregon but also the very profitable trade with the northwest coast, where furs were obtained which could be exchanged in China for silks and tea. Salem became for a time the tea market of America and Europe and the third city in the union. The heyday of New England's mercantile success was shared to a considerable extent by all classes. There was speculation in timberlands and a rapid shift of population into the frontier states—Maine, New Hampshire, Vermont, western New York and Ohio. The Napoleonic wars altered this picture. Although equipped to compensate the loss inflicted on her commerce by English and French wartime restriction through the enormous profits made in privateering and in block-

ade running, the New England shipper could not survive the devastating effect of the Republican embargo policy. The war of 1812 was regarded in New England as James Madison's war, forced upon him by the "warhawks" of the west, and was viewed as another and convincing demonstration that the annexation of Louisiana and the development of the western states was ruinous to the interests of the old commercial states of the northeast and justified that group in seceding from a union in which they would clearly form a hopeless minority. Convinced of the injustice done to their section, New Englanders disregarded the embargoes, carried on illicit trade with the English in Canada and West Indian ports, discouraged recruiting and subscriptions to war loans and refused to celebrate victories gained by the French over the common enemy, the British.

In three respects only did New England enter the war. It supplied men and ships to the navy, was especially active in fitting out privateers and tried in vain to prevent by its own militia the occupation by the British of its seaboard east of the Kennebec river and the harassment of its coastal waters by British frigates. A threatened secession movement in 1804 had been headed off by the wiser Federalist leaders like George Cabot and Alexander Hamilton, but by 1814 the sentiment had got beyond the control of the moderates and resulted in the convention at Hartford, Conn., which demanded an amendment of the constitution to protect New England interests. The termination of the war left this movement high and dry; it brought its sponsors—the Federalist party and New England generally—into disrepute among the nationalistically minded rising generation of statesmen from the south and west. The interference with its commerce wrought by the embargo together with the interruption of the usual flow of manufactured merchandise from England and the continent caused some New England capitalists to transfer their money from shipping to the new textile plants which had been introduced during the last decade of the 18th century. At Beverly and Waltham in Massachusetts, at Pawtucket and Woonsocket in Rhode Island, the new spinning and weaving machines had been set up. Saved by the war from immediate competition with English textiles, these factories gained a start. The termination of the war saw a great importation of English goods. Faced with ruin, the millowners of New England joined with the infant woollen manufacturers of Pennsylvania to secure a protective tariff in 1816. As part of a general burst of nationalism the policy of protection and creation of a home market as advocated in Hamilton's famous report on manufactures was adopted. Increased rates were sought after the depression of 1819 and by 1824 New England politicians of all parties were faced with a new sectional issue. Manufacturing as a New England occupation grew steadily through the next generation, bringing with it the social, economic and political problems of concentration of population and constant demand for cheap labour and widening markets. In the same period, 1816–50, the rapid expansion of the agricultural regions of the south and west brought into the eastern markets the cheaper cotton as well as the cheaper foodstuffs. The former stimulated more textile activity—the latter drove the less well-situated farmers to abandon their farms and migrate to the west.

Several of the shibboleths, such as "Manifest Destiny," which swept the national government in the first half of the 19th century, left New England cold. Its own northern and eastern regions of New Hampshire, Vermont and Maine were losing their frontier character. The northern boundary, long subject to dispute even to the extent of an armed clash known as the Aroostook War of 1838, was finally determined by the Webster-Ashburton treaty in 1842. While hostile to western expansion, and to the policy of cheap public lands which went with it, New England had contributed mightily to people the new areas. Lois K. Mathews' *Expansion of New England* admirably relates the direction, quantity and peculiar quality of the migration from the New England states. Through this transplantation of population to the new states of the old northwest and later to Iowa, Kansas and Oregon, New England continued to exert the peculiar influence of its Puritan traditions. In the great problem which confronted the inhabitants of the areas of the Mississippi valley and the western plains—transportation—New England took little interest until railroad building came into the class of capitalistic enterprises. Its location excluded it from the competition in canal, highway and railroad building for access to the west, and the port of Boston fell behind its rivals. Yet New England had locally been a pioneer in railroad experimentation. One of the first railroads in the U.S. was built in 1826 to carry granite blocks from the Quincy quarries to tidewater. In the '40s, short lines were built connecting Boston with Providence, Lowell, Portsmouth, Worcester, Springfield, New Haven and New York. In 1850 Massachusetts ranked third to New York and Pennsylvania in railroad mileage.

The humanitarian movements of the '30s produced lively response in New England. Not only were the social problems incident to concentration of population in its mill towns provocative of controversy over questions such as the length of a working day and conditions of labour, the right to strike and the association of workers, but the assembling of people within easy reach of such potent agencies for education and enlightenment as schools, colleges and lyceum lectures had a stimulating effect on the popular interest in all sorts of questions. In this soil flourished many new ideas—advocates of liberal movements in religion, like William Ellery Channing, Theodore Parker and Horace Bushnell, crusaders for temperance like Neal Dow, who in Maine secured the first prohibition law in the United States, or for abolition of slavery like William Lloyd Garrison, for public high schools like Horace Mann; the Concord group—Ralph Waldo Emerson, Henry D. Thoreau and Bronson Alcott—gave New England an international reputation for "transcendental philosophy"—and with Henry Wadsworth Longfellow, Oliver Wendell Holmes and James Russell Lowell made this section the literary centre of America. The colleges and the academies that had survived the Revolution largely as sectarian institutions or theological schools now took on more liberal aims and methods and sent their graduates all over the country. At Litchfield, Conn., the first real law school in the U.S. flourished, under the guidance of Chancellor Kent, and produced such men as John C. Calhoun. Harvard college, where the triumph of liberalism over the more orthodox Puritan party in Boston in the early 18th century had led to the founding of Yale by conservatives, carried its liberalism still farther and in mid-19th century, borrowing its educational methods largely from Germany, gradually widened its curriculum on an elective basis and developed graduate schools of law, medicine, arts and science. In Providence the Baptists had founded Brown; at Middletown, Conn., the Methodists established Wesleyan; in the Connecticut valley arose Amherst; in the Berkshires Williams college; and in Maine appeared Bowdoin, Bates and Colby. In Vermont a state university was established through the benevolence of Ira Allen.

The position of New England in the Civil War accords with the double character of that struggle—the abolition of slavery and the preservation of the union. The same men who gave their lives for the latter issue had heaped abuse upon the men like Garrison who had agitated for 20 years in favour of the former issue. On the other hand, Wendell Phillips had denounced the clergy and the Cotton Whigs for their willingness to compromise with the slaveowners, and a great convention at Worcester advocated New England's secession from a union which required its members to enforce the Fugitive Slave law and to recognize slaveholders' property rights in human flesh. Once war began, New Englanders supported the administration steadfastly although the persistent demands of Charles Sumner and other abolitionists for immediate emancipation frequently caused embarrassment to Pres. Abraham Lincoln. During the Reconstruction period New England remained consistently Republican in spite of a liberal wing led by Charles Francis Adams.

New England commerce suffered severely during the Civil War. The whaling fleet, once the pride of New Bedford and Nantucket, was broken up by Confederate raiders, and its monopoly of the illuminating oil market was destroyed by introduction of kerosene oil and gas. By the change from wooden to iron and then to steel ships, and by the rising costs of operation under the U.S.

flag, all the natural advantages in the construction and operation of ships which New England formerly possessed were lost.

Again as in 1812 New England's answer was to shift its capital from shipping to manufacturing. Again as in the 1830s and '40s it succeeded, but toward the close of the century was faced with competition from new centres in the south and west, equally well-equipped with power sites, with capital and within easier reach of the source of raw materials and of the markets.

The electrical age developed early in New England. From a small local plant in Lynn, Mass., the Thompson Houston company developed in two decades into the General Electric company, extending its chain of factories across the continent. The Bell Telephone company, initiated by Boston capital and engineers, had a similar history. Again New England capital and engineering skill led by the Boston firm of Stone & Webster spread electric trolley lines into nearly every state in the union and led in the development of hydroelectric power. Vulcanized rubber process was another New England specialty which saw its greatest application in the midwest. Probably New England's greatest contribution to the typically modern American facility in mass production stemmed from the late 18th century, when the idea of replaceable parts, specialized part manufacture and assembly sprang from Connecticut clockmakers and was applied successively to firearms, sewing machines, typewriters, agricultural implements, machine tools and automotive machinery. The names of Pratt and Whitney are associated with much of this development.

The necessity of self-sufficient communities in colonial days produced the "jack-of-all-trades" quality in the Yankee which made him especially efficient in the early stages of industrial development, when resourcefulness in adaptation of materials and ingenuity in their use were required. As manufacturing processes became standardized and semiautomatic machines were evolved, the bulk of the work could be done by the semiskilled or even unskilled labour supplied by the great waves of immigration of the late 19th century. The population of New England by the 1940s reflected this change, but the persistent value of the Yankee all-round mechanic is seen in the preference shown for New England by industries requiring a high percentage of value added by labour to the total cost of the product.

Throughout the national period New England not only supplied most of its own capital but was most of the time a chief exporter of capital to other sections—western land mortgages, steam and electric railways, mining, stockyards, hydroelectric developments. Typical of the enterprises thus financed in the early 20th century were the Chicago, Burlington & Quincy railroad and the Calumet and Hecla mines.

The distribution of foreign-born or native-born of foreign parentage followed roughly the diffusion of industry from the coastal cities to inland towns. In some rural areas the immigrant largely replaced native farming stocks. In the old Puritan town of Salem in 1940, at least one-third of the population was of recent French-Canadian origin. Most of the chief textile and metal manufacturing centres began to depend in the 20th century on immigrant labour of non-English-speaking stock. In neither the boom years nor the depression years between 1914 and 1941 did New England prosper or suffer so much as most sections of the U.S. This is explained by the diversity of New England's investment of capital, the variety and generally limited size of the industrial units, the high percentage of skilled labour capable, with the plant, of conversion from one product to another. A further factor making for stability was the conservatism of New England banking, the large percentage of savings bank accounts and insurance policy holders and the persistence of a considerable fraction of the population on small, partly self-sufficient farms.

The fisheries, earliest of New England's enterprises, survived periodic depressions and revolutionary changes in techniques. Although by 1920 largely mechanized and dependent on refrigeration, it still retained elasticity in personnel, equipment and methods enabling it to support a considerable part of the sea coast population, although only a minority remained of the older native stocks. After 1880 the water power upon which colonial and early 19th-century milling and manufacturing had depended gave way to steam-coal power plants. After 1915 hydroelectric lines brought power to a large part of the section, but did not displace oil or coal steam generated plants near the coast.

Apart from the decline in its relative position in commerce, the chief respect in which New England altered in comparison with other sections of the union was in the character of its population. From being the most homogeneous section of the original states, New England became one of the most cosmopolitan areas. The first development of industries on a factory basis was effected by drawing the native New England stock from farms to factories without reliance on the recent immigrants. It was not till after 1840 that the number of non-English immigrants began seriously to affect its political or social structure. The great immigration of Irish after the famine in 1846 produced some serious disturbances in the many industrial towns, and New England shared the anti-foreign sentiment which took political shape in the Know-Nothing party. The immigration of large groups of non-Protestant southern and eastern Europeans between 1890 and 1914 altered the situation rapidly. Although the number of native-born of English ancestry even then formed a minority in New England as a whole, and was almost negligible in the industrial centres, the blocs of foreign-born or those of non-English ancestry tended largely to offset each other for political and social or economic purposes. Of these "foreigners" the Irish took the most active part in politics. Except for a short period in 1912 during strikes in the textile centres, the influence of radical leaders was slight among the working classes. Trade unionism existing in most industries was generally directed in conformity with the conservative policy of the American Federation of Labor. That there was no general attack on the principles of capitalism was due in part to the fact that the New England states were leaders in legislation favourable to labour as respects conditions and hours of work, and in part to the conservative attitude of the Catholic Church on this issue and, to a less ascertainable degree, to the high proportion of small capitalistic enterprises employing highly skilled labour.

(P. P. C.)

NEW ENGLAND PRIMER, "The Little Bible of New England," was a famous children's schoolbook published sometime before 1690 by Benjamin Harris (*fl.* 1673–1716), who, in Sept. 1690, published the quickly suppressed first issue of the first newspaper printed in the colonies, *Publick Occurrences Both Forreign and Domestick.* The catechism contained woodcuts illustrating the alphabet, crude couplets and moral texts, including the child's prayer "Now I Lay Me Down to Sleep." Frequently revised, it was an important children's textbook for more than a century.

NEW FOREST, one of the few woodland regions left in England, covering 92,365 ac. in the southwest of Hampshire, between the Solent, Southampton Water and the river Avon. The crown has the right to keep enclosed and planted 16,000 ac. Pop. of rural district (1938) 36,660. Area 148.4 sq.mi.

The New forest is one of the five forests mentioned in Domesday. It was a hunting ground of the West Saxon kings, but derives its name from the extensive afforestation schemes carried out in the region by William the Conqueror in 1079. The deaths of two of his sons within its confines—Richard killed by a stag and William Rufus by an arrow—were regarded in their generation as a judgment of heaven for the cruelty and injustice perpetrated by their father when appropriating the forest. One of the chief sources of the wealth of the forest in early times was the herds of pigs fed there. The New forest, being under the forest laws, was affected by the forest clauses of Magna Carta and by the Forest charter (1217), which mitigated their severity. The chief officer was the justice in eyre who held the justice seat, the highest forest court. The lower courts were the Swainmote and Wodemote, the former of which is still held, in a modified form, in the Verderers' hall of the king's house at Lyndhurst.

The circuit of the justices in eyre, or their deputies, continued down to 1635; they were virtually ended by the Act for the Limitation of Forests (1640), though Charles II attempted to revive them, and they were not legally abolished until 1817. The lower officers of the forest, who held merely local appointments,

were the verderers, the regarders, the foresters, the woodwards and the agisters. There was also a lord warden, who was usually a nobleman and performed no judicial functions. The Deer Removal act (1851) resulted in the almost total extinction of the forest deer. Under the act of 1877 the forest is administered as a national park. About one-fourth of the area is under cultivation by private owners and tenants, and the remainder is open woodland, bog and heath. The principal village within the forest is Lyndhurst (pop. [1932], 2,594), with the verderers' court, in charge of the crown portion of the forest. On the western outskirts lies the town of Ringwood (*q.v.*). Beaulieu village on the estuary of the Beaulieu river has ruins of Beaulieu abbey, founded by King John for Cistercians. The gatehouse is restored as a residence, and the Early English refectory as a church. There are considerable remains of the cloisters, chapter house and domestic buildings.

NEWFOUNDLAND. An island off the northeast coast of North America, lying roughly between the parallels 52° and 60° N. lat. and the meridians 47° and 52°; together with Labrador (*q.v.*) on the mainland it forms the tenth province of Canada, having joined the confederation on March 31, 1949. The total population of the island, 1951 census, was 361,416; the capital, St. John's, had a population of 52,873.

Physical Features.—Newfoundland lies across the Gulf of St. Lawrence, separated from the main continent by the Strait of Belle Isle (11 mi. across at the narrowest point) on the northwest and by 70-mi.-wide Cabot strait on the south. Newfoundland forms a rough isosceles triangle, with sides about 320 mi. long. Its area is 42,734 sq.mi., of which 5,721 sq.mi. are fresh water. The coastline, which totals about 6,000 mi., is much indented, with headlands and peninsulas thrust out boldly into the Atlantic, or into the Gulf of St. Lawrence. Two of these, the Avalon peninsula and the Northern peninsula, form an appreciable portion of the island.

Geology.—It seems probable that the structure of Newfoundland was determined essentially far back in Devonian times (about 300,000,000 years ago). A subcontinent known as Greater Acadia occupied land and sea near Newfoundland, and this was corrugated into northeast-southwest folds in the Newfoundland region and in the Canadian Atlantic coast provinces, as well as in adjacent United States. These folds are still obvious in Newfoundland, though most of Greater Acadia has sunk beneath the sea. The harder formations stand out as the numerous promontories, the softer beds have been eroded to form the shallow valleys and deep bays of the island. (*See* map.)

In Carboniferous times swamps and forests in the White bay depression gave rise ultimately to beds of workable coal, especially near St. Georges bay. During later Permian times—when the Appalachian mountains were elevated in the U.S.—only minor folding affected Newfoundland.

In Tertiary times there was pronounced uplift of the whole island, which previously had been a peneplain near sea level. The west was elevated about 2,000 ft., while the east was only raised about 800 ft. A good deal of faulting probably occurred in Tertiary times, and this seems to have produced the Long Range horst (elevated block rising to a maximum of slightly more than 2,500 ft.) all along the west coast, and the Humber graben (depression) between Corner Brook and White bay. During the Pleistocene ice ages the island was covered with ice; only a small amount of glacial debris is found on the elevated plateaus, but much in the valleys. The lakes were gouged out a little deeper by the ice, and the outlet of the Humber near Corner Brook was probably widened. Rounded hills, U-shaped valleys and coastal fjords are other evidences of these extensive ice forces. The geological zones agree with the dominant fold axes of the island, and are shown in a somewhat general fashion in the accompanying map.

Drainage is mainly toward the east and the northeast. Only two major rivers, the Humber and the St. George, pierce the mountains of the west coast. The other great rivers, the Gander, the Exploits and the Terra Nova, empty into eastern bays. Innumerable lakes and ponds dot central Newfoundland. The most considerable are Red Indian lake, Grand lake and Gander lake.

The climate of Newfoundland is moderated by the close presence of the ocean. The extreme range of temperature is between 0° and 81° F. February is the coldest, August the warmest month. Both rainfall and snowfall are heavy, although the latter is not so heavy as in neighbouring parts of Canada. In general, the western coast of Newfoundland experiences a much more continental form of climate than the east coast. The southern and western coastlines, between St. John's and the Bay of Islands, are never icebound. Elsewhere, ice blockades, caused by wind conditions, are known to occur.

History.—The precise date of the discovery of Newfoundland by Europeans cannot be determined. Recent investigation upon the subject of transatlantic navigation suggests that Newfoundland and the Grand Banks fishing ground were well known considerably before John Cabot made his voyage in 1497. Ships from Bristol and the western English ports were engaged in the Icelandic and northern fisheries from at least a century earlier. Cabot gave emphatic advertisement to the wealth of the western waters, an advertisement reinforced by the Portuguese explorer, Gaspar Corte-Real, in 1501. By the first quarter of the 16th century, French, Basque, English and Portuguese adventurers were fishing regularly off Newfoundland. By 1534 the chief features of the coastline were known and named. The term Newfoundland is probably a modernized form of the generic "new-found-land," which was used in the Cabot charter of 1496.

Newfoundland occupied a vital place in the scientific and military activity of the 16th century: it was associated with the search for the northwest passage, and it was of great strategic importance in the Anglo-Spanish maritime contest. In 1583 Sir Humphrey Gilbert formally annexed Newfoundland for England and, in the course of the next 30 years, attempts were made to colonize the island. In 1610 the London and Bristol company planted a colony at Cupids, on Conception bay. The leader of the Cupids colony was John Guy. Colonization was attempted also in the Avalon peninsula by Sir William Vaughan, Lord Falkland and Sir George Calvert, later Lord Baltimore. The Baltimore colony at Ferryland promised well, till its proprietors procured the patent for Maryland in 1632. In 1637 all Newfoundland, including the Baltimore holdings, was transferred to Sir David Kirke and his associates. Although the Kirke family seems to have retained possession till the 1670s, efforts at permanent settlement were at an end; 17th-century economic theory and practice far preferred the codfisheries to established colonies.

The Old Colonial System, 1633–1800.—Throughout the 16th century the codfisheries attracted great annual expeditions from maritime Europe. In England, these reached the position of supreme national importance. Poole, Bristol, Exeter, Teignmouth and the other western ports became the centres of English enterprise, thus establishing in the Newfoundland trade a dominance which endured for more than two centuries. In contrast to the practice of the continental Europeans, the English adventurers engaged in "dry fishing." That is, having made their catch, the English dried the codfish on the island. Under favourable climatic conditions, from five to six weeks were sufficient for this process. The cod were then shipped overseas, the best fish going to the Mediterranean, the least valuable to the slave plantations in the West Indies. Marketing was done by large merchant vessels, or "sack" ships. The sack ships brought to Newfoundland the all-essential salt; in the late autumn they returned to England with wine or oil, or with the more precious bullion from abroad. In the eyes of the 17th- and 18th-century theorist, these transactions had a double value: first, they made England the beneficiary of the profitable export trade in dried cod. Second, the western fisheries were a great nursery of hardy seamen. It is not surprising, therefore, that the fisheries were regarded as being of fundamental importance to England's security and prosperity. It was manifestly contrary to national policy to permit permanent settlement, or to allow the fishermen to winter in Newfoundland. It was equally in the interests of the western merchants to discourage settlement. Accordingly, they adroitly identified their private interests with the widely accepted mercantilist theories, and argued that possession of the fisheries was synonymous with maritime

supremacy.

In pursuance of this policy the western merchants secured valuable fishing privileges. One of these, the Western charter, issued in 1634 and reissued in 1661 and 1670, prohibited settlement on the coast of Newfoundland. The culmination of discriminatory legislation was reached in 1698. The act (10 and 11 William III cap. 25) refused to recognize the private ownership of fishing stages, and forbade any islander to appropriate a stage till all the overseas fishermen were accommodated. Thus the monopoly of the adventurers was secured, and Newfoundland relegated to the role of accessory to the overseas fisheries.

BY COURTESY OF THE NEWFOUNDLAND TOURIST TRAFFIC DEVELOPMENT BOARD

COAT OF ARMS GRANTED TO NEWFOUNDLAND BY ROYAL LETTERS PATENT DATED JAN. 1, 1637

The intensification of maritime rivalry probably forced the issue. In 1662 the French established themselves at Placentia; in 1665 the Dutch burned St. John's, even at that early date a centre of English trade. Beginning with 1696, the French made concerted attempts to conquer Newfoundland, clearing the English out of their establishments in the Avalon peninsula and, early in 1697, attacking their stations in Conception bay. These exploits were repeated by the French in 1705 and again in 1709. By the terms of the treaty of Utrecht (1713), the French recognized English sovereignty over Newfoundland, although they retained valuable fishing privileges between Cape Bonavista and Point Riche. These concessions graphically indicate the high value set on the fisheries by both French and English. The ultimate settlement of these claims was postponed for nearly two centuries. During the Seven Years' War (1756–63), Newfoundland became again a centre of conflict, St. John's being lost and retaken by the English in 1762. During the American and French Revolutionary Wars, Newfoundland's coasts were ravaged afresh.

The subordination of Newfoundland's social and political development to the codfisheries was complete. After the failure of the early colonization schemes, authority was chaotically exercised by the fishermen themselves, under the title of "fishing admirals." In 1729 an officer of the royal navy was appointed governor. His tenure was seasonal, as was that of his successors till 1817. The naval governors wholeheartedly sought to aid the overseas fisheries as auxiliary to national policy. As late as 1775, Palliser's act (15 Geo. III cap. 31) attempted to forestall settlement by refusing to recognize the right of private ownership. In 1791 a civil court was instituted and, in 1792, a supreme court. In this way the earliest attempt was made to introduce an element of constructive order into Newfoundland affairs.

The population of the island was almost entirely seasonal, the fishermen returning each autumn to England; as late as 1683–84 there were only 120 permanent residents on the island. Throughout the 18th century numbers increased from 3,400 in 1754 to more than 12,000 in 1774. Settlement spread north from Cape Bonavista and west from Placentia.

The newcomers were drawn increasingly from Ireland to provide inexpensive labour for the codfisheries. Food and supplies were brought in from New England. Thus were the less favoured members of the empire subordinated to maintain England's monopoly of the Newfoundland staple industry. The great prosperity the fisheries enjoyed in the late 18th century probably accounted for the steady increase in population, which by 1804 reached 20,000. The peak year was 1814–15, when more than 11,000 immigrants arrived in St. John's from southern Ireland.

The prosecution of the shore fisheries was left chiefly to these newcomers. The prosperous deep-sea fishermen became resident merchants, buying dried cod, fish oil and sealskins for speculation abroad. Their headquarters were St. John's, which to its old character of a fishing station added that of a distributing and financial centre. Between the poor English and Irish "youngsters" (*i.e.*, employees) and the merchant oligarchs, a vast social and economic gulf was set. This cleavage may explain the disturbances in Newfoundland during the French Revolution, particularly the abortive mutiny of part of the local defense force in 1800. By the end of the 18th century, therefore, the hold of the old colonial system on Newfoundland life was weakening sensibly.

Representative and Responsible Government.—As early as 1802 Gov. James Gambier proposed that a form of representative government be granted Newfoundland. A decade and a half later the colonial secretary instructed the governor (Adm. Sir Francis Pickmore) to advise the British government in the matter of administrative reform. The leading advocates of self-government in the island were William Carson, a politically inclined Scottish physician, and Patrick Morris, an Irish-born merchant. Opposed to any reform were the agents of the great western interests and the local merchants. In 1832 representative institutions were established with a bicameral legislature, the lower house of which was elected on a broad franchise. From an early period discord developed between the two houses. The legislative councillors were residents of St. John's, and representative of the economically dominant "fishocracy" of the merchants; the assembly was a much more popular body. So serious did the collisions be come that in 1841 the constitution was suspended. In 1843 it was restored partially, a unicameral or amalgamated legislature being set up. In 1847, however, the old constitution was restored. The amalgamated houses enacted much useful legislation: a general education act; a road-building program; aid to agriculture. From 1848 onward, agitation was set in train for complete responsible government. The colonial office withheld approval until 1855. In that year full legislative responsibility was admitted, on the analogy that what had been recognized in Nova Scotia and Canada could not be withheld in Newfoundland. An adequate civil list and a parliamentary redistribution were effected and, thus equipped, Newfoundland emerged as a completely self-governing community.

Economic Maturity, 1800–70.—Increasing economic maturity underlay the constitutional changes. The early 19th century was characterized by the growth of the inshore fisheries, as distinct from the bank fisheries. The war years, especially from 1800 to 1815, drastically curtailed the deep-sea fisheries. The bank fisheries did not recover their former importance, the dominant economic position passing to the shore fisheries. These fisheries were prosecuted by resident Newfoundlanders, and their rise was responsible for the political changes of 1832. During the war years the Newfoundlanders established a virtual control over the Mediterranean market for dried cod. In 1813 and 1814 they established an important new market in Brazil. Peace brought a disastrous fall in the price of dried fish, occasioning a prostration in business which lasted until 1818 or 1819. Thereafter, till the middle of the 19th century, the export of cod remained remarkably constant.

An important adjunct to economic prosperity was the seal fishery. From the middle of the 18th century, the people of the northern bays took a few seals annually by means of nets. Somewhat later, small boats were employed. These ships sailed each spring for "the ice," in order to intercept the great herds of seal on their migrations. In 1831 and 1844 phenomenal catches were made, 686,830 and 685,530 respectively. The industry gave employment to a large number of men and brought handsome returns to the capitalists who directed it. In 1857, 13,600 men shipped for the ice; the catch was valued at $1,700,000. After the middle of the century, sealing declined.

Throughout this period, concerted efforts were made to broaden the economic basis of island life. Sir Thomas Cochrane, the first governor under the representative system, attempted to forward road building and farming. Under the direction of Sir John Harvey in the '40s, agricultural societies were formed in an effort to put farming on a rational and extensive basis. The success of these efforts may be judged by the progressive increase of land under cultivation: 1836, 11,062 ac.; 1845, 29,656 ac.; 1855, 41,108 ac. The majority of such holdings were small, usually being worked as auxiliary to the all-absorbing fisheries. Nevertheless,

they did impart a degree of self-sufficiency and permanency to Newfoundland life.

Allied to the fisheries were overseas commerce and banking. Newfoundlanders were excellent shipbuilders and frequently sailed the vessels they constructed to the Mediterranean and the Caribbean. Foreign shipping, chiefly Spanish and German, crowded St. John's. The history of banking in Newfoundland begins with the opening of a branch of the Bank of British North America in 1836. In 1844 the Newfoundland bank was incorporated; in 1854 the Union bank; in 1857 the Commercial bank. The last three were local institutions, and their success demonstrates the competence of Newfoundlanders to direct all phases of their economic life in the mid-19th century.

The social development of the island kept pace with the economic. The merchant class became Newfoundland by birth and outlook and, with the rise of the enterprising Irish shopkeeper, began to lose its exclusively Anglican caste. The outport merchants, with the increasing importance of the seal fishery, played a more decisive role in business life. St. John's was transformed gradually into a commercial centre and colonial capital. In 1800 the population of the city was about 3,000, living along two narrow paths which straggled on the north side of the harbour. A series of disastrous fires in 1816, 1817 and 1819 largely destroyed the ancient malodorous fishing town and made possible a degree of planning. In 1846 another fire hastened this process and opened the way for such improvements as a general water supply system, the St. John's Water company being incorporated in 1846. In this period, some of the most conspicuous landmarks of St. John's took form. In 1841 the cornerstone of the Roman Catholic cathedral was laid; in 1855 the church was consecrated. In 1843 the building of the Anglican cathedral was commenced.

The Newfoundland churches owe their modern organization to the early 19th century. In 1847 the Roman Catholic diocese of St. John's was erected. Catholic worship had been conducted regularly as early as 1627 in the Baltimore colony; a prefecture was created in 1784 and a vicariate in 1796. The early clergy were Irish Franciscans, an arresting commentary on the close integration of social and religious forces. The opening of a diocesan seminary in 1857 made possible the training of a native clergy and the formation of a completely indigenous church. The Anglican diocese of Newfoundland was created in 1839. Provision for Anglican worship was made as early as 1583, and the first Anglican minister reached the island in 1610. The consecration of Bishop Edward Feild in 1844 introduced the modern period in church extension and education. Methodism was introduced into Newfoundland in 1764, establishing itself strongly in the northern outports. In 1855 the Methodist churches joined the Eastern British American conference, thus breaking the administrative connection with England. The entrance of the Methodist Church into the United Church of Canada was effected in 1925. Organized Presbyterianism dated from 1842. The other chief religious bodies, Salvation Army, Adventists and Pentecostals, came into being at a later time.

In the decade of the 1860s Newfoundland passed through a confusing period. The conventional historian employs alarmist language to describe the lean years 1860–68, and ascribes the economic collapse and social demoralization to the decline of the fisheries. A critical examination of the available evidence suggests that equally potent factors were poor harvests, occasioned by prolonged drought, and the dislocation of the southern market for cod, produced by the U.S. Civil War. Against this dark picture must be contrasted the unchallenged statement, made in 1864, that Newfoundland was in a sounder financial position than any other British American community. By 1869 good harvests, supplementing abundant fisheries, brought prosperity. In 1869, also, the proposition of including Newfoundland in Canada was rejected at a general election. Whatever local or temporary issues were involved, the rejection may be regarded as symptomatic of the economic well-being of Newfoundland in the mid-century.

The Age of Local Enterprise, 1870–95.—The quarter century (1870–95) was one of general prosperity. This may be ascribed to the progressive broadening of economic life through farming and mining, and also to the stimulus of railway building. An additional reason was the high price the increasing exports of dried codfish commanded. In an era of general price decline, the price level of dried fish remained almost stationary. Thus the fisherman had the absolute advantage of a high selling price and the relative advantage of greater purchasing power. Moreover, the capitalistic enterprises of the period were locally managed and financed. The intrusion of alien direction and control following 1895 may be regarded as closing one period in Newfoundland history.

The search for economic self-sufficiency was initiated as early as the '60s. The rapid increase in population (1857, 124,288; 1869, 146,536; 1874, 161,374) gave a note of urgency to these investigations. In 1862 two committees of the legislature examined the fisheries and agriculture and in 1864 the geological survey of the island was begun. Independent of, but associated with this was the discovery of copper ore at Tilt cove on Notre Dame bay. Working was begun in 1864 and by 1879 the mine had yielded $1,572,514 of copper and $32,740 of nickel. Other mines, notably at Bett's cove, gave even greater yields, producing minerals valued at $2,982,836 between 1875 and 1879. The discovery of considerable deposits of lead, coal and other minerals on the west coast increased optimism and stimulated efforts to promote ways and means to exploit these new forms of wealth.

Railway construction became the great end of national policy. In 1875 Sir Sandford Fleming, the engineer of the Canadian Pacific, surveyed a practicable route from St. John's to St. Georges bay. Difficulties raised by the colonial office, lest such a line trespass on French privileges, delayed the construction of the railway as originally projected. In 1880 a joint committee of the legislature recommended the building of a railway northward, as the best means of making accessible the mining and agricultural regions of Notre Dame bay and Exploits valley. In 1881 a company was incorporated and construction begun. The company was aided by government subsidies of $180,000 per annum for 35 years, and a land grant of 5,000 ac. for each completed mile. At the same time, new enterprises were initiated at St. John's. In 1882 a ropewalk was established for the manufacture of fishing gear, netting, cordage and cables, thus freeing Newfoundland from its dependence on foreign sources for these indispensable supplies. Between 1882 and 1884 a large dry dock was constructed. Other industries developed locally, foundries, machine shops and engineering works, all associated with the railway or with shipping.

In the early 1890s two disasters altered completely the pattern of Newfoundland growth. In 1892 three-quarters of St. John's was devastated by fire. The damage to property was computed at $20,000,000, of which less than one-quarter was covered by insurance. In Dec. 1894 the two leading banks, the Commercial and the Union, failed, while the Government Savings bank was compelled to suspend payment. The notes of these banks, the normal currency of the island, became valueless, business stagnated and workingmen were dismissed. As the Union bank was under obligation to provide the half-yearly interest (about $225,000) on the public debt, the crisis assumed a serious shape. A loan from the United Kingdom serving for immediate relief, Newfoundland sought permanent solution by union with Canada. The insistence of the Canadian government on certain debt settlements caused the negotiations to break down early in 1895. Left to their own devices, Newfoundland public men, directed by Sir Robert Bond, succeeded in raising loans in Montreal, New York and London, thus staving off the danger of complete financial collapse.

The bank failures brought to an end a distinct era in Newfoundland history. Local enterprise had been overwhelmed by disaster. The Canadian banks entered the island and their notes replaced the local Newfoundland dollar. Five years before, Sir Robert Reid of Montreal had become influential in pushing the construction of the transinsular railway. By these means, alien direction invaded the business life of Newfoundland.

The Era of Foreign Investment, 1900–30.—For the first 30 years of the 20th century, Newfoundland development followed

a consistent pattern. Foreign enterprise increasingly sought to exploit Newfoundland's natural resources. As a corollary, Newfoundland standards of living sought approximation to standards elsewhere. World War I intensified this process. The liquidation of long-standing differences with France and the United States was a feature of this period.

As early as the 1890s, foreign investment was attracted to railway construction and mining. The decision to build a transisland railway brought in Sir Robert Reid, a Scotch-Canadian promoter of great practical experience. The financial disaster of 1894–95 induced the government in 1899 to transfer to Reid virtually all the island's communications, railway, shipping lines and telegraph, as well as the St. John's dry dock and extensive timber and mining rights. Strong protest produced an amendment of the contract in 1901, whereby the more objectionable monopolistic features were surrendered at the price of about $2,500,000. Construction was pushed vigorously; in 1893 the railway reached Norris Arm on the Exploits; in 1897, Port aux Basques. Fast steamships were put in service between this point and Sydney, N.S. The profitable working of these enterprises proving increasingly difficult, in 1923 the government assumed their operation as part of the public charge. In 1895 the exploitation by a Canadian company of the iron deposits on Bell Island commenced.

In 1905 the Anglo-Newfoundland Development company was constituted for the manufacture of newsprint. The company was originated by Lord Alfred Charles Northcliffe, who wished to make his chain of newspapers independent of foreign countries for supplies of print. The location of the original plant was at Grand Falls, where the company received power rights on the Exploits river and timber limits amounting to 2,000 sq.mi. The first paper was produced in 1909. For export purposes the company installed docks and sheds at Botwood, which was connected with Grand Falls by private railway. Since its establishment, the Anglo-Newfoundland Development company was much expanded. In 1923 it acquired the pulp mill of the Albert Reed company at Bishop's Falls. It also increased its timber holdings to 7,400 sq.mi. The plants at Grand Falls and Bishop's Falls were modernized completely. The rise in production may be accepted as an accurate commentary on the company's efficiency. In 1909 and 1910 the original mill produced 30,000 tons of newsprint. By 1912 production was doubled; in 1933 it stood at 100,000 tons annually. In carrying out surveys, officials of the company discovered outcroppings of copper-lead-zinc ore on Buchans river. It was not till 1925, however, that these deposits were made profitably exploitable. The American Smelting and Mining company undertook development under agreement with the parent Anglo-Newfoundland company. Mining operations were begun in 1927. In 1931 the plant was enlarged, obtaining a production capacity of about 1,200 tons of ore daily.

In the era following World War I came the exploitation of the timber resources of the west coast. The potentialities of the region were well-known, but it was not until after 1919 that development was undertaken seriously. The leader was Sir Richard Squires, then the prime minister, and one of the most vocal exponents of exploitation by means of foreign capital.

World Depression.—In 1931 Newfoundland began to experience the effects of the world depression. These were intensified by the heavy service charges on the Newfoundland debt. Throughout the 1920s, the program of railway consolidation and highway construction, along with increased aid to education, raised the national debt from $43,000,000 to $101,000,000. Moreover, the budgets had not been balanced after 1920, the annual deficits amounting to an average of $2,000,000. The deficits were met by loans, which, of course, added to the general indebtedness. The onset of the depression, therefore, found Newfoundland in a dangerous financial position. By an unfortunate coincidence, Newfoundland's best customers for newsprint, minerals and dried cod were themselves affected seriously. Employment declined in Canada and the United States, forcing home scores of seasonal workers. Throughout 1930, 1931 and 1932, the shore fisheries were low, with the result that in the winter of 1932–33 about one-quarter of the population was on relief. In 1931 a loan for $8,000,000 received no tenders. Upon request, a financial adviser for the government was dispatched from the United Kingdom. In 1932 loans were successfully raised from the Canadian banks and from local subscriptions. An unusual feature of this agreement was the provision which gave the Imperial Oil Company of Canada a monopoly of the import of petroleum products in return for an annual subsidy of $300,000. Drastic cuts were made in expenditure and taxes steeply increased. During 1933, however, no improvement was visible, and additional loans were sought from the governments of Canada and the United Kingdom: January, Canada-United Kingdom loan, $1,250,000; July, United Kingdom loan, $1,850,000. At the same period, application was made for the appointment of a royal commission to inquire into Newfoundland affairs.

Commission of Government, 1934–49.—In February a royal commission was appointed. It consisted of three members, a Newfoundlander, a Canadian and a representative from the United Kingdom. The terms of reference stressed the examination of Newfoundland's financial situation and prospects. The royal commission met throughout the summer of 1933, gathering information on Newfoundland life. A report of these investigations, along with certain recommendations, was published in the autumn of 1933.

The report was a comprehensive document, containing an extensive survey of Newfoundland's existing condition and past history. The ills of the dominion were set down to the functionings of a perverted parliamentary system which had been exploited for party and personal gain. As a solution, the royal commission recommended the temporary suspension of responsible government. It recommended, also, that the government of the United Kingdom should assist Newfoundland financially until such time as the dominion became self-supporting. Other recommendations touched the rehabilitation of the fisheries, the revision of the educational system, and so on. The constitutional proposals were startling since they envisaged the establishment of a unique body, the commission of government, which should exercise both legislative and executive functions. A candid analysis of the report suggests that the royal commissioners misunderstood the nature of Newfoundland's difficulties and that they were anxious chiefly to protect the holders of Newfoundland securities. These were, principally, British, Canadian and United States. In the 1920s Newfoundland had borrowed about one-half its funds from New York. It is probable that the dominion office feared the consequence to British financial prestige of the default of Newfoundland; hence the extraordinary measures suggested to ensure solvency. Early in the winter, the Newfoundland legislature debated the report, and accepted the recommendations. The British parliament thereupon examined the measure, which became law in Dec. 1933. The chief critic of the proposed change was the Labour party. It attacked the bill as designed to assist the *rentier* class, and as constituting a dangerous precedent in dictatorship.

In its operations, the commission of government encountered a number of difficulties. The most obstinate were the low prices tendered for Newfoundland's primary products. As such prices were determined by world conditions, their improvement was beyond the power of local administration.

The program of the commission was assisted, however, by advances from the British treasury. Deficits in ordinary expenditure were met by grants-in-aid; money for capital outlays was borrowed from the Colonial Development fund. The annual deficits were in the neighbourhood of $1,500,000. In order to effect economies, the commission carried out an extensive conversion scheme. In this way, the cost of debt service was reduced by more than $2,000,000 annually. The government of the United Kingdom guaranteed both interest and principal of the new sterling 3% stock issued to replace the old Newfoundland securities. In matters of finance, the commission of government, like the parliamentary regime which preceded it, was unable to find an equilibrium between expenditure and income. The artificial character of the budgetary balances must not be overlooked.

The most substantial advances made by the commission were

in administration and in administrative reform. At an early period, the tariff was subject to thorough revision. Customs duties had been for long the staple of Newfoundland finances, producing in normal times about three-quarters of the dominion's revenues. During the depression years, the tariff had been so steeply increased that the law of diminishing returns was operating. The commission simplified and reduced the tariff (Revenue act, 1934). The result was a considerable increase in revenue, which rose from $7,043,504 in 1935 to $8,683,181 in 1938.

Another promising accomplishment of the commission was land settlement. The experiment was begun in the winter of 1933–34 by a group of St. John's citizens. The success of the Markland scheme attracted the attention of the government. Under the direction of the Land Settlement board, and later under the department of rural reconstruction, the Markland scheme was repeated elsewhere. To subsistence farming, winter logging, fishing and lobster canning were added. The moral value of such settlements was great. Stimulation to the co-operative movement was given formally in the Co-operative Societies act (1939), which sought to make the principle of self-help operative throughout the dominion. In sponsoring these measures, the commission of government indicated its awareness of problems other than the material.

With the advent of World War II the island, because of its bastion position off the North American continent, at once began to play a major role. Air bases were created and garrisoned by the United States and Canada; the harbour of St. John's became an important naval base and convoy point; and Newfoundland raised troops for service in Europe. The impact of World War II on the economic, political and social life of the island was heavier, more disturbing and more prolonged than the impact of World War I had been. By 1945 boom conditions prevailed in many parts of the island. Throughout the 1939–45 period the commission of government continued, but in the years following the end of the war the future of Newfoundland's government became increasingly controversial.

Confederation with Canada, 1949.—Partly because of the effect of World War II on the economy of the United Kingdom, that country was reluctant to continue the financial and other aid extended to the island under the commission of government. Many Newfoundlanders were themselves anxious to see the end of the commission of government, which they felt was only a temporary if necessary expedient, and certainly an undesirable intrusion of autocracy. However, some did favour a retention of the paternalism of the commission. In addition, there was a resurgence of the 1895 union-with-Canada movement. Thus three main types of agitation developed: retention of the commission; return to responsible government (dominion status under the 1931 Statute of Westminster); confederation with Canada. There was a minor and abortive move for economic union with the United States. A national convention was called in Sept. 1946 to discuss the problems. The convention ended its deliberations in Jan. 1948. Its final decision was United Kingdom permission for an island referendum on June 3, 1948, with three alternatives: (1) commission of government (for five more years and then another referendum); (2) responsible government; (3) union with Canada. The vote was respectively 23,311, 69,400 and 64,006. Because under the referendum arrangement there was no clear majority for any alternative, a second ballot was taken July 22, 1948, which resulted in 71,334 votes for responsible government and 78,323 votes for confederation. (Eighteen of the 25 electoral districts established in 1933 showed a clear majority for the union.)

Negotiations for union opened in Ottawa on Oct. 6, 1948; the terms were signed Dec. 11; the Canadian parliament approved the terms (13 Geo. VI., c. 1) on Feb. 18, 1949; the commission of government announced its approval on Feb. 21; the British parliament confirmed the arrangement on March 23; and in accordance with the terms Newfoundland (comprising the island of Newfoundland and the islands adjacent thereto and the coast of Labrador as delimited by the judicial committee of the imperial privy council in March 1927) joined Canada as its tenth province at midnight on March 31, 1949. The terms were complicated, but the main constitutional, financial, taxation, welfare and public service provisions were as follows:

Constitutional.—The British North America acts, 1867 to 1946, except for such provisions that affect only one or more and not all of the provinces, and the Statute of Westminster, 1931, apply to the province of Newfoundland in the same way that they apply to the other provinces; the new province is entitled to six senators and seven members in the house of commons, with readjustment as population changes; a provincial government was created.

Financial.—The federal government assumed responsibility for the island's sterling debt; subsidies were of several kinds: (1) a fixed annual payment of $180,000; (2) an adjustable annual payment of 80 cents per capita; (3) a special subsidy of $1,100,000 in recognition of the island's special problems of geography; (4) a transitional grant of $42,750,000 to be paid over a 12-year period; (5) a royal commission to be appointed before 1957 to review the financial position of the province.

Taxation.—An agreement for the rental by the federal government of personal income, corporation income, corporation taxes, succession duties.

Welfare.—The extension of federal unemployment insurance, family allowances, veterans' benefits, merchant seamen's benefits, old-age and blind pensions, health grants, housing assistance to the island.

Public services.—Railway, steamship, postal, telecommunications, civil aviation, defense, customs and excise, public radio, encouragement and protection of fisheries taken over by the federal government so as to relieve the province of Newfoundland of the costs incurred for such services.

Sir Albert Joseph Walsh was appointed first lieutenant governor on April 1, 1949, succeeded by Sir Leonard Outerbridge, C.B.E., on Aug. 17, 1949. Joseph R. Smallwood, a Liberal and one of the chief architects of confederation with Canada, was appointed the province's first premier on April 1, 1949. On May 27 he held the new province's first election, in which 22 Liberals, 5 Conservatives and 1 independent were returned.

Economics.—Geographical factors have had a powerful influence on the economy and the characteristics of Newfoundland. The arctic currents keep the coastal waters cool, thus producing ideal conditions for the fisheries. They make for late springs, temperate summers and damp autumns, thus putting agriculture under a handicap. These circumstances made Newfoundland a producer of a number of relatively simple staples; hence, the island had not attracted a large population nor had it developed extensive secondary industry by mid-20th century.

Farming in Newfoundland developed slowly. It was not until 1813 that land could be held for agricultural purposes. The shortness of the season and the lack of fertility of the soil in the more settled areas of the island were additional hindrances. In spite of numerous efforts in the 19th century, farming was not undertaken on a large scale. The majority of the farms are small, usually in the nature of garden plots cultivated to supply the fisherman with his year's vegetables. In the Avalon peninsula, chiefly in the Waterford valley, and also on the west coast, in the Codroy valley and on the Bay of Islands, some mixed farming is done. On the larger farms of 100 to 200 ac., cereals can be grown. Elsewhere, however, farming usually takes the form of vegetable raising. The relatively high prices these commodities command in the local market stimulate their production. Cultivated fruits have little export value, but wild fruits are sent in large quantities to the United States. Successive governments attempted to stimulate farming, usually by granting bonuses for land clearing. The commission of government continued this policy. It established, also, a demonstration farm, to which an agricultural school is attached. District agricultural officers were appointed to advise the farmers as to crops, fertilizers, and so on. The department of rural reconstruction sought to develop subsistence farming as a means of increasing the independence of the fisherman. It gave its support to various self-help organizations and co-operative societies. After confederation in 1949, the provincial agricultural division continued and intensified this work. Subsidies took the shape of bonuses for purchase of purebred

sires, in addition to land clearing, and a soil survey service was maintained. By these means, the government attempted to mitigate some of the prejudices against which, and the difficulties under which, farming labours.

The forest industries are very important. Woodlands cover at least 25,000 of the 42,734 sq.mi. of the island. The best timberlands are found along the rivers and in the bottom lands, chiefly in the Exploits valley on the northeast coast and in the Humber valley on the west coast. The commonest woods are black and white spruce and balsam fir. These are extremely valuable, not only for local manufacturing purposes, but also for making newsprint. In some sections are considerable stands of white pine; in others, birch and juniper. At mid-century more than 600 sawmills drew on these forests for building material, cooperage stock and various lumber products, the value of these reaching the figure of about $1,000,000 annually. Pit props, as well as newsprint, are exported to the United Kingdom. The production of newsprint is one of the most important activities of Newfoundland. The pioneer in this enterprise was the Anglo-Newfoundland Development company which began to manufacture paper in 1909. In 1925 the Bowater paper mill was opened at Corner Brook, and it was enlarged in 1950 to make it the largest paper mill in the world. The administration of forests and the rental of timber limits are vested in the department of natural resources.

The mineral resources of Newfoundland are believed to be considerable. Formed as it is of ancient rock, it is said to contain almost all metallic substances. Iron, copper, zinc and lead are the chief minerals commercially exploited. Iron mining is carried on at Bell Island in Conception bay. The ore beds appear in the cliffs on the north side of the island, and seem to extend far under the sea. The ore is mined at Wabana, Bell Island, and is of first-class quality. In 1895 mining was actively commenced. In 1921 all the mines on Bell Island were acquired by the Dominion Steel and Coal corporation of Sydney, N.S. After the first ore was taken out in 1895, the Bell Island mines produced more than 28,000,000 tons of ore, valued at more than $75,000,000. In 1947, 1,280,000 tons of ore were mined. Some Bell Island ore goes to the United States and some to the United Kingdom but the bulk is exported to the company's furnaces at Sydney.

In central Newfoundland, at Buchans on Red Indian lake, copper, zinc and lead are mined. As early as 1906 the outcroppings were discovered, but it was not until after 1925 that the extraction of the metals became feasible. Operations were begun in 1927, and in 1931 the plant was further extended. The mine is equipped with modern machinery including a crushing plant, a concentrating mill and a hydroelectric plant. Between 1929 and 1932 the Buchans Mining company produced more than 325,000 tons of zinc and 140,000 tons of lead. In 1947 this mine produced 70,000 tons of zinc, 34,000 tons of lead and 16,000 tons of copper. Export is made by way of the Anglo-Newfoundland Development company's port at Botwood.

There are indications of other minerals in considerable amounts elsewhere. Coal is found in the neighbourhood of St. Georges bay on the west coast, with an estimated content of 147,000,000 tons. Copper mining was carried on profitably around Notre Dame bay between 1864 and 1918 when the mines were thought exhausted, but they were reopened in 1951 by the flotation process. In 1933 fluorspar veins were developed in the St. Lawrence peninsula. By 1939 two companies were engaged actively in the exploitation of this mineral and as late as 1951 Newfoundland led by far in Canadian fluorspar production. In various sections of the island gold, silver, nickel, chromium, antimony, asbestos and vanadium exist. In 1934 the commission of government organized a geological survey in order to make known the resources of the country. After confederation in 1949, federal geological parties operated on the island.

The fisheries are conventionally regarded as Newfoundland's chief industry. Proximity to the Grand Banks (*q.v.*) makes Newfoundland one of the world's greatest fishing stations. Fishing employs the most considerable number of persons in the province, and until the development of forest and mineral resources it provided the largest single element in the national income.

The codfishery is the oldest of the Newfoundland fisheries. It is pursued in three forms, inshore, on the Grand Banks and off the coast of Labrador. The shore fishery is followed from the coast in the summer months. It is engaged in by individual fishermen in small boats. Normally it accounts for more than half the total catch. The cod is cured by the fisherman and his family on the "flakes" (*i.e.*, wooden stages) which form such a distinctive feature of the Newfoundland shore. The dried cod is disposed of to the local merchant. The bank fishery is a deep-sea fishery conducted from schooners, locally called "bankers." The actual operation of fishing is done by dories, which play out lines carrying 1,000 hooks. The "bankers" make three voyages annually, in spring, summer and autumn. The catch is stored on board, heavily salted, to be cured when the ships return to land. The bank fishery represents about one-tenth the total catch. The Labrador fishery is followed in the summer and the autumn either as a shore or as a sea fishery. The Labrador fish are processed locally, or carried in salt bulk to Newfoundland.

The other fisheries are of relatively less importance, though still of major proportions. A considerable amount of salmon is dispatched frozen to the Canadian mainland and to the United Kingdom. Lobsters are taken on the south coast. Smelt and halibut are sent iced to the Canadian market. Herring are caught at all points around the coast, but only on the west coast has this fishery any commercial importance. The seal and the whale fisheries declined greatly, until in 1948 they brought in only $480,000 and $224,000 respectively.

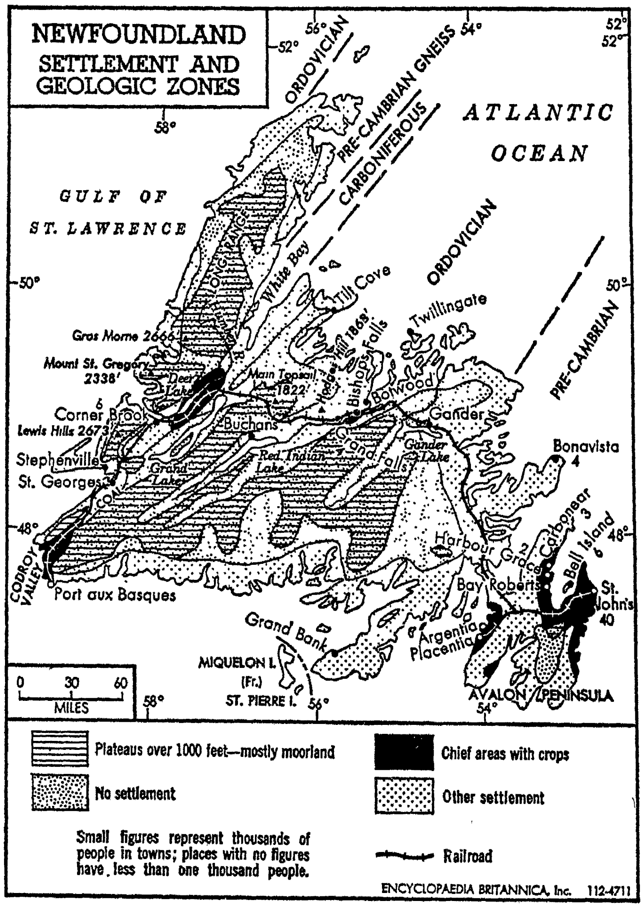
The various fisheries are conducted on a credit basis. Since a commodity is usually disposed of in a distant market, such an arrangement is almost inevitable. At the beginning of the season, the fisherman appeals to the local merchant for fishing equipment and for household supplies; at the end, his catch is valued, and any balance is squared in cash or goods. Should there be no balance, the fisherman remains in debt. The effects of the credit system, economically and psychologically, have been deplored by all students of Newfoundland life. The ramifications of indebtedness are extended by the fact that the local merchants operate on a credit granted by the great exporting houses of St. John's. Various efforts were made to overthrow this ancient system, and in 1933 the royal commission suggested the statutory substitution of a fraction of payment in cash. This proved unworkable. Later efforts in the direction of mutual-aid societies, fishermen's co-operatives, and so on, gave greater promise of success.

The chief markets for Newfoundland fish are the Mediterranean and Caribbean countries and Brazil. The export trade is primarily in dried, salted fish; little attempt is made to export cod, canned, filleted or smoked. During the 1930s, disturbances in the overseas markets profoundly affected the fish trade. Between 1928 and 1938 the value of the codfish catch fell from $11,500,000 to $4,000,000. In 1948–49 the export of salt codfish was worth $17,723,000, while other fisheries produced a further $14,485,000. As the codfisheries, directly or indirectly, affect about one-third of the entire population, the consequences of price decline are catastrophic.

Trade conditions make Newfoundland an exporter of primary products. Originally, this was exclusively dried codfish. In the 20th century, however, forest and mineral products outstripped the codfish export in value. In 1933–34 Canada supplied 39.96% of Newfoundland's imports; the United States, 28.18%; the United Kingdom, 23.51%. After 1935, the United States increased its business progressively in Newfoundland. An important trade agreement was made between the two in 1938. Under the terms of this agreement, the United States substantially reduced duties on a number of Newfoundland fish products, as well as upon frozen small fruits and certain minerals: At the same time, Newfoundland reduced its tariff on 47 United States manufactured commodities. The dislocation of international food supplies by World War II created a boom in Newfoundland fish, while its wood products and minerals also found ready buyers. As a result of confederation in 1949, the tariff arrangements became the same as those for Canada. The great bulk of Newfoundland trade is

conducted through the port of St. John's. Distribution is largely in the hands of the St. John's wholesale houses. The city has an excellent harbour.

Environment and Settlement.—No better example exists



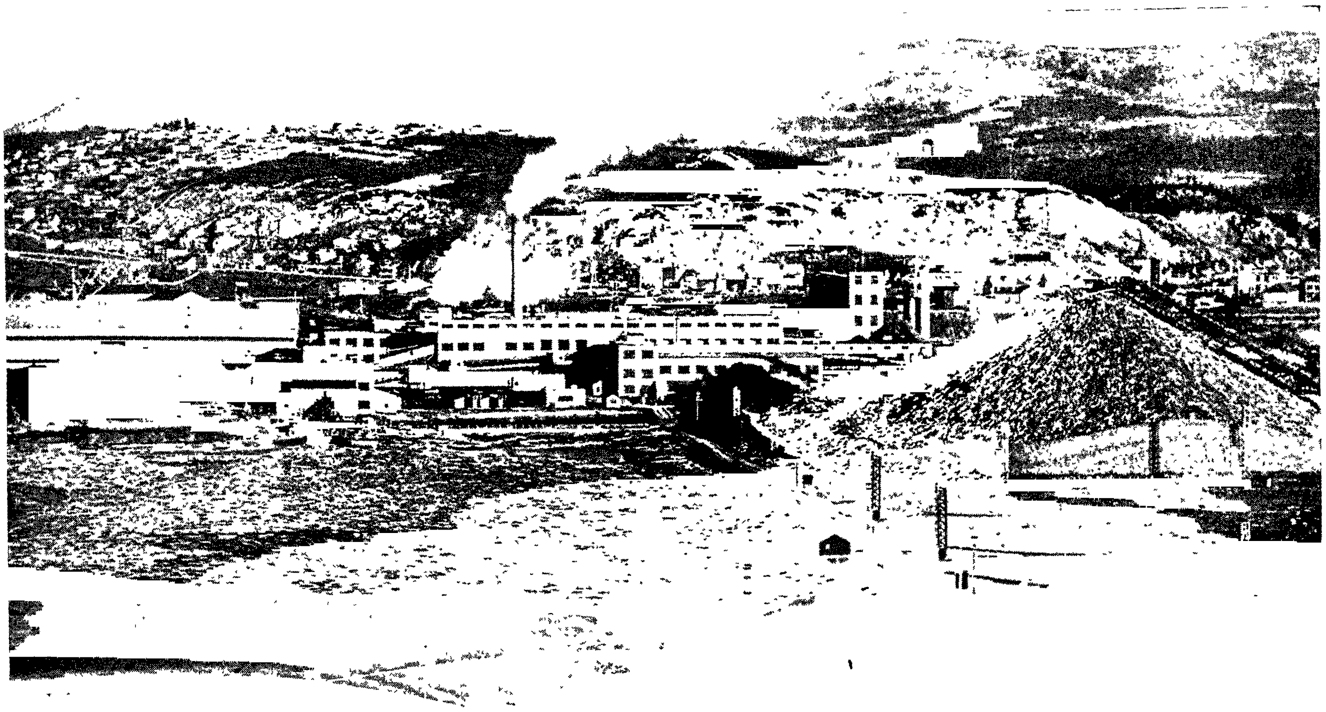
RUGGED TOPOGRAPHY AND INFERTILE LAND COVER NEARLY THE ENTIRE ISLAND LEAVING ONLY A NARROW AND BROKEN FRINGE AVAILABLE FOR HABITATION

anywhere than in Newfoundland of the dominant part played by climate, topography and soil in the distribution of the settlement. Added to these natural controls, the strategic importance of Newfoundland in World War II led to a tremendous redistribution of population, though there was some readjustment when peace came. The key to settlement is of course the fact that agriculture is of little importance in the island. Conditions are quite different in Prince Edward Island, which lies only 170 mi. to the southwest: there, one finds the highest proportion of farmers in Canada, and farms cover the whole island. In Newfoundland (*see* map) there is no settlement away from the coast anywhere, except near Deer lake and near Red Indian lake. Few districts have average temperatures above 57° F. in July. The areas where there are a considerable number of farms are near Deer lake, in the extreme southwest in the Codroy valley and in the Avalon peninsula (*see* map). What is the explanation of this difference in the two St. Lawrence gulf islands? The southern island has a low flat undulating surface built up of relatively young Permian formations, and these conditions are eminently suited for a farming population. The northern island, as shown earlier, is an uplifted peneplain built of ancient sterile formations for the most part. Soils are carried from such a surface, whereas they tend to accumulate on a lowland surface. As a result there are numerous tiny fishing villages along every coast of Newfoundland except to the northwest. No roads or railways link these villages, and in all cases except perhaps in the northeast the shores are steep and there is little lowland even in the small bays or gulfs.

It is because of the position of Newfoundland, guarding the main corridor of entry into Canada, as well as forming a bastion to the narrowing waters of the Atlantic, that Newfoundland became of great strategic importance in World War II. The great airport at Gander was vulnerable after the fall of France in 1940; as also was Botwood, the seaplane base on the north of the island. (*See* map.) Canada sent large garrisons to defend these strategic points, while a new base was constructed at Torbay just north of St. John's. In the later months of 1941 a great airport was built at Goose bay in the interior of Labrador with the sanction of the commission of government in Newfoundland. In the same year the United States sent thousands of American soldiers and techni cians to build and occupy military stations at Quidi Vidi in the suburbs of St. John's; at Argentia on the southwest coast of the Avalon peninsula; and at Stephenville on the west coast south of Corner Brook (*see* map). This influx of Americans, with the consequent demands for local labour, brought about a period of wartime prosperity in many parts of Newfoundland.

Communications.—Communications are made by steamship through St. John's, or through Port aux Basques at the western end of the island. Until confederation the Newfoundland government operated steamers between Port aux Basques and Sydney, where connection was made with the Canadian railways. After confederation this service became the responsibility of the federal department of transport, and large new-style steam rail ferries were specially built for the run. Aeroplane service is maintained also for both transatlantic and for North American travel. In 1937 the British air ministry began to construct the Newfoundland airport at Gander lake. At the same time, an agreement was made between Newfoundland, the United Kingdom, Canada and Eire for the operation of the Atlantic route. Agreements were made also with the Pan American World Airways for connections with the United States points. For both oceanic and continental flying, Newfoundland occupies an increasingly important position. It is not without significance that every major transatlantic flight from that of Sir John William Alcock and Arthur Whitten Brown in 1919 used Newfoundland as a necessary part of the project. After confederation the federal department of transport assumed responsibility for Gander airport. Within the island, the most important medium of transportation is the Newfoundland narrow-gauge railway, a publicly owned utility, which crosses the country from west to east. The railway links such centres as St. John's, Grand Falls, Corner Brook and Port aux Basques. After confederation it became part of the publicly owned Canadian National railways system. There are, in addition, about 1,150 mi. of highway and 6,000 mi. of local road. Most of the mileage is on the Avalon peninsula, but there are important road connections in other areas, particularly in the neighbourhood of Corner Brook, Grand Falls and Millerton. The commission of government began the building of a 610-mi. transisland highway, which in June 1950 officially became the most easterly section of the Trans-Canada highway. Newfoundland is an important cable relay station. It was in 1858 that the first cable connection was made between Newfoundland and Ireland, but it was not till 1866 that permanent connections were successfully made. Until confederation the Newfoundland government maintained radio stations both on the island and in Labrador. After confederation they became the responsibility of the federal department of transport. It was in Newfoundland in 1901 that the first successful radio transmission was effected.

Political and Social.—Constitutionally, Newfoundland was first a British colony and then for nearly a century a member state of the British Commonwealth of Nations. In 1832 the island attained a form of representative government and, in 1855, self-government. From that date till 1934 the administration followed the conventional British overseas type: a governor appointed by the crown acting on the advice of an executive council, which in turn was dependent upon the support of a legislative council and a legislative assembly. The council was appointed; the assembly elected on practically universal adult suffrage, women having been enfranchised in 1925. The executive councillors were also heads of the departments of state, finance, public works, justice and so on. In 1934, as a result of grave economic difficulties, this type



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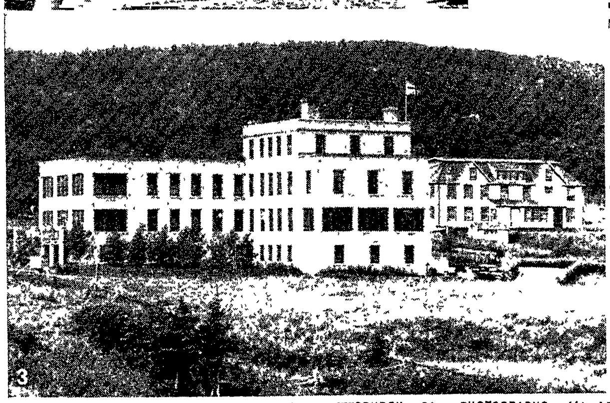

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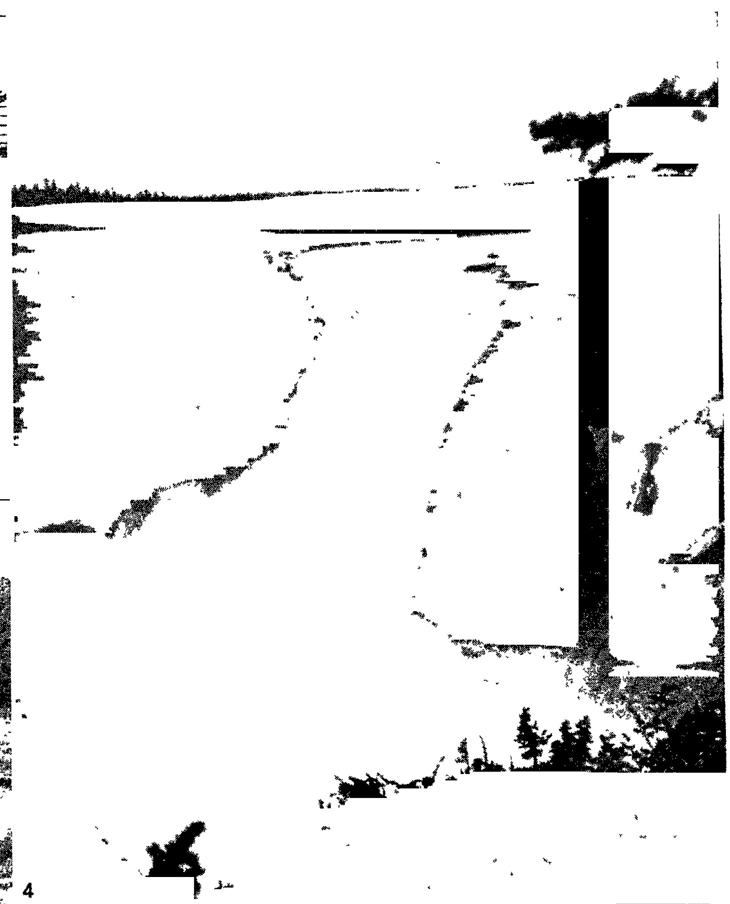

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COURTESY OF (2, 3, 4) CARNEGIE MUSEUM, PITTSBURGH, PA ; PHOTOGRAPHS, (1) LEE WULFF, SHUSHAN, N Y , (2, 3) S. T. BROOKS, (4) J. K. DOUTT

VIEWS OF NEWFOUNDLAND AND LABRADOR

1. Paper mill, Corner Brook, Newfoundland
2. The main "city street" under the fish flakes, platforms for drying fish, at La Manche, a fishing port on the southern shore of Newfoundland. La Manche dates back to Newfoundland's earliest occupation by Europeans
3. Grenfell hospital, St. Anthony, Newfoundland, the headquarters of the Grenfell activities in Newfoundland and Labrador. The large building is used mainly as a receiving hospital for serious cases, while the building to the right is used as an orphanage
4. Grand falls, Hamilton river, Labrador. Famed for their magnificence, the falls are more than 300 ft. high

of responsible government was temporarily suspended. A body described as the commission of government assumed office in 1934, as a result of recommendations of the royal commission. The commission consisted of six members, three Newfoundlanders and three members appointed from the United Kingdom. The governor in commission communicated with the secretary of state for dominion affairs. The commission of government was an instrument unique in commonwealth practice, called into being in response to a temporary emergency, but it was not until 1949 that the emergency ended and the commission was recalled. At the union with Canada, a provincial government was created, consisting of a federally appointed and paid lieutenant governor and a 28-member legislative assembly elected (from 25 constituencies) for five years unless dissolved sooner. Within the assembly there was set up a 13-member executive council or cabinet led by the premier. The provincial civil service is nonpolitical. Public revenue is drawn in part from subsidies, federal rental of tax fields, gasoline taxes, net revenue from the control of liquor and a variety of licenses.

St. John's is the only incorporated city in Newfoundland. Its affairs are administered by an elected council, which possesses the power of raising local taxes. Outside of 15 organized towns (1949) and 4 rural districts, the traditional functions of local municipal government are exercised by the central authority from St. John's.

Education in Newfoundland is denominational in character. The denominational system reaches far back into the history of the island. The first school in Newfoundland was set up at Bonavista in 1726, by the Society for the Propagation of the Gospel, the Church of England missionary organization. Schools for Roman Catholics were supplied by the Benevolent Irish society, beginning in 1826. It was not until 1836 that government aided education, when a grant of £2,100 was voted. The Education act of 1876 formally recognized the denominational principle by accepting Catholic, Anglican and Methodist schools, and by dividing the government grant to education on a proportional basis. Successive amendments to the act did not substantially alter this arrangement, the appearance of the Salvation Army, Seventh Day Adventists and Pentecostals being marked by schools conducted by those bodies on the same basis as those of the older churches. By 1949 there were also 33 nondenominational schools. All classes of schools are subject to the same regulations, follow the same curriculum and receive provincial grants on the same basis. In St. John's, the larger denominations maintain "colleges" or secondary schools. These represent an investment of about $3,000,000 on the part of the churches. In 1920 a department of education, under the direction of a minister of education, was created. In 1935 the commission of government attempted to consolidate the educational system by appointing a single departmental executive, the secretary for education, who was responsible to the commission. In 1939 another amendment to the Education act replaced this functionary by three denominational officers. Thus, the control exercised by the churches continued unimpaired.

In 1925 Memorial University college at St. John's was opened as a permanent memorial to the Newfoundlanders who served in World War I. In the 1925–50 period the university gave courses in the first two years of the arts and the pure sciences and in the first three years of engineering, provided teacher training and sponsored an active adult educational program. In 1950 the university was expanded into Newfoundland Memorial university with full authority to train students in complete arts and sciences courses.

The International Grenfell association carries on important educational and medical work in the northern outposts and on the Labrador coast. Commenced in 1892 by Sir Wilfred Grenfell, the association maintains a chain of schools and hospitals and an orphanage. The association stresses spiritual as well as physical rehabilitation.

Population.—The population of Newfoundland was 361,416 in 1951 and 263,033 in 1921. Other 1951 population figures: St. John's, 52,873; Corner Brook, 10,276; Wabana, 6,460; Harbour Grace, 2,331; Carbonear, 3,551. The term "outport" is applied to all centres outside St. John's. There are about 1,292 settlements on the island, of which 1,192 have fewer than 500 inhabitants.

The modern Newfoundlanders are the descendants of English, Irish and Channel Islands settlers of the 18th and 19th centuries. About 98% of the people are of British stock. Newfoundland possesses, therefore, a remarkably homogeneous population. Such cleavages as exist are denominational, rather than national or racial or social. Newfoundland is divided numerically almost equally among the Church of England, the Church of Rome and the United Church of Canada. In the chief towns there is considerable overlapping; elsewhere, the various churches monopolize the outports. The churches form the centre of community life, and nowhere in the Anglo-Saxon world does the church play a more decisive part in the lives of the people. The historic fishing industry powerfully influences the distribution of the population. The census figures show that about one-third of the total population is dependent on the fisheries for its livelihood. About one-half lives on the Avalon peninsula, and more than three-quarters on the eastern, or the Atlantic, face of the island.

Population movements in Newfoundland have followed an arresting pattern. The period of immigration lay in the first quarter of the 19th century. Between 1800 and 1850 the population rose from about 15,000 to almost 60,000. This increase seems to have been caused by a remarkable influx from Ireland. Thereafter, immigration declined till by the third quarter of the century it was negligible. Population nearly doubled every generation: 1836, 75,094; 1869, 146,536; 1901, 220,984.

From the beginning of the 20th century, a strong current of emigration set in to the United States and Canada. This exodus is said to have reached the figure of 15,000 a year. Large emigration supplied the normal means of accommodating the rapidly increasing population; it was an emphatic commentary on the small power of absorption of the industries of Newfoundland. But a drive for expanded secondary industries followed confederation, and the effects of that industrial growth on population movements was being watched with interest in the early 1950s.

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(J. I. C.; G. TR.; C. CY.)

NEW GLARUS, a town and a village of Green county, Wisconsin, U.S.A., about 26 mi. S.W. of Madison, on the Little Sugar river, a branch of the Rock river. Pop. (1950) 1,224; (1940) 1,068. New Glarus is served by a branch of the Chicago, Milwaukee and St. Paul railway.

It has agricultural and dairying industries, a large milk condensing plant, a stock shipping company and the only Swiss embroidery factory in Wisconsin.

It had its origin in a colonizing experiment made by the canton of Glarus, Switzerland, in 1845.

Two men sent by the canton chose the site of New Glarus largely because the hills and deep valley suggested their Alpine home.

The settlers brought with them a "form of government" drawn up by the cantonal council of Glarus and providing in great detail for a system of schools, for what was practically a State church (Reformed Lutheran) supported by tithes, for a system of poor relief, for a system of courts and for a set of town officers elected on a limited property franchise.

The original plan provided also for an equitable distribution of land to each head of a family. Old world traditions are upheld in

an annual Labor day week end outdoor presentation of Schiller's *Wilhelm Tell.*

NEW GLASGOW, a manufacturing and mining town of Pictou county, N.S., on the East river, 8 mi. from Pictou harbour, and on the Canadian National railway, 104 mi. N.E. of Halifax. Pop. (1951) 9,862. Extensive coal mines are in the vicinity, and there are manufactures of iron and steel, mill machinery, door and sash factories, steel spring and mattress works, blanket and yarn plants, as well as several ship-building yards.

NEW GRANADA (Span. *Nueva Granada*), the title under Spanish colonial administration of that part of South America now known as the republic of Colombia, which at one time was extended to include Venezuela and Ecuador. It also was for a time the title of the united territories of Panamá and Colombia under republican auspices. The Bogotá plateau was invaded from the Caribbean coast and conquered in 1537 by Gonzalo Jiménez de Quesada, who, in honour of his native province, called it the "Nuevo Reino de Granada." In 1550 an *audiencia real* under the viceroyalty of Peru was established at Santa Fé (Bogotá), but in 1564 this isolated group of Spanish settlements was transformed into a presidency. In 1739, owing to the unmanageable size of the viceroyalty of Peru, it was divided and a new viceroyalty was created from the various provinces lying in the northwestern angle of the continent, extending from Tumbez northward to the northern limits of Panamá, and eastward to the Orinoco, to which the name of Nueva Granada was given. The new viceroyalty included the provinces of Tierra Firma (now the republic of Panamá); Maracaibo, Caracas, Cumaná and Guyana (now included in Venezuela); Cartagena, Santa Marta, Rio Hacha, Antioquia, Pamplona, Socorro, Tunja, Santa Fé, Neiva, Mariquita, Popayán and Pasto (now included in Colombia); and Quito, Cuenca and Guayaquil (now included in Ecuador). In 1777 the provinces of Maracaibo, Caracas, Cumaná and Guyana were detached from the viceroyalty to form the captaincy-general of Caracas; otherwise it remained as above until the termination of Spanish rule in South America.

For the republic of Colombia (1819–30), the republic of New Granada (1831–61), the United States of Colombia (1861–86) and the republic of Colombia (1886 to date), *see* COLOMBIA.

NEW GUINEA, island, of estimated area 312,329 sq.m., stretching from the equator in the north-west to 12° 5′ S. in the south-east and from 130° 50′ E. to 151° 30′ E.; separated from Australia by the shallow Torres strait and Arafura sea. On its eastern side lies the Bismarck archipelago. Pop. 1,312,013.

STRUCTURE AND PHYSICAL GEOGRAPHY

The island consists of a long central mountain chain of complex formation, a northern coastal range, and a small planed down hill country on the south coast, west of the mouth of the Fly river, together with the alluvial surfaces formed mainly by the rivers under the influence of equatorial rains. The structure shows, in the west, the influences of great earth movements ranging from the Banda sea. These give arcs (1) Banda islands, (2) Buru, Ceram, West Timorlaut, (3) East Timorlaut, Kei islands, coastal mountains of south-west New Guinea from the Baik mountains to Cape Fatingar, thence via Misol island, Obi island, and then north on the west side of Halmahera. This curve is separated, in West New Guinea, from the central chain by the deep McCluer inlet. The central chain stretches from northwest to southeast. In Dutch New Guinea the name Nassau mountains is applied to the chain as a whole.

In this chain the snow line is to be found approximately at 14,600 ft. and Mt. Idenburg (15,748 ft.) and Mt. Carstensz (16,404 ft.) have glaciers. The next section is the Orange mts. with Mt. Wilhelmina (15,584 ft.). There seems to be a more or less parallel range 25–45 mi. to the north of this succession of ranges, and in it a height of 12,500 ft. has been observed in the Weijland mountains. The composite nature of the great chain is maintained eastwards and it is believed that the main watershed lies in the Mandated and not in the British territory. In the former a height of 13,700 ft. has been found in the Otto mts.; on the south flank the chain grades into a complex of mountains of lesser height. The southeastern part of the chain called the Owen Stanley range (Mt. Albert Edward, 13,222 ft.) declines gradually to the end of the long peninsula.

Towards the west the central chain is formed principally of palaeozoic sandstones and slates on which much younger rocks, nummulitic sandstone and limestone are laid. In Dutch New Guinea, the lower mountain country is of Miocene rock. Towards the south-eastern peninsula there are again old rocks, some with gold-bearing quartz, especially along the axis, as well as granite and folded Tertiary limestone on both coasts of the peninsula; here also, and in the d'Entrecasteaux islands is much evidence of volcanic activity (Miocene, Pliocene, Pleistocene and recent).

The northern coastal range in Dutch New Guinea is said to reach a height of about 6,900 ft.; it declines towards the mouth of the Sepik, beyond which it rises again to a height of about 10,500 ft. and ends at King William's cape. It is formed of ancient elements with diorites, gabbro, andesites, etc., mostly covered with Tertiary and even possibly younger sediments, and is probably still in process of uplift; recent coral reefs adorn some cliff sides and may reach a level of some 5,500 feet. There is abundant evidence in New Guinea of large earth movements from Miocene times onwards, with a probable maximum in the Pliocene or Pleistocene. The southern hills between the mouths of Digul and Fly rivers are an extension of Australia structurally. Between these lines of hills there run lowlands, floored near the Idenburg river by Pliocene sandstones.

The most important rivers are the Mamberamo, reaching the sea north of the Nassau range; the Sepik, also on the north, navigable by seagoing steamers for 180 m.; the Fly river flowing into the Gulf of Papua, navigable by a whale boat for 600 miles; and the Digul in the south-west. Many of the rivers have gold, but it is important in few places save the Louisiade archipelago beyond the south-east extremity and Woodlark island. Murua (Woodlark island) beyond the d'Entrecasteaux islands has banded quartzite much valued for making adzes. Petroleum occurs near the coast of the Gulf of Papua and in the so-called Bird's Head.

Climate.—In the northern summer the south-east trades dominate New Guinea; they bring rain to the south-east peninsula but the rain diminishes farther west on the south side as the wind is affected more and more by the passage across the corner of Australia. Northward on the east coast the rain at this season appears to be very heavy where the land faces south-east. Farther west there is little rain while the south-east trades blow. In the southern summer, New Guinea is on the wind-path from Asia, round to the very marked Australian low pressure centre. The wind is swinging round from the north-west to north-easterly direction and it brings heavy rain to northern New Guinea and to the southern part of the Dutch Territory. In one place in the rain shadow of the northerly mountains an annual rainfall of 96 in. has been measured, but on the exposed heights, especially between 3,000 and 6,500 ft., it must be enormously greater. In the lowlands the convection currents rule all the year round, but the amount of rain varies. The temperature remains near the average of about 81° declining to about 72° and rising to about 92° as rough monthly averages. 72° is not far from the average morning, and 92° not much above the average noon, temperatures.

Flora and Fauna.—The general vegetation is that of the rain-forest, but under the conditions of great heat the rain-forest cannot grow where there is a long dry season. The tree limit is more than 10,500 ft. above sea-level. Towards the mountain tops one finds European (*Rubus, Ranunculus, Leontodon, Aspidium*), Himalayan, New Zealand (*Veronica*), South American (*Drymus, Libocedrus*) and even Antarctic species. From 6,000 ft. upwards fine Agapetes (*Ericaceae*), pines (*Araucaria, Libocedrus*) and palms adapted to hill-life abound. In the lower lands palms are very abundant, and along the tidal courses of rivers those of the genus *Nipa* are common; sago palms are numerous in the seasonal swamps while grass and cane swamps occur where the land remains long under water. On the Alang steppe is the tall, tough grass, *Imperata arundinacea.*

New Guinea was probably united to Australia as recently as Pleistocene times, whereas its last effective connections farther

west are much older. It thus belongs in the main to the Australian region with nine species of Echidna (*Monotremata*) and 84 of marsupials among which are two genera peculiar to the island (*Distoechurus* and *Dorcopsis*). Small kangaroos live on the borders of steppe and forest in the higher lands. Bats abound and there is a pig (*Sus papuensis*), a dingo and 50 indigenous species of rats and mice chiefly on the steppe, and a few squirrels. The bird fauna includes well over 500 species and at least 50 genera are peculiar to the island. Birds of prey hover over the steppe and catch rats and mice, but apparently they avoid the great forests and here flourish the famed birds of paradise, which are absent from all the islands east of New Guinea. The Bismarck islands have birds allied to those of New Guinea but 74 species are peculiar to them. Turtles and tortoises are plentiful on the coast and have curious relationships with South American forms; many lizard species are peculiar to the island but comparatively few snakes. Amphibia are abundant and of Australian affinities. Insects are very numerous and the butterflies are gorgeous. Land molluscs are related to those of India and Malaya.

POLITICAL DIVISIONS

British New Guinea (TERRITORY OF PAPUA).—Area about 90,540 sq.mi., European population 1,822. Natives estimated 337,000. A British protectorate was declared in 1884 after the government of Queensland had annexed the land in 1883, and after various changes it became (1906) the Territory of Papua under the governor-general of Australia, with a lieutenant-governor of its own. An executive council of one unofficial and eight official nominees helps the lieutenant-governor and also forms part of the legislative council, which has five additional unofficial nominees. There are eight magisterial districts and a central court at Port Moresby, and an appeal thence to the high court of the commonwealth. Some simple regulations of native government are administered with the help of village constables. About 190,000 ac. of land have been leased, chiefly by planters, and over 62,000 are cultivated, chiefly for coco-nuts, rubber and sisal.

(A. C. H.; X.)

Mandated Territory of New Guinea.—The northern section of south-east New Guinea (formerly called Kaiser Wilhelmsland) was mandated in 1919 by the League of Nations to the government of the Commonwealth of Australia, together with the Bismarck archipelago (New Britain, New Ireland, and adjacent islands), the Admiralty islands and several outlying groups, and the northern Solomon islands (Bougainville and Buka). North-eastern New Guinea lies between 2° 15′ and 8° S., and 141° 30′ and 148° E. It had been declared a German protectorate in 1884 when not a single white man lived there. Plantations arose in the islands and on the mainland, and three German mission societies soon formed settlements in New Guinea. Under the mandate, the system of indirect rule through native chiefs has been continued. The administrator advises the governor-general of Australia who can legislate by ordinance. There are ten district officers, six of whom are in the islands. The headquarters is at Rabaul. No slavery or forced labour is permitted, but natives are not allowed to leave the territory, and labour indentures are made. No one may supply natives with firearms, ammunition, alcoholic liquor, opium or derivatives of opium.

The total native population was estimated at 581,342 (1938), excluding territories not yet under control and also excluding 41,849 indentured labourers. Of the above population *c.* 250,000 are on the mainland. The non-native elements number 6,283 including 1,737 Chinese, 3,472 British and 473 Germans. The area of the mainland mandated territory is 68,500 sq.mi.; pop. (1940 est.) 675,389. Products include coconuts, cacao, rubber and cotton.

Both Papua and the mandated territory of New Guinea were battlefields between Japan and Australian-U.S. forces in World War II. The initial Japanese penetration into the area occurred Jan. 23, 1942, when landings were effected on New Britain and New Ireland, and in the Solomons. On the following March 8, a Japanese convoy landed forces at Salamaua and Lae on the northeast coast of New Guinea. Still later, troops landed at Buna and Gona, tiny shore points in northern Papua. The Japanese then began a concerted drive southward across the Owen Stanley mountains toward Port Moresby. By Sept. 1942 they had passed the crest of the range, taken Kokoda and Kagi, and were threatening Port Moresby, key to the invasion of Australia. They were driven back by an Allied counterattack, Sept. 25. Thereafter, the Allies drove first toward the north coast and then westward along this shoreline until they reached the tip of the island at Sansapor by Aug. 1, 1944. With the Japanese surrender on Sept. 2, 1945, the island was restored to its former owners. (*See* WORLD WAR II.)

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Dutch New Guinea.—Dutch New Guinea, which lies between 10° S. and the equator, comprises practically half of the entire island of New Guinea. The boundary line between it and British New Guinea starts from the south coast and follows the line 141° E. up to the Fly river, which river then forms the boundary until 141° E. is reached, when the meridian becomes the boundary again, right up to the north coast. The area is 151,789 sq.mi., and the population is estimated at 350,000, of whom 310 are Europeans or Eurasians. The territory is practically undeveloped; save for the extreme western coastal portion opposite Ceram, and parts of the northern coast, its coasts are imperfectly charted, and large stretches in the interior are only superficially explored. The northern half is mainly hilly, with a very high range of mountains traversing it east by west, though along the northern coast and on either side of the Mamberamo river, which flows into the sea at Cape d'Urville, are great alluvial tracts of land; the extreme west is almost wholly hilly; the south very flat, with vast swamps near the coast, especially in the south-west, where Prince Frederick Henry island, separated from the mainland by the narrow and tortuous Princess Marianne strait, is perfectly flat and marshy, and covered with dense forest. Into McCluer gulf (Teluk Berau), which divides the western portion of Dutch New Guinea almost into two, flow several rivers, including the Seljar and Ketero, the former navigable, for small vessels, for 34 and the latter for 23 miles. Along the south-western coast stretch, in succession, from north to south, the Mimika, Utakwa, North-West river, Lorentz, Utumbuwe, Eilanden, Digul and Merauke. Some of these are situated so close to each other that they are connected by channels navigable for small, light-draught boats, several are navigable for distances of from 25 to 50 mi. for steamers of 12 ft. draught, and the Digul the largest, is 6 mi. wide at its mouth and has been ascended for nearly 400 mi. by a steamer of 6 ft. draught. The south-western coast is flat and fairly even, until the Charles Louis mts. are reached, where it becomes high and much indented. Flat tracts alternate with high ground along the western coast, very much indented after McCluer gulf, and the north coast, from Cape Sorong along Little Geelvink bay, to the middle of the coastline of Great Geelvink bay, is generally high, especially where, near Manokwari, the Arfak mts. come very near to the sea. The remaining shores of Geelvink bay, to Cape d'Urville, and beyond, as far as Sarmi point, are low, flat and alluvial, but from here to Humboldt bay it is mostly high, rugged and rocky. The entrance to Great Geelvink bay is blocked by several islands, the northernmost being the Schouten group, Suk, or Supiori, to the west, and Biak, or Wiak, to the east. The former is 17 mi. long and has hills reaching 1,600 ft.; the latter is 45 mi. long and 23 mi. wide, with a hill 800 ft. high at the southern end, otherwise it is only 50 ft., above sea-level. Farther within the bay is the important island of Jobi, or Jappen, 110 mi. long and 15 wide, with a ridge of mountains 2,500 ft. high running along the centre, the south coast being indented with deep creeks, fronted by wooded islets and reefs. Between Ceram and the north-west coast of Dutch New Guinea lies Misol, 50 mi. long and 23 broad (narrow in the west, wide in the east), with numbers of very small islands to the north and south of it. It is flat in the north and hilly in the south, no point being over 1,800 ft., the coast is rocky, but swampy in places, and there are three rivers, navigable for a few miles. Separated from the north-west coast by the narrow Galewo straits is Salwatti, a round island, 30 mi. across, with regular coasts, and limestone hills on the north coast, 1,000 ft. high, but low and swampy in the east, and no rivers of

note: east of Salwatti is the small island of Popa. North of Salwatti, separated by Pitt strait, is Batanta, 40 mi. long and only from 4 to 8 mi. wide, densely wooded and mountainous (highest point 3,676 ft.). Due north of Batanta is the island of Waigiou, 28 mi. wide, nearly 80 in length, and separated from New Guinea by Dampier strait, 30 mi. in width. It is covered with forest.

Commerce and industry in Dutch New Guinea are almost unknown. The people generally live in a very wild state, head-hunting and cannibalism are all too prevalent; some are semi-nomadic, others entirely, and as they live largely on sago, and this is obtainable almost everywhere, in large quantities, with a minimum amount of labour, while the coconut abounds, and the sweet potato, sugar-cane, plaintain, papaya and tobacco are grown with little trouble, there is no incentive to work, apart from hunting the cassowary, pig and kangaroo, for their flesh, and fishing, the only lucrative employments followed being those of hunting the bird of paradise, collecting the wild nutmeg, the mace of which is much esteemed and marketed specially in Macassar, and the preparation of copra. Men and women go about almost entirely naked, the men armed with bow and arrow, axes of polished stone, and daggers of the jaw-bone of a crocodile or the thigh-bone of a cassowary. There are head men of villages, but they have little power, the people of the coast are often at war with those of the scrub lands of the interior, and there is enmity between these and the mountain folk: language varies considerably. There are no extensive roads.

In the whole of South New Guinea there is only one settlement, Merauke, a few miles inland up the Merauke river. A Dutch *Gezaghebber* resides here, there is a small garrison, a hospital, Catholic mission church, and settlement, and a few shops, mostly run by Chinese traders, a wireless station, and a small wharf, where vessels of the Dutch Royal Packet company land passengers and collect copra and other cargo. Merauke was established in 1902, as the result of a military expedition. The nearest Dutch settlement to Merauke is at Kaimana, on the McCluer gulf, 500 mi. distant. Here, and at Kokas and Fak Fak (headquarters for West New Guinea, where there is a *Gezaghebber*), there are small trading stations with Malay, Chinese and Arab settlers; Fak Fak is the most important, where proximity to Ceram and generations of outside influence have resulted in settled and semi-civilized conditions among some of the Papuans. All three places are ports of call for vessels of the Dutch Royal Packet company, also Sorong, on the northwest coast, opposite Salwatti, and Manokwari (Doreh), on the northeast coast, which is the seat of an assistant resident and the headquarters of administration for North New Guinea. Wasior, on Little Geelvink bay, is another port of call, also Sarmi, Demta, Hollandia and Humboldts bay, and here, too, are Chinese and Malay traders, dealing mostly in copra and bird of paradise plumes, and there is some exploitation of the hinterland. The development of Dutch New Guinea will probably be more rapid than that of North New Guinea, for there is good land available and more chance of being able to utilize imported labour, when this can be procured. Trade is being developed with Jappen island, where Dutch Royal Packet vessels call at two ports, Seroei and Wooibaai; and with Biak, of the Schouten islands, the port of which is Bosnik.

A treaty dated 1660 between the Dutch East India company and the three states of Ternate, Tidore and Bachian, acknowledged the company to be "lord of the Papuans or all their islands which are subject to the king of Tidore." This gave the Dutch a nominal sovereignty over the Tidorese fiefs on the islands of Waigiou, Salwatti and Misol, and as on the latter two islands there were kingdoms possessing a vague sovereignty over parts of the mainland of New Guinea, while the suzerainty of Tidore was acknowledged in the neighbourhood of McCluer gulf, eventually the Dutch succeeded to these somewhat shadowy rights. Their first establishment was in 1828, when Fort de Bus was erected, but before this, in 1814, Dutch sovereignty in North-West New Guinea had been admitted, practically, by Great Britain by the convention of 1814, which restored to the Dutch their colonies as they had existed prior to 1803. In 1828 the Dutch government declared North-West New Guinea, as a dependency of Tidore, a part of the Dutch East Indian colonies, which claim was confirmed in 1848, the frontier then being stated to run straight from Cape Bonpland to the north coast. In 1884, when South-East New Guinea was declared a British protectorate, the meridian of 141° E. was acknowledged as the frontier between British and Dutch territory, and later, in 1885, the same meridian was accepted by the Dutch as defining the frontier of German New Guinea. A convention entered into by Holland and Great Britain in 1895 made a slight alteration in the boundary (the Fly river) and made the navigation of the Fly river free to subjects of both powers, except for the carriage of munitions of war. In 1898 Tidorese territory was assigned to the Ternate residency, in 1911 West New Guinea was attached to the Residency of Amboyna. The division of territory is North New Guinea, West New Guinea, and South-West New Guinea, all three being parts of the residency of the Moluccas. The coastline of Dutch New Guinea except for the southeastern part was conquered by the Japanese in World War II. (E. E. L.; X.)

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ANTHROPOLOGY

The island of New Guinea and its island-clusters, together with those adjacent island-groups, of which the principal are the Louisiades and the Torres Straits islands, is a region of considerable racial and cultural diversity. The territory of New Guinea, the north-eastern quarter of the island, is, however, still very incompletely surveyed ethnologically, and of the inhabitants of Dutch New Guinea, our knowledge is comparatively slight.

Racial History.—Although there is considerable variety of racial type, the inhabitants of New Guinea belong almost entirely to the ulotrichous (frizzy-haired) branch of mankind. The principal varieties are the Negritos, the Papuans and the Melanesians. The only typical Negritos that have been found in New Guinea are the Tapiro at the source of the Mimika river in the Snow mountains of Dutch New Guinea, and the Pesechem. The Mafulu, the Kai and some others have probably a Negrito element.

The Papuan, the dominant stock in New Guinea, is dark, of short stature and generally long-headed. Evidently, Papuan man occupied not only New Guinea, but also Melanesia in very early times (*see* OCEANIA: *Racial History*), later migrations from Indonesia having on the whole less racial than cultural effects. The Melanesian element in New Guinea is certainly comparatively recent, and appears to be a mixture of Papuan with Indonesian and proto-Malay, a mixture which may in part have taken place in Indonesia. The Melanesian influence is strongest in the north and north-eastern coastal regions; and on the south-east coast of Papua the immigrant nature of this Melanesian type is clear.

Principal Groups.—Taking the whole New Guinea area, and

working from west to east, some of the principal culture-areas (or tribes where these exist) may be enumerated. Belonging to New Guinea rather than Australia we have the islands of Torres Straits with a well-developed and distinctive culture. Two groups on the mainland between the Fly and the Dutch boundary may be mentioned, the Tugeri, partly in British but mainly in Dutch territory where they are known as Marind-Anim (their name for themselves) and the Kiwais. A culture of which little is known occurs in the neighbourhood of Lake Murray, between the Strickland and the Fly; and between the Fly and the Aramia, we have a tribe, the Gogodara, containing many distinctive characters. In the Gulf of Papua, from a little west of the Kikori river to Cape Possession, four main groups are distinguished by Dr. Haddon, Kerewa, Urama, Namau and Elema, and far from the coast on the upper waters of the St. Joseph river the Mafulu show distinctive characters, physically and culturally. To the east of these Papuan districts we meet the farthest westward extension of Melanesian-speaking peoples. There are two main groups of these Papuo-Melanesians, the Western Papuo-Melanesians, the Roro, Mekeo, Motu and others, and the eastern Papuo-Melanesians or Massim, inhabiting the eastern extremity of New Guinea and the islands beyond, including the whole of the Louisiades, except possibly the island of Rossel, the inhabitants of which speak a non-Melanesian language. Passing westward along the north coast, Melanesian-speaking peoples give way for a while to Papuan-speaking peoples, such as the Orokaiva.

In the territory of New Guinea (excluding the Bismarck Archipelago, *q.v.*), the Bukaua, Huon gulf and the adjoining Jabim are Melanesian in culture, while the Tami of the neighbouring islands seem to be fairly pure Melanesian. Farther north the Kai, who inhabit the Rawlinson and Sattelberg ranges, are Papuan with Pygmy admixture. Both Papuan-speaking and Melanesian-speaking peoples occur along the coast farther north and west. Flourishing cultures occur on the Sepik river, and something is known of the Banaro on the Keran river.

In Dutch New Guinea something is known of the Geelvink bay district, where Melanesian-speaking peoples occur. On the west coast we find Papuans on the Mimika river, and at the headwaters of this river are the Tapiro pygmies.

Mode of Life.—With very few exceptions the inhabitants of New Guinea are horticulturists, cultivating coconuts, yams, taro, bananas and a number of other food plants. Sago is also an important food in some parts, constituting the main article of diet in the swampy region of western Papua. Fish are caught by net and spear, and occasionally by hook; and the harpooning of the dugong is an important feature amongst certain of the coastal peoples. The pig, domesticated and wild, is the only important flesh-food, though the wallaby and many birds are caught by various devices. Betel-nut is chewed with lime and pepper-plant, and the use of tobacco is now universal. Kava, the Polynesian drug, is limited to one or two places. Family houses are usually small, and are often built on piles. They may be scattered, as amongst the Massim, or grouped in big villages, as amongst the Motu and Gulf peoples. Club-houses in which initiated males live most of their lives occur in many parts and may be of considerable size; structures of this kind which entail enormous labour occur on the Sepik and in the Papuan gulf. Canoes are simple dugouts, or provided with an outrigger. Double canoes occur amongst the western Papuo-Melanesians. The Motu, joining several canoes together, make vessels of considerable size. For clothing the men usually wear some sort of girdle, and the women a petticoat of shredded palm; the Papuans of the north-west coast of Papua clothe the waist with tapa-cloth. Armlets of cane or of shell are common; necklaces of shell, dogs' teeth or seeds. The septum of the nose is commonly pierced to admit a nose-stick, usually of clam-shell, and the lobes of the ear are pierced and decorated in the east with turtle-shell rings and sapi-sapi beads. Tattooing has an irregular distribution, being confined to women in the case of the Massim, who are tattooed from forehead to thighs. Considerable artistic skill is shown, particularly by the Melanesian-speaking inhabitants, the carved and fretted woodwork of the Massim being of unusual excellence. Pottery is in general use among the Melanesian-speaking peoples. The drum is the commonest musical instrument, though absent from Rossel island in the Louisiades. Slit wooden gongs, with a most limited distribution, are found north of Huon gulf, in the territory of New Guinea, and in Dutch New Guinea. With these gongs are associated sacred flutes, which, however, are also found in the northern division of Papua.

Social Organization.—Although the family (*q.v.*) is an important unit in the social structure of all New Guinea peoples, a wider group, the clan (*q.v.*), seems in general to be more fundamental. Moreover, family relationships are not usually distinguished by name from many more remote relationships, and relationship terms used between persons who can trace genealogical relationship are also used in a systematic way between persons who are unable to trace any genealogical connection. This system, known as the classificatory system, takes a variety of forms in New Guinea, and social organization is unintelligible without an understanding of this system. Within the clan the classificatory system establishes a comparatively small number of relationships, and in general members of the same generation within a clan address one another as brothers and sisters, and the tie uniting members of one clan will be found to be similar to that uniting brothers and sisters by one father or mother. Both matrilineal clans (membership of which is determined by descent through the mother), and patrilineal clans (membership of which is determined by descent through the father), are found in New Guinea. The principal matrilineal area is the Massim district of Papua, and in this area the clans are totemic. (*See* TOTEMISM.) Each clan is associated with four linked totems, bird, plant, fish and snake, and the bird-totem is not eaten by members of the clan. A person will also avoid the bird-totem of his father's clan, the totems of which are necessarily different, since the rule of clan-exogamy (marrying out of the clan) is strictly observed. Amongst the patrilineal Papuans of the west, the clan seems to become of rather less importance, and totemism occurs only in an attenuated form in the Gulf region.

In the east the clan figures as the important unit in the rituals of marriage and death, and the series of feasts more or less connected with these events, which play a dominant part in the life of the Massim. Reciprocal exchanges of pigs and objects of value between persons more or less representative of clans is an important part of all such activities, as in the Big Feast which extends from the Massim as far as the Mafulu. This reciprocity between clans was also shown in warfare, cannibalism being a ceremonial act of revenge on the part of one clan for the death of one of its members by another clan.

In the social organization of the Papuans of the west, as well as the Papuans of the northern division, and the Jabim, Bukaua, Tami islanders and others in the territory of New Guinea, the outstanding feature is the existence of tribal initiation-ceremonies. The Elema tribes commence this initiation of the males at about the age of eight, when the boy is first taken into the club-house of the village and shown the bullroarer, the noise of which has previously been a mystery to him. Only after two or three years is his initiation complete, and the process involves not only various ordeals and instruction for the initiates, but a great deal of ceremonial in which the whole of the village, and maybe other villages, are involved. In other initiation rites the swallowing of novices by a monster and subsequent resurrection is prominent, this occurring both amongst the extreme western tribes of Papua and in the Huon peninsular district of the territory of New Guinea.

Religion.—A cult of the dead occurs throughout New Guinea, and only rarely is a cult of gods associated with it. The Big Feast of eastern Papua is to a large extent a collective celebration of the dead, though in the Soi feast of the Massim a being is continually addressed, who is not strictly an ancestor, and is supposed to have performed supernatural feats in olden times, and to have introduced the pig into New Guinea. This being is related to a number of other superhuman beings who lived in the past, but they can hardly be regarded as objects of a religious cult. On Rossel island, on the other hand, at the extreme east of the Massim area, we find an elaborate god-cult and constant care of the gods, who control the processes of nature by a priesthood.

The religion of the Elema tribes in the west of Papua may be described as an ancestor-cult, the name for ancestor being the same as that for all sacred objects; but some of these ancestors are regarded as deities who temporarily assumed a human form, giving birth to various tribes.

That death results from sorcery or is brought about by ghosts is probably a universal belief in New Guinea. The magic employed by sorcerers for this end is usually of the sympathetic type, some part of the victim being utilized by the sorcerer, or some imitative action being made to the accompaniment of a spell. Divination is also common, and where it is believed that ghosts may cause sickness divination is used to discover whether a ghost or sorcerer is responsible. On Rossel island an alternative cause of death is the desecration of the sacred ground of a god. (W. E. A.)

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HISTORY

Exploration.—Although New Guinea may have been seen by Antonio d'Abreu in 1511, its first visitor was apparently Dom Jorge de Meneses, who in 1526 took shelter at "Isla de Versija," either Warsia on the north coast, or Waigiu island. Two years later Alvaro de Saavedra discovered "Isla de Oro," probably one of the Schouten islands, and sailed along the north coast. The name "Nova Guinea" is due to Ynigo Ortiz de Retez (or Rotha) who landed on the north coast in 1546, and thought the natives resembled those of West Africa. The chart of Ortelius (1580) shows "Nova Guinea" as an island seventeen years before the fact was proved by Luis Vas de Torres sailing through the straits now bearing his name.

Dutch navigators, Willem Jansz (1605), Jacques le Maire and Willem Schouten (1616), Jan Carstensz (1623), Gerrit Pool (1636), Abel Tasman and others, appeared after the conquest of the Moluccas. In 1700 William Dampier sailed along the northern coast, and Philip Carteret (1767) and L. A. de Bougainville explored the islands. James Cook re-discovered Torres Straits, and landed in New Guinea near Prince Frederick Henry island (1770). Thomas Forrest (1774) wrote an interesting account of the island (*Voyage*, 1780). Although parts of the coast were surveyed by La Perouse (1788), John MacCluer (1790), D'Entrecasteaux (1793, *Voyage* by Rossel), and also by Duperrey (1823), D. H. Kolff (1826), and Dumont d'Urville (1828), very little knowledge was gained of the country or people.

The Papuan Gulf and shores eastward were visited by F. P. Blackwood (1842–6, *Voyage of the Fly*, by J. B. Jukes), Owen Stanley (1846–50, *Voyage of the Rattlesnake*, by J. Macgillivray), Charles B. Yule (1864) and J. Moresby (1874). In 1875 Schleinitz explored the north coast and islands. During this period scientific observers visited the islands, notably A. R. Wallace (1858), Odoardo Beccari (1871–76), Maria d'Albertis (1871–78), C. B. H. Rosenberg (1869–70, *Bijdragen*, 1875), and Nicholas von Miklucho-Maclay (1871–81). Expeditions were made for the Netherlands India Government by P. van der Crab, E. Teysmann, J. G. Coorengel, A. J. Langeveldt van Hemert and P. Swaan (*Bijdragen*, 1879). Missionaries of the Utrecht Missionary society were at Port Dorey in 1858, and English missionaries have resided in the south-east since 1871. Of these, Samuel Macfarlane (1875), James Chalmers (1877–1901), and George Brown (1875–1897) have described both country and people. Otto Finsch (1882), and Theodore Bevan (1884–87) explored the southern rivers. Since the annexations, explorers and observers have been constantly at work. During and since the administration of Sir William MacGregor (1888–98), large areas of British territory were surveyed, and the natives pacified by a system of patrols (*Annual Reports*). The island was first crossed in 1897. James Chalmers was murdered in 1901. The anthropology has been made known by C. G. Seligman, V. M. Egidi, W. Mersh Strong, R. W. Williamson, B. Malinowski, W. J. Saville, E. B. Riley, G. Landtman, J. H. Holmes, A. C. Haddon and others. In 1922 Leo Austen ascended the Fly river to the Netherlands boundary.

In German territory the Sepik (Kaiserin Augusta) river was visited by Otto Finsch (1885) and the Ramu river by Schleinitz (1887). In 1893 O. Ehlers and N. Piering lost their lives in crossing the island. Other explorations were carried out by C. Lauterbach (1896), Poch (1904), Heine (1908), Full and Friederici (1908). The northern part of Netherlands territory was explored by C. E. A. Wichman, G. A. J. van de Sande, and H. A. Lorentz (1903) and the south by Lorentz (1909–*Nova Guinea* by A. Wichman). South-west New Guinea has been explored (*Netherlands Geographical Society* 1908) and Central New Guinea in 1920 (H. J. T. Bijlers, 1923). In the 1930s a number of expeditions explored the interior (*e.g.*, R. Archbold).

Annexations.—In 1793 New Guinea was annexed by the (English) East India company, who placed a garrison for some time on Manuswari island in Geelvink bay. As suzerain of the sultan of Tidore the Dutch (after 1848), claimed control over the northern coast as far as Humboldt bay. In 1828 they established a fort in Triton bay and took possession of the south-west coast as far as the 141st meridian. Their claim to the western half of the island was admitted by Britain and Germany in 1885. In 1905 the sultan of Tidore ceded his rights to the government.

In 1864 Yule annexed the south coast for the British crown, and Moresby in 1873 took possession of the islands of Eastern New Guinea. The possible dangers to the commerce of Queensland and Australia generally, should the island come into the possession of a foreign power, led to a demand for annexation. The Germans in 1882 having advised their government to annex, the Queensland government in 1883 actually annexed all the mainland opposite their shores and east of the 141st meridian, but, as with the annexations of Yule and Moresby, this action was disavowed by the home government. In 1884 Germany annexed the north-east coast and adjacent islands, and Commodore Erskine proclaimed a British protectorate over the region east of the 141st meridian as far as East cape and the islands to Kosmann island. In 1885 the German New Guinea company was chartered to acquire and occupy those portions of the island not under British or Dutch sovereignty, the mainland being styled Kaiser Wilhelmsland, and the islands the Bismarck archipel. A boundary agreement was made in the same year, the British territory being named British New Guinea. In 1888 the protectorate became a dependency controlled by Queensland and in 1906 was renamed the Territory of Papua. In 1889 the German New Guinea company surrendered their charter. After the capitulations in 1914, the German territory was occupied by an Australian administration. As the Territory of New Guinea, it passed to Australia under mandate from the League of Nations. (See *Political Divisions*, above, for World War II; *see also* WORLD WAR II.)

BIBLIOGRAPHY.—Accounts of voyages published under the explorers' names are not noted here. A few others are mentioned in the text. Many Dutch expeditions are described in the *Bijdragen tot de taal-land-en volkenkunde van Nederl. Indië*, and Tijdschrift Kon. Aardrijkskundig Genootschap. German explorations are recorded in *Nachrichten über Kaiser Wilhelmsland*. English surveys will be found in *Annual Reports on British New Guinea (and Papua)*. Other works are: A. Dalrymple, *Historical Collection* (1770–71); Burney, *Chronological History* (1803); Meyners d' Estree, *La Papouasie* (Paris, 1881).

NEW HAMPSHIRE, popularly known as the "Granite state," is one of the New England group of the United States of America and one of the original 13. The state lies between approximately 42° 40′ and 45° 18′ N., and between 70° 37′ and 72° 37′ W. It is bounded north by the Canadian province of Quebec; east by Maine, by the Salmon Falls river, which separates it in part from Maine and by the Atlantic ocean; southeast and south by Massachusetts; west and northwest by Vermont (from which it is separated by the Connecticut river—the low water mark on the west bank of the Connecticut is New Hampshire's west boundary), and by Halls stream which separates it from Quebec. The state has an area of 9,304 sq.mi., of which 287 sq.mi. are water surface.

Physical Features.—In the north central portion of the state, the White mountains, a continuation of the Appalachian system, rise abruptly in several short ranges and in outlying mountain masses from a base level of 700 to 1,500 ft. The highest, Mt. Washington, attains an elevation of 6,288 ft. The principal ranges, the Presidential, the Franconia and the Carter-Moriah, have a northeastern and southwestern trend. The Presidential, in the northeastern part of the region, is separated from the Franconia on the southwest by the Crawford or White Mountain notch, about 2,000 ft. in depth, in which the Ammonoosuc and Saco rivers find a passage, and from the Carter-Moriah, parallel to it on the east, by the Glen-Ellis and Peabody rivers, the former noted for its beautiful falls. On the Presidential range, which is about 20 mi. in length, are Mount Washington and nine other peaks exceeding 5,000 ft. in height. On the Franconia, a much shorter range, are Mount Lafayette, 5,269 ft.; Mount Lincoln, 5,098 ft.; and four others exceeding 4,000 ft. The highest peak on the Carter-Moriah range is Carter Dome, 4,860 ft.; but seven others exceed 4,000 ft. Separating Franconia and Pemigewasset ranges is the romantic Franconia notch, overlooking which from the upper cliffs of Profile mountain is the Great Stone Face, immortalized by Nathaniel Hawthorne.

The part of the state which lies north of the White mountains is occupied by ridges and wide rolling valleys, the ridges rising occasionally to heights of 2,000 ft. or more. South of the mountains a plateaulike surface—a part of the New England uplands—extends from the intervales of the Connecticut river to the eastern border of the Merrimack valley. Between the Merrimack valley and the sea is the only low surface in the state; a considerable portion of this region is less than 500 ft. above the sea. The seashore, about 18 mi. in length, is mainly a low sandy beach. The only harbour is at Portsmouth near the mouth of the Piscataqua. About 9 mi. from the shore are the bleak and nearly barren Isles of Shoals, divided between New Hampshire and Maine.

The lakes and ponds, numbering several hundred, were formed by glacial action; and the scenery of many of them is scarcely less attractive than that of the mountains. The largest and most widely known is Lake Winnipesaukee, 20 mi. long and from 1 to 8 mi. wide, dotted by 274 islands, mostly verdant. It has clear water and a rather level shore, behind which hills or mountains rise on all sides. The rivers with their numerous falls and the lakes with their high altitudes furnish a vast amount of water power for manufacturing—the Merrimack, in particular, into which many of the larger lakes, including Winnipesaukee, find an outlet.

Fertile soil in New Hampshire is confined largely to the bottomlands of the Merrimack and Connecticut rivers. In the southeastern section is also a moderately productive soil derived largely from the disintegration of slate. Elsewhere south of the mountains, the surface soil is mostly hardpan or till, this being deepest on the drumlins. In the mountain region the soil is mostly a sandy loam composed of disintegrated granite gneiss and organic matter; on the lower and more gentle slopes as well as in the valleys this is generally deep enough for a luxuriant vegetable growth but on the steeper slopes it is thin or the rocks are bare.

Climate.—The winters are usually long and severe, and the summers cool and fine. The mean annual temperature ranges from about 42° F. at only moderate elevations in the White mountain region and farther north to 47° at low altitudes in the southeast. The greatest extremes of temperature occur in the deep mountain valleys where it sometimes rises to 102° or above, in summer, and falls to −38° or below in winter; higher up on the mountains it is never so warm and along the seacoast both extremes are considerably less. The mean precipitation for the entire state is about 40 in. The distribution is even throughout the year, but summer and autumn are slightly more wet than winter and spring. Among the mountains and in the northern part of the state the annual fall of snow is from 7 to 8 ft., but in the southeast corner it is little more than one-half that amount. The prevailing winds are generally northwest, but in the vicinity of the sea they are southeast during summer.

History.—Martin Pring was at the mouth of the Piscataqua in 1603 and, returning to England in the same year, gave an account of the New England coast from Casco bay to Cape Cod bay. Samuel de Champlain discovered the Isles of Shoals and sailed along the New Hampshire coast in 1605, and much more information concerning this part of the new world was gathered in 1614 by Capt. John Smith, who in his *Description of New England* refers to the convenient harbour at the mouth of the Piscataqua and praises the country back from the rocky shore. Under the leadership of Sir Ferdinando Gorges there was formed in 1620 the Council for New England, which procured from King James I a grant of all the country from sea to sea between 40° and 48° N. lat., and which made nine grants bearing upon the history of New Hampshire. The first of these grants was to John Mason, who has been called "the founder of New Hampshire," on March 9, 1622. The name New Hampshire was first applied to a grant which lay between the Merrimack and Piscataqua, and given to John Mason on Nov. 7, 1629. The first settlement of which there is indisputable evidence was established in 1623 by David Thomson at Little harbour, now in the town of Rye. Thomson was the head of a company which was organized for fishing and trading and whose entire stock was to be held jointly for five years. He built a house on Odiorne's point overlooking Little harbour, and, although he moved to an island in Boston harbour in 1626, he may have continued to superintend the business of the company until the expiration of the five-year term. At least there was a settlement here which was assessed in 1628, and it may not have been completely abandoned when colonists sent over by the Laconia company, which had received a grant on Nov. 17, 1629, arrived in 1630. The Laconia company received its first grant under the erroneous impression that the Piscataqua river had its source in or near Lake Champlain, and its principal object was to establish an extensive fur trade with the Iroquois Indians. The company sent over colonists who occupied the house left standing by Thomson and, not far away, built "Mason hall" or the "Great house" in what is now Portsmouth, a name (for the entire settlement) that replaced "Strawberry Banke" in 1653. Edward Hilton with a few associates appears to have established a settlement on Dover point about the time of Thomson's arrival at Little harbour, and in the Hilton grant of 1630 it is stated that he had already built houses and planted there; as early as 1630 this settlement was named Dover. In 1638 the Rev. John Wheelwright, an Antinomian leader who had been banished from Massachusetts, founded Exeter on land claimed to have been bought by him from the Indians. In the same year Massachusetts encouraged friendly Puritans to settle Hampton on the same purchase, and about a year later this colony organized Hampton as a town with the right to send a deputy to the general court. Serious dissensions had already arisen between Puritan and Anglican factions in Dover, and Capt. John Underhill, another Antinomian, became for a time a leader of the Puritan faction. Puritan Massachusetts was naturally hostile to the Antinomians at Exeter as well as to the Anglicans at Strawberry Banke. Under these conditions Massachusetts discovered a new claim for its northern boundary. The charter of that colony was drafted under the impression that the Merrimack flowed east for its entire course, but now an investigation was in progress which was to show that its source in Lake Winnipesaukee was several miles north of any of the four settlements in New Hampshire. Accordingly, Massachusetts resolved to make the most of the clause in the charter which described the northern boundary as three English miles

north of the Merrimack river, "or to the northward of any and every part thereof," to ignore the conflicting grants to Mason and to extend its jurisdiction over the offending settlements.

The heirs of Mason protested, but little was done about the matter during the period of Puritan ascendancy in the mother country. Immediately after the resignation of Richard Cromwell, however, Robert Tufton Mason (a grandson of the original proprietor), who had become sole heir in 1655, began petitioning first parliament and later the king, for relief. The commission appointed by the king in 1664 to hear and determine complaints in New England decided that Mason's lands were not within the jurisdiction of Massachusetts, and made an attempt to set up a government under which his claims could be tried, but this was a failure. Mason then petitioned again, and this time Massachusetts was requested to send agents to England to answer his complaints. They arrived in Dec. 1676, and the case was tried before the lords chief justices of the king's bench and common pleas in April 1677. Mason presented no claim to the right of government, and as to the title to the lands claimed by him the court decided that this was a question between him and the several tenants to be determined by the local court having jurisdiction in such matters. Thereupon Mason, in Jan. 1679, petitioned the king to appoint a governor who should have jurisdiction over all the lands which he claimed, and on Sept. 18 of this year New Hampshire was constituted a separate province with a government vested in a president and council appointed by the king and an assembly chosen by the people. This was the principal outcome of Mason's persistent efforts to establish his rights to the land.

From 1686 to 1689 New Hampshire formed a part of the dominion of New England which, after the first few months, was under Sir Edmund Andros as governor general. There being no provincial authority in New Hampshire at the close of this period, a convention of the leading citizens of its four towns attempted to establish one. Upon the failure of this attempt, a temporary nominal union with Massachusetts was formed, but in 1692 Samuel Allen, the assign of Mason, caused a royal government to be established with his son-in-law, John Usher, as lieutenant governor, and during the remainder of the colonial era New Hampshire was separate from Massachusetts except that from 1699 to 1741 the two had the same governor. The boundary disputes between Massachusetts and New Hampshire were long and bitter. Both provinces granted townships within the disputed territory; Massachusetts arrested men there who refused to pay taxes to its officers, and sought to defer the settlement of the dispute. New Hampshire, being on more friendly terms with the home government, finally petitioned the king to decide the matter, and in 1737 a royal order referred it to a commission to be composed of councillors from New York, Nova Scotia and Rhode Island. This body agreed upon the eastern boundary but evaded deciding the southern one. Both parties then appealed to the king, and in 1741 the king in council confirmed the decision of the commission in regard to the eastern boundary and established a southern boundary very favourable to New Hampshire. The western boundary was not yet defined, and as early as 1749 a controversy over that arose with New York. The governor of New Hampshire granted in the disputed territory 138 townships which were rapidly settled, but there was a reluctance to incur the expense of a contest with so powerful a neighbour as New York. In 1764 New York procured a royal order declaring the western boundary of New Hampshire to be the western bank of the Connecticut river.

At the outbreak of the Revolution New Hampshire had about 80,000 inhabitants, the great majority of whom were with the patriot or Whig party during that struggle. By June 1775 the once popular governor, Sir John Wentworth, was a refugee; on Jan. 5, 1776, the fifth provincial congress established a provisional government; on June 15 the first assembly elected under that government declared for independence; and on Aug. 16, 1777, the important victory at Bennington was won by New Hampshire and Vermont troops under the command of Gen. John Stark, who had a commission from New Hampshire. Six states had ratified the federal constitution when the New Hampshire convention met at Exeter on Feb. 13, 1788, to accept or reject that instrument, and so great was the opposition to it among the delegates from the central part of the state that after a discussion of ten days the leaders in favour of ratification dared not risk a decisive vote, but procured an adjournment in order that certain delegates who had been instructed to vote against it might consult their constituents. Eight states had ratified when the convention reassembled at Concord on June 17, and four days later, when a motion to ratify was carried by a vote of 57 to 47, adoption by the necessary nine states was assured.

The War of Independence left the state heavily burdened with debt and many of its citizens threatened with a debtor's prison. As a means of relief, a number of citizens demanded of the legislature the issue of paper money equal in amount to the state's debt; and, as this was refused, an armed mob numbering about 200 surrounded the meetinghouse in Exeter in which the legislature was in session, toward evening on Sept. 20, 1786. But Gen. John Sullivan (1740–95) was at that time president of the state; and on Sept. 21 he, with 2,000 or more militia and volunteers, captured 39 of the leaders and suppressed the revolt without bloodshed.

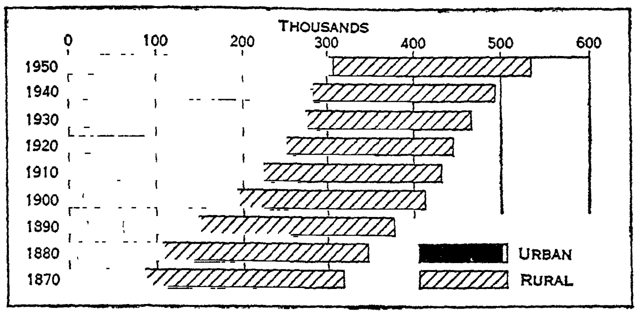
National elections in New Hampshire were carried by the Federalists until 1816, except in 1804 when Pres. Thomas Jefferson won by a small majority; but within this period of Federalist supremacy in national politics the Democrat-Republicans elected the governor from 1805 to 1812 inclusive except in 1809. In 1816 the Democrats won both state and national elections; and out of the transition from Federalist to Democratic control, which was effected under the leadership of William Plumer (1750–1850), a prominent politician in New Hampshire, arose the famous Dartmouth college case. As the trustees of this institution were Federalists with the right to fill vacancies in their number, the Democrats attempted to gain control by converting it into a state university and increasing the number of trustees, but when the case reached the U.S. supreme court that body pronounced (1819) the charter a contract which the federal constitution forbade the state to violate. Heretofore the Federalist regime had taxed the people to support the Congregational Church, but now the Baptists, Methodists and Universalists joined the Democrats, and in 1819 this state support was abolished by the "Toleration act." Because of Daniel Webster's arguments in the Dartmouth college case, and because his party had favoured the support of the Congregational Church by public taxation, he became very unpopular in this his native state. Accordingly, his denunciation of Pres. Andrew Jackson's bank policy added strength to the Jacksonian Democracy, and, later, his Whig connections were the greatest source of the Whig party's weakness in New Hampshire. John Quincy Adams was an intimate friend of William Plumer, the Democratic leader, and carried the state both in 1824 and 1828. The Whigs never won a national or state election, and often their vote was only about one-half that of the Democrats. But the Democrats broke into two factions in 1846 over the question of slavery (*see* HALE, JOHN PARKER); the American or "Know-Nothing" party elected a governor in 1855 and 1856; and then control of the state passed to the Republican party which held it until the presidential election of 1912 and 1916 when the Democrats won. Thereafter the state returned to its Republican tradition until 1936, 1940 and 1944 when it supported Franklin D. Roosevelt. The state government remained Republican although a Democratic governor was elected in 1922.

Population.—The population of New Hampshire in 1790 was 141,885; in 1840 it was 284,574; in 1880, 346,991; in 1910, 430,572; in 1940, 491,524; and in 1950, 533,242. This last figure represented an increase of 8.5% over the population in 1940. The population per square mile in 1950 was 59.1, as compared with 54.5 in 1940 and with 50.7 for the U.S. in 1950.

The urban area of New Hampshire in 1940 comprised 11 cities, the smallest having a population of more than 6,000, and 7 towns (townships) classified as urban under special rule. The population of this area was 283,225, or 57.6% of the state total. The population of the same area in 1950 was 301,249, or 6.4% more than in 1940, and represented 56.5% of the state total.

Prior to the enumeration in 1950, boundaries were set up for the thickly settled suburban area, or "urban fringe," around the

city of Manchester, and also for the larger villages outside this urban fringe, so that they might be enumerated separately from the towns in which they were located. In 1950 the urban area comprised 12 cities, the urban fringe around Manchester and 9 "unincorporated places" (villages for which arbitrary boundaries had been set up) of 2,500 or more. The urban population under this new definition amounted to 306,806, or 57.5% of the state total. Of the seven special-rule towns, one had been incorporated as a city and six were found to contain villages of urban size. The additions just specified were found to contain more inhabitants than were lost to the urban classification by the omission of the outlying parts of the six special-rule towns, so that the urban population of the state under the new 1950 rule was somewhat larger than it would have been under the 1940 rule.



BY COURTESY OF THE U S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF NEW HAMPSHIRE: 1870 TO 1950
The narrow white space at the end of the black section of the 1950 bar represents the population of the small additional area counted as urban under the new 1950 definition

The number of households in 1950 was 155,174, as compared with 135,960 in 1940. The average population per household had declined from 3.7 in 1940 to 3.4 in 1950.

Area	Population			Per cent of increase	
	1950	1940	1930	1940–50	1930–40
The state	533,242	491,524	465,293	8.5	5.6
Urban*	306,806	283,225	273,079	8.3	3.7
Rural*	226,436	208,299	192,214	8.7	8.4
Per cent urban	57.5	57.6	58.7	..	.
Principal cities					
Manchester	82,732	77,685	76,834	6.5	1.1
Nashua	34,669	32,927	31,463	5.3	4.7
Concord	27,988	27,171	25,228	3.0	7.7
Portsmouth	18,830	14,821	14,495	27.0	2.2
Berlin	16,615	19,084	20,018	−12.9	−4.7
Dover	15,874	14,990	13,573	5 9	10.4
Keene	15,638	13,832	13,794	13 0	0.3

*Final figures for 1950 based on *new* definition. *See* comment in text.

The population of the state was distributed by colour and nativity in 1950 as follows: 88.9% native white; 10.9% foreign-born white; and 0.2% nonwhite. Of the 58,134 foreign-born white, 60.0% were born in Canada, including 42.9% Canadian-French alone. There were 97.9 males per 100 females in the native white population and 88.9 in the foreign-born; 10.9% of the population was 65 years old or over; and 53.7% of the population 14 years old and over was in the labour force. Of the total number of employed males, 8.9% was engaged in agriculture, 8.7% in construction, 40.0% in manufacturing and 20.6% in transportation and trade and 12.5% in services of various kinds.

Government.—New Hampshire was the first of the original states to establish a government wholly independent of Great Britain. This was designed to be only temporary, but was in operation from Jan. 5, 1776, to June 2, 1784. The constitution provided for a general court consisting of a senate and a house of representatives and made the council a body advisory to the state president; the 1784 instrument was amended in 1792; with the amendments adopted in that year it is in large measure the constitution of today. For 60 years there was no change whatever, and only three amendments, those of 1852 (removing the property qualifications of representatives, senators and the governor), were adopted until 1877, when 12 amendments were adopted—the most important being those providing for biennial (instead of annual) state elections in November (instead of March), and those doing away with the previous requirement that representatives, senators and the governor "be of the Protestant religion." Five amendments were ratified in 1889, four in 1902 and four in 1912. Most important of those adopted in 1912 was one providing for the election of the governor and members of the council by a plurality instead of a majority vote. New Hampshire is the only state in which amendments to the constitution may be proposed only by a constitutional convention, and once in seven years at the general election a popular vote is taken on the necessity of a revision of the constitution. By an act approved on April 9, 1909, provision was made for direct nominations of candidates at primaries. The government of the state was extensively reorganized as a result of legislation passed in 1949.

There is a governor's council of five members, one from each councillor district, which has advisory duties and shares with the governor most of his powers. There is no lieutenant governor. The governor and the councillors are elected for a term of two years. The governor and council appoint all judicial officers, the attorney general, comptroller, important administrative boards and commissions and the medical referees; they have power to pardon offenses; and they may exercise some control over expenditure through the constitutional requirement of the governor's warrant for drawing money from the treasury. The governor may veto within five days, besides Sunday, after it has been presented to him, any bill or resolution of which he disapproves, and a two-thirds vote of the members of both houses is required to pass over his veto. A senate and a house of representatives, which together constitute the general court, meet at Concord on the first Wednesday in January of every odd-numbered year, and at such other times as the governor may appoint for a special session, principally for the making of laws and for the election of the secretary of state and the state treasurer. The senate is composed of 24 members, one from each senatorial district. Membership in the house of representatives varies according to a plan adopted in 1931, by which towns having less than 600 inhabitants elect representatives according to a special schedule. There were 399 representatives chosen in 1950. Both senators and representatives are elected for a two-year term.

For the administration of justice the state has a supreme court and a superior court, each county has a probate court, and some towns as well as the cities have a municipal court. The supreme court consists of a chief justice and four associate justices; the superior court, of a chief justice and five associate justices. The supreme court sits at Concord on the first Tuesday of every month except July and August; while the superior court holds two or three sessions a year in each of the ten counties. Each county has a single probate judge, who has jurisdiction over the probating of wills, insolvency proceedings, decisions regarding adoption of children and similar judicial functions. Supreme, superior and probate judges are appointed by the governor and council to serve until they are 70 years of age. Municipal judges are similarly chosen. Like justices of the peace, they have jurisdiction in criminal cases where the punishment is by fine not exceeding $20, by imprisonment not exceeding six months, or by both, and in minor civil cases. A municipal court has the same jurisdiction as that of justices of the peace, and municipal judges possess, in addition, concurrent jurisdiction with the superior court in certain cases where the title to real estate is not involved and the damage demanded does not exceed $100. Justices of the peace are appointed for a term of five years only, but they may be reappointed. Local affairs are administered by counties (ten in number), towns (townships), village districts and cities. In each county a convention, composed of representatives from the towns, meets every two years to levy taxes and to authorize expenditures for grounds and buildings whenever more than $1,000 is required. For the discharge of other county functions the qualified electors of each county elect every two years three commissioners, a sheriff, a solicitor, a treasurer, a register of deeds and a register of probate; two auditors also are appointed annually by the supreme court. The county commissioners have the care of all county property, as well as of county paupers;

and once every four years they are required to visit each town of their county, inspect the taxable property therein, determine whether it is incorrectly assessed and report to the state board of equalization. In each town a regular annual meeting of the qualified electors is called on the second Tuesday in March for the transaction of miscellaneous business and the election of town officers.

Finances.—The total valuation of property for the purposes of taxation in 1950 was $746,825,197; the total of taxes assessed in cities, towns and unincorporated places was $32,691,619 or $43.10 per $1,000. The chief sources of the income of the state government in 1950 were the gasoline tax, motor vehicle and operators' licence fees, income derived from taxes on beer and taxes on, or the sale of liquor (sold in state liquor stores), the tobacco tax and income derived from the regulation of betting on horse racing. The total income of the state government for the year ending June 30, 1950, was $50,099,272 of which $44,849,272 was revenue and $5,250,000 borrowed money. The total payments for the same period were $49,659,306. The cash balance on hand July 1, 1950, was $4,021,271 as compared with $3,422,728 a year before.

Education.—New Hampshire formed a part of Massachusetts when, in 1647, the general court of that province passed the famous act requiring every town in which there were 50 householders to maintain a school for teaching reading and writing, and every town in which there were 100 householders to maintain a grammar school. During the 19th and early part of the 20th century various experiments for improving the public school system were tried.

The public-school system has at its head a state board of education composed of seven persons appointed by the governor and council. The administrative work is carried on by a commissioner of education, appointed by the board for an indefinite term, a deputy commissioner, nominated by the commissioner and appointed by the board, and a director of technical institutes, appointed by the board. Each town is constituted a school district, and some special districts are organized under special acts of the legislature. For the purpose of inspecting and supervising all institutions in which state money is spent, the several school districts in the state are combined into supervision unions consisting of one or more school districts. The schools are maintained chiefly out of the proceeds of a district school tax, which must not be less than $3.50 on each $1,000 of assessed property. To this is added a "literary fund" (designed originally for founding a college) from various sources. All children between the ages of 8 and 16 are required to attend either a public or an approved private school for the full term unless they are more than 14 years old and have completed the studies prescribed for the elementary schools, or have been excused by the school board on account of physical or mental infirmity. For the year ending June 30, 1950, there were 73,314 attending public schools and 26,429 attending parochial or private schools or approved public academies. Of the total public school enrolment, 52,513 were in the elementary grades and 18,823 in high schools. There were 6,440 in other secondary schools. The total expended on public-school education for the same year was $18,043,423.25.

The only state institutions of higher education are the Plymouth Teachers college (1870) at Plymouth, the Keene Teachers college (1909) at Keene and the University of New Hampshire, organized as a department of Dartmouth college in 1866, but reorganized as the New Hampshire College of Agriculture and Mechanic Arts and removed to Durham as a separate institution in 1893. It was given its present name in 1923 by an act of the legislature. Other institutions of higher learning in the state are Dartmouth college (nonsectarian, 1770) at Hanover and Saint Anselm's college (Roman Catholic, 1889) at Manchester.

Charities and Corrections.—The state charitable and correctional institutions include the New Hampshire school for feeble-minded children, at Laconia; the New Hampshire soldiers' home, at Tilton; the New Hampshire industrial school, at Manchester; the New Hampshire hospital for the insane, and the state prison, at Concord; and the New Hampshire sanatorium for tuberculars, at Glencliff in the town of Warren. The state also makes annual appropriations for the care and education of blind and deaf and dumb persons in institutions outside of the state. Each county has an almshouse and house of correction.

Agriculture.—Agriculture on the farms of New Hampshire still working has been greatly modified, the production of vegetables, fruits, dairy products, poultry and eggs largely supplanting the production of cereals. The total acreage in farms decreased from 3,249,458 in 1910 to 2,017,049 in 1945. During the same period the number of farms decreased from 27,053 to 18,786, and average acreage per farm from 120.1 to 107.4. The value of all farm property, including lands and buildings, had likewise decreased from $103,704,196 to $80,394,869; average value per acre in 1945 was $39.86. Of the total number of farms in the state in 1945 (18,786), 17,880 were worked by owners or part owners, 668 by tenants and 238 by managers. The total value of all farm crops in 1949 was $17,832,000. Hay was the principal crop; in 1949 the acreage was 361,000 and the yield was 391,000 tons, valued at $13,020,000. Apples were the crop second in importance, valued at $1,954,000, and potatoes were third in importance, valued at $1,529,000. Dairying has long been an important industry in New Hampshire. In 1949 the milk production was 337,000,000 lb. and the gross income from dairy products was $19,008,000. The gross income from the poultry and egg production of 1949 was $29,725,000. The livestock on the farms of the state on Jan. 1, 1950, included 10,000 horses, 7,000 sheep, 13,000 swine and 118,000 cattle.

Forests and Fisheries.—Except on the summits of the higher mountains New Hampshire was originally an unbroken forest of which the principal trees were the white pine, hemlock, sugar maple, yellow birch, beech, red oak and white oak in the south, red spruce, balsam and white birch on the upper mountain slopes, and red spruce, white pine, sugar maple, white spruce and white cedar in the other parts of the north. For 1948 the U.S. forest service reported a forestland acreage of 4,847,800—83.9% of all land in the state. Of this forest land, 12% was good saw-timber stand, 26% light saw-timber stand, 37% pole-timber stand and 25% poorly stocked. The federal government owned 585,000 ac. or 12.5% and 96,800 ac. or 2.1% were owned by the state, counties or municipalities. The forests of the state produced, in 1947, 327,882,000 bd.ft. of lumber, 243,093 standard cords of pulpwood and 279,272 standard cords of fuel wood. Total yield of primary timber products (logging waste included) was 108,400,000 cu.ft.

New Hampshire, with only one coastal county (Rockingham), in 1947 was credited with less than 0.1% of New England's fishing yield. The total yield of its fisheries amounted to 707,000 lb., valued at $238,400.

Minerals.—The most important of the mineral products of New Hampshire, which has long been known as the "Granite state," is granite, which is quarried in the southern part of the state in the area of Lake Winnipesaukee; gneiss, near Concord, Merrimack county, near Milford, Hillsboro county and east of Manchester in Rockingham county; in Sullivan county, near Sunapee; and in the east central region in Carroll county, near Conway and Madison. The U.S. bureau of mines reported that the value of stone quarried in New Hampshire in 1949 was $381,141. Clay products ($19,795), peat ($296), noncommercial sand and gravel ($236,895) and other minerals (abrasive stones, beryllium concentrates, feldspar, mica, commercial sand and gravel, etc.) valued at $746,009, make a total value, for all 1949 mineral products of the state, of $1,384,136. Mica, first mined at Grafton, Grafton county, in 1803, was later found in other parts of the state in such quantities that for 60 years New Hampshire was the largest producer of mica in the United States.

Manufactures.—The values of the products for all manufacturing industries of New Hampshire combined for 1924, 1935 and 1947 were $333,124,503; $209,384,111; and $306,932,000 (value added by manufacture) respectively. The number of industrial establishments (1,078, 788 and 1,124) and the number of wage earners (75,310, 54,212, 74,752) showed a corresponding trend. Textiles and leather and leather products represented in 1947 approximately one-half of the total. Cotton goods, the leading industry for more than a century and a quarter after its introduction in 1804, was replaced by woollen goods in the textile in-

dustry. The textile industry in 1947 had 108 mills, employed 20,456 employees and had an output value added by manufacture of $85,318,000. The manufacture of leather and leather products (chiefly boots and shoes) accounted for 115 factories, gave employment to 20,070 and had a product value added by manufacture of $70,107,000. The other leading industries and the value of their products added by manufacture in 1947 were paper and allied products $33,520,000, machinery (except electrical) $32,209,000, lumber and products (except furniture) $22,447,000 and printing and publishing industries $10,960,000. Most of the manufacturing centres of the state are south of Lake Winnipesaukee. An exception is Berlin, the chief manufacturing centre north of the White mountains, important for its manufacture of paper and wood pulp.

Transportation.—With the exception of the Grand Trunk line in the northern part of the state the several steam railways are owned or leased by the Boston and Maine. This company was the first to operate a railway within the state, service being maintained between Boston, Mass., and Dover, N.H., as early as 1842. The steam railway mileage decreased from 1,234 to 951 during the years 1925–46. The amounts spent by the highway department have varied. A total of $12,940,124 was disbursed during the calendar year 1950. This amount included expenditures for construction, maintenance, interest and principal payments on highway bonds, transfers to local units, etc.

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(H. W. K.; W. E. Ss.; P. M. M.)

NEW HARMONY, a village in Posey county, Indiana, on the Wabash river, about 22 mi. N.W. of Evansville. Pop. (1950) 1,380. It is served by the Illinois Central railway. New Harmony had its beginning in 1814–15, when it became the home of a communistic religious sect known variously as the Harmonists, Harmonites and Rappites, founded in Germany toward the end of the 18th century by George Rapp (1757–1847), a native of Iptingen in Württemberg. Rapp and his followers, who sought to form a community after the manner of the primitive Christian church, were persecuted in Germany, and in 1803–04 emigrated to Butler county, Pennsylvania. There they established in 1805 a community known as Harmony, consisting of about 600 persons, who held their property in common and in 1807 adopted celibacy. In 1814 Rapp sold most of his Pennsylvania land and bought about 24,735 ac. (in the next ten years more than 14,000 ac. in addition) on the Wabash river in Indiana territory. In 1814–15 Rapp and a thousand of his followers settled on the Indiana tract, their headquarters being established at New Harmony or Harmonie as they called it. The settlers, mostly Germans, devoted themselves to agriculture, weaving and leatherworking so industriously that they prospered from the start. Rapp, however, in 1825 disposed of his lands and property to Robert Owen, having returned with part of his followers to Pennsylvania and founded a new community known as Economy, in Beaver county, where he died in 1847. Intent on founding a socialistic community, Owen went to the United States in 1824, and purchased Rapp's lands and livestock for $182,000. He interested several well-known scientists in his settlement, and with them went to New Harmony in the spring of 1826. Within six months the community numbered more than 1,000.

Among the most notable members of the community were Robert Owen's sons, Robert Dale Owen (1801–77), a political leader and diplomat; David Dale Owen (1807–60) and Richard Owen (1810–90), both geologists of note; William Maclure (1763–1840), the founder of the Academy of Natural Sciences at Philadelphia; Thomas Say (1787–1834), "the father of American zoology"; Charles Lesueur, a scientist and antiquarian; and Gerard Troost (1776–1850), a well-known geologist.

The greater part of the settlers, however, were impractical theorists or adventurers. Constitution after constitution was adopted, and with the adoption of each new constitution and with each new religious discussion a group would secede and form a separate community—in 1828 there were ten.

The best known and most successful group was Macluria (like the others, occupying a part of Owen's land), named after William Maclure, who became its directing power.

The whole organization broke up in 1827, and Owen left New Harmony in 1828. The Workingmen's Institute Public library, founded in 1838 by William Maclure, has a collection rich in works dealing with socialism.

See "The Harmony Society," *German-American Annals* (1904); G B. Lockwood and C. A. Prosser, *The New Harmony Movement* (1907); Meredith Nicholson, *The Hoosiers* (1901); Morris Hillquit, *History of Socialism in the United States* (1903); Frank Podmore, *Robert Owen* (1906); G. H. Holiday, "An Indiana Village, New Harmony" (1906); and Caroline Dale Snedeker, *Town of the Fearless* (1931).

NEWHAVEN, a seaport and urban district of Sussex, Eng., 56 mi. S. from London by the Southern Region Railway route, on the English channel at the mouth of the Ouse. Pop. (est. 1938) 7,062. Area 2.8 sq.mi. The port is protected by fortifications. A harbour was first granted to Newhaven in 1713, and during the early 18th century it possessed a large shipping trade. It is a packet station. The tidal harbour is enclosed by two piers and a breakwater, the area being about 30 ac. and the quayage 1,400 yd. There is ordinarily a large traffic with France in wines, spirits, silk, fruit, vegetables and general provisions.

NEW HAVEN, the second largest city of Connecticut, U.S.A., a port of entry, the county seat of New Haven county and the seat of Yale university; in the southwestern part of the state, on Long Island sound, 72 mi. E.N.E. of New York city. It is on federal highway 1, and is served by the New York, New Haven and Hartford railroad, interurban trolleys, motorbus and truck lines and coastwise steamers. Pop. (1950) 163,344; (1940) 160,605; (1930) 162,655.

The city of New Haven occupies 22.45 sq.mi. at the head of a broad, deep bay, into which empty the Quinnipiac, the Mill and the West rivers. New Haven's site is a level, sandy plain, behind which rises a line of hills, terminating in two spurs, East Rock (360 ft. high) and West Rock (400 ft.), respectively 2¼ and 2 mi. from the green. On the central green of 16 ac., reserved for the public when the town was laid out, are three churches built in 1814: Trinity (Protestant Episcopal), United (Congregational) and Center (Congregational; designed by Ithiel Towne). Facing the green are some of the buildings of Yale university (*q.v.*), a large hotel and the principal public buildings. The Harkness tower of the memorial quadrangle of the university can be seen from the green, and near by is the old Grove Street cemetery, containing the graves of many famous Americans. The Yale Bowl (seating 70,896) is in the western part of the city. New Haven has long been called "the city of elms." Parks, playgrounds and public squares cover 2,119 ac. In West Rock park is a cave where the regicide judges Edward Whalley and William Goffe are said to have been hid for several weeks when pursued by royal officers in 1661. Nathan Hale park contains old Fort Hale (used in 1812), with its moat and defenses well preserved. A large tract at Lighthouse point (the eastern end of the harbour) is developed as a municipal bathing beach and seaside park. New Haven is the seat of a state teachers' college (established 1893), Albertus Magnus college for women (Roman Catholic) Larson college (girls), New Haven YMCA·Junior college, Junior College of Commerce, Whitney Art School and Connecticut university college of pharmacy. There are also a number of widely known private academies for boys and girls, including the Hopkins Grammar school, established in 1660. Among the newspapers are the morn-

ing *Journal-Courier* (1766), and the evening *Register* (1812).

New Haven is an important commercial and industrial city. The general offices of the New York, New Haven and Hartford railroad are there, and just outside the city is its Cedar Hill freight classification yard, covering 1,160 ac. The traffic of the harbour amounted to 5,250,489 tons in 1950. There are 375 wholesale houses, doing a large business. The manufacturing industries are widely diversified and highly specialized, with an output in 1949 valued at $250,000,000. Among the leading products are guns, ammunition, hardware, corsets, wire and wire goods, paper boxes, razor blades, plastic products, automobile ignitions and clocks. A coke plant manufactures gas which is piped to towns as far as Hartford. Bank debits in 1949 aggregated $2,158,426,934. The city's assessed valuation for 1949 was $365,038,253. It operates under a mayor and aldermen form of government. New Haven is a leading medical centre.

In the spring of 1638 a company of English Puritans, led by Theophilus Eaton and the Rev. John Davenport, established a settlement there. It was governed under a "plantation covenant" until June 4, 1639, when the "free planters" adopted a theocracy. They agreed that the Scriptures should be their guide in civil affairs, and that only approved church members should be admitted to the body politic; 12 men were appointed to choose 7 men ("7 pillars") who should found the church and admit to its original membership such planters as they thought properly qualified. This having been done, the first general court of which there is record met on Oct. 25. At this court the members of the new church, together with six members of other approved churches, were admitted to citizenship; a magistrate, four assistants, a secretary and a constable were chosen as the civil officers; annual elections and an annual session of the general court in the last week of October were agreed upon; English statute and common law were expressly excluded; and the "worde of God was adopted as the onely rule to be attended unto in ordering the affayres of government in this plantation." As thus founded, New Haven was town and colony combined.

In 1643–44 the towns of Guilford, Milford, Stamford, Branford and Southold on Long Island were admitted to the "New Haven jurisdiction." The government of the jurisdiction was of the strictest Puritan type, but some of the 45 "blue laws" ascribed to it were enactments of other New England Colonies, and some were pure invention. Among those laws which the Rev. Samuel Peters in his *General History of Connecticut* ascribed to New Haven which were wholly or substantially true are the following: "The judges shall determine controversies without a jury"; "married persons must live together or be imprisoned"; "a wife shall be good evidence against her husband"; "no minister shall keep school"; "the selectmen, on finding children ignorant, may take them away from their parents and put them into better hands, at the expense of their parents." Among those in the same list which are wholly or in part spurious are: "No woman shall kiss her child on the Sabbath or fasting day," and "No one shall travel, cook victuals, make beds, sweep house, cut hair or shave on the Sabbath day."

In 1664 New Haven, with the other towns (except Southold) of the jurisdiction, became part of the Colony of Connecticut, and in 1784 it was chartered as a city. From 1701 to 1873 New Haven was one of the capitals of Connecticut. A state house (designed by Ithiel Towne after the temple of Theseus) stood on the green, or market place, from 1827 until 1889. In 1716 the Collegiate School of Connecticut, which developed into Yale university, was moved to New Haven from Saybrook. After 1763 a thriving trade with the West Indies, Newfoundland and neighbouring ports on the Atlantic coast began to develop, which flourished, with some periods of depression, until the War of 1812; and after 1800 commerce sprang up with China, the East Indies, the Pacific and the South Seas. A collector of the port was appointed in 1760. In 1769 the merchants at a public meeting unanimously agreed not to import goods from England, but in June 1770 they renounced the agreement and voted to open the port. When the news of the embargo of Boston arrived, a committee of correspondence was formed at once; and through the Revolution the people supported the American cause with ardour, though there were many Loyalists in the town, 75 of whom had property confiscated. On July 5, 1779, the town was invaded and sacked by Gen. William Tryon, but he was driven out before he could burn it. When the War of 1812 opened there were fully 600 seamen in the city (among them Capt. Isaac Hull), all engaged in privateering or in the regular naval service of the United States. Manufacturing began early. Shoes were shipped from the town in 1647 and ironworks were opened in 1656. The loss of foreign trade through the War of 1812, the opening of the Farmington canal in 1828 and the building of the railroad in 1833–38 gave such impetus to industrial development that manufacturing rapidly became the chief interest of the city. In 1820 the population was 8,327; in 1860, 39,267; in 1900, 108,027. New Haven was the birthplace or the home of many inventors, including Eli Whitney, Eli Whitney Blake, Charles Goodyear, Thomas Sanford, James Brewster, David Bushnell, Samuel F. B. Morse, Elias Loomis, Chauncey Jerome and Henry S. Parmelee; and it was the home of Noah Webster and Willard Gibbs.

NEW HEBRIDES, an island group in the western Pacific, about 50 mi. W. of Fiji and 250 mi. N.E. of New Caledonia. Area 5,790 sq.mi., pop. (1942) about 45,000, including about 40,000 natives, 150 British, 750 French, 2,100 Tonkinese and some other Asiatics. The islands are under a condominium, or joint British and French administration.

Administration.—The islands were placed under joint Anglo-French administration, as provided by the Anglo-French convention of Feb. 1906, which was ratified in Oct. 1906, and the Anglo-French protocol, signed in London in 1914 and ratified only in March 1922. Great Britain and France are represented in the islands by high commissioners, who delegate their powers to resident commissioners stationed in the group. There are British and French courts, together with a mixed court with a judge who is a national neither of Great Britain nor of France. The New Hebrides are south and west of the farthest points reached by the Japanese in their southward advance in 1942 and were therefore not directly drawn into the Pacific hostilities. British high commissioner in 1950: Sir Leslie Brian Freeston. French high commissioner: Pierre Cournarie. British resident commissioner: R. D. Blandy. French resident commissioner: P. Anthonioz.

History.—The islands were sighted by the Portuguese navigator Pedro Fernandez de Quiros in 1606. Believing he had discovered a great southern continent, he named it Australia del Espiritu Santo. The islands were visited by the French explorer Louis de Bougainville in 1768, and received their present name from the British navigator Capt. James Cook in 1774. Their rugged outline suggested the Hebrides Islands off the northern coast of Scotland.

The islands were found to be rich in sandalwood and were opened up to communication with the outside world by the visits of traders and missionaries during the 19th century. Great Britain and France declared the New Hebrides neutral in 1878. Both Great Britain and France found occasion to intervene in protection of the lives of their nationals in clashes with the natives. The islands were placed under the surveillance of a mixed Anglo-French commission of naval officers in 1887.

A more detailed scheme of joint administration went into effect as a result of the convention of 1906. This provided that British and French nationals should have equal rights in all respects and that each power should retain jurisdiction over its own subjects or citizens. It was agreed that there should be no penal settlement and no fortifications on the islands. The second protocol, ratified on March 18, 1922, regulated British, French and native interests, fixed conditions of land tenure and provided regulations for the recruiting of native labour. The sale of drink and firearms to natives and the practice of forced labour are illegal.

Topography and Climate.—Espiritu Santo, with an area of 875 sq.mi., is the largest of the islands. Efaté, with the two excellent harbours of Vila and Havannah, is the seat of the administration, located in Vila. Port Sandwich, largest port in the islands after Vila, is on the island of Malekula (Mallicolo). The islands are of volcanic, not coral, formation and some active volcanoes still exist. Because of their volcanic origin, the islands reach a con-

siderable elevation, Mount Lopevi reaching a height of 4,755 ft. A height of 6,169 ft. has been recorded in Espiritu Santo. The climate is generally hot and damp, especially in the months between November and April. Natural vegetation is luxuriant and abundant.

Ethnology and Education.—The natives are Melanesians of mixed blood, with a minority of Polynesians in some places. As is usually the case in Melanesian lands, the natives are divided into small tribal units, no one of which acknowledges the authority of another. Cannibalism is still found in Espiritu Santo, Malekula and the Pentecost Islands. Education is largely in the hands of Catholic and Presbyterian missions. There are hospitals with foreign doctors and nurses and there are one government school and two Catholic mission schools for the white population. Malaria and various fevers are prevalent in the islands. Infectious diseases like influenza and whooping cough are sometimes brought into the islands by foreigners and take a high toll of the natives whose sanitary standards are low.

Economics and Finance.—The islands produce bananas, sugar cane, oranges, tropical fruits, corn, vanilla and coconuts. There are several British and French trading companies. New Hebrides trade is mostly with Australia and New Caledonia. Principal imports are food, clothing, metal wares and furniture. Exports include copra, cocoa, coffee, cotton and kauri logs. Imports of wine and spirits, arms and ammunition are forbidden, except under special permit.

Imports were £88,800 sterling, exports £107,688 sterling in 1941. Administration revenue in 1942 was £31,048 sterling and expenditure was £20,061 sterling. (W. H. Ch.)

NEW HYDE PARK, a city in Nassau county, N.Y., U.S., in the southeastern part of the state, 15 mi. E. of Brooklyn. It is served by the Long Island railway.

The population by the federal census was 7,323 in 1950 and 4,691 in 1940.

The city has a mayor-council form of government; the mayor is selected for a term of two years by four elected councilmen.

New Hyde Park is known as a residential city. There is a hosiery mill in the city, and there are a number of truck farms in the surrounding areas.

Two weekly newspapers are published there, and the city also has a public library.

NEW IBERIA, a city of Louisiana, U.S., 125 mi. W. of New Orleans, on Bayou Teche and federal highway 90; county seat of Iberia parish. It is served by the Missouri Pacific and the Southern Pacific railways, and by a barge canal connecting with the intracoastal canal. Pop. 16,460 in 1950; 13,747 in 1940. This rich agricultural region is the home of the "Acadians" from Nova Scotia. Near by are Avery, Jefferson and Weeks Islands, all of which have salt mines. On Jefferson Island was the home (Bob Acres) of Joseph Jefferson, and on Avery is a bird refuge. The city was laid out in 1835, chartered in 1839.

The "colony of Iberia" appears in the census reports of the Spanish government for 1785 and 1788 with a population of "190 souls." The name of the city is one of the few Spanish names which remain in southern Louisiana.

A severe yellow fever epidemic struck New Iberia in 1839, and virtually every family there suffered from the disease. A heroine of the emergency was an old Negro slave named Félicité, who indefatigably and skilfully ministered to the sufferers. Her feats became a legend in the community. The city was not freed from the threat of recurrent epidemics until the disease was conquered early in the 20th century.

Although no military engagements took place there, New Iberia fell to the Union forces during the Civil War Red river campaign in 1863.

NEW IRELAND (native *Tombara*), an island of the Bismarck archipelago, lying east of New Guinea, in the Pacific ocean, and northeast of New Britain, practically at right angles to its northern end. It is long, narrow, and mountainous (maximum height, 6,500 ft.), with no rivers of any size. Geologically it is older than New Britain (*q.v., see* also New Guinea), but it has not the definite volcanic appearances of that island. The coast line is fairly even, and there are good harbours at Kaewieng, Namatanai and Muliama. It is divided into two districts, northern (Kaewieng), and southern (Namatanai), the latter including the small island of New Hanover. Kaewieng is a port with a wharf capable of berthing ships up to 2,000 tons. There are fair roads in many places, and ordinarily there is steamer communication with New Britain and the mainland. The natives resemble those of New Britain. New Ireland formed part of German New Guinea; it was captured by Australian forces in 1914, was mandated by the League of Nations to Australia. The island was seen by Jacob Lemaire and William Cornelis Schouten in 1616, recognized as separate from New Guinea by William Dampier, in 1700..

New Ireland was invaded by the Japanese Jan. 23, 1942. Kaewieng became a Japanese naval base second in importance in this part of the Pacific only to Rabaul in New Britain. Japanese shipping there was bombed by United Nations air forces.

NEW JERSEY, the "Garden state," is an Atlantic coast state of the United States lying between approximately 38° 56′ and 41° 21′ N. and 73° 54′ and 75° 35′ W. Except for its 50-mi. northern border with New York, its boundaries are natural waterways, more than 300 mi. of which are navigable: on the east the Atlantic ocean, and the Hudson river which for 22 mi. separates the state from New York; on the west and south the Delaware river and bay which separate it from Pennsylvania and Delaware. New Jersey has an extreme length, north and south, of 166 mi., an extreme width, east and west, of 57 mi. and a total area of 7,836 sq.mi. Its inland water area is 314 sq.mi. The land is 46% in forests, 40% in farms.

Physical Features.—The state's four topographic belts record 1,000,000,000 years of rock forming, mountain building, erosion, submergence, re-emergence, glaciation. Crossing the northwest corner of the state, the folded Appalachian belt includes Kittatinny mountain and valley. The Kittatinny mountain range with northeast-southwest trend, crosses the Delaware river at the Water Gap and continues southwest into Pennsylvania. Where the crest of the ridge enters the state, its elevation is 1,539 ft.; at High Point, 1 mi. S.W., the ridge attains 1,805 ft., the highest point in the state. A short distance to the southwest, in a depression in the crest, is Lake Marcia at an elevation of 1,570 ft. The Water Gap testifies to the power of the river which, holding to its course as the mountain rose, formed a valley 900 ft. wide at the base and 4,500 ft. wide at the top with sides rising impressively to a height of more than 1,200 ft.

Southeast of and parallel to the Kittatinny range, the Kittatinny valley, about 40 mi. long and 12 mi. wide, has an average elevation of 700 ft. The second topographic belt, the highlands, parallels this valley on the southeast. With average altitude of about 1,000 ft., this upland plateau, bisected by streams into a series of ridges extending from northeast to southwest for 60 mi., is 9-18 mi. wide and embraces 900 sq.mi. The third belt, or Triassic lowland, with altitude ranging from sea level to 900 ft., has traprock ridges, the best-known of which is the Palisades on the Hudson. The trap extends to the Kill van Kull channel and includes the First and Second Watchung (or Orange) mountains west of the suburbs known as the "Oranges." Bordered on the northwest by Pompton, Morristown, Lebanon and Highbridge, and on the southeast by a line extending from Woodbridge to Trenton, it occupies about one-fifth of the surface of the state. To the southeast the fourth topographic belt—a coastal plain, bordered on east, south and west by water, with an area of 4,400 sq.mi., highest near its centre—ranges mostly under 100 ft. in altitude. About one-eighth is tidal marsh, lying chiefly between the barrier beaches of the coast and the mainland. The average elevation for the state is 250 ft. These four belts correspond closely to the outcrops of the geological formations: the rocks of the Appalachian belt being Palaeozoic; the formation of the highlands, Archaean; the Triassic lowlands, Triassic; the irregular hills of the coastal plain, Cretaceous and Tertiary. The great terminal moraine of the glacial epoch crosses the northeast-southwest topographic belts of the state in an irregular line west and northwest from Staten Island, N.Y.

The Delaware river, from its junction with the Neversink river to the capes, flows along the western and southern borders of the

state for 245 mi. and has a total drainage area in New Jersey of 2,345 sq.mi. The Hudson drains a small part of the state but has contributed materially to its commercial development. The principal stream of the highlands and Triassic lowland, the Passaic, rising in Morris county, passes through a gap in the traprock at Little falls, descends 40 ft. and at Paterson drops 70 ft. as the Great falls of the Passaic and, bending southward, empties into Newark bay. It drains an area of about 950 sq.mi. The Hackensack river enters the state about 5 mi. W. of the Hudson, flows almost parallel with it and empties into Newark bay, having a length of 34 mi. and a drainage area of 201 sq.mi. The Raritan, the largest stream lying wholly within New Jersey, flows eastward through the centre of the state and drains 1,105 sq.mi. Among the highlands are numerous lakes of which the largest are Lake Hopatcong in Morris and Sussex counties and Greenwood lake partly in New York and partly in New Jersey.

The soils vary greatly: those of the northern and central sections are made up in part of glacial drift; those of the south are sandy or loamy and enriched locally by deposits of marl. The most fertile soils lie in the clay and marl region, a belt 10–20 mi. wide extending in a general southwesterly direction from Long Branch to Salem.

Climate.—Because of the proximity of the ocean in the south and the relatively high altitudes in the north there is a greater variation in climate between the extreme northern and southern sections of the state than would naturally result from their difference in latitude. The mean annual temperature ranges from 49.8°at Sussex in the north to 54.7° at Bridgeton in the south. At Sussex the mean for the winter is 28° with an extreme minimum of −24°, the mean for the summer is 69.7° with extreme maximum recorded of 106°. At Atlantic City the annual mean temperature is 52.9°: for the winter it is 34.8° with an extreme of −9°; for the summer, 71° with an extreme of 104°. The normal annual precipitation is 45.6 in. varying from slightly less than 36 in. at Runyon to slightly more than 50 in. at Toms River and at Paterson. The growing season is 155 days in the Kittatinny mountain region and 203 days on the coast.

History.—The earliest inhabitants of New Jersey of whom there is clear record were the Leni-Lenape or Delaware Indians, of the Algonkin family. In 1758 an Indian reservation, perhaps the first in the U.S., was established at Edgepelick or Brotherton (Indian Mills). When in 1832 the legislature settled the Indians' last claims their spokesman declared, "Not a drop of our blood have you spilled in battle; not an acre of our land have you taken without our consent."

Although in 1524 the Florentine, Giovanni da Verrazano, under French authority, and in 1525 the Portuguese Estevan Gomes, in the service of Charles V, visited what is now New Jersey, voyages to those shores for exploration, trade and settlement really began in 1609 when Henry Hudson, an English navigator employed by the Dutch East India company, sailed up the river which bears his name. Cornelis Jacobson Mey (1614) and Cornelius Hendricksen explored the Delaware. In 1623 permanent homeseekers arrived at New Amsterdam. Some built Fort Nassau near the present Gloucester. On the western bank of the Hudson others had established by 1640 the trading post of Hobocan Hackingh, on the site of Hoboken. From all of these places the Dutch spread into the Raritan valley. Meanwhile, in 1638, 50 Swedish colonists landed on the western bank of the Delaware and built Fort Christina on the site of Wilmington. A triangular fort, called Elfsborg, was constructed in 1643 on the eastern bank near modern Salem. In 1655 Peter Stuyvesant brought these settlements under Dutch control.

On March 12, 1664, Charles II granted to his brother James, duke of York, all lands between the Connecticut river and the eastern side of Delaware bay and all islands between Cape Cod and the Hudson. An expedition left England in May under Richard Nicolls and in August the English flag floated over New Amsterdam. In October, when Sir Robert Carr seized the settlements on the Delaware, the few inhabitants of what is now New Jersey acquiesced. While Nicolls was still at sea, the duke of York, by deeds of lease and release, transferred to Lord John Berkeley, baron of Stratton, and Sir George Carteret (*q.v.*) all that part of his new possessions extending eastward from the Delaware bay and river to the Atlantic ocean and the Hudson river, and northward from Cape May to a line drawn from the northernmost branch of the Delaware, "which is 41° 40′ lat.," to the Hudson river in 41° N. latitude. He accompanied the grant with a unique transfer of political authority over all who should settle within its limits. To this tract the name of Nova Caesarea, or New Jersey, was given in honour of Carteret who governed the Isle of Jersey in 1643–51.

To attract immigrants the proprietors in Feb. 1665 published their "Concessions and Agreement" by which they provided for a governor, a governor's council and an assembly chosen by the freemen and empowered to levy taxes. Land grants were offered to persons embarking with the first governor. Meanwhile Governor Nicolls of New York, ignorant of the grant to Berkeley and Carteret, had confirmed Indian sales to settlers of sites which later became Elizabethtown, Middletown and Shrewsbury. In 1669 trouble between the proprietary governor and the inhabitants of the last two towns over quitrents caused the nullification of the grants made by Nicolls. Four years later the Dutch fleet brought New Jersey under Dutch control, but England reacquired it by the treaty of Westminster, Feb. 9, 1674. The eastern half of the state was restored to Carteret's proprietorship. Berkeley had sold to John Fenwicke and Edward Byllynge, Quakers, his lands which subsequently were acquired by William Penn, Gawen Lawrie and Nicholas Lucas.

By the "quintipartite deed" of July 1676, the province east of the line from Little Egg harbour to a point on the Delaware river in 41° 40′ N. (East Jersey) was assigned to Carteret, and that west of this line (West Jersey), about five-eighths of the whole, to the Quaker associates (first Quaker colony in America). In 1677 230 Quakers from London and Yorkshire founded a settlement which became Burlington. East Jersey was never actually governed under the liberal "Concessions and Agreements," presumably drafted by Penn, because Byllynge's title to the land conveyed to him alone the right to govern. Byllynge commissioned Samuel Jennings as deputy governor with the consent of the other proprietors. Jennings called the first assembly which passed fundamental laws providing for a governor and council. Meanwhile the death of Sir George Carteret gave the governor of New York, then Sir Edmund Andros, another chance to claim the jurisdiction. In 1680 after Philip Carteret, the governor, had been forcibly carried to New York and imprisoned, Andros appeared before the East Jersey assembly as governor, but the deputies refused to pass the measures he recommended. A New York jury freed Carteret of charges of illegal exercise of authority and the duke of York recalled Andros. In 1682 the province which Sir George Carteret had bequeathed to eight trustees to administer for the benefit of his creditors was purchased at public auction by Penn and 11 associates for £3,400. Each sold one-half of his share thus making 24 proprietors whom the duke of York authorized to govern the province. They directed the appointment of the American Board of Proprietors (1684) who with the deputy governor cared for such proprietary interests as approval of legislation and grant of lands. In 1686 Perth Amboy, the newly created port of East Jersey, became its seat of government. After becoming king in 1685, James II—determined to unite New York, New Jersey and the New England colonies—extended accordingly the authority of Andros, already viceroy of New England. In order to save their rights in the soil, the proprietors of East and West Jersey surrendered their claims to jurisdiction but were able to resume them again when Andros was seized by the people of Boston in April 1689 following the news of revolt against James II in England.

In April 1702 the proprietors transferred to the crown all of their rights of jurisdiction but retained their rights to the soil. The provinces of East and West Jersey were then united and governed as a royal province. Until 1738 New York and New Jersey had the same governor; thereafter each had its own. The legislature met alternately at Burlington and Perth Amboy until 1790 when Trenton became the capital. The first four decades under royal government were disturbed by friction between the assembly and the royal governors and by disputes with the proprietors and creditors, accompanied by rioting (1744–54, 1770).

Meanwhile significant innovations in religious outlook were developing in the state. David Brainerd, the Presbyterian missionary, from 1744 to 1747 devoted his life to ministry among the Indians. In 1770, under the instruction of Thomas Potter, the Rev. John Murray established in Ocean county the first Universalist church. Between 1743 and 1772 John Woolman, the Quaker tailor, of Mount Holly, aroused his contemporaries to concern over military conscription, the condition of the poor, the practices of landholders and traders and the inhumanity of slaveholding. Political and religious differences persisted between East Jersey, settled largely by Puritans from New England and Long Island, and West Jersey, settled by Quakers.

When, after 1763, England tried to consolidate its victory over France, the curtailment of paper money, the termination of trade with the West Indies and the inclusion of iron and lumber on the enumerated list stirred unrest. The colonial assembly of New Jersey dissolved in Nov. 1775. From May 26 to July 2, 1776, the second provincial congress met at Burlington, Trenton and New Brunswick, for a time became the supreme governing power and was the fourth assembly to enact a constitution, July 2, 1776. Distinguished for its bill of rights and the predominant position of the legislature, the constitution subordinated representation of population to that of counties and retained property qualifications for suffrage and office holding.

Important battles of the war were fought in New Jersey. Late in 1776 George Washington, commander in chief of the continental forces, unable longer to hold the lower Hudson, retreated to the Delaware near Trenton and, by commandeering all available boats, won for his dispirited troops the river as defense against their pursuers. Recrossing with 2,500 men on Dec. 25, he surprised three Hessian regiments next morning and took 1,000 prisoners and 1,000 stands of arms; outgeneralling Lord Cornwallis, he defeated a detachment of the British commander's army at Princeton on Jan. 3, 1777. The American army went into winter quarters near Morristown. (There, in 1950, a monument was dedicated to Thomas Paine, whose *American Crisis* had inspired the soldiers just before these two crucial battles and whose $500 "mite" in 1780 initiated the fund which relieved the distress of the army again encamped there.) As the British army was retreating from Philadelphia to New York, Washington's forces engaged it in the indecisive battle of Monmouth (June 28, 1778).

Released by the war from the century-old conflict over proprietary titles and quitrents and from the restraints of British mercantilism, New Jersey found its commercial existence threatened by New York city and Philadelphia, and joined movements for a closer federal union. Speaking for the smaller states which objected to representation in a national congress on the basis of wealth or population, one of the New Jersey delegates, William Paterson (1745–1800), presented to the federal convention at Philadelphia the "New Jersey plan" of union, representing the wishes of the smaller states, which objected to representation in a national congress being based on wealth or on population. This merely federal plan, reported from a conference attended by the delegates from Connecticut, New York and Delaware, as well as those from New Jersey (and by Luther Martin of Maryland), consisted of nine resolutions; the first was that "the Articles of Confederation ought to be so revised, corrected and enlarged as to render the federal Constitution adequate to the exigencies of government and the preservation of the Union"; and the actual "plan" was for a single legislative body, in which each state should be represented by one member, and which should elect the supreme court and have power to remove the executive (a council), to levy taxes and import duties, to control commerce, and even, if necessary, to make requisitions for funds to the states. James Madison opposed the plan on the ground that it would not prevent violations by the states of treaties and the laws of nations. On the first resolution only there was a definite vote; on June 19 it was voted to postpone the consideration of this resolution and to report the resolutions (the Virginia plan) formerly agreed upon by the committee of the whole. The New Jersey plan left its imprint in the provision of the constitution for equal representation in the national senate and for the supremacy of federal law. By unanimous vote the state convention at Trenton, summoned by unanimous vote of the legislature, on Dec. 18, 1787, became the third state to ratify the federal constitution. In 1801 Aaron Burr, who had been born in Newark, became vice-president of the United States.

On Aug. 22, 1787, John Fitch demonstrated on the Delaware the first steamboat (31 years later the Vail works near Morristown built the machinery for the "Savannah," the first steamboat to cross the Atlantic). In 1794, under the auspices of Alexander Hamilton's "Society for Establishment of Useful Manufactures," chartered by the legislature in 1791, a calico-printing factory inaugurated at the Great falls of the Passaic the first factory town in the U.S., now Paterson. In 1806 the first interstate railroad bridge was opened at Trenton. This material progress was interrupted by the War of 1812 which in the beginning was so unpopular, especially among the Quakers, that the Federalists carried the elections of 1812. After the war the construction of the Morris (1824–38) and the Delaware and Raritan (1826–38) canals and the completion of New Jersey's first railway, the Camden and Amboy (1834), provided facilities for a widespread industrial development.

Agitation for democratic reform culminated in a constitutional convention at Trenton (May 14–June 27, 1844) which drafted a new frame of government, ratified at the polls on Aug. 13. Thereby New Jersey abolished property qualifications for suffrage, modified the basis of representation in the assembly from county toward population, separated legislative, executive and judicial powers and provided for direct election of the governor. A major experiment in social organization, the North American Phalanx, flourished near Red Bank between 1844 and 1856.

Opinion was divided on the question of slavery. The underground railroad transported fugitives to freedom; but when the Civil War broke out, 18 people in New Jersey were legally still slaves. In 1860 three of the state's electoral votes went to Stephen Douglas and four to Abraham Lincoln. New Jersey was one of the three states which voted for Lincoln's opponent in 1864. It furnished 88,305 men for the Union cause and incurred extraordinary expenditures to the amount of $2,894,385. Ratifications of the 13th and 15th amendments were each first refused by the respective legislatures before being voted by their successors in which the Republican party had gained a majority; in 1868 the Democratic legislature sought in vain to withdraw the ratification of the 14th amendment voted by its Republican-controlled predecessor.

A bitter railway war followed the Civil War. The Pennsylvania railroad was charged with virtually monopolizing the route between New York city and Philadelphia as a result of a 999-year lease through which it had gained control of the properties of companies previously granted monopolistic privileges. In 1873 the state opened the route to other railroads.

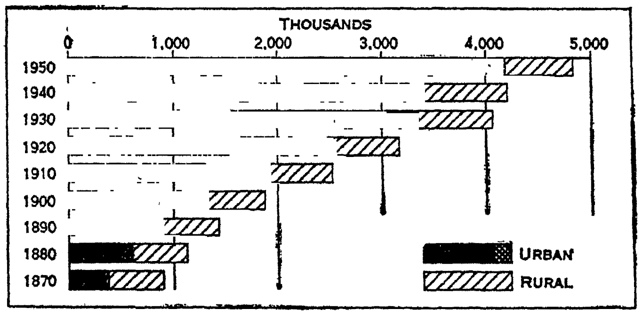
This same period was marked by great cultural, scientific and industrial development. Walt Whitman, in Camden (1873–92), was enlarging *Leaves of Grass*. George Inness, in Montclair and Perth Amboy, was bringing to his countrymen a new sensitivity for the landscape. From 1870 to 1931 in Newark, Menlo Park and West Orange, Thomas Edison was producing inventions evaluated in 1928 by the congress of the U.S. at $15,599,000,000 which included: the mimeograph, indispensable elements for the extensive use of telegraph (1874) and telephone (1876), the dynamo, the storage battery, the talking machine (1877), the incandescent lamp (1879), the electric railway (1880–82), the motion picture (1888–94). In 1881 John Holland launched in the Passaic river the first successful submarine. In 1891 Hudson Maxim demonstrated smokeless powder. With no limit fixed either to capitalization or to bonded indebtedness, with a policy of encouragement of the holding company structure, with a tax rate lower for large than for small corporations, by 1904 New Jersey had chartered 3 of the 7 largest trusts and had "mothered" 150 of the 298 next largest business organizations in the U.S. Growing concern over the effects of industrialism led to direct primaries (1907, 1911), a new ballot form (1911), the election of Woodrow Wilson as governor (1911–13) and the passage in 1913 of the "Seven Sisters" acts for eliminating the power of trusts to create monopoly, limit production,

fix prices and restrain trade. New laws limited public service franchises to 20 years, subject to municipal referendum.

Political power in New Jersey has usually been shared by the two major parties, but between 1914 and 1951 the Democrats never gained control of both houses of the legislature and only twice had control of either. After 1910 six of the nine governors elected were Democrats, as just half had been since the election of the first Republican in 1857. In the presidential elections from 1892 through 1948 the state voted Democratic in 1912 for Woodrow Wilson and in the four elections of Franklin D. Roosevelt.

Following popular rejection in 1944 of the draft constitution which the legislature had passed pursuant to a popular referendum in 1943, the convention, delegates to which had been popularly elected on June 3, 1947, assembled in New Brunswick on June 12. By Sept. 12 they had prepared the new constitution which on Nov. 2 the voters approved. On Jan. 1, 1948, consequently, New Jersey replaced its 103-year-old constitution. For the first time in more than 100 years the electorate in Nov. 1949 could re-elect a governor and for the first time in 40 years the Republicans held the governorship for two successive terms. Legislative sessions in 1948–51 enacted the basic measures for effecting the structural changes required under the new constitution.

Population.—The population of New Jersey in 1790 was 184,139; in 1830 it was 320,823; in 1870, 906,096; in 1910, 2,537,167; in 1940, 4,160,165; and in 1950, 4,835,329. This last figure represented an increase of 16.2% over the population in 1940. The population per square mile in 1950 was 642.8, as compared with 553.1 in 1940 and with 50.7 for the U.S. in 1950.



BY COURTESY OF THE U.S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF NEW JERSEY: 1870 TO 1950

The crosshatched part of the 1950 bar represents the population of the additional areas counted as urban under the new 1950 definition

The urban area of New Jersey in 1940 comprised all incorporated places of 2,500 or more plus 12 townships classified as urban under a special rule which counted as urban any township with a total population of 10,000 or more and a density of 1,000 persons or more per square mile. The population of this area was 3,394,773, or 81.6% of the state total. The population in 1950 of all incorporated places plus the 12 special-rule townships was 3,847,771, or 13.3% more than in 1940, and represented 79.6% of the state total.

TABLE I.—*Population of New Jersey and Its Principal Cities*

Area	Population			Per cent of increase	
	1950	1940	1930	1940–50	1930–40
The state	4,835,329	4,160,165	4,041,334	16.2	2.9
Urban	4,186,207*	3,394,773	3,339,244	23.3	1.7
Rural	649,122*	765,392	702,090	−15.2	9.0
Per cent urban	86.6	81.6	82.6	..	..
Principal cities					
Newark	438,776	429,760	442,337	2.1	−2.8
Jersey City	299,017	301,173	316,715	−0.7	−4.9
Paterson	139,336	139,656	138,513	−0.2	0.8
Trenton	128,009	124,697	123,356	2.7	1.1
Camden	124,555	117,536	118,700	6.0	−1.0
Elizabeth	112,817	109,912	114,589	2.6	−4.1
East Orange	79,340	68,945	68,020	15.1	1.4
Bayonne	77,203	79,198	88,979	−2.5	−11.0
Clifton	64,511	48,827	46,875	32 1	4.2
Atlantic City	61,657	64,094	66,198	−3.8	−3.2
Passaic	57,702	61,394	62,959	−6 0	−2.5
Union City	55,537	56,173	58,659	−1.1	−4.2
Hoboken	50,676	50,115	59,261	1.1	−15.4

*Final figures for 1950 based on new definition. *See* comment in text.

The entire urban population under a new definition set up for 1950, which included also the thickly settled suburban area, or "urban fringe," adjacent to the 13 cities which had a population of 50,000 or more in 1940, and 15 unincorporated places of 2,500 or more outside this fringe, amounted to 4,186,207 or 86.6% of the state total.

The number of households in 1950 was 1,374,422, as compared with 1,100,260 in 1940.

The average population per household had declined from 3.8 in 1940 to 3.5 in 1950.

The population of the state was distributed by colour and nativity in 1950 as follows: 80.3% native white; 13.0% foreign-born white; and 6.6% nonwhite, practically all Negro. There were 97.2 males per 100 females in the 1950 population, as compared with 99.0 in 1940; 8.1% of the population was 65 years old or over; and 55.8% of the population 14 years old and over was in the labour force.

Of the total number of employed males, 3.2% was engaged in agriculture, 8.6% in construction, 37.7% in manufacturing, 9.8% in transportation, communication and other public utilities; 18.3% in wholesale and retail trade and 16.6% in service activities of all kinds, including public administration.

Government.—Through the constitutions of 1776, 1844 and 1947, New Jersey moved from a government of legislative dominance to one of separation of powers and a strengthened executive. The third constitution was notable for changes in the bill of rights, the administration and the judiciary. For the first time a state granted women constitutional recognition of equal rights. Discriminatory treatment and segregation "because of religious principles, race, color, ancestry or national origins" was prohibited in the militia and public schools. (In 1948 the legislature vested in the division of civil rights responsibility for administering all protections of civil rights in education, health, recreation and public accommodations.) Labour was guaranteed the right to organize and bargain collectively. The suffrage is vested in all U.S. citizens, 21 years old and over, resident in the state for one year and in the county five months preceding the election.

The governor alone is chosen by state-wide electorate. Following a four-year term he may be re-elected but an interval of four years must elapse before further re-eligibility. If the governor dies, resigns or is removed from office, the president of the senate or the speaker of the assembly succeeds him. Since the executive departments were limited to 20, the legislature in 1948 consolidated more than 80 agencies into 13 departments, the heads of which the governor appoints with senate approval. He likewise appoints the chief justice and associate justices of the supreme court and judges of all other courts with jurisdiction extending to more than one municipality. The legislature appoints the auditor. Other appointments and promotions in the state and its subdivisions are subject to constitutional provision for competitive examinations and the merit principle.

The senate has 21 members, one for each county, chosen approximately one-half each biennium. The assembly has 60 seats apportioned according to population, provided that each county has at least one member (two-year term). The legislature meets annually. The governor may (from 1875) veto any item in appropriation bills. Two-thirds of all members in each house may override his veto. After 10 days during the session or 45 after adjournment, bills become law without his signature. Amendments to the constitution must first be passed either by three-fifths of all of the members of each house or in two successive legislative years by a majority of all of the members of each house, then ratified by a majority of the legally qualified voters voting thereon.

The American Judicature society in 1948 reported that the reorganized judiciary "attains most of the objectives for which (they) and others have contended for the past thirty-five years." The supreme court consisting of a chief justice and six associate justices has administrative direction over the superior court (not less than 24 members), the county courts and such courts as the legislature may establish. Reappointment of a member of the supreme or superior court after his initial seven-year term is for an indefinite period. Retirement at 70 is compulsory. The supreme

court replaced the court of errors and appeals. A superior court with appellate, chancery and law divisions replaced the chancery, supreme and circuit courts. County courts with law and probate divisions replaced courts of common pleas, oyer and terminer, quarter sessions and special sessions. Judges are appointed for five years. The legislature in 1948 retained the juvenile courts and the district courts of criminal jurisdiction, reorganized the district courts of civil jurisdiction and established municipal courts to replace the following courts: police, recorders, family, magistrates, justices of peace, city district and small cause. In place of the court of pardons, the governor alone grants pardons. The constitution provides that power of local government be liberally interpreted. A broader area of home rule became available under the Optional Charter act of 1950. First to form a commission for interstate co-operation (1935), New Jersey has a diversity of compacts with other states, and participates in the interstate agency, the Port of New York authority (1921).

Finances.—The division of taxation in the department of the treasury in 1948 superseded the department of taxation which in 1944 had replaced the state tax department (1931). The director supervises eight bureaus administering respectively the following taxes: motor fuels, public utility and local, cigarette, railroad, beverage, transfer inheritance, corporation, outdoor advertising. The net assessed valuation of real and personal property exclusive of bank and trust company stock in 1950 was $5,944,408,870. In the state fund, cash receipts for the year ending June 30, 1950, were $218,487,528 and disbursements $166,554,540. Bonded indebtedness on July 2 was $76,090,000, all in serial bonds.

TABLE II.—*Distribution of All Federal, State and Local Taxes in New Jersey, Exclusive of Pay Roll Taxes, 1948*
(amounts in thousands of dollars)

Measures of tax	State and local	Federal	State, local and federal	Per cent of total taxes	Per cent increase 1939–48
Corporation income .	..	312,575	312,575	18.6	746.1
Individual income	..	681,014	681,014	40.5	1,344.0
Corporation franchise	7,092	..	7,092	0 4	266.1
Corporation insurance	6,951	..	6,951	0.4	57.4
Inheritance and estate	9,590	39,573	49,163	2 9	96.7
Excises. . . .	54,529	173,758	228,287	13.6	112.9
Property—real and personal . . .	322,160	..	322,160	19.2	−28.9
Property—railroad .	16,027	..	16,027	0.9	−13 8
Public utilities . .	24,448	..	24,448	1 5	88 3
Motor vehicles and drivers	30,480	..	30,480	1.8	49.7
All others . . .	2,033	1,528	3,561	0.2	133.0
Total taxes . .	473,310	1,208,448	1,681,758	100.0	219.7

Source: Commission on State Tax Policy.

The distribution of total expenditures of state and local governments in 1949 was: state purposes, 20.5%; county, 16.8%; municipalities, 37.6%; school districts, 25.1%. Relying upon special taxes for general state purposes (in 1949, 73% from taxes on cigarettes, alcoholic beverages, pari-mutuel racing and inheritances), the state maintained the lowest per capita state tax collection. Local government services depended primarily upon the general property tax, assessed and administered locally, which in 1949 amounted to 66.8% of total state and local revenue. The tax policy commission (1945) issued in 1950 its fifth basic study on the tax position of the state.

Education.—A total of 699,076 pupils enrolled in public schools during 1948–49, an increase of 6,314 over 1947–48. Children of migratory workers were brought under the school law. Employment of a child under 16 years of age while public schools are in session is illegal. The high schools had 164,070 enrolled, with an average of more than 700 pupils per school. The school system included: 556 districts with 800 kindergartens, 1,544 elementary schools, 153 high schools of four years or less, 72 junior and 48 senior high schools; a school for the deaf at West Trenton and a manual training and industrial school at Bordentown; five junior colleges; teachers colleges at Trenton (1855), Upper Montclair (1908), Newark (1855), Paterson (1855), Glassboro (1917) and Jersey City (1929). Rutgers university (1766, New Brunswick) by legislative act in 1945 became the "state university." New Jersey College for Women, New Brunswick, affiliated with Rutgers, opened in 1918.

A 12-member board (six-year term) and a commissioner of education (five-year term) are responsible for elementary, secondary and vocational education, junior colleges, higher education, the state library, the state museum and the civil rights division. The total expense of maintaining the public day schools in 1948–49 was $140,667,766 or a yearly average per pupil in average day attendance of $251. The investment in school property averaged $670 per pupil. Salaries for teachers including superintendents, principals and supervisors totalled $95,408,953. Eighty-seven per cent of the total school income was derived from the local property tax.

The second oldest public library in the U.S. opened in Trenton in 1750, the third oldest high school, in Newark in 1838. The free public-school system was achieved in 1871.

The department supervised in 1950 the licensing of 300 private nursery, child care and kindergarten schools. Industrial schools in Newark, Hoboken and Trenton received some state aid. Roman Catholic elementary schools enrolled 129,399 and high schools, 22,286 in 1949. Four junior colleges operated under private auspices. Private institutions of higher education having 1,000 or more students are: Princeton university (1746, Princeton), Seton Hall university (1856, South Orange), Rider college (1865, Trenton), Stevens Institute of Technology (1870, Hoboken), Newark College of Engineering (1881, Newark), Upsala college (1893, East Orange), Fairleigh Dickinson college (1941, Rutherford). Among the theological seminaries in the state are: New Brunswick, oldest in the U.S. (1784, Dutch Reformed, New Brunswick), Princeton (1812, Presbyterian), Drew (1867, Methodist, Madison), Bloomfield (1868, Presbyterian, Bloomfield), Immaculate Conception (1927, Roman Catholic, Ramsey).

Public Welfare.—The following 20 institutions were co-ordinated in 1950 under the department of institutions and agencies: the Diagnostic centre at Menlo Park; the Arthur Brisbane Child Treatment centre at Allaire; mental hospitals at Trenton, Greystone Park and Marlboro; for the mentally deficient, homes at Vineland, New Lisbon, Woodbine and schools at Vineland and Totowa; the Glen Gardner Sanatorium for Tuberculous Diseases; a village for epileptics near Skillman; reformatories near Clinton and at Annandale and Bordentown; reform schools near Jamesburg and at Trenton; the state prison at Trenton and prison farms at Rahway and Leesburg; a home for disabled soldiers at Menlo Park and for disabled veterans and their families at Vineland; a firemen's home at Boonton. About 5.1% of the aged population received old-age assistance.

Agriculture.—With only 3.1% of its population (1945) engaged in agriculture, the state supplied its own food needs directly or by exchange of surpluses. Favourable climate, stretches of good soil, heavy fertilization, abundant water supply for canneries, deep freezes and dehydrating plants, an unparalleled market easily accessible, the development of farmer-owned marketing co-operatives under state supervision kept agriculture a major industry in 14 of the 21 counties. The 26,226 farms in 1945 (84.4% owner-operated) comprised 1,818,103 ac. and were valued at $292,980,843. The average size of a farm in 1945 was 69.3 ac. and the average value per acre was $161.15; in 1948 the gross average cash income per farm was $12,370. During 1912–50 the index of estimated value of farm real estate rose for New Jersey 97%. Receipts from farm marketings in 1948 were distributed as follows: livestock and products, 58%; crops, 41%; government payments, 0.3%. Among the state's agricultural products in 1950 having a total value of $311,473,000, eggs led ($77,154,000) and with poultry meat ($24,200,000) contributed nearly 33% of the total value of farm products. Of the 14,634,000 chickens on farms, 9,930,000 were layers. Milk, second in value, brought $61,600,000. The average value per head of cattle was $285. The third most valuable agricultural commodity was vegetables. Grains, valued at $21,800,000, during 1943–50 displaced nurseries ($17,500,000) for fifth place. Compared with an average of 803,000 ac. in 1939–48, 799,000 ac. were harvested in 1950, of which 260,000 yielded 467,000 tons of hay, 177,000 ac., 9,588,000 bu. of corn; 78,000 ac., 1,677,000 bu. of wheat; 44,000 ac., 12,980,000 bu. of white potatoes (7,439,827 bu. in 1940). Of livestock having a value exceeding

$1,000,000 on Jan. 1, 1950, there were: all cattle, 228,000 ($63,-156,000); milch cows, 164,000 ($55,760,000); hogs, 69,000 ($2,-242,000); chickens, 14,636,000 ($30,000,000). The agricultural experiment station (1880), under Rutgers college (from 1924, Rutgers university), and the extension service (1912) fostered scientific agriculture. By 1949 New Jersey was one of eight states completely covered by soil conservation districts.

Manufacturing.—Of the total income in 1948, 34.4% came from manufacturing pay rolls. With resources of timber, sand, clays, copper and iron, New Jersey early developed shipbuilding, brick, terra cotta, pottery (*c.* 1684) industries, iron (1676), copper and glass (1740) works. The water resources of deep rivers, protected harbours, falls, canals and subsoil reserves aided industry in achieving that dominance which it held after 1880. Location in the centre of the commercial, financial and industrial region from Boston to Baltimore having 25,000,000 people and 23% of the national income, together with a growing market within the state (retail sales aggregated, in 1948, $4,470,800,000) encouraged industries which require cheap transportation and easy access to large markets.

TABLE III.—*Leading Industries of New Jersey, 1950*

Industry	Wage earners	Value in dollars
Chemicals and allied products	59,760	744,601,000
Electrical machinery	70,867	393,992,000
Food and kindred products	35,803	354,821,000
Machinery (except electrical)	51,761	334,610,000
Textile-mill products	56,734	326,239,000
Apparel and related products	65,694	252,037,000
Transportation equipment	34,490	221,725,000
Primary metal industries	33,013	216,426,000
Petroleum and coal products	13,307	212,807,000
Paper and allied products	18,086	154,568,000

In production of chemicals New Jersey led the U.S. and employed 13.1% of all in that industry. Of its 148,000 business establishments in 1950, 10,755 were manufacturing concerns which added $4,177,080,000 in the process of manufacturing (5.6% of U.S. total). Wages paid to 601,748 employees amounted to $1,-644,207,000. Aided by a high proportion of war-supply contracts, by 1947 New Jersey had risen from an industrial rank of seventh in 1939 to sixth place among the states. During 1939–50, however, its rate of expansion fell relative to that of the U.S.: number of establishments in the U.S. increased 30.7%, in New Jersey 25.7%; average number of wage earners in U.S. 51%, in New Jersey 38.8%; total wages in U.S. 232.7%, in New Jersey 215.4%; value added by manufacture in U.S. 201.5%, in New Jersey 174.1%. Employees were about equally distributed, in 1948, among durable goods industries (45.9%) and nondurable (48.9%). The chief manufacturing centres were Newark, Jersey City, Camden, Trenton, Bayonne and Paterson. The succession of inventors who enlarged the economic life of the state included John Fitch, John Stevens and his son Robert, Seth Boyden, John Wesley Hyatt, Hannibal Goodwin, Hudson Maxim and, most prolific of all, Thomas A. Edison. In a basement laboratory Allan B. DuMont of Upper Montclair developed the cathode ray television tube which led to his first experimental telecasts in 1938 and first commercial television station in 1948.

Labour.—New Jersey labour played a leading part in the establishment of the Knights of Labor (Uriah Smith Stevens, 1869), Labor day (Peter J. Maguire) and the events culminating in the Congress of Industrial Organizations. The oldest recorded strike in the U.S. occurred in 1828 in the Paterson cotton mills; for the first time the workers in the U.S. faced the state militia. New Jersey was the first state to enact maximum hour (1892) and employer liability laws (1911) and the third state to enact full workmen's compensation coverage (1949). A labour-management institute was established at Rutgers university by legislative act (1947) to enlist co-operation between the public, unions and management in basic research in industrial relations. In New Jersey the American Federation of Labor had its greatest strength in electrical, chauffeurs and teamsters, building constructing, culinary alliance, ladies' garment and chemical trades. C.I.O. strength lay especially in textiles, steel, automobile, electrical and radio machinery and rubber industries.

Minerals.—With a total value of $51,092,000 in 1948, mineral products included: zinc (76 short tons) $20,710,000; clay products (other than potteries and refractories) $8,149,000; sand and gravel, $7,490,000; limestone and sandstone for buildings and traprock for road construction, $6,376,000. The extraction and processing of iron ore in New Jersey, beginning about 1675, became a major support for the Revolutionary armies and the chief industry of the state by 1850; it declined in relative importance, however, after the Civil War. The 448,489 long tons produced in 1949 had a value of $4,468,575 or 11.6% of the total value of minerals produced in that year ($38,584,000).

Transportation.—Railways reaching New York city directly from the south and west and reaching Philadelphia from the north and east cross the state. Except for the Pennsylvania railroad, these lines have their terminals on the west bank of the Hudson in Jersey City, Hoboken or Weehawken, whence passengers and freight are ferried to New York. Electric railway tunnels under the Hudson connect Hoboken and Jersey City with New York; the latter have additional connections through the Holland and Lincoln tunnels. The 2,011 mi. of railroads (Dec. 31, 1948), 1,771 mi. of state highways, 6,556 mi. of county and 19,663 mi. of municipal roads and streets carry daily 1,000 passenger and 300 freight trains and the traffic of 1,440,773 automobiles, buses and trucks. Of the vehicles using the highways, streets and roads, the highway department estimated passenger cars at 79.4%, trucks at 19.7% and buses at 0.9% (1949). The New Jersey Turnpike authority (1948) undertook completion of New Jersey's part in an express highway to connect New York city with Washington, D.C.

The Newark airport, earliest major air terminal in the U.S., and that at Teterboro, which in 1948 and 1949 respectively came under the Port of New York authority, are the two best-known of New Jersey's 94 airports, 12 of which were commercial, 68 municipal and 5 military.

A great volume of water-borne commerce clears annually through the ports of Hoboken, Jersey City, Bayonne, Newark, Perth Amboy and Paulsboro.

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NEW JERSEY TEA (*Ceanothus americanus*), a North American shrub of the buckthorn family (Rhamnaceae), called also redroot, native to dry open woods and gravelly banks from Maine to Manitoba and southward to Florida and Texas. Its low, branching stems, one to three feet high, which spring from a dark red root, bear ovate, three-ribbed, somewhat downy, toothed leaves and attractive white flowers in umbel-like clusters. During the Revolutionary War the leaves were used as tea. (*See* CEANOTHUS.)

NEW JERUSALEM CHURCH or NEW CHURCH, the community founded by the followers of Emmanuel Swedenborg (*q.v.*). Swedenborg himself took no steps to found a church, but

having given a new interpretation of Scripture, it was inevitable that those who accepted his doctrine should separate themselves and organize a society in accordance therewith. Those who received them fully during Swedenborg's lifetime were few and scattered, but courageously undertook the task of dissemination, and gave themselves to translating and distributing their master's writings. Two Anglican clergymen were conspicuous in this work: Thomas Hartley (d. 1784), rector of Winwick, and John Clowes (1743–1831), vicar of St. John's, Manchester. Hartley translated *Heaven and Hell* (1778) and *True Christian Religion* (1781); Clowes, who taught New Church doctrine in the existing churches and was opposed to the forming of new organizations, translated 17 volumes, including the *Arcana Coelestia*, and published more than 50 volumes of exposition and defense. Through his influence Lancashire became the stronghold of the Swedenborgians.

In 1782 a society for publishing Swedenborg's writings was formed in Manchester, and in Dec. 1783 a little company of sympathizers with similar aims met in London and founded the Theosophical society, among the members of which were John Flaxman the sculptor, William Sharpe the engraver and F. H. Barthélemon the composer. In the early days most of them worshipped at the Female Orphan asylum, St. George's, whose chaplain, Rev. Jacob Duche, like Clowes at Manchester, preached the doctrines from his own pulpit.

In 1785 and 1787 J. W. Salmon and R. Mather conducted an open-air missionary tour in the midlands and the north with some success. Five prominent Wesleyan preachers adopted the new teaching and were cut off from their connection, a step which led, in spite of remonstrance from Clowes and others, to the formal organization of the New Jerusalem Church on May 7, 1787.

The first organized congregation of Swedenborgians met in a church in Great Eastcheap in Jan. 1788; and in April 1789 a general conference of British Swedenborgians was held in Great Eastcheap church, followed by another and by the publication of a journal, the *New Jerusalem Magazine*, in 1790. In the provinces the first church was at Birmingham (1791), followed by one at Manchester and another at Liverpool (1793). The Accrington church, the largest in Great Britain, was founded in 1802. Many of the early converts to the New Church were among the most fervent advocates of the abolition of slavery, one was the medical officer of the first batch of convicts sent to Botany Bay.

In 1815 the conference took up the question of home missionary work, and its agents were able to found many branches of the church. In 1813 the Manchester and Salford (now the North of England) Missionary society was founded, chiefly to provide preachers for the smaller churches in its area; in 1857 a National Missionary institution was founded and endowed, to which most of the local ones became affiliated. Other denominational agencies have been concerned with the printing and circulation of Swedenborgian literature, a training college for the ministry (founded in 1852), and a Ministers' Aid fund (1854), and an orphanage (1881). The constitution of the New Church is of the Independent Congregational type; the conference may advise and counsel, but cannot compel the obedience of the societies. Returns for 1928 showed 70 societies with about 6,300 members.

The New Church in Europe.—In Sweden the Philanthropic Exegetic society was formed by C. F. Nordenskiold in 1786 to collect documents about Swedenborg and to publish his writings. The introduction of alchemy and mesmerism led to its dissolution in 1789, but its work was continued by the society "Pro fide et charitate," which existed from 1796 to 1820. For many years the works of Swedenborg and his followers were proscribed, and receivers of his writings fined or deprived of office, but in 1866, when religious liberty had made progress, the cause was again taken up; in 1875 the society of "Confessors of the New Church" was formed in Stockholm, and propaganda has been carried on in most of the towns of Sweden, as also in Norway and Denmark. In Germany the great name is that of Immanuel Tafel (d. 1863), librarian of Tübingen, who not only edited, translated and published, but in 1848 founded a "Union of the New Church in Germany and Switzerland" which held quarterly meetings. In Switzerland, on the contrary, there is an organized body of the New Church. In France about 1838 J. F. E. Le Boys de Guays began his masterly translation of all Swedenborg's theological works; and nearly every European country has some known adherents.

In America.—About 1784 James Glen, a London Scot, delivered lectures in Philadelphia and Boston and circulated some of Swedenborg's works. Francis Bailey, state printer of Pennsylvania, was attracted by them and became active in their promulgation. During the next ten years a number of prominent men gave their support to the teaching, which spread inland and southward.

The first society for worship was formed in Baltimore, Md., in 1792 (reorganized 1798), though a short-lived one had preceded it at Halifax, N.S., in 1791. Other churches grew up in Philadelphia, Cincinnati, Boston and New York, and the general convention, which later met annually, was formed at Philadelphia in 1817.

In Australia, etc.—The formation of societies in Australia began at Adelaide in 1844. Melbourne and Sydney followed in 1854, Brisbane in 1865. New Zealand has a church at Auckland (1883). Mission churches have been established in Japan, the Philippine Islands and British Guiana; and in 1910 David W. Mooki organized a church for the natives of South Africa.

See L. P. Mercer, *The New Jerusalem in the World's Religious Congresses of 1893; Minutes of the General Conference of the New Church* (annual); *Journal of the Annual Session of the General Convention of the New Jerusalem in the United States of America.*

NEW KENSINGTON, a third-class city of Westmoreland county, Pennsylvania, U.S., on the Allegheny river and the Pennsylvania railroad, 18 mi. N.E. of Pittsburgh. Pop. 25,146 in 1950; in 1940 it was 24,055 by the federal census. It is a coal mining centre, and has important manufactures (including aluminum, glass, malleable iron and car springs, conduits, plastics and textiles).

The borough was founded in 1891, incorporated in 1892 and took on a city status in 1930.

NEWLANDS, JOHN ALEXANDER REINA (1838–1899), English chemist, was born in 1838.

He was one of the first to propound the conception of periodicity among the chemical elements. His earliest contribution to the question took the form of a letter published in the *Chemical News* in Feb. 1863. In the succeeding year he showed, in the same journal, that if the elements be arranged in the order of their atomic weights, those having consecutive numbers frequently either belong to the same group or occupy similar positions in different groups, and he pointed out that each eighth element starting from a given one is in this arrangement a kind of repetition of the first, like the eighth note of an octave in music.

The law of octaves thus enunciated was at first ignored or treated with ridicule as a fantastic notion unworthy of serious consideration, but the idea, subsequently elaborated by D. I. Mendeleyev (*q.v.*) and other investigators of the periodic law, took its place as an important generalization in modern chemical theory.

Newlands was of Italian extraction on his mother's side, and fought as a volunteer in the cause of Italian freedom under Giuseppe Garibaldi in 1860. He died in London on July 29, 1898.

He collected his various papers on the atomicity of the elements in a little volume on the *Discovery of the Periodic Law* published in London in 1884.

NEW LONDON, a city of southeastern Connecticut, U.S., on the west bank of the Thames river, at its junction with Long Island sound, and a port of entry. It is on federal highway 1 and is served by the Central Vermont and the New York, New Haven and Hartford railways. Pop. (1950) 30,551 (about 80% native white); in 1940 it was 30,456 by federal census. The city lies on sloping ground which commands wide views of the sound and the surrounding country from its higher points, and has a fine natural harbour.

At the entrance to the harbour, on either side of the river, stand Fort Trumbull and Fort Griswold, which during the American Revolution guarded the approach to the harbour. New London was a rendezvous for privateers during the Revolutionary War and the first naval expedition was organized in its harbour in 1776. In 1781 New London was nearly totally destroyed by fire at the

hands of the British, but a new community replaced the older settlement. There are many piers and wharves along the harbour including a state pier more than 1,000 ft. long with depressed railroad tracks.

New London was founded in 1646 by John Winthrop the younger. In 1658 the modern name was substituted for the original Indian name "Nameaug," and the Pequot or Monhegin river became the Thames. The city was incorporated in 1784. In the 18th century New London had a large trade with the West Indies, Gibraltar and the Barbary states but this declined after the War of 1812. It was also an important whaling and sealing port.

The Connecticut College for Women, United States Coast Guard academy, Admiral Billard academy and Mitchell college are located there. The city is a seaside summer resort and the home of several yacht clubs. Among points of special interest are the old town mill (1650), Shaw mansion, Hempsted house (1678), Huguenot house (*c.* 1759), New London County courthouse (1784), Ye Ancientest Burial Place (1653), the Whaling Museum and the Nathan Hale school.

Industrial production includes tools, turbines, textiles, printing presses, cigarette papers, paper boxes, machines, radio and television receiving sets, collapsible tubes, chucks and gears, wood products and chemicals

NEW LONDON, a city of Wisconsin, U.S., on the Wolf river, in Outagamie and Waupaca counties. It is on federal highway 45 and is served by the Chicago and North Western and the Green Bay and Western railways. Pop (1950) 4.922. It is a dairying region and has various manufacturing industries.

NEW MADRID, a city and the county seat of New Madrid county, Mo., U.S., on the right bank of the Mississippi river, about 35 mi. S. by W. of Cairo, Ill. Pop. (1950) 2,726; (1940) 2,450. It is served by the St. Louis Southwestern railway and by river barges. The city is a shipping point for a rich grain, cotton, livestock and lumber region. Among its manufactures are lumber and lumber products. The municipality owns its waterworks.

Because of the encroachments of the Mississippi river, the site of the first permanent settlement of New Madrid is said to lie now about 1½ mi. from the east bank of the river, in Kentucky. This settlement was made in 1788, on an elaborately laid out townsite, and was named New Madrid by its founder, Col. George Morgan (1742–1810), who, late in 1787, had received a grant of a large tract of land on the right bank of the Mississippi river from Don Diego de Gardoqui, Spanish minister to the United States. The tract lay within the province of "Louisiana," and the grant to Morgan was a part of Gardoqui's plan to annex to that province the western American settlements. Earthquake shocks in 1811 and 1812 caused a general emigration.

New Madrid was occupied by Confederate troops under Gen. Gideon J. Pillow, on July 28, 1861, and after the surrender of Fort Donelson (Feb. 16, 1862) the troops previously at Columbus, forming the Confederate left flank, were withdrawn to New Madrid and Island No. 10 (in the Mississippi about ten miles south). Early in March, Maj. Gen. John Pope and Commodore A. H. Foote proceeded against the positions on the left bank; New Madrid, then in command of Gen. John P. McGown, was evacuated on the 14th; Adm. Henry Walke (1808–96), commanding the "Carondelet," ran past the batteries of Island No. 10 and the shore batteries on April 4, and Lieut. Com. Egbert Thompson, commanding the "Pittsburgh," on the 7th; meanwhile the Federals under the direction of Col. Josiah W. Bissell (b. 1818), of the engineer corps, had, with great difficulty, constructed an artificial channel to New Madrid across the peninsula (swamp land) formed by a great loop of the Mississippi; troops were conveyed by transports through this channel below the island, Federal batteries having been established on the right bank of the river; the retreat of the Confederates downstream was effectually blocked; they evacuated the island on April 7, and on the 8th the garrison and the forces stationed in the shore batteries, a total of about 7,000, under Gen. W. W. Mackall, was surrendered at Tiptonville.

NEWMAN, FRANCIS WILLIAM (1805–1897), English scholar and miscellaneous writer, younger brother of John Cardinal Newman, was born in London on June 27, 1805. He was educated at Ealing, and at Oxford, where he was elected fellow of Balliol in 1826. Conscientious scruples respecting the ceremony of infant baptism led him to resign his fellowship in 1830, and he went to Baghdad as assistant in the mission of the Rev. A. N. Groves. In 1833 he returned to England on behalf of the mission, but finding himself suspected of heterodoxy, he became classical tutor in an unsectarian college at Bristol. In 1846 he became professor in University college, London, where he remained until 1869. In 1847 he published anonymously a *History of the Hebrew Monarchy.* In 1849 appeared *The Soul, her Sorrows and Aspirations,* and in 1850, *Phases of Faith, or Passages from the History of my Creed*—the former a tender but searching analysis of the relations of the spirit of man with the Creator; the latter a religious autobiography detailing the author's passage from Calvinism to pure theism. It is on these two books that Newman's fame rests, though he was a versatile writer on many subjects. He wrote on logic, political economy, English reforms, Austrian politics, Roman history, diet, grammar, the most abstruse departments of mathematics, Arabic, the emendation of Greek texts, and languages as out of the way as the Berber and as obsolete as the dialect of the Iguvine inscriptions. In treating all these subjects he showed signal ability but, wherever the theme allowed, an incurable "crotchetiness"; and in his numerous metrical translations from the classics, especially his version of the *Iliad,* he betrayed an insensibility to the ridiculous.

His character was vividly drawn by Thomas Carlyle in his life of John Sterling, of whose son Newman was guardian: "a man of fine attainments, of the sharpest-cutting and most restlessly advancing intellect and of the mildest pious enthusiasm." It was his great misfortune that this enthusiasm should have been correlated, as is frequently the case, with an entire insensibility to the humorous side of things.

His last publication, *Contributions chiefly to the Early History of Cardinal Newman* (1891), was severely criticized. He died at Weston-super-Mare on Oct. 7, 1897. *See* T. G. Sieveking, *Memoir and Letters of Francis W. Newman* (1909).

NEWMAN, JOHN HENRY (1801–1890), English cardinal and leader of the Tractarian movement, was born in London on Feb. 21, 1801, the eldest son of John Newman, banker, of the firm of Ramsbottom, Newman and company. At the age of seven Newman was sent to a private school conducted by Dr. Nicholas at Ealing.

At the age of 15 he was conscious of an "inward conversion," an incident which throughout life remains "more certain than that he had hands or feet." In 1816 he matriculated at Trinity college, Oxford.

After graduation in 1821 he took pupils and read for a fellowship at Oriel, to which he was elected in 1822. Two years later he was ordained in the Anglican ministry and became curate of St. Clement's, Oxford. For a year he was vice-principal of the St. Alban's hall, but in 1826 he became tutor at Oriel. In 1827 he was appointed vicar of St. Mary's (to which was attached the chapelry of Littlemore) and in 1831–32 was select preacher before the university.

In 1832 a difference with Edward Hawkins, provost of Oriel, on the "substantially religious nature" of a tutorship, led to his resignation from that post. He then went for a tour on the Mediterranean with R. H. Froude, but at that time was still strongly Protestant in his views, as his comments on his stay in Rome show. During this tour he wrote many of the poems in the *Lyra Apostolica,* and "Lead, Kindly Light."

Tractarian Movement.—He was at home again in Oxford on July 9, 1833, and on the 14th John Keble preached at St. Mary's an assize sermon on "National Apostasy," which Newman afterward regarded as the inauguration of the Oxford movement. In the words of Dean Church, it was "Keble who inspired, Froude who gave the impetus and Newman who took up the work"; but the first organization of it was due to H. J. Rose, editor of the *British Magazine,* who has been styled "the Cambridge originator of the Oxford movement." It was in his rectory at Hadleigh, Suffolk, that a meeting of High Church clergymen was held, July 25–29 (Newman was not present), at which it was resolved

to fight for "the apostolical succession and the integrity of the Prayer-Book." A few weeks later, Newman started, apparently on his own initiative, the *Tracts for the Times,* from which the movement was subsequently named "Tractarian." Its aim was to secure for the Church of England a definite basis of doctrine and discipline, in case either of disestablishment or of a determination of High Churchmen to quit the establishment. The teaching of the tracts was supplemented by Newman's Sunday afternoon sermons at St. Mary's, the influence of which was very great during the next eight years. In 1835 Pusey joined the movement, which, so far as concerned ritual observances, was later called "Puseyite"; and in 1836 its supporters secured further coherence by their united opposition to the appointment of Hampden as regius professor of divinity. His Bampton lectures (in the preparation of which Blanco White had assisted him) were suspected of heresy, and this suspicion was accentuated by a pamphlet put forth by Newman, *Elucidations of Dr. Hampden's Theological Statements.*

At this date Newman became editor of the *British Critic,* and he also gave courses of lectures in a side chapel of St. Mary's in defense of the *via media* of the Anglican Church as between "Romanism" and popular Protestantism. His influence in Oxford was supreme about the year 1839, when, however, his study of the monophysite heresy first raised in his mind a doubt as to whether the Anglican position was really tenable on those principles of ecclesiastical authority which he had accepted; and this doubt returned when he read, in Wiseman's article in the *Dublin Review* on "The Anglican Claim," the words of St. Augustine against the Donatists, *securus iudicat orbis terrarum,* words which suggested a simpler authoritative rule than that of the teaching of antiquity. He continued his work, however, as a High Anglican controversialist until he had published, in 1841, *Tract 90,* the last of the series, in which he put forth, as a kind of proof charge, to test the tenability of all Catholic doctrine within the Church of England, a detailed examination of the XXXIX Articles, suggesting that their negations were not directed against the authorized creed of Roman Catholics, but only against popular errors and exaggeration. This theory, though not altogether new, aroused much indignation in Oxford, and, at the request of the bishop of Oxford, the publication of the *Tracts* came to an end. At this date Newman also resigned the editorship of the *British Critic,* and was thenceforth, as he himself later described it, "on his deathbed as regards membership with the Anglican Church." He now concluded that the position of Anglicans was similar to that of the semi-Arians in the Arian controversy; and the arrangement made at this time that an Anglican bishopric should be established in Jerusalem, the appointment to lie alternately with the British and Prussian governments, was to him further evidence of the nonapostolical character of the Church of England. In 1842 he withdrew to Littlemore, and lived there under monastic conditions with a small band of followers, their life being one of great physical austerity as well as of intense reflection and prayer. To his disciples there he assigned the task of writing lives of the English saints, while his own time was largely devoted to the completion of an essay on the development of Christian doctrine, by which principle he sought to establish the identity of the teachings of the Christian Church throughout the centuries with those of the Roman Catholic Church. In Feb. 1843 he published, as an advertisement in the *Oxford Conservative Journal,* an anonymous but otherwise formal retractation of all the hard things he had said against Rome; and in September, after the secession of one of the inmates of the house, he preached his last Anglican sermon at Littlemore and resigned the living of St Mary's.

Reception into the Catholic Church.—But still an interval of two years elapsed before he was formally received into the Roman Catholic Church (Oct. 9, 1845) by Father Dominic, an Italian Passionist. In Feb. 1846 he left Oxford for Oscott, where Bishop Wiseman, then vicar-apostolic of the Midland district, resided; and in October he proceeded to Rome, where he was ordained priest. Four years later, he was given the degree of D.D. by the pope, *honoris causa.* At the close of 1847 he returned to England as an Oratorian, and resided first at Maryvale (near Oscott); then at St. Wilfrid's college, Cheadle; then at St. Ann's, Alcester street, Birmingham; and finally at Edgbaston, where spacious premises were built for the community, and where (except for four years in Ireland) he lived a secluded life for nearly 40 years. Before the house at Edgbaston was occupied he had established the London Oratory, with Father Faber as its superior. In 1850, at the Corn exchange in Birmingham, he delivered a course of lectures on "The Present Position of Catholics in England," in the fifth of which he protested against the anti-Catholic utterances of Dr. Achilli, an ex-Dominican friar, whom he accused in detail of numerous acts of immorality. Popular Protestant feeling ran very high at the time, partly in consequence of the recent establishment of a Roman Catholic diocesan hierarchy by Pius IX, and criminal proceedings against Newman for libel resulted in an acknowledged gross miscarriage of justice. He was found guilty, and was sentenced to pay a fine of £100, while his expenses as defendant amounted to about £14,000, a sum that was at once raised by public subscription, a surplus being spent on the purchase of Rednall, a small property on the Lickey hills, with a chapel and cemetery, where Newman is buried.

In 1854, at the request of the Irish bishops, Newman went to Dublin as rector of the newly-established Catholic university there. But conditions were not favourable and complications became so great that after four years he retired, the happy outcome of his stay there being a volume of lectures entitled *Idea of a University,* containing some of his most effective writing. In 1858 he projected a branch house of the Oratory at Oxford; but this was opposed by Manning and others, as likely to induce Catholics to send their sons to that university, and the scheme was abandoned. In 1859 he established, in connection with the Birmingham Oratory, a school for the education of the sons of gentlemen on lines similar to those of the English public schools, an important work in which he never ceased to take the greatest interest. But all this time (since 1841) Newman had been under a cloud, so far as concerned the great mass of cultivated Englishmen, and he was now awaiting an opportunity to vindicate his career. In 1862 he began to prepare memoranda for the purpose.

Works.—The occasion came when, in Jan. 1864, Charles Kingsley, reviewing Froude's *History of England* in *Macmillan's Magazine,* incidentally asserted that "Father Newman informs us that truth for its own sake need not be, and on the whole ought not to be, a virtue of the Roman clergy." After some preliminary sparring between the two, Newman published, in weekly parts, his *Apologia pro vita sua,* a religious autobiography of unsurpassed interest, the simple confidential tone of which "revolutionized the popular estimate of its author," establishing the strength and sincerity of the convictions which had led him into the Roman Catholic Church.

In 1870 he put forth his *Grammar of Assent,* the most closely reasoned of his works, in which the case for religious belief is maintained by arguments differing somewhat from those commonly used by Catholic theologians; and in 1877, in the republication of his Anglican works, he added to the two volumes containing his defense of the *via media* a long preface and numerous notes in which he criticized and replied to sundry anti-Catholic arguments of his own in the original issues. At the time of the Vatican Council (1869–70) he thought the time inopportune for a definition of Papal infallibility, and in a private letter to his bishop (Ullathorne), surreptitiously published, he denounced the "insolent and aggressive faction" that had pushed the matter forward. But he made no sign of disapproval when the doctrine was defined, and subsequently, in a letter nominally addressed to the duke of Norfolk on the occasion of Mr. Gladstone's accusing the Roman Church of having "equally repudiated modern thought and ancient history," Newman affirmed that he had always believed the doctrine, and had only feared the deterrent effect of its definition on conversions on account of acknowledged historical difficulties.

In 1878 his old college (Trinity), to his great delight, elected him an honorary fellow, and he revisited Oxford after an interval of 32 years. At the same date died Pius IX. His scholarly suc-

cessor and illustrious patron of education, Leo XIII, was encouraged by the duke of Norfolk and other distinguished Roman Catholic laymen to make Newman a cardinal, the distinction being a marked one, because he was a simple priest and not resident in Rome. The offer was made in Feb. 1879, and the announcement of it was received with universal applause throughout the English-speaking world. The "creation" took place on May 12, with the title of St. George in Velabro, Newman taking occasion while in Rome to insist on the lifelong consistency of his opposition to "liberalism in religion." After an illness that excited apprehension he returned to England, and thenceforward resided at the Oratory until his death, Aug. 11, 1890, making occasional visits to London, and chiefly to his old friend, R. W. Church, dean of St. Paul's, who as proctor had vetoed the condemnation of *Tract 90* in 1841.

Newman's influence as controversialist and preacher was very great. Some hundreds of clergymen, influenced by the Tractarian movement of which for 10 or 12 years he was the acknowledged leader, made their submission to the Church of Rome. And the influence continued to be felt. Practically all English converts since 1845 partly attribute their conversion to Newman. Newman's works were translated into several European languages. The accompanying schools of thought, the "Credo in Newmanum," were especially characteristic of France and Germany before Sept., 1939. The attempts of the "Modernists" to make a protagonist of Newman failed, as is evident from Pius X's letter to Bishop O'Dwyer and from the tribute paid to Newman by Pius XI. Many anthologies from his writings appeared, especially in the United States, where, too, a large number of societies, etc., were named in his honour. Several of his works were edited for collegiate study, and similarly his sermons as homiletical models. Passages from his devotional writings were adapted to the form of petition and published as Newman prayerbooks. A movement was started to promote his being declared "Venerable," the first process towards canonization. Newman had a vivid sense of man's personal relationship with God. As he expressed it . . . "alone with the Alone," two beings in all creation, God and himself. All else was a reflection of the Supreme Being. His sincerity of purpose was acknowledged by the English people slowly but in the end generously, in their happiness over his being chosen a cardinal. He was a man of magnetic personality, with an intense belief in the apostleship of his own career; and his character may be described as strong, with an almost feminine sensitiveness to impressions. As a poet he had inspiration and genuine power. "The Dream of Gerontius" is generally recognized as a masterpiece. His prose style is fresh and vigorous.

There is at Oxford a bust of Newman by Woolner. His portrait by Ouless is at the Birmingham Oratory, and his portrait by Millais is in the possession of the duke of Norfolk, a replica being at the London Oratory. Outside the latter building, facing Brompton road, is a marble statue of Newman as cardinal.

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(A. W. Hu.; D. Ol.)

NEWMARKET, a market town 13½ mi. N.E. of Cambridge, England, on the Bury branch of the North-Eastern Railway route. Pop. of urban district (1938) 9,207, and of rural district (1938) 18,820. Area of former, 8.6 sq.mi. For administrative and parliamentary purposes the town and urban district are in West Suffolk, though the rural district is in Cambridgeshire. Newmarket has been celebrated for its horse races from the time of James I, though at that time there was more coursing and hawking. Charles I instituted the first cup race there.

The racecourse, which lies southwest of the town, has a full extent of four miles, but is divided into different lengths to suit various races. It intersects the Devil's ditch or dyke (sometimes also known as St. Edmund's dyke) an earthwork consisting of a ditch and mound about seven and one-half miles long. It starts southeast of the Swaffham-Burwell road, and the ditch has a depth of 15 ft., the slope from the top of the dyke to the bottom of the ditch measures 62 ft., while the over-all breadth of dyke and ditch is 37 yd. It is surmised that it belongs to the Iron Age, and that the builders were the Iceni.

Roman remains have been found in the neighbourhood, and in later times the dyke formed a part of the boundary of East Anglia. (*See* C. Fox, *Archaeology of the Cambridge Region*, 1923.)

NEW MEXICO, popularly known as the "Sunshine state," is located in the southwestern part of the United States. The southern boundary varies from 31° 20′ to 32° N. lat. The eastern boundary is 103° W. from Greenwich; the western, 109° W. It is bounded north by Colorado; east by Oklahoma and Texas; south by Texas and the republic of Mexico; and west by Arizona. It has an extreme length north and south of 400 mi., an extreme width east and west of 358 mi. and a total area of 121,666 sq.mi., of which 155 sq.mi. are water surface.

Physical Features.—The borders of the state are characterized by high plateaus cut by deep canyons, while in the central part faulted mountains surround comparatively level areas filled with alluvial deposits. Between the Rio Grande and the Pecos valley the mountains form a more continuous range than on the west side of the river where the elevated areas form the main continental divide.

The Sangre de Cristo mass is a part of the Colorado mountains which extend into New Mexico slightly east of the north central part of the state and east of the Rio Grande. South of this northern mass two series of ridges extend to the southern boundary: the one near the Rio Grande, called in places from north to south the Sandía, the Manzano, the San Andrés, the Oscura and the Organ mountains; while the eastern group consists of the hills of Pedernal, the White, the Sacramento and the Guadalupe mountains.

On the west side of the Rio Grande the San Juan mountains dominate the country north of the Chama river. A second somewhat smaller mass lies between the Chama and the Jemez river, the Jemez mountains. Across the Puerco the Mount Taylor mountains carry the main divide in a southwestern direction to the Zuñi mountains, which are continued farther south in one of the largest mountain masses of the state, the Mogollons, with the San Mateo and the Magdalena as outlying ridges in the direction of the Rio Grande, and the Black range forming the southeastern part. In the extreme southwestern part of the state the western mountains terminate in several parallel ridges; the Burro, the Pyramid, the Big Hatchet and the Peloncillo mountains. The altitude ranges from 2,876 ft. above sea level to

13,306 ft.

The major divides following the tops of the ranges and high plateaus run generally north and south. Of the most important there may be mentioned the divides between the Pecos and the Canadian valleys; between the Pecos and Tularosa valleys; between the Tularosa and the Rio Grande; and between the Rio Grande and the San Juan, Little Colorado and Gila valleys.

The rivers are the only important bodies of water that make up a part of the physiography of the state. In the northeastern part of the state, in Union county, two of the branches of the Arkansas river have their sources. These are the Cimarron and the North Canadian rivers. A third branch of the Arkansas, the Canadian, flows through Colfax, Mora, San Miguel and Quay counties.

As the Canadian drains the eastern part of the Sangre de Cristo range, so the Pecos river receives the water from the southern part of the range and flows in a southerly direction across the state.

The Rio Grande is the only important river in New Mexico that does not have its source within the state. It enters New Mexico in a deep canyon a short distance to the east of the 106th meridian, and flows south through the centre of the state. On the western side of the continental divide the principal rivers are the San Juan, Little Colorado and Gila, tributaries of the Colorado which flows to the Gulf of California.

The principal characteristics of the soils of New Mexico are: a large amount of mineral matter; a small amount of organic matter; deep soils; and a marked degree of productivity when irrigated.

Climate.—The climate is relatively dry with considerable variation in temperature. The extremes range from 110° F. to −29°. The average winter temperature is about 39° in the south and 29° in the north; for the summer the figures are about 77° and 68°. The average rainfall is 8.57 in. The northwestern quarter of the state has an average rainfall of 7 in. to 20 in. or more, varying with the altitude, and the northeastern quarter experiences 14 in. to 25 in. or more.

The winds blow from the south and west with occasional winter variations to the north and northwest in the northwestern quarter. The average relative daytime humidity varies from 36% to 70% at Roswell, in the southeast, to 41% and 59% at Santa Fe, in north central New Mexico. The skies are generally clear and sunshine is abundant.

Flora and Fauna.—The physiographical conditions of New Mexico determine, in a measure, the distribution of plants and animals. Six life zones are represented in the state, caused by variation in altitude which is a striking characteristic of mountainous areas.

The Lower Sonoran is the zone of mesquite, occupying the valleys of the southern part of the state. For agricultural purposes it is the most important of the zones, because of the long growing period and the high temperatures.

The woody plants of this region include the creosote bush, the Spanish bayonet, the screw bean, the desert willow and valley cottonwood. Cactuses in a variety of species are a part of the flora of this zone.

Among the mammals there are a number of species of rats, mice, squirrels, rabbits, skunks and bats. There are also the jaguar, the New Mexico desert fox, the Mearns coyote, the Mexican badger and the New Mexico weasel. The birds are numerous.

The Upper Sonoran, the largest of the zones, ranks first in economic wealth. It embraces the grazing lands that include about three-fourths of the state, or 92,000 sq.mi. The grasses that give this zone its value are the grama, the galleta, buffalo and porcupine.

Several species of deer, coyotes, antelopes, wolves, prairie dogs and mountain sheep are common to the area.

The Transition zone, covering about 10,000 sq.mi., is the section of the state important for timber. Very little agriculture is carried on, but there is good range for stock. The Merriam elk, Rocky mountain lion, Mexican mountain lion, the mountain bobcat, mountain coyote, Mexican wolf, black bear, grizzly bear, otter and mink are found in this zone.

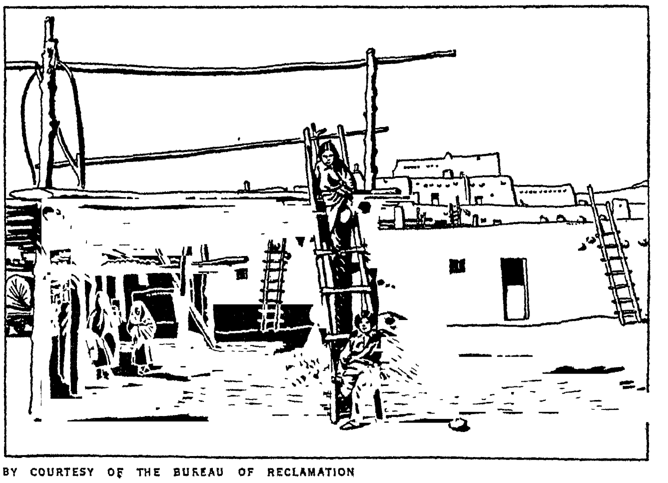
The Canadian zone is about one-fifth the size of the Transition. Its importance lies in the water supply that it stores for the regions of lower altitude. Its lowest parts on the cold slopes are at an altitude of 8,500 ft. The trees found are the Bristol cone pine, the western white pine, Douglas spruce and the balsam.

The Hudsonian is a very narrow zone along the timber line on the upper slopes of the high mountains with an area of 300 sq.mi. The trees and shrubs include the Siberian juniper, Englemann's fir, Parry's fir, several species of currants and sedges. The mammals are few, being mountain sheep, Rocky Mountain woodchuck, the grey and dusky rock cony.

The Arctic-Alpine is the smallest of the life zones represented in New Mexico. The area is above the timber line, at about 12,500 ft. Among the plants are the Colorado poppy, several species of saxifrages, sedges and rushes, the dwarfed closed gentian, alpine larkspur, alpine sagebrush. Few mammals enter the region.

History.—In the period 1525–43 explorations extending from Florida to the California coast paved the way for the later colonization of Florida and New Mexico in the latter part of the 16th century, Texas in the early part of the 18th and California in the latter part of that century. The first of the expeditions was that of Pánfilo de Narvaez. The treasurer of this expedition, Cabeza de Vaca, wandered across the continent to New Spain in the years 1528–36.

The appointment of Antonio de Mendoza as first viceroy of New Spain in 1535 marked the beginning of a period of improved organization in the continental possessions of Spain. Early in 1539 Friar Marcos de Niza was chosen by the viceroy to investigate the land north of Culiacán and inaugurate a new policy in Indian affairs. When Friar Marcos left Culiacán, March 1539, he was accompanied by Estevan, as guide, who was one of the four survivors of the Narvaez expedition. The party reached the vicinity of the Zuñi pueblos, in western New Mexico. In



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EXTERIOR VIEW OF TAOS, SHOWING ONE OF THE TWO SIX-STORY PUEBLOS AND THE LADDERS BY WHICH IT IS ENTERED

the following year the well-equipped expedition of about 300 soldiers under Francisco Coronado arrived by the same trail. The Zuñi pueblos were conquered and the expedition established winter headquarters near the present town of Bernalillo. The Grand canyon of the Colorado was discovered and other parties explored the Rio Grande valley and the country as far east as the present state of Kansas.

An expedition was organized by the Franciscan friar, Augustín Rodríguez, in the summer of 1581 for the purpose of converting the Indians of the lands to the north of Mexico. A year later Antonio de Espejo led an expedition to rescue the friars of the Rodríguez party, who had remained in New Mexico without protection after the return of their military escort to Mexico. (The name New Mexico seems to have been applied to the pueblos of the Rio Grande valley in the summer of 1582, although the name applied by the members of the Rodríguez expedition, San Felipe, and the name given by Espejo, Nueva

Andalucía, were probably sometimes used.) Near the close of the century a contract was made with Juan de Oñate for the colonization of New Mexico.

The expedition was assembled in the vicinity of Santa Bárbara in Aug. 1597, and after several delays proceeded up the Rio Grande. The first settlement was made at San Juan de los Caballeros in the Chama river valley, July 11, 1598. The construction of the first church in New Mexico was completed and mass was celebrated on Sept. 9, 1598. The present capital of New Mexico, Santa Fe, was founded in 1610.

New Mexico remained a frontier mission field during the 17th century. Twenty friars were serving by 1624; the churches numbered 43; and the number of Christian Indians 34,000. The total Spanish population at the end of the century was only 2,000, which shows that the colony had not become an important source of wealth.

The differences between the Indian culture and the Spanish European manner of life were the principal causes of the revolt of the Pueblos in 1680. The Pueblo Indians were willing to accept the God of the Christians as an additional protecting power, but they could not give up their own beliefs concerning the spirits of the universe without completely destroying their organized tribal life, because every phase of their existence is affected by their conceptions of the relation of the tribe to the world.

The Spanish settlers abandoned their holdings and retreated southward to El Paso. Diego de Vargas effected a reconquest of the province between 1692 and 1696. Albuquerque was founded in 1706 and by 1799 had a population of 4,020. The total population of the province at the close of the 18th century was about 30,000; 20,000 Spanish and 10,000 Indians.

The internal affairs of New Mexico prior to 1821 were not affected to any great degree by the revolutionary developments which took place during this period in Spain and Mexico. New Mexico became a political subdivision of the Mexican republic; granted independence from Spain by the treaty of Córdoba, Aug. 24, 1821.

Trade with the U.S. settlements in the Missouri valley, which had been discouraged during the Spanish regime, was legalized in 1821. An annual caravan set out from Missouri in the spring of the year. The value of the merchandise carried on the outward journey increased from $15,000 in 1822 to $450,000 in 1843. The Santa Fe trade was a success because merchandise could be freighted across the plains to the markets of New Mexico and sold for a lower price than goods could be brought from Vera Cruz by way of Chihuahua.

The republic of Texas claimed the Rio Grande as its western boundary. The prosperous Sante Fe trade, which would be a rich source of taxation, encouraged Texas to assert this claim. An expedition was organized in 1841 which arrived in New Mexico in a disorganized condition and surrendered to Gov. Manuel Armijo at Anton Chico. A second expedition in 1843 also failed.

Upon the outbreak of war with Mexico the army of the west under command of Col. Stephen Watts Kearny, occupied Las Vegas Aug. 15, 1846, and took formal possession of the country. The capital was occupied three days later and a military government was established which ruled the territory for five years. The civil government was retained for two years during which period a rebellion broke out resulting in the assassination of Gov. Charles Bent at Taos, on Jan. 19, 1847. The territory of New Mexico was created by act of congress, Sept. 9, 1850, extending from the 103 meridian of longitude on the east to the territory of California on the west.

The present boundaries were fixed by 1863 with the formation of the territory of Arizona from the western half, and the territory of Colorado from a northern portion two years earlier.

At the outbreak of the Civil War the territory was invaded by a Confederate force, under command of Brig. Gen. H. H. Sibley, which marched up the Rio Grande valley and occupied the capital. The Union army under command of Col. E. R. S. Canby, with reinforcements from Colorado, won the decisive battle of the campaign at Apache canyon, on March 28, 1862. The period following the U.S. occupation was marked by the solution of the nomadic Indian problem and the economic development of the territory. A reservation was established in 1868 for the Navajo Indians in the northwestern part of the territory; the Mescalero Apache were settled in the southern part of the territory in 1873; and the Jicarilla Apache in the northern part in 1880. The legal status of the Pueblo Indian was complicated by the treaty of Guadalupe Hidalgo and later decisions of the U.S. supreme court.

BY COURTESY OF THE ATCHISON, TOPEKA AND SANTA FE RAILROAD

THE STATE ART MUSEUM AT SANTA FE

The building of railways into the west, the increasing population, and the quieting of the Indians resulted in a great increase in cattle and sheep. The overflowing cattle herds of Texas were used to stock the ranges in New Mexico and the States to the north. The Goodnight-Chisom trail up the Pecos valley was followed by the overland drives to the ranges in Colorado and Wyoming; and to the railway shipping points in Kansas. Conflicts occurred between the cattle and sheep raisers over water and the use of the open range. The most bitter of these was the Lincoln county war which started in 1877 and lasted about three years.

The Atchison, Topeka and Santa Fe railway was extended to Albuquerque in 1880. A year later connection was made with the Southern Pacific railway at Deming, which placed the territory on a transcontinental line.

With the advent of the railways mining and irrigation developed; the population increased and a public-school system was established in 1891.

The Spanish and Mexican land grants in New Mexico have constituted one of the most difficult land problems in the history of the state. The treaty of Guadalupe Hidalgo confirmed the grants but lack of accurate documents made difficult the settlement of conflicting claims.

Constant efforts were made to secure statehood. The Enabling act was passed by congress on June 20, 1910, a constitution was drafted and approved, and on Jan. 6, 1912, the state was formally admitted to the union. In politics during the first half of the 20th century New Mexico voted Democratic except in 1918, 1920, 1926 and 1928.

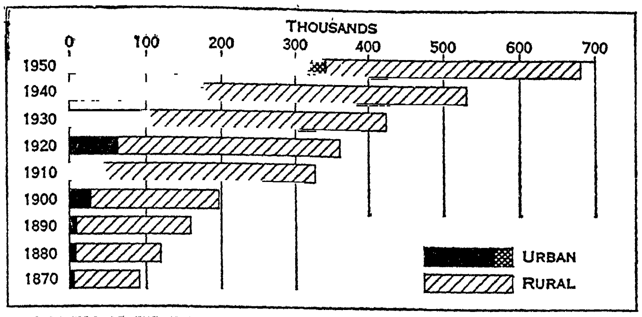
Population.—The population of New Mexico in 1850 was 61,547; in 1880 it was 119,565; in 1910, 327,301; in 1940, 531,818; and in 1950, 681,187. This last figure represented an increase of 28.1% over the population in 1940. The population per square mile in 1950 was 5.6, as compared with 4.4 in 1940, and with 50.7 for the U.S. in 1950.

Of the 1950 population, 314,636, or 46.2%, lived in incorporated places of 2,500 or more, as compared with 33.2% in 1940, when these places constituted the urban area. The entire urban population, under a new definition set up for 1950, which included also five unincorporated places of 2,500 or more, amounted to 341,889, or 50.2% of the state total.

The number of households in 1950 was 177,128, as compared with 129,475 in 1940.

The average population per household had declined from 4.1 in 1940 to 3.8 in 1950.

The population of the state was distributed by colour and nativity in 1950 as follows: 90.0% native white; 2.5% foreign-born



BY COURTESY OF THE U.S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF NEW MEXICO: 1870 TO 1950

The crosshatched part of the 1950 bar represents the population of the additional areas counted as urban under the new 1950 definition

white; and 7.5% nonwhite, mainly Indians. There were 104.2 males per 100 females in the total population, and 103.6 in the native white population alone.

Four and nine-tenths per cent of the population was 65 years old or over, and 50.4% of the population 14 years old and over was in the labour force.

Of the total number of employed males, 22.8% was engaged in agriculture, 6.5% in mining, 14.4% in construction, 6.6% in manufacturing, 7.2% in transportation and 16.4% in wholesale and retail trade.

Area	Population			Per cent of increase	
	1950	1940	1930	1940–50	1930–40
The state	681,187	531,818	423,317	28.1	25.6
Urban	341,889*	176,401	106,816	93.8	65 1
Rural	339,298*	355,417	316,501	—4.5	12.3
Per cent urban .	50.2	33.2	25.2	. .	. .
Principal cities					
Albuquerque . .	96,815	35,449	26,570	173.1	33.4
Santa Fe . . .	27,998	20,325	11,176	37.8	81.9
Roswell . . .	25,738	13,482	11,173	90.9	20.7

*Final figures for 1950 based on new definition. *See* comment in text.

Government.—With slight amendments the constitution adopted in 1911 remains the basis of the state government. Amendments may be proposed by a majority of the members in each house and must then be voted upon by the people at the next general election or a special election called not less than six months after adjournment of the legislature.

The state legislature is composed of a senate and house of representatives having 31 (beginning in 1953) and 55 members respectively. Regular sessions are held in odd-numbered years, beginning the second Tuesday in January. Representatives are elected for two years and senators for four. Special sessions can be called by the governor, and must be called by him on request of three-fifths of the legislators. The governor possesses the veto power which can be overridden by a two-thirds vote of the legislative members present and voting in each house. The people have the right of referendum.

A direct primary system was established in 1938. In 1949 it was changed to a preprimary nominating convention. The state has two representatives and two senators in the national congress.

The constitution provides for 11 elective administrative officers, namely, governor, lieutenant governor, secretary of state, auditor, treasurer, attorney general, commissioner of public lands, superintendent of public instruction and three corporation commissioners, all serving two years. They may succeed themselves for one term but are not afterward eligible for re-election until a two-year period has elapsed, except the lieutenant governor who may succeed himself indefinitely.

State boards and commissions numbered about 80 in 1950. Newer bodies included a board of examiners in the basic sciences for the healing arts, a fair employment practices commission, a commission on alcoholism, an economic development commission, a five-member state highway commission with overlapping six-year terms, and five-member bipartisan boards of regents with six-year overlapping terms for educational institutions.

There are five supreme court justices elected one at a time for terms of eight years each. Nine district courts (but 12 judges) hold two regular sessions each year at the county seat. The district judge is elected for six years. There are probate and juvenile courts in each county and justices of the peace in each precinct.

Finance.—The cost of state government nearly trebled in terms of dollars during the decade 1938 to 1948, increasing from $22,300,354 to $61,220,990. The assessed value of property subject to taxation increased during the decade from $312,442,485 to $482,441,779.

The adoption of a constitutional amendment limiting property taxation to 20 mills made necessary a sales tax in 1935, a severance tax in 1937, a compensating tax in 1939 and a tobacco tax in 1943.

In 1948 the gross state debt was $22,704,896, chiefly highway debentures. Because of that fact, the gasoline tax was raised from five cents to seven cents per gallon, with the increase earmarked for retirement of the highway indebtedness. The total of all receipts was $64,537,264, including $8,892,788 from the five-cent gasoline tax; $13,433,200 from the 2% sales tax; and $8,321,960 from oil and gas rentals and royalties.

There were 48 banks with total deposits of $275,578,000.

Education.—Previous to 1891 when the general public-school system of New Mexico was established, education was carried on mainly by private and religious agencies which established mission schools and academies. Progress in the public-school system was slow from 1891 until 1911 when statehood was granted, but was rapid thereafter, as is shown by the increase in expenditures for public schools.

The governing authority of the public-school system is the state board of education consisting of the governor, the superintendent of public instruction, who is elected for two years, and five members, who are appointed by the governor. During the period 1937–38 to 1947–48, enrolment increased from 129,877 to 136,097 in the public schools; expenditures from $9,001,045 to $22,940,958; and property valuation from $15,635,022 to $38,696,093. There were, in 1947–48, 868 schools, a marked decline for the decade; 982 buses transported about 33,000 students daily at a cost of $1,715,769. Teachers must have ordinarily a minimum of one year of college work; their average annual salary in 1950 was $2,287 in the rural schools and $2,854 in the city. Free basic elementary textbooks are supplied. A broad curriculum is provided; in the elementary schools it includes safety instruction and special attention for handicapped children. Summer workshop training for teachers was introduced in higher institutions. In addition to the public schools, there were 57 private and parochial schools in 1950 employing about 375 teachers for instructing approximately 13,500 pupils. The state maintains a contributory teacher retirement plan.

The University of New Mexico, in Albuquerque, is organized with a graduate school and eight colleges: arts and sciences, engineering, education, fine arts, pharmacy, business administration, law and general. It had a faculty of about 300 and an enrolment of about 4,800 annually at mid-century. Work is offered in summer session, field session, extension division, naval reserve officers' and air force reserve officers' training corps. The Ph.D. degree is granted in certain departments.

The New Mexico College of Agriculture and Mechanic Arts, near Las Cruces, offers work in schools of arts and sciences, engineering and agriculture. The latter includes the extension service, experiment station, regulatory services and instructional services. It is a land-grant college staffed with a faculty of about 150 and a student enrolment of about 1,700 at mid-century. The M.A. degree is granted.

The New Mexico School of Mines, in Socorro, includes the college division, bureau of mines and mineral resources and the research and development division. At mid-century it had a faculty of about 45, and the student enrolment was limited to about 300. The bachelor and a professional degree are granted.

New Mexico Highlands university (formerly New Mexico Normal university), Las Vegas, had a faculty of about 70, and an additional group of instructors in technical trades. The M.A.

degree is granted and extension work is offered. The university operates on the quarter system.

Eastern New Mexico university (formerly Eastern New Mexico college), Portales, had a faculty of about 60 in 1950. It is organized into schools of liberal arts and sciences, business and economics, music, teacher education and vocations. The B.A. degree is granted.

New Mexico Western college (formerly New Mexico State Teachers college), Silver City, offers work in liberal arts, teacher training and vocational training. It had a faculty of about 60 in 1950. The M.A. degree is granted.

The New Mexico Military institute, Roswell, is supported in part by state funds. High school and senior college work is offered.

A school for the blind is maintained in Alamogordo and a school for the deaf in Santa Fe.

Charities and Corrections.—The state supports a penitentiary, established at Santa Fe in 1884, and a prison farm of 2,000 ac. acquired in 1939 for outdoor rehabilitation; a hospital for the insane at Las Vegas, established in 1889; a miners' hospital at Raton, 1903; an industrial school for boys, originally established at El Rito in 1903 and moved to Springer in 1909; a girls' welfare home, Albuquerque, 1919; a school for mental defectives, Los Lunas, 1925; and the Carrie Tingley Crippled Children's hospital, Hot Springs, 1937.

Agriculture and Livestock.—The area east of the Rio Grande valley contains about four-fifths of the cropland harvested in the state. The valley and region to the west has an acreage of about 330,000, principally in the middle Rio Grande valley and Catron county northward.

In Curry, Roosevelt, Quay, Harding, Union and Colfax counties an average rainfall of approximately 14.3 in. permits considerable dry farming, while over the rest of the state crops are dependent almost entirely upon irrigation and confined to those river valleys where it is practicable: the Rio Grande, Pecos, San Juan, Gila, Canadian and their tributaries.

The estimated value of the major crops of New Mexico in 1949 was $90,051,000; the total cropland, including minor crops, was 1,830,000 ac. For the period 1938–47 the average acreage for leading crops was: grain sorghums, 190,000; winter wheat, 305,000; corn (maize), 177,000; dry beans, 196,000; cotton, 115,000; all hay, 217,000. The average annual production: grain sorghums, 2,663,000 bu. or 12.5 bu. per acre; winter wheat, 3,580,000 and 11.4; corn, 2,474,000 and 14.0; dry beans, 642,000 bags and 308 lb. per acre; cotton, 119,000 bales, 497 lb. per acre; all hay, 453,000 tons, 2.09 per acre.

The leading cash crop, cotton, was valued in 1948 at $38,249,000 in lint and $6,650,000 in cottonseed. For the same year all hay was valued at $14,022,000; dry beans, $2,938,000; grain sorghums, $4,486,000; corn, $3,024,000; and winter wheat, $6,397,000. Minor crops were: potatoes, $446,000; oats, $718,000; and barley, $703,000. Apples to the amount of 750,000 bu. were raised; peaches, 74,000 bu.; and 9,180,000 lb. of peanuts.

The chief farm animals in New Mexico are horses, mules, cattle, sheep and hogs. Their average annual value for the years 1939–48 was $94,720,000 and in 1949, $180,384,000. The number of horses and mules declined steadily during the period; they averaged respectively 114,000 and 9,000 head, but in 1949 numbered only 84,000 and 6,000. The average number of cattle for the period was 1,275,000, at an average value of $56.30 per head; in 1949 the number was 1,178,000 worth $149,606,000. Sheep averaged 1,888,000 at $8.40 per head; in 1949 1,393,000 were worth $23,820,000. Hogs averaged 103,000 at $17.30, but were estimated at 66,000 in 1949, worth $1,907,000.

The total estimated cash crop value for 1949 was $90,051,000; for livestock the total was $180,384,000.

Mining.—The high point in gold production was reached in 1915 with 70,681 oz. It dropped during World War I, reached a high point again in 1938, then declined to 3,249 oz. in 1949 worth $113,715. Silver reached a high point of 2,005,531 oz. in 1915 and 1,400,876 oz. in 1939, then declined to 380,855 in 1949 with a value of $344,693.

Copper has been a leading mineral; 160,200,000 lb. were produced in 1942, declining to 110,776,000 lb. in 1949, valued at $21,822,872. Lead ranged above an annual production of 20,000,000 lb. during the depression years 1929–33, then declined to 9,304,000 lb. in 1949, worth $1,470,032. Zinc reached a production of 119,048,000 lb. in 1943, then declined to 58,692,000 lb. in 1949, valued at $7,277,808.

Coal production slowly declined from 3,709,000 tons in 1913 to 980,000 tons in 1949 valued at $4,998,000. Newer sources of mineral wealth are petroleum, potash and natural gas. Petroleum production increased from 38,854,000 bbl. in 1937 to 47,932,000 bbl. in 1949. Potash was valued at $7,026,609 in 1941 and $33,529,132 in 1949. The estimated value of gas was $985,000 in 1940 and $5,365,000 in 1949.

Manufactures.—Without taking into account changes in classification of manufactures by the bureau of the census, and fluctuations during depression and recovery, manufacturing increased slowly in the first half of the 20th century. In 1899, 174 establishments employed 2,578 persons, paid them $1,290,000 and added $2,062,000 to value by manufacture. Comparable figures for 1947 were: 432; 7,590; $18,222,000; and $55,486,000. The great increase occurred after the census of 1939; for instance, value added by manufacture was only $8,640,000 in the latter year.

The chief industries in 1947 were food and kindred products; 144 establishments added $7,898,000 in value by manufacture. Lumber and products (except furniture) were 92 and $8,250,000. Printing and publishing industries; 78 and $3,729,000. Chemicals and allied products; 10 and $13,738.

Transportation.—Six railroads operate in New Mexico; the most important is the Atchison, Topeka and Santa Fe. Commercial air transportation is provided by one transcontinental and three regional lines (Albuquerque is the junction airport). Improved surface highways increased from about 2,100 mi. in 1929 to 9,154 mi. in 1948. A motorized state police was established in 1933 and a state driver's licence has been required since 1937. The ports of entry, established to collect the commercial mileage tax instituted in 1933, were placed under the state police and called registration stations.

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NEW MILFORD, an incorporated city of Bergen county in northeastern New Jersey, U.S.A. It is about 13 mi. N.E. of Paterson and about 10 mi. W. of the Hudson river. The altitude is 15 ft.

New Milford is on state highway 200 and is served by the New Jersey and New York railroad which is part of the Erie system. The population was 3,215 in 1940 and 6,018 by the federal census of 1950.

The city is governed by a mayor and a city council; the mayor

is elected directly by the people for a two-year term, the six city councilmen for three-year overlapping terms. There is a sewage treatment plant which is municipally owned and operated. New Milford is served by the Dennis Memorial library. Close by the city is the Oradell reservoir.

NEWNAN, a city of western Georgia, U.S., the county seat of Coweta county; on federal highway 29, 40 mi. S.W. of Atlanta. It is served by the Atlanta and West Point and the Central of Georgia railways.

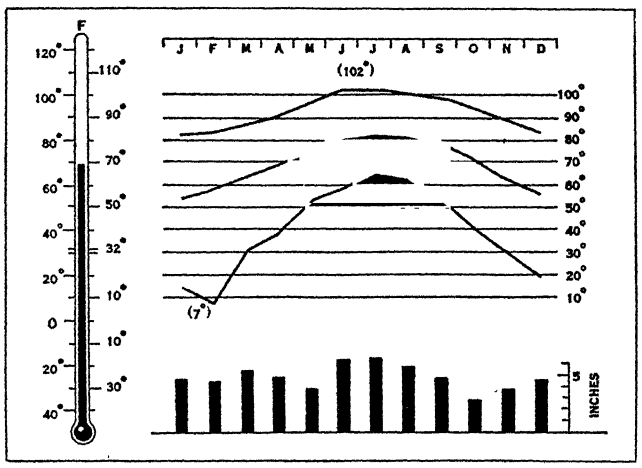
The population was 8,190 in 1950 and was 7,182 in 1940. It is a shipping point for agricultural products.

NEW ORLEANS, a city of Louisiana, U.S., situated on the east bank of the Mississippi river about 107 mi. from its mouth. It was originally on a bend in the river and from that fact its popular name, "Crescent City," was derived.

Physical Features.—The soil is an alluvial deposit from the river and, therefore, has its greatest elevation at the river bank, where the ground behind the levees is from 10 to 15 ft. above the mean level of the Gulf of Mexico; but the lower parts of the city are below gulf level. Built on the narrow ridge of land at the river bank, the growing city first expanded along the river front and later, the cypress swamps between the river and Lake Pontchartrain having been cleared and drained, covered a distance of from 4.5 to 7.3 mi.

The river approaches New Orleans flowing eastward, turns rather abruptly to the south at the upper municipal limits, then eastward as it passes the modern city, and finally northward in one of the sharpest bends to be found in the lower river, near the site of the original city or *vieux carré.*

The difficulties involved in building a city on such a site as that of New Orleans were great. Drainage, sanitation and a satisfactory water supply were realized nearly two centuries after the establishment of the first settlement, and in the interim yellow fever



WEATHER GRAPH OF NEW ORLEANS. THE THERMOMETER INDICATES THE NORMAL ANNUAL MEAN TEMPERATURE. THE MIDDLE CURVE SHOWS THE NORMAL MONTHLY MEAN TEMPERATURE; THE CURVES ABOVE AND BELOW, THE HIGHEST AND LOWEST EVER RECORDED IN EACH MONTH. THE COLUMNS INDICATE THE NORMAL MONTHLY PRECIPITATION

and cholera took frightful tolls. Modern engineering and sanitation finally triumphed, and modern New Orleans became one of the healthiest cities of the world.

The boundaries of the parish of Orleans and the city of New Orleans are the same, with a land area of 199.4 sq.mi. The boundary line is very irregular, but may be given approximately as Lake Pontchartrain on the north, the Rigolets and Lake Borgne on the east, the parish of St. Bernard and the Mississippi river on the south and Jefferson parish on the west.

The city gradually expanded by spreading along the higher lands near the river bank.

New Orleans is noted for its mild and balmy winters; the summers are uniformly warm but extreme heat is unknown, and the highest temperature recorded by the weather bureau is 102° F., while a temperature of 100° F. is seldom reached, because of the cool breezes from the Gulf of Mexico. Mean temperatures are:

January	54.5°	July	82.4°
February	57.2	August	82.3
March	63.0	September	79.4
April	68.9	October	70.4
May	75.2	November	61.9
June	80.9	December	55.7
Yearly average			69.3

The rainfall averages 56.77 in., well distributed through the year.

Population.—The population of New Orleans was 567,257 in 1950, 494,537 in 1940, 458,762 in 1930, and 387,219 in 1920. The increase in the decade 1940–50 was 14.7%; 1930–40, 7.3%; 1920–30, 18.5%. Every country in Europe is represented in the inhabitants. The Italians are the most numerous; other nationalities of great numerical strength are Irish, Germans, English and French. The French, because of the creole element, feel perfectly at home, speaking their own language, and living among sympathetic surroundings. The creoles are the descendants of the French and Spanish settlers of Louisiana. When the city passed under the U.S. flag the Americans built up a quarter for themselves, upstream from the *vieux carré,* the upper boundary of which was Canal street.

The line is not as strictly drawn now as in earlier years, as many creoles have settled in the newer portions of the city and some Americans have moved to the French quarter. This change was more pronounced in the third decade of the 20th century during which time a lively interest in the old quarter developed into a movement to preserve those buildings and other historical sites of the city.

Water Supply, Drainage and Sewerage.—The entire city, except for its levees, is below the river high-water mark while a large portion of it is below that of Lake Pontchartrain. Combined with these difficulties New Orleans has heavy rainfall; occasionally more than 3 in. in 1 hr., 7 in. in 5 hr. and 9 in. in 12 hr., having been experienced. As a result of the occasional excessive rainfalls, it has been necessary to provide large canal systems to convey the water to and from the pumping plants, and eight pumping stations for the removal of storm water have been built. The average annual rainfall is more than 56 in.; the topography is such that the runoff must be removed by pumping. The capacity of the drainage pumps is 27,000 cu.ft. per second; this is sufficient to remove the water from a lake 10 sq.mi. in area and 8.6 ft. deep in 24 hr.

Some drainage water is pumped more than once; altogether this is the greatest aggregation of drainage pumps to be found anywhere in the world.

The sewage of the city is collected separately from the drainage and is finally discharged into the Mississippi, where the dilution is so great that it is not noticeable farther downstream. Like the drainage, the sewage has to be pumped, much of it through two or more lifts, and this is accomplished by electric pumping stations operating automatically.

In the early days of the colony the turbid water from the Mississippi was carried from the river and settled in large earthen jars. Wells were used to supply water for household purposes but not for human consumption. In 1810, a first attempt was made to established waterworks. In 1833 the Commercial bank was organized for the purpose of establishing waterworks in New Orleans and iron pipes replaced the early wooden ones. In 1869 the city bought the system from the company, issuing bonds for that purpose; but lack of funds and bad management obliged the city in 1877 to give a monopoly to the New Orleans Water-Works company. The river water was too muddy to be useful for most purposes and cisterns were preferred, although a time of drought often caused scant supply.

To solve the problems involved and to study the methods of treatment for purification of the river water, an experimental plant was established in 1900, and a process adopted for softening by the use of lime and small amounts of sulphate of iron, producing a coagulation whereby the fine clay particles are brought together into large masses that will settle out in a few hours, or which are large enough to be completely removed by the filters. By this

process, first put into operation in 1909, New Orleans has had continuously an abundant supply of clear, pure water of the highest quality.

Later additions to the water purification plant increased its capacity to a normal production of 112,000,000 gal. per day and to a maximum of 160,000,000 gal. if necessary.

Streets, Bridges and Parks.—The streets of the *vieux carré* or old French city are narrow, but in the newer portions there are many wide avenues and boulevards, some of which were originally canals. Some of the avenues, such as St. Charles, Esplanade, Claiborne and others, were originally laid out with sufficient width for a street on each side, accommodating traffic in both directions and with a "neutral ground" between, which has been used for street car tracks and planted with trees.

New Orleans is situated on the Old Spanish trail which extends from San Diego, Calif., to St. Augustine, Fla. It is at the southern end of the Jefferson highway which runs to Winnipeg, and the Colonial highway which leads to New York. The Jackson and Mississippi Valley highways lead to points in the middle west and the Mississippi valley.

Early in the year 1928 the New Orleans-Pontchartrain bridge was opened to traffic. This concrete structure, nearly 25,000 ft. in length, was built by a private corporation at a cost of $5,500,000.

A more direct line to the Gulf coast was created shortly after by building bridges across Chef Menteur and the Rigolets by the Louisiana Highway commission.

New Orleans is well supplied with parks. Audubon park, with 234 ac., is situated in the upper portion of the city and contains a statue of Audubon. The original area of City park was about 1,400 ac., later developed and beautified further. The area was added to by hydraulic dredging on the lake shore front between West End and beyond Bayou St. John on the east. A large municipal yacht harbour was constructed at West End. Many miles of boulevards and driveways, with parks and bathing beaches, were also developed as residential areas. Most of the military installations constructed in this area during World War II were later disbanded, only a naval air base and Camp Leroy Johnson remaining. The old New Orleans airport on the lake was replaced in 1946 as the municipal terminal by the Moisant International, located 10 mi. W. of the city and covering 1,360 ac. It was served in 1950 by eight lines: Capital, Chicago & Southern, Eastern, National, Delta, Mid-Continent, Pan American and Taca.

Gas and Electricity.—Electric cars were first used in New Orleans in 1893. At that time there were several independent competing lines which were later consolidated into a modern, efficient system. In the 1940s these were replaced in part by buses. The New Orleans public service supplies electricity and natural gas for power, lighting and domestic use.

Port.—New Orleans is one of the largest North American ports, accommodating more than 80 steamship lines. Roughly 3,000 vessels enter the port annually. Foreign trade alone in 1949 amounted to 7,005,800 tons, with a value of $1,226,000,000, making it the second port in the nation. Water-borne commerce for the same year totalled 29,889,400 short tons. The limits of the port include a frontage of 41 mi. on both sides of the Mississippi and 11 mi. on the Industrial canal, which extends 5 mi. from the river to Lake Pontchartrain; 11 mi. of publicly owned wharves, steel sheds, cotton warehouses, grain elevators and other facilities are maintained. Located in the city is the nation's second foreign trade zone, and the construction of a shorter tidewater ship canal to the Gulf was approved by the U.S. engineers.

Transportation.—All railroad lines entering New Orleans terminate there: the Gulf Coast Line; Gulf, Mobile and Ohio; Illinois Central; Louisiana and Arkansas-Kansas City Southern; Louisville and Nashville; Missouri Pacific; Southern; Southern Pacific; Texas Pacific; and two short local lines to the delta below the city. Construction began in 1950 on a central union station and a complete rerouting of tracks.

The Federal Barge line supplies freight service to points on the Mississippi and Warrior rivers.

Commerce and Industry.—In 1948 there were 724 businesses producing products with a value added by manufacture of $222,995,000. Bank debits in 1949 were $8,345,725,000; in the same year property valuation was $619,249,761.

Education.—The New Orleans public-school system in 1949–50 consisted of 173 schools with a total attendance of 69,241. Of these 61 were kindergarten, 84 elementary, 13 high schools, 12 evening and 3 trade. Included were 54 separate schools for Negroes, with an attendance of 31,684. In addition there were 122 nonpublic schools, both private and parochial (mostly Catholic), 83 at the elementary level and 28 at the high school, with a total attendance of 38,364. The school population of the city below the college level, therefore, was divided into three roughly equal groups: white public schools, Negro public and nonpublic. There were 28 nonpublic high schools in contrast to 13 public. More than 5,000 students attended night school, slightly more than half of whom were Negroes.

Both the Catholic Church and the Lutherans operated their own systems. Uniform textbooks purchased by the state department of education were supplied to all nonpublic schools, and their classes were conducted under a curriculum approved by the department. Largest of the strictly private schools was Newman, founded in 1903, which is coeducational. The Delgado Trades school, opened in 1921, was the first of its type. The public school budget for 1949–50 was $10,200,000.

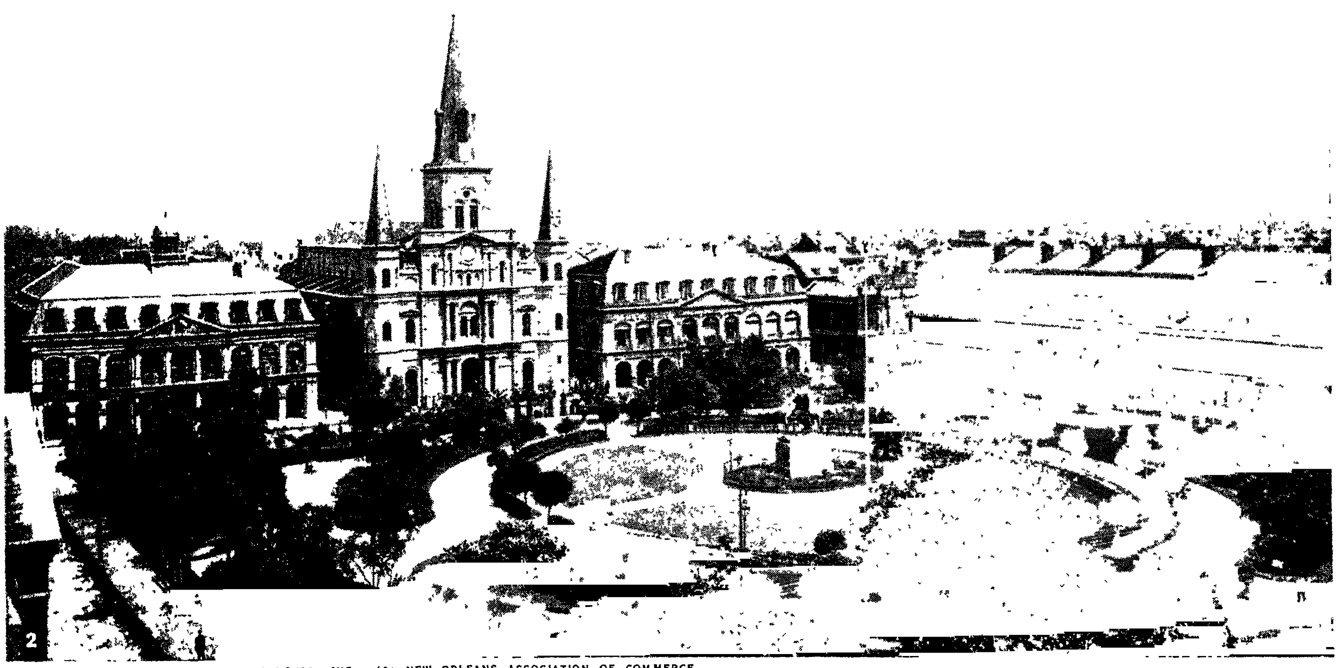
Tulane University.—The history of Tulane university dates back to the foundation of the medical college in 1834. It was chartered in 1835 and in the following year issued the first degree in medicine conferred in the southwest. The constitution of 1845 provided for the establishment of a university in New Orleans, embracing the medical college to which law and academic departments were to be added.

In 1882 Paul Tulane, for many years a merchant in New Orleans, gave liberally for the higher education of "the white young persons in the city of New Orleans." His entire donations reached the sum of $1,050,000. He died at Princeton, N.J., in 1887. In 1884 the board of administrators of the Tulane educational fund received from the legislature complete and perpetual control of the University of Louisiana. This act was ratified in 1888 and again in the constitutions of 1898, 1913 and 1921.

H. Sophie Newcomb Memorial college is the women's department of Tulane university. Tulane university had a total enrolment of 7,698 in all departments during the 1949–50 session, exclusive of the summer school, which numbered 1,902 more. Its endowment in June 1950 was $14,272,547.

Loyola University.—In 1904, the Jesuit fathers opened a school opposite Audubon park. A collegiate course was added and in 1912 the legislature granted them power to confer "degrees in arts and sciences and all the learned professions, such as are granted by other universities in the United States."

Monuments, Public Institutions and Customs.—The Delgado Art museum in City park was established by a gift from Isaac M. Delgado in 1911. There is a nucleus of an art collection containing many works of great merit. The annual exhibition of the Art association is an important event. The Cabildo houses an important historical museum containing much of interest and value pertaining to the history of Louisiana and New Orleans. The Presbytery, facing Jackson square on the side of the Cathedral of St. Louis, contains a valuable museum of natural history, principally relating to Louisiana. The Confederate Memorial hall contains relics of the Civil War. It is located on Camp street. The Tulane university museum occupies the entire third floor of Gibson hall; it contains petrological, palaeontological, zoological and anthropological sections. New Orleans has become one of the cultural centres of the United States and the mecca for writers, painters, sculptors and artists in all fields. Several galleries exhibiting contemporary art are to be found in the *vieux carré*. A civic symphony has been established and the Philharmonic society brings the great contemporary musicians and concerts to the city. The Metropolitan Opera comes annually, thus reviving interest in French opera which was originally heard in New Orleans long before it was heard in New York. The Middle American research institute, created in 1924 as a department of Tulane university, has a museum and library,



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VIEWS OF THE NEW AND OLD CITY OF NEW ORLEANS

1. Air view of New Orleans, showing at the left Canal street, the centre of the retail business district, and the skyscrapers of the modern city. In the distance is the Mississippi river
2. Historic Jackson Square, formerly the Place d'Armes, in the old French Quarter. On the left side of the St. Louis Cathedral, built in 1794, is the Spanish Cabildo, now part of the Louisiana State Museum, and on the right is the Presbytere, construction on which was started in 1794. On adjoining sides of this Square are the so-called Pontalba apartments built by the Baroness de Pontalba in 1849

field work and publications as its primary activities. The library of 40,000 items and the museum contain manuscripts, documents and other material relating to Mexico and Central America from expeditions and purchases which are being constantly increased. The institute has a permanent endowment of $300,000. The New Orleans spring fiesta was organized in 1937 and has created tourist interest in art, architecture, gardens and local traditions. New Orleans has been enriched by the liberal planting of azaleas and camellias, resulting in increased interest in gardening and landscaping.

New Orleans has a number of excellent hospitals: the Baptist; Charity; City (for mental diseases); Eye, Ear, Nose and Throat; Hôtel Dieu; Soniat Memorial-Mercy hospital; the Flint-Goodrich hospital of Dillard university for Negroes; Ochsner foundation; Sara-Mayo; Metarie; and the U.S. marine and U.S. veterans' hospitals, Illinois Central hospital and the Touro infirmary.

In 1950 construction began on a new $14,000,000 veterans' hospital.

More than 50 newspapers and periodicals are published in New Orleans, including two morning and two afternoon papers. The *New Orleans Picayune* was founded in 1837, the *Daily Times* in 1863, the *Daily Democrat* in 1875. The two latter formed the *Times-Democrat* in 1881 and this and the *Picayune* became the *Times-Picayune* in 1914. The *Daily Item* began publication in 1877, later becoming the *New Orleans Item* and in 1924 publishing the *Morning-Tribune* and the *Sunday Item-Tribune*, suspended in 1941 but resumed later. The *Daily States*, started in 1880, was purchased by the Times-Picayune Publishing company in 1933 as an afternoon and combined Sunday publication.

There are some 300 churches in New Orleans, representing different denominations. Roman Catholic churches are the most numerous.

The French opera house, designed by Gallier, was erected in 1859 at the corner of Bourbon and Toulouse streets. It was a distinctive and widely known centre of artistic and social life in New Orleans for many years. The Mardi Gras balls were held there until the building was destroyed by fire in 1919.

The carnival season extends from Twelfth Night to Lent, and its climax is reached in the festivities of Mardi Gras, the eve of Ash Wednesday. The ancient custom of celebrating the carnival was brought to New Orleans by the Latin peoples, and especially by the young creoles who studied in Paris and returned to live in New Orleans. Beginning with Twelfth Night there is a series of brilliant balls, and during the last week the balls of Momus, Proteus and Comus, preceded by gorgeous pageants, bring the season of mirth to a conclusion. On Mardi Gras, Rex parades the streets and at night the final parade is that of Comus.

Among writers and historians of note associated closely with New Orleans should be mentioned: John James Audubon, C. E. A. Gayarré, Alcée Fortier, Grace King, Mary Ashley Townsend, Lafcadio Hearn, George W. Cable, Mollie Moore Davis, Lyle Saxon and Harnett Kane.

Government.—The city government was at first carried out by a mayor and administrators, seven in number. Finally, in 1912, by act of the legislature, the commission form of government was adopted; the mayor became commissioner of public affairs. Four other commissioners had charge of public finances, public safety, public utilities and public property. In 1950, upon the re-election of Mayor deLesseps Morrison, a hostile legislature restored a semialdermanic system, increasing the number of commissioners to seven, each elected by a separate municipal district.

History.—The city of La Nouvelle Orléans was founded by a French governor of Louisiana, Jean Baptiste Le Moyne, Sieur de Bienville, and was named in honour of the regent, the duc d'Orléans. The island of Orleans was chosen for the site, on an elevation along the east bank of the river and about 107 mi. from its mouth, between the head of Bayou St. John and the river. Among the advantages of this site were the higher land, accessibility by two main waterways (the Mississippi and the lakes), and by Bayou St. John for the small craft of that day. On the other side of the river it was not far to Bayou Barataria, which later was destined to become the rendezvous of the famous pirates, Jean and Pierre Lafitte, and which offered access to the gulf without stemming the current of the Mississippi.

There is some doubt as to the exact date of the founding of New Orleans, but it is generally given as 1718. It was then proposed that John Law's famous company, which had obtained charter for the territory from France, should move its headquarters from the barren coast country to the new site. New Orleans thus became the capital of the Colony in 1722. At this time the city had but 100 houses and 500 inhabitants. It was laid out in approximately a parallelogram, 4,000 ft. long on the river by 1,800 ft. in depth, divided into regular squares 300 ft. on each side. In 1724 the streets were named. The houses were rude cabins of split cypress boards, roofed with cypress bark. They were separated from one another by willow copses and weed-grown ponds swarming with reptiles. Two squares on the river front near the centre of the city were set apart for military and ecclesiastical uses. The front was the Place d'Armes, now Jackson square; the rear one was early occupied by a church. In 1726 a monastery was erected to the east of the church for the Capuchin monks, who had arrived two years earlier. A company of Ursuline nuns came to New Orleans in 1727. At the same time the Jesuits arrived and received a large tract of land from Bienville, the French governor. This tract, bounded by what is now Common, Tchoupitoulas, Annunciation and Terpsichore streets, was later added to by donation and purchase and extended to Felicity street. Here the Jesuits cultivated myrtle, the wax of which was then a staple article of commerce; the orange, the fig, indigo and probably sugar-cane. These became staple crops. The Order was suppressed for political reasons in 1763 and its great plantation confiscated by the king of Spain.

Many storms and disasters occurred during the early years of the city. In 1719 the river rose to a great height and the site was completely inundated to a depth of a few inches. In 1722 a hurricane destroyed 30 houses and damaged crops. German colonists who had settled on the banks of the Arkansas managed to reach New Orleans and there prayed Bienville to send them back to their homes. He persuaded them to establish themselves along the river above the city, and thus was formed the nucleus of the German settlement, which to this day is called the German coast.

There were few women of good character in the Colony in the early days; and many of the better class of settlers, missing their home life, desired to return to France. It thus became imperative that if the settlement was to survive, the men must have good wives to make homes for them. When Bienville left the Colony in 1724, he promised to send a load of good women as soon as possible. In 1727 the "Casket Girls" (*Filles à la cassette*) arrived and were placed under the care of the Ursuline nuns whose convent had been established in the same year. They were first domiciled in Bienville's former home, but in 1730 their own house on Chartres and Ursuline streets was completed. This is one of the oldest buildings in the United States west of the Alleghenies.

In 1763 the Treaty of Paris was concluded between France and England. By this treaty England gained all the territory east of the Mississippi except the Isle of Orleans. On Nov. 3, 1762, Louis XV. had, by the secret treaty of St. Ildefonso, given the Isle of Orleans and all of Louisiana west of the Mississippi to his cousin, Charles III. of Spain. It was not until Oct. 1764 that the French king notified governor Abbadie of the transfer of the Colony, nearly two years previously, to Spain, and ordered him to surrender Louisiana to accredited Spanish commissioners when they should present themselves. There was sorrow and dismay when these tidings were received. In 1783, the Treaty of Paris confirmed Spain in possession of this territory and granted free and open navigation of the Mississippi river to the subjects of Great Britain and the United States. In 1788, and again in 1794, fires destroyed large portions of the city. By the first, 19 squares were devastated, and 856 houses were burned. The second fire destroyed 212 houses and caused a loss estimated at $2,600,000. Rebuilding with brick instead of wood, resulted in a more permanent city.

During this period the Spanish Governor, Almonaster y

Rojas, was the greatest benefactor of New Orleans; he gave freely of his private fortune for many purposes. He rented in perpetuity the squares flanking the Place d'Armes and erected a row of brick buildings to be used as shops and retail stores. These were replaced in 1845 by the Pontalba buildings, which bear the name of their builder, Baroness Pontalba, a daughter of the governor. He rebuilt the Charity hospital, which had been destroyed by a hurricane, and a chapel for the Ursuline nuns. Through his generosity the cathedral was completed in 1794; it was constructed of bricks and had much the same appearance as to-day except in details of the belfry and towers. A town-hall, or hall of the Cabildo, presented to the city in 1795, was used as a meeting place of the Spanish Cabildo. It was here that the formal transfer of Louisiana from France to the United States took place.

Before the cultivation of sugar-cane the staple crop of Louisiana had been indigo; but it did not prove successful. In 1794 Etienne de Boré succeeded in making granulated sugar. His plantation is now within the city limits. By the Treaty of Madrid, signed in Oct. 1795, Spain and the United States agreed that New Orleans should be open to the Americans as a port of deposit for three years; the produce was to be free of duty but a reasonable price for storage was to be paid. The commerce of New Orleans increased greatly, the levee was the scene of noisy, bustling business.

The purchase of Louisiana by the United States in 1803 had a further beneficial effect on trade. The first half of that year showed an increase of 37% in tonnage over that of 1802; exports exceeded $2,000,000 and imports $2,500,000. The flat-boat trade with the upper valley also increased enormously. Above the *vieux carré* commercial houses were erected and this newer portion of the city gradually became a business centre. Above the Terre Commune, Common street, was Madame Gravier's plantation, a part of the former Jesuit grant. Many of the street names are reminders of the first owners or of the first use of the locality. Gravier street bears the name of its original owner; Poydras that of a philanthropist; Magazine was so named because of the great tobacco warehouses on Magazine and Common, and Camp street because of a slave camp between Poydras and Girod. An aristocratic suburb was along the Bayou St. John road. Below the old city the Marigny plantation was settled by the French.

In 1805, New Orleans was incorporated as a city and the people exercised their right of suffrage for the first time in electing aldermen. Between 1803 and 1810 the population more than doubled with the arrival of many whites, mulattoes and slaves from Cuba, Santo Domingo and other islands of the West Indies. The creoles of those islands had much in common with the creoles of Louisiana—many were of French ancestry, they had the same religion, language and political ideas, and had met with the same political misfortunes. The creoles were numerically so strong that they dominated the city.

On Jan. 10, 1812, the "New Orleans," a steam propelled vessel built by Nicholas Roosevelt, arrived on her maiden trip from Pittsburgh.

The War of 1812 found New Orleans without adequate defences; Wilkinson was ordered to occupy that part of Florida west of the Perdido river; the Creek Indians massacred 350 whites at Ft. Mimms, Miss.; drunken Choctaws roamed the streets of New Orleans; Barataria bay was held by the Lafittes and their band of piratical smugglers, who appeared daily in the city. Claiborne had great difficulty in raising the quota of 1,000 men called for by the President, but finally accomplished it. Congress ordered Jackson to proceed to New Orleans for its defence.

Commerce on the Mississippi was greatly stimulated by the advent of steam navigation. In 1817, 1,500 flat-boats and 500 barges brought the produce of the valley to New Orleans. Four years later 287 steamboats, 441 flat-boats and 174 barges moored along the water front of the city. The American section became the market for cotton, tobacco, pork, beef, corn and flour, while the old city retained control of coffee, indigo, sugar, rice, foreign fruits and wine. In the year 1825, the imports and exports of the city were valued at $17,000,000, and by 1835 at more than $53,000,000, a part of the increase being due to the extraordinary rise of prices throughout the country. The population was cosmopolitan. In 1815 it numbered 33,000 and in 1820 had advanced to 41,000. Commerce increased more rapidly than population because of the absence of manufacturing; between 1830 and 1840 trade advanced 75% and the population only 20%.

In 1847–48 the exports of domestic products from New Orleans exceeded those of New York, although the total exports were less than those of the northern city; but imports at New Orleans were far less.

In 1842 receipts from the interior were valued at $45,700,000 and in 1851 they had increased to $107,000,000. One tenth of the arrivals were now steamships. This trade was carried on in spite of the danger from bars on entering the river; in the space of a few weeks, in 1852, 40 ships went aground at the entrance to the river. The terrible yellow fever epidemics of 1853–55 reduced the volume of trade, which was regained, however, and a high-water mark reached in 1857, to be followed by a financial crash which was disastrous to the business houses of New Orleans.

Louisiana seceded from the Union on Jan. 26, 1861. New Orleans was recognized as a strategic point by the authorities at Washington and two expeditions started to secure the Mississippi for the Union: Grant was to descend the river and Farragut and Butler were to ascend it. The city had sent 5,000 soldiers to the defence of the northern line of the Confederacy but the Southern Government seemed oblivious to the importance of holding New Orleans. While Grant was endeavouring to push his way down stream, Farragut was entering the river from the gulf with a fleet of 43 vessels. The assistance asked by Gen. Lovell could not be given by the Confederacy. An attempt was made to obstruct the passage of the Federal fleet by cables put across the river below the city, but New Orleans was captured by Farragut on April 25, 1862 and the city front blazed with the fire from thousands of bales of cotton and hogsheads of sugar and molasses which were burned to prevent their falling into the hands of the Federals.

Gen. Benjamin T. Butler with 15,000 soldiers took charge of the city on May 1, 1862. Mayor Monroe was removed from office and a military commandant appointed in his place. The city council was replaced by the bureau of finance and the bureau of streets and landings. Butler's rule in New Orleans was execrated by the people of the city and he was removed before the year expired.

The Republican Congress decided that the Southern States should be regarded as conquered territory, reconstructed and admitted to the Union. First of all the new freemen were to be secured in the enjoyment of their citizenship and suffrage. The white men of the State were virtually deprived of the ballot by all the restrictions placed upon its exercise. In the wake of the war came a host of undesirables seeking fortunes by easy means They became known as "carpet baggers," and their Southern friends and associates were known as "scalawags." In New Orleans they gained control of the city government through leadership of the voting population—largely composed of the newly enfranchised negroes. The property of the city disappeared; extravagant expenditures reached $6,961,381 by 1872 and the bonded indebtedness $21,000,000, paying up to 10% interest.

The citizens of New Orleans formed the "White League" for the expulsion of the "carpet-bag" government and for restoring white supremacy. To frustrate their plan an order was issued forbidding a citizen to keep a firearm even in his home. It was rumoured that a ship was to arrive on Sept. 14, 1874, with a cargo of ammunition and the metropolitan police formed at the foot of Canal street with mounted cannon to prevent the citizens from reaching the vessel. The White League formed at Poydras street and moved out to the levee; a skirmish followed in which the metropolitan police were worsted, suffering considerable loss. By gradual successes the White League restored white control.

Improvements made but slow progress during restoration times and for many years after; the city undertook the operation of the water works in 1869; a drainage system was proposed in 1871 but proved too expensive to be carried out; in 1871 the board of park commissioners bought the Upper City park, now Audubon park. The population in 1860 was 168,755 and had

increased by 1870 to 191,418. During this decade many freed Negroes had come to the city from the country districts. In 1870 the fifth and sixth districts were added by the annexation of the town of Algiers on the opposite bank of the river and of Jefferson City (formerly Lafayette), a town adjoining the fourth district. In 1874 Carrollton was admitted as the seventh municipal district, and New Orleans attained its present limits.

In the spring of 1927, New Orleans was saved from a great Mississippi river flood by blasting the levee at Poydras, about 15 mi. below the city, on April 29. This operation sacrificed the adjacent parishes of St. Bernard and Plaquemines at a cost to the city of approximately $5,000,000. To avoid similar danger in the future a spillway was constructed about 35 mi. above the city to remove 250,000 sec.-ft. of water from the river during excessive floods and deliver it into Lake Pontchartrain.

A railway and highway bridge across the river at New Orleans was completed in 1935. (W. B. G.; G. M. CA.)

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The Battle of New Orleans.—This was the final engagement of the American War of 1812 (*q.v.*), fought on Jan. 8, 1815, between the forces of the United States, under Maj.-gen. Andrew Jackson, and those of Great Britain under Maj.-gen. Sir Edward Pakenham. The abdication of Napoleon in April 1814 made it possible for Great Britain to give more attention to her American antagonist. The Gulf of Mexico region was selected for the attack, and late in 1814 a fleet of 50 vessels and an army of nearly 10,000 veterans were dispatched to the region of the Mississippi river. The British advance was made by way of Lake Borgne and the Villere canal to the bank of the Mississippi where the advance-guard appeared on Dec. 23, 1814. Jackson was wholly surprised by this movement but with a superior force made an immediate (Dec. 24) attack with such effect that the British decided to wait for the main army and their artillery. This gave Jackson time to fortify a dry canal and to receive additional reinforcements.

At last, in the early morning of Jan. 8, 1815, a direct attack was made on the now strongly entrenched line of the defenders at Chalmette, near the Mississippi river. It failed disastrously with a loss of about 2,000 out of 9,000 British troops engaged, among the dead being Pakenham and Maj.-gen. Gibbs. The British attack on the right bank had been successful but Gen. Lambert, Pakenham's successor, was unwilling to take the responsibility of any further fighting. The expedition was soon abandoned, and by the end of the month the troops embarked for England. The American loss proved to be 71, out of a total of about 4,000 engaged on both sides of the river. The battle of New Orleans had no bearing on the outcome of the war as peace had been made at Ghent 15 days before the battle was fought, but news of the battle and the peace reached Washington almost together. (*See* WAR OF 1812.)

NEW PHILADELPHIA, a city of eastern Ohio, U.S.A., 75 mi. S. by E. of Cleveland, adjoining Dover, on the Tuscarawas river and federal highway 21, at an altitude of 890 ft.; the county seat of Tuscarawas county. It is served by the Baltimore and Ohio and the Pennsylvania railways. The population of New Philadelphia was 12,948 in 1950, 12,328 in 1940 and 12,365 in 1930 by the federal census. Coal and fire clay abound in the immediate vicinity, and the city has important manufactures, including mine equipment, enamelled ware, decorative metal stampings, malleable iron castings, earth-moving machines, plastic products, pottery and adhesives.

On May 3, 1772, a company of Christian Indians which was led by the Moravian missionary, David Zeisberger (1721–1808), came from western Pennsylvania, and three months later John Heckewelder (1743–1823) arrived with 200 more Indians. They laid out the town of Schoenbrunn at the "big spring" a little southeast of the present city of New Philadelphia, built the first church and the first schoolhouse in Ohio and more than 60 dwellings of hewn timber, but were obliged to abandon the settlement in 1777 on account of the hostility of the neighbouring Indians. The site of Schoenbrunn, discovered in 1923, was bought by the Ohio state archaeological and historical society. Other missions were planted in this region at Gnadenhütten (1772), Lichtenau (1776) and Salem (1780). On March 7 and 8, 1782, the 96 peaceful Christian Indians at Gnadenhütten were tricked and brutally massacred by a force of 100 whites sent out from Ft. Pitt under Col. Williamson. At Zoar, 5 mi. N. of New Philadelphia, a settlement was made in 1817 by 225 Germans under the leadership of Joseph Bimeler. In 1824 they organized a communistic society, which lasted until 1898. New Philadelphia was founded in 1804 by John Knisely, from Pennsylvania. It was incorporated as a village in 1815 and chartered as a city in 1896.

NEW PLYMOUTH, municipality and seaport on the west coast of the North Island, New Zealand, capital of the provincial district of Taranaki, 251 mi. N.N.W. of Wellington by rail. Pop. (1953) 22,500 (24,700 including urban areas). The town is noted for its parks and gardens, and the district, sometimes called "the garden of New Zealand," produces cereals and fruit and is one of the chief dairy centres of New Zealand. The settlement was founded in 1841 by the Plymouth company under the auspices of the New Zealand company, and chiefly consisted of emigrants from Devonshire and Cornwall. On the seashore are extensive deposits of ironsand. Mount Egmont (8,260 ft.), 18 mi. from New Plymouth, is well-known for its winter sports.

NEWPORT (Welsh, *Casnewydd*), a municipal, county and parliamentary borough, seaport and market town of Monmouthshire, a county of England which for most administrative purposes is still part of Wales. Newport lies on the Usk, 5 mi. from its confluence with the Severn, and is 12 mi. N.E. of Cardiff and 24 mi. S.W. of Monmouth by road. Pop. (1951) 105,285. Area 12.3 sq.mi. It lies chiefly on the right (west) bank of the river, and on the east, north and west it is sheltered by a line of hills.

An ancient mesne borough and castle, it occupied an important position on the Welsh marches. The town, which is not mentioned in Domesday, grew up round the castle built early in the 12th century. Giraldus Cambrensis, writing in 1187, calls it *Novus Burgus*, probably to distinguish it from Caerleon, whose prosperity declined as that of Newport increased. From Robert Fitz Hamon (d. 1107) the lordship passed to the earls of Gloucester and Stafford and the dukes of Buckingham.

The town received its first charter in 1227, and Hugh le Despenser, who held the lordship for a short time, obtained in 1323 a charter of liberties for the burgesses, granting them freedom from toll throughout England, Ireland and Aquitaine. The earl of Stafford granted a further charter in 1385, confirmed by his grandson in 1427, which gave the burgesses the right of self-government and of a merchant guild. On the attainder of the duke of Buckingham in 1483 the lordship lapsed to the crown, of whom it was held in the 16th and 17th centuries by the Pembrokes, and in the 19th by the Beauforts. The town was incorporated by James I in 1624. In 1385 the borough obtained a market lasting 15 days from the vigil of St. Lawrence (Aug. 10). The charter of 1624 granted two fairs. Newport was the scene of a serious Chartist riot in 1839. The town became a county borough in 1891 and returns one member of parliament.

The old parish church of St. Woollos (since 1921 the cathedral church of the Anglican diocese of Monmouth) stands on Stow hill. Originally it consisted only of the present nave, a fine specimen of grand, though unadorned, Norman architecture; but a massive square tower (of the time of Henry III) and a chancel were added later; a large western Early English lady-chapel is interposed between the nave and the tower.

The castle was greatly altered in the late Perpendicular period and was restored in 1929–30. The old Dominican monastery is entirely rebuilt and occupied as a private residence; but there are a few fragments of a house of White Friars. The town has a

museum and an art gallery. Newport increased rapidly in the later part of the 19th century owing to its situation on a fine tidal river which renders it an outlet for the eastern section of the South Wales coalfields.

There are the Alexandra, North and South, docks with a quayage of 7,839 and 17,189 ft. respectively, and the Town (Old) dock with a quayage of 4,853 ft. The Alexandra docks, opened in 1875, enclose a sheet of water 28¾ ac. in extent. The average depth of water in both Alexandra docks is 45 ft. at spring tides and 35 ft. at neap tides. In the Old dock, begun in 1842, the depths are 30 ft. and 20 ft. respectively. There are two dry docks connected with the Alexandra docks, one being 523 ft. long and 74 ft. wide and the other 453 ft. long and 64 ft. wide. There are three other dry docks, all of them entered from the river. The town grew rapidly during the first quarter of the 20th century under a town planning scheme, and extensive building was carried out at Somerleyton and St. Julian's.

A transporter bridge, opened in 1906, gives 177 ft. clearance and a road bridge, 60 ft. wide, forms the main gateway for traffic from London to South Wales. There is an impounding reservoir at Talybont, Breconshire, with a capacity of 2,567,000,000 gal. Newport's industries were greatly diversified in the 1940s. In 1953 the biggest electrical power station in Europe was completed at Uskmouth and plans were approved for a shipbuilding yard at Newport capable of building the largest type of tanker.

NEWPORT, a market town, municipal borough and county town of the Isle of Wight, England. Pop. (1951) 20,426. Area 24.3 sq.mi. It is near the centre of the island, at the head of the wide estuary of the Medina river, 5 mi. S. from its mouth at Cowes. Industries include plastics and woodwork, milling, brewing and mineral water manufacture. Newport is the centre of the island's agriculture and its harbour is used for import and export business. The church of St. Thomas of Canterbury was rebuilt in 1854 in the Decorated style; the county hall was built in 1938 and the town hall (1816) was designed by John Nash. The grammar school was founded in 1614. The Albany barracks, Parkhurst prison and Camp Hill Borstal institution, the last two in Parkhurst forest, lie north of the town. Newport was probably a Roman settlement, then known as Medina; remains of a villa in good preservation were found in 1926. There are no traces of Saxon occupation and no evidence that Newport became a borough before the reign of Henry II. The first charter was granted by Richard de Redvers between 1177 and 1184, and a second, by Isabel de Fortibus, was confirmed by successive kings. The borough was incorporated by James I in 1608 and the final charter, by which Newport was governed until 1835, was granted by Charles II in 1661. It was represented in parliament in 1295, but no other return was made until 1584, when it regularly sent two members. From 1867 to 1885 it sent one but in 1885 its representation was merged in that of the island. The Saturday market dates from 1184, and there is a Tuesday market. Owing to its facilities for trade, Newport early superseded Carisbrooke (*q.v.*) as the capital of the island.

NEWPORT, a market town and urban district in the Wrekin parliamentary division of Shropshire, England, 19 mi. E.N.E. of Shrewsbury by road, on the borders of Staffordshire. Pop. (1951) 3,744. Area 1.2 sq.mi. It is the centre of a wide agricultural area, with markets for cattle, corn and provisions. Newport is not mentioned in Domesday, but at the Conquest was part of the manor of Edgmond, which William I gave with the rest of Shropshire to Roger, earl of Shrewsbury. Henry I is thought to have founded the borough, at first called New Borough, and the site was probably chosen partly because of the fisheries (Aqualate mere, 1 mi. E. is the largest lake in Staffordshire) which are mentioned in Domesday. Henry II granted all the liberties, rights and customs which the town enjoyed under Henry I; Henry III granted the borough, with the manor of Edgmond, to Henry de Audley. Confirmation charters were granted by Edward I in 1287 and Edward II in 1311. The town was incorporated in 1551 by Edward VI whose charter was confirmed by James I in 1604; but the corporation was abolished in 1883, and a local board was formed which gave place in 1894 to an urban district council. The church of St. Nicolas, Early English and Perpendicular, has a fine tower. Newport possesses a grammar school founded in 1656. To the south of the town are the ruins of Lilleshall abbey, founded in 1145 for Austin canons and presented to the nation in 1950.

NEWPORT, a city of Campbell county, Kentucky, U.S.A., on the Ohio river, opposite Cincinnati and adjoining Bellevue, Dayton, Southgate and Ft. Thomas and separated from Covington only by the Licking river. It is on federal highway 27 and on state highways 8 and 9, and is served by the Chesapeake and Ohio and the Louisville and Nashville railways, trolley and bus lines and river steamers. Population 1940 census, 30,631; 1950, 31.044. It is a residential suburb of Cincinnati and also an industrial area largely given to metal fabrication.

Two miles back from Newport is the city of Ft. Thomas (a U.S. military post, established in 1888 to supersede Newport barracks [1804] and a city of the same name); pop., 10,870 in 1950. A Veterans administration hospital is located on the post.

Newport was laid out in 1791, incorporated as a town in 1795 and chartered as a city in 1834.

NEWPORT, a city of Rhode Island, U.S.A., 30 mi. S. by E. of Providence, occupying the southern end of the island of Rhode Island (or Aquidneck); a port of entry, the county seat of Newport county, a place of great historic interest, and a fashionable summer and autumn resort. Pop. (1950) 37,564; (1940) 30,532, an increase of 5.1%.

From the harbour on the west the city rises to a gently rolling plateau with maximum elevations of about 250 feet. The climate is mild and equable throughout the greater part of the year. The "Old Town," with its narrow streets and 18th century houses, climbs the hill back of the harbour.

At the head of Washington square, or the Parade, stands the old State house (or Colony house, when it was built in 1739), now an historic shrine where Washington, Adams, Monroe and other presidents have been entertained. Near by is the Vernon house (built in 1758, and occupied by Rochambeau during the Revolution), which still has its beautiful mahogany balustrades, panelled chimney pieces and delft-tiled hearths. Rare Chinese murals have been found behind panelling. Trinity church (1725) has a beautiful white spire, tipped with a golden crown. At the head of Touro street (named for Isaac Touro, an early rabbi of Dutch nativity) is the Hebrew cemetery (established in 1677) and farther down the street is a fine synagogue (1763), said to be the oldest in America. The old Friends' meetinghouse, part of which dates from 1699 (the first one built on American soil), is now a recreation centre. In Touro park, near the upper end of Bellevue avenue, is the old stone mill, frequently attributed to the Norsemen but probably erected by Benedict Arnold for a corn mill. Near by is the Redwood library, incorporated in 1747 (a development of the Philosophical society founded in 1730), occupying a building erected in 1750, and named for Abraham Redwood (d. 1788), a Friend who contributed £500 for books. A little farther on is the Casino, and from this point Bellevue avenue, extending south to the ocean, is bordered on both sides with the summer "cottages" of wealthy New Yorkers—palatial structures representing almost every possible style of architecture, set in ancient trees and modern gardens, behind high stone or brick walls or grilled fences. On Conanicut island, west of Newport, is the old town of Jamestown (pop. [1950] 1,757), also a summer resort. Newport's inner harbour, formed by a deep indentation in the western shore, has a depth of about 18 ft. and is almost landlocked.

It is guarded by Ft. Adams on the point forming its western boundary. On Goat island, lying in the entrance of the harbour, is the U.S. torpedo station; and on Coasters Harbor island, farther north, off which the old frigate "Constellation" is moored, are a training station of the U.S. navy, a naval war college and, near by, a naval hospital. Newport is an important naval base.

Newport was founded in 1639 by John Clarke, William Coddington and other Antinomians, who had been driven out of the Massachusetts Bay colony, but first settled at Portsmouth on the northern end of the island in 1638.

In 1640 Portsmouth and Newport united and elected Codding-

ton as governor. In 1644 the two towns with Providence formed a government under a parliamentary charter. In 1647 Warwick was included but the southern towns formed a separate government in 1651. They were reunited in 1654, and a liberal charter was obtained in 1663 from King Charles II.

The first newspaper was published in 1732 by James Franklin (a brother of Benjamin), whose son James in 1758 established the *Mercury,* still published. Between 1739 and 1760 great fortunes were made in the "triangular trade" with Africa and the Barbados, in which rum from Newport was exchanged for slaves in Africa, who were exchanged for sugar and molasses in the Barbados, which were brought back to Newport to be made into more rum. In 1770 Newport's foreign trade was greater than that of New York, but it was entirely destroyed by the Revolution, when the town was in the hands of the British from Dec. 1776 to Oct. 25, 1779. After the evacuation of the British it was occupied by French troops under Rochambeau, and in 1780–81 it was a station of the French fleet. Newport was chartered as a city in 1784; resumed the town form of government in 1787; was again chartered as a city in 1853; and secured a new charter in 1906. Until 1900 it was one of the capitals of Rhode Island. The influx of wealthy New Yorkers began after the Civil War.

NEWPORT, a city of northern Vermont, U.S.A., a port of entry and the county seat of Orleans county; situated at the southern end of Lake Memphremagog, 6 mi. from the Canadian border. It is on federal highway 5, and is served by the Canadian Pacific and the Quebec Central railways, and in summer by lake steamers. Pop. (1950) 5,217. It is a summer resort, a centre for winter sports, a shipping point for maple sugar and farm products, and has several industries. It was founded about 1810 and incorporated as a city in 1918.

NEWPORT NEWS, a city and a port of entry of southeastern Virginia, U.S., on the north side of Hampton Roads and the James river, opposite Norfolk; in Warwick county, but independent of it. It is on federal highway 60; is the tidewater terminus of the Chesapeake and Ohio railway; and is served also by air, bus and truck lines, several ferries and numerous steamship lines.

The origin of the city's name has aroused much discussion. Records of the Virginia company of London placed settlers "along the bankes of the great river between Kequotan and Newportes Newes" in 1619. Off Newport News was fought the first ironclad naval engagement in history, the battle of the "Monitor" and "Merrimac" on March 9, 1862.

Newport News remained a village until 1880, when it was chosen by Collis P. Huntington as the Atlantic deep-water coal-shipping terminal for the Chesapeake & Ohio Railway system. It is the country's principal coal-shipping terminal. The city was laid out in 1882 and incorporated in 1896. Pop. (1950) 42,358.

The harbour, spacious and well protected, is connected with the ocean by a channel 600 ft. wide and 35 ft. deep. Nearly a mile of the water front, at the southern end of the city, is occupied by the great railway terminal, covering 337 ac., and comprising 125 mi. of track, storage space for 5,000 cars, warehouses with 1,725,000 sq.ft. of floor space, and piers specially equipped for handling bunker and cargo coal and other commodities. Farther north on the river are the shipyards, among the largest in the world. There were built many famous U.S. fighting ships and merchant vessels. During World War I Newport News was an important port for supplying Great Britain, France and Italy, and also served as a major supply and embarkation port for U.S. forces. During World War II it was the headquarters of the Hampton Roads port of embarkation.

Newport News is one of the four cities forming the port of Hampton Roads, the principal coal and tobacco port of the United States. Other important items in the export trade are grains and preparations, dairy products, semimanufactures of cotton, oilseeds, lumber, iron and steel manufactures, machinery and vehicles, petroleum, coke, coal tar products and industrial chemicals. In the import trade residual fuel oil looms large, with fertilizer materials, gypsum rock, meat products, inedible molasses, crude rubber and allied gums, unmanufactured tobacco, burlap and jute bagging, mahogany logs, standard newsprint paper, nonmetallic minerals and manganese and chrome ores all representing important items.

NEWQUAY, a seaport and watering place of Cornwall, England, 14 mi. N. of Truro by rail. Pop. of urban district (1951) 9,928. It is on Newquay bay, sheltered to the west by Towan head. The harbour, artificially constructed, and equipped with a jetty and piers, admits vessels of 200 tons. China stone and China clay are exported and coal is the chief import.

NEW ROCHELLE, a city of Westchester county, New York, U.S.A., on Long Island sound and federal highway 1 (the Boston Post road); 16 mi. N.E. of the Grand Central station in New York city. It is served by the New York, New Haven and Hartford and electric railways. The population was 59,725 in 1950, 58,408 in 1940 and 54,000 in 1930. New Rochelle is primarily a residential suburb of New York, with some fine old colonial dwellings still standing, and many beautiful modern residential districts of parklike contour. It is the seat of the College of New Rochelle (Roman Catholic; 1904). The city has an area of 9.9 sq.mi., 9 mi. of water front, and a rolling surface reaching an altitude of 289 ft. Zoning ordinances are in effect, and there is a city-planning commission. Besides three city parks covering 83 ac., there are within the city limits parks, parkways and bathing beaches (including Glen island) aggregating 385 ac., owned by the county. There is comparatively little manufacturing, except for local consumption.

On the landward side the city is fringed by residential suburbs, including Larchmont, Pelham and Pelham Manor. The farm given by the state to Thomas Paine at the close of the Revolution is marked by a monument on the road to White Plains, and the farmhouse is now a museum. On David's island, 2 mi. S.W. of New Rochelle, is Ft. Slocum, a U.S army post. The first settlement of importance on the site of New Rochelle was made in 1688 by Huguenots, some of whom came from La Rochelle. The village was incorporated in 1847 and in 1899 it became a city.

NEW ROMNEY, a municipal borough in the Ashford parliamentary division of Kent, England, and one of the Cinque Ports, 75 mi. E.S.E. of London by the S. Ry. Pop. (1951) 2,356. Area 2.4 sq.mi.

Its harbour was the cause of the early importance of Romney, as it was called before 1562–63, and the annual assembly of the Cinque Ports, called the Brodhull, was held there owing to its central position. At the time of Domesday the archbishop of Canterbury and the bishop of Bayeux were joint lords. Romney owed the maritime service to the king of supplying five ships to serve for 15 days in the year. A confirmation of liberties was granted by John in 1205. The town was incorporated by Edward III and was represented in the parliament of 1265. It returned two members from 1366 to 1832, when it was disfranchised. After Elizabeth's charter of 1562–63 the town was officially New Romney. Important documents relating to the Cinque Ports are in the Guild Hall at New Romney. It lies on Romney marsh, part of a level extending from Winchelsea in the southwest to Hythe in the northeast, which was within historic times in great part covered by an estuarine inlet of the sea. The river Rother, which now has its mouth at Rye harbour, formerly entered the sea here, but had its course wholly changed during a great storm in 1287, and the gradual accretion of land led to the decay, not only of New Romney, but of Winchelsea and Rye as seaports. Romney marsh itself is protected by a seawall, and its guardianship and drainage are in the hands of a special corporation dating from 1462. New Romney, which is now over a mile from the sea, has a large sheep fair in August, but little other trade. Of the five churches mentioned in Domesday only the Norman church of St. Nicholas remains. The Romney, Hythe and Dymchurch railway, of 15 in. gauge, incorporated in 1926, is one of the smallest public railways in existence.

NEW ROSS, a town of Co. Wexford, Ireland, on the Barrow, 2 mi. below its junction with the Nore, 102 mi. S.S.W. of Dublin by the Great Southern railway. Pop. (1946) 4,894. St. Alban built the abbey of Rossmactreoin, which gave rise to the ancient

city Rossglas. There are remains in Rosbercon of a 13th century Dominican foundation. According to Camden, New Ross was founded by Isabella, daughter of Strongbow and wife of William Marshal, afterward earl of Pembroke. A charter granted to it by Roger Bigod in the reign of Edward I was extended by James I and James II. In 1269 the town was surrounded by walls. The fortresses were dismantled by Cromwell, but some remains are extant. The Barrow is crossed by a swivel bridge. The inland water communications reach to Dublin by means of the Barrow and the Grand canal. The Nore is navigable to Inistioge. New Ross has breweries and tanyards, a salmon fishery, and exports agricultural produce. The urban district includes Rosbercon.

NEWRY, a seaport, urban district and market town in County Down, Northern Ireland, on the Newry water and Newry canal at the head of Carlingford lough, 38 mi. S. of Belfast by road. Pop. (1951) 13,264. Area 1.09 sq.mi. The site of an abbey founded in 1175, Newry was granted by Edward VI to Sir Nicholas Bagenal, marshal of Ireland. It had an important strategic situation on the route through the "Gap in the North" by which armies attempted to penetrate Ulster from Dublin, Drogheda and Dundalk. In 1689 Newry was set on fire by the duke of Berwick when in retreat before Schomberg. Charters were granted to the town by James I and James II and until 1898 a portion of Newry belonged to County Armagh. The town is picturesquely situated and contains some very attractive Georgian buildings. Spinning and weaving of linen is carried on in Newry and the adjacent village of Bessbrook, and Newry's many industries also include cotton spinning and weaving and the manufacture of waterproofs, dehydrated potato preparations and other food products. Granite is quarried in the vicinity.

NEWS AGENCY, an agency which supplies news to newspapers, periodicals, clubs, associations or private persons, by telegram, in manuscript, proof, by tape machine or duplicated; less frequently by telephone. A news agency does not itself publish news but supplies information privately to its subscribers.

The paramount virtue of the news agency is that, by supplying material to a large number of subscribers, it spreads the cost of collecting such information among all those taking the service and so puts it on an economical basis: no newspaper could, on its own, afford to maintain the kind of coverage which a great news agency such as the Press association provides. All newspapers rely chiefly on the agencies for the receipt of what may be called formal or expected news: *e.g.*, market returns, city quotations, honours lists and election results.

For general news the agencies cover a larger area than any one journal could. At any one of the smaller London police courts, for example, an interesting or scandalous case may at any moment come up without warning. No private reporting staff could hope to catch every such case but an agency man is almost certain to be in attendance. If, again, it is known that a case or a function is expected in a town where the paper concerned has no correspondent, a "special" may be ordered from an agency. An outstanding example of routine agency work is the coverage given by the Press association's representatives of the dozens of football matches that take place all over the United Kingdom each Saturday between August and May: interest in the games is widespread, but no single newspaper possesses the resources in cash or manpower to enable it to have representatives at each of the many matches of which it will expect reports.

In Great Britain the dominant news agency is the Press association, or the P.A., which is owned co-operatively by the British newspaper press, national and provincial, although its services are available to all. It has special parliamentary and law-court reporting divisions.

The P.A. disseminates home news only. Overseas news is put out by Reuters, with which the P.A. is linked. Although Reuters supplies only overseas coverage to its subscribers in the United Kingdom, it takes the P.A.'s home-news service for dissemination to its subscribers in other countries. There is also a P.A.-Reuters Features and a P.A.-Reuters Photos organization.

Also active in Great Britain on a large scale are the Exchange Telegraph Co., Ltd.: the Associated Press, Ltd., London end of the Associated Press of America (the P.A.'s equivalent in the United States); the British United Press, Ltd., which is associated with the United Press of America; and the International News service.

The Press association and Reuters are established in a large modern building at 85 Fleet street, which also contains the London offices of many of the overseas news agencies. These have clients in Great Britain but are for the most part concerned with the transmission of news from the United Kingdom to their several national newspapers.

Among the important national news agencies of countries outside the United Kingdom are Agence France-Presse, the U.S.S.R.'s Tass (Telegrafnaya Agentsia Sovietskogo Soyuza) and the Irish News agency.

The true news agencies must not be confused with the numerous feature agencies which submit general and specialist articles on a free-lance basis. There are also many governmental and "propaganda" agencies which supply news on a broadcast scale for which no fee is charged: thus most commonwealth and foreign countries maintain services in Great Britain to put out regular daily or weekly bulletins carrying items of a "national" character to which they are anxious to give publicity (such news sheets are mailed off free to editors, who may make use of them from time to time but are aware that, in many cases, they are not of a disinterested character). (K. R. V.)

United States.—The oldest and largest of U.S. news agencies is the Associated Press. Its forerunner was an informal, unincorporated group of New York newspapers which agreed in May 1848 to obtain in one telegraphic dispatch the foreign news brought by ships arriving at Boston, first U.S. port of visit by transatlantic vessels. This co-operation was successful, and the principle was gradually extended. Shortly after an 1856 reorganization, the group came to be called Associated Press of New York; mutual itself, it sold its service to various regional groups. In 1882, however, the Western Associated Press obtained a share in management; ten years later N.Y.A.P. perished in a realignment in which the modern A.P., incorporated as Associated Press of Illinois but operating in both the east and the west, was set up in opposition to the United Press (1882–97). An antimonopoly suit by the *Chicago Inter Ocean* in 1900 caused the dissolution of this corporation, which was immediately supplanted by a new one under New York's more lenient laws. A prosecution for violation of the Antitrust act, founded on complaints of the *Chicago Sun,* was successful in 1942–45; thus blackballing of new members by old ones, and practices similar in effect, were no longer possible. By the 1950s A.P. had some 1,700 members, as well as about 1,000 radio and television stations which were associate members. Though a mutual, it pays many local correspondents connected with member papers.

United Press associations was formed in 1907 by E. W. Scripps as a merger of two of his own agencies and one independent. Under Roy W. Howard's aggressive management (1908–20), the U.P. had obtained more than 1,400 clients before the outbreak of World War II, 130 of them in Latin America and 320 in Europe and Asia. Though not a co-operative, its clients share its news efforts.

International News service was organized by W. R. Hearst in 1909 for morning papers. After repeated shuffling of Hearst services, INS emerged in 1928 as a round-the-clock service. By the 1950s it was said to have in the neighbourhood of 1,000 clients, some in foreign countries.

Besides these three great agencies, there were in the 1950s more than 100 news services, all of which were, in one way or another, more limited in scope. Some were restricted geographically. Some were specialized, as Science service, Religious News service, Educational Newsfeatures, Daily Sports News service, Associated Negro Press. Several large newspapers syndicated their own correspondence through special agencies such as the Chicago Daily News Foreign service, Chicago Tribune Press service and Chicago Tribune-New York News syndicate, New York Times syndicate, and New York Herald Tribune News service.

Reuters was allied with A.P., exchanging its United Kingdom domestic report for A.P.'s corresponding report from the United

States; but each retains the right to market its report in the other's territory as foreign news, and thus Reuters served some 30 U.S. papers with its foreign report at mid-20th century. Canadian Press, founded 1910 as Canadian Press Ltd., exchanged reports with A.P. from its beginning.

Many of the news agencies mentioned handle features as well; likewise the great feature syndicates handle much straight news, as North American Newspaper alliance (NANA) and Newspaper Enterprise association (NEA). The service of the former includes the report of the Kemsley Foreign News service. McGraw-Hill's World News is an agency established 1945 to serve magazines.

Pictures are often quite as much news as word reports. By the 1950s there were some 75 agencies distributing news pictures located in various U.S. cities, more than one-half of them in New York. Prominent were Wide World Photos, organized by the *New York Times* in 1919 and later taken over by the A.P.; Acme Newspictures, NEA subsidiary, founded 1924; International Photos, Hearst unit begun in 1910 and later a subsidiary of King Features.

(F. L. Mt.)

NEW SCOTLAND YARD: *see* Scotland Yard.

NEW SIBERIAN ISLANDS are situated off the Arctic coast of Siberia, in Yakut Autonomous S.S.R., Russian S.F S.R. from 73° to 76° 6′ N., and 135° 30′ to 151° E. The name is loosely applied, covering either the northern group only of these islands, for which the name of New Siberian or Anjou Islands ought properly to be reserved, or the southern group as well, which ought to retain its name of Lyakhov Islands. Some confusion prevails also as to whether the islands Bennett, Jokhov, Vilkitski, Henrietta and Jeannette, ought to be included in the same archipelago, or described separately as the Jeannette or De Long Islands. The first three of these belong geographically, and probably geologically to the New Siberian group, from which they are less than 100 mi. distant. Henrietta and Jeannette Islands lie 200 mi. northeast of Novaya Sibir Island, in 157° to 159° E. Sannikov Land, reported by J. Sannikov in 1805 to lie north of Kotelni Island, probably does not exist.

The *New Siberian Islands* consist of Kotelni, the largest (116 mi. long, 100 mi. wide), having the small island Byelkovski near its western shore; Thaddeus (Faddeevski), in the middle; and Novaya Sibir, New Siberia, in the east (90 mi. long, 40 mi. wide). Kotelni is the largest and reaches an altitude of 1,200 ft. in the volcanic Malakatyn-tas mountain. It is built of Silurian coral limestones (Llandovery division), containing a rich fossil fauna. The same Silurian deposits are widely spread on the mainland as far as the Olenek. Middle Devonian limestones and slates are all faulted north-northwest and south-southeast. Triassic slates appear in the southeast. Diabases pierce to Devonian rocks. The eastern portion of the island, named Bunge's Land, is covered with post-Tertiary deposits. Novaya Sibir Island attains altitudes of 200 to 300 ft. in its western portion. The so-called Wood Mountains, which were supposed to be accumulations of floating wood, are denudations of Miocene deposits containing layers of brown coal with full stems of trees. These Tertiary deposits are characterized by a rich flora and fauna, testifying to a climate once very much warmer. The only representative of tree vegetation now is a dwarf willow 1 in. high.

The *Lyakhov Islands* consist of Bolshoi, or Blizhni, which is separated by Laptev strait, 27 mi. wide, from Svyatoi Nos of Siberia; Mali, or Dalni; and several smaller islands to the west of Mali. Bolshoi too consists of granite protruding from beneath nonfossiliferous deposits. Along its southern coast Baron Toll found immense layers of fossil ice, 70 ft. thick, evidently relics from the Ice Age, covered by an upper layer of post-Tertiary deposits containing numbers of perfectly well-preserved mammoth remains, rhinoceros, *Ovibos,* and bones of the horse, reindeer, American stag, antelope, *saiga,* and even the tiger, associated with relics of forest vegetation. A stem of *Alnus fruticosa,* 90 ft. high, was found with all its roots and even fruit. Similar deposits of ground ice occur in Vasilievski Island. Basalts and Tertiary brown coal deposits enter into the composition of the southern extremity of Bennett Island; Vilkitski Island is low (50 ft.) and basaltic. Bennett and Henrietta Islands have a few small glaciers. The New Siberian Islands have none.

The climate of these islands is very severe. In 1886 the winter ended only in June, to begin anew in August (May 21, −5.8° F; Oct. 16, −34 6°). The highest summer temperature was 50°. Flocks of geese and other birds come to the islands in summer. The lemmings are numerous. Reindeer, followed by wolves, come across the ice from Siberia; the fox and polar bear feed on the lemmings. The islands have been long known to Siberian hunters who come for furs and fossil ivory. There is much driftwood.

A Yakutsk Cossack, named Vaghin, wintered on Bolshoi in 1712, but it was a merchant, Lyakhov, who first described the two greater islands of this group in 1770, and three years later reached on sledges the largest island of the New Siberian group. which he named Kotelni. M. Hedenstrom, accompanied by Sannikov, explored the archipelago and published a map of it in 1811. Anjou visited it in 1821–23. A scientific expedition under A. Bunge (including Baron E. Toll) explored it in 1885–86. Toll revisited it in 1893 with Shileiko, and again in 1900 with F. G. Seeberg in the "Zarya." The Russian hydrographical expedition in "Taimir" and "Vaigach" in 1912 did some surveys in the New Siberian Islands; in 1913 it discovered Vilkitski Island and in 1914, Jokhov Island. The "Maud" in 1924 visited the New Siberian Islands. (*See* Arctic Regions.)

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(R. N. R.-B.)

NEW SMYRNA BEACH, a city in Volusia county, Florida, U.S., 13 mi. S.S.E. of Daytona Beach, on the Atlantic coast. The population was 5,775 in 1950 and 4,402 in 1940 by the federal census. Served by the Florida East Coast railway, New Smyrna Beach is a resort centre. Its principal products include fish, shrimp and citrus fruit.

In 1696 the Mission of Atocuimi was established on the site by Spanish missionaries. In 1767, 1,500 colonists from Greece, Italy and the island of Minorca were brought to the settlement by a Scottish physician, Andrew Turnbull. The colonists were given a ship, £4,500 and 100,000 ac. by the British government as an aid in the development of the settlement. Within nine years the settlers had succeeded in laying the foundation for a new community. They had built a complex canal system and many roads, some of which were still in use in the middle of the 20th century. At the outbreak of the American Revolution, however, discontent with the administration of the community had arisen. The situation became so intense that troops had to be called in and those who wished to leave the settlement were granted permission by Patrick Tonyn, then governor of East Florida. Most of the settlers moved north to St. Augustine. In 1803 the town was resettled; it then expanded slowly under the stimulus of new highways and the completion of the railroad and intracoastal waterway.

NEW SOUTH WALES, a state of the Commonwealth of Australia, lying in the southeast, and occupying 309,432 sq.mi. or 10.4% of the continent. From the east coast (Point Danger-Cape Howe, 700 mi.) to the western boundary which runs for 240 mi. along longitude 141° E., the average breadth is *c.* 650 mi. The northern boundary lies along lat. 29° S. and further east, along the Upper Darling (Barwon-Macintyre-Dumaresq) streams and thence along a crooked line of highland divide (Macpherson range, etc.) to Point Danger. The southern boundary is formed by the middle and upper Murray to the head of the Indi (Forest Hill), thence in a straight line southeast to Cape Howe.

Physiographically four main divisions may be distinguished, corresponding to fairly well-marked climatic and economic areas.

(i.) **Eastern Highlands,** the most striking, as also the most decisive, of the relief features, consists of a belt of plateaux extending from the Macpherson range on the north to the Australian Alps (*q.v.*) on the south. (*See* Australia: *Geomorphology;* Queensland.) In the north the *New England Plateau* (*c.* 200 miles long, 70–80 miles broad, with *c.* 9,000 sq.mi. lying above 3,000 ft.) rises in its centre to *c.* 5,000 ft.—Ben Lomond,

4,877 ft.; Mount Capoompeta, 5,100 ft.—sinks at either extremity to *c.* 4,000 ft.; Mount Lindsay (Macpherson Range), 4,583 ft.; Oxley's Peak (Liverpool Range), 4,500 ft.—and has considerable outliers, on the west the volcanic Nandewars (4,000 ft.) and Warrumbungle Range (3,000 ft.), and on the east and south the semi-detached spurs carved out by stream erosion into the likeness of ranges—Hastings, Mount Royal, Liverpool, etc., "Ranges." To the south of these ranges the plateau belt is broken across and the Central Plateau is separated from the more northerly by the remarkable Hunter River valley, the saddle at the head of which (near Cassilis) lies at *c.* 1,500 ft. The *Central Plateau* extends from this gap to the Lake George depression just north of the Federal Capital Territory. In general it repeats the features of the New England Plateau (*cf.* volcanic outliers on the west: Canobolas group, *c.* 3,000 ft.) but it is smaller and lower, few areas rising above 4,000 ft., and altitudes vary considerably. Its north-eastern section, the Blue Mountain Plateau, capped with (Triassic) sandstone, tilts from 4,000 ft. (west) to 700 ft. (east). From the Lake George fault-depression ("Senkungsfeld") to the border extends the *Southern Plateau,* a portion of the Australian Alps, a series of massive flattish-topped blocks diversified by (mainly north to south) down-faulted depressions (Mount Kosciusko, 7,328 ft.). Geologically this highland belt is characterised by its prevailingly ancient rocks (pre-Cambrian granites, folded Palaeozoics, etc.); by the volcanic flows (basalt, trachyte, etc.) which form cappings over considerable areas; by the extensive faulting which has differentiated levels, dislocated former drainage and resulted, in particular, in the abrupt scarps and declivities of the eastern flank; by the flattening by erosion (peneplanation) of the surfaces.

(ii.) **The Coastal Lowlands** belong structurally to the highland belt, being mainly, perhaps, down-faulted portions of it. The coast-line also appears in certain stretches (*e.g.,* in the south) to be fault-determined. Almost everywhere the plateaux behind break away in sharp declivities and form steep backing walls often scarred by deep gorges. The coastal lowlands are mostly narrow (10–20 miles)—often mere deltaic fringes at river-mouths. In three places—around Sydney, Hunter River, Clarence-Richmond-Tweed rivers—they form roomier basins in which later rock-formations (*e.g.,* Triassic) have been preserved. The Hunter-Goulburn Valley is a down-faulted trough worked out by erosion in weak strata and breaks across the highlands, running almost straight south-east to north-west for 120 miles to the Cassilis saddle (*v. sup.*) and is floored in its lower part with deltaic deposits. The structure of the Hunter Valley and of the Sydney Basin accounts for the outcropping of valuable coal seams. The coast-line, backed in many parts by bold heights, consists mainly of a succession of rugged promontories alternating with sandy bays and some inlets. In the central portion, on the other hand, subsidence has produced fine drowned valley harbours (Sydney, Port Stephens, Broken Bay, etc.).

(iii.) **The Western Slopes** are the "ramp" of the eastern plateaux, their uneven but relatively gentle declivity towards the great interior plains. In addition to outliers of the highlands (Mount Exmouth group, Curumbenya Range, etc.) the Cobar (*c.* 300 miles south-east–north-west; 150 miles wide; altitude 500–1,000 ft.) and Wyalong peneplains—worn-down relics of the buckled ancient floor which protrude through the later surface deposits—are the chief irregularities, though the streams have excavated long and broad transverse furrows.

(iv.) **The (Western) Plains** occupy all the remainder (nearly ⅔) of the State except along the western edge where the Barrier "Range" (*c.* 100 miles north to south; 30 miles east to west; altitude *c.* 1,000 ft. or 500 ft. above the surrounding plains) forms a series of hard etched and scarped ridges and resembles in structure the Cobar "peneplain." The immense plains—substantially the basins of the Upper Darling and a good part of that of the Murray—are floored with recent deposits (probably residuals of an earlier and wetter epoch). The western portions, and the older and higher of these deposits, are prevailingly red and are generally fertile. Black soils are found in the river valleys (*e.g.,* middle Macquarie, Castlereagh, Namoi, etc.) and along the silted-up courses of old streams. The streams, meandering, distributing, and flooding wide over these levels, are continually spreading fresh alluvium. The northern portion (80,000 sq. miles) reaching south-eastwards to Dubbo, falls within the Great Artesian basin, and the south-western parts (Riverina) fall within the Murray-River artesian area. In the former area bores vary from *c.* 90–4,340 ft. (av. *c.* 1,750 ft.), while 380 flowing wells discharge 80,780,000 gals. a day (maximum for single well, 1·5 million gallons).

Of the rivers the coastward-draining are relatively short, the Hunter and Wollondilly, each *c.* 340 mi. are the longest—rapid and constant-flowing streams, and owing to recent (Pleistocene and earlier) uplift, they are vigorously cutting back and excavating deep canyon-like gorges in the plateaux behind (*cf.* upper Macleay gorge, 3,000 ft. deep), creating wild and beautiful scenery and opportunities for the development of water-power. The lower basins are undulating to hilly with rich alluvial flats. Sand-barred mouths are common and also lagoon-like lakes (*e.g.,* Lake Macquarie) due to damming of mouths by marine drift. (*Cf.* south to north current along the coast.) Few are navigable for any great distance and then usually for small craft only (*e.g.,* Hawkesbury, 70 miles; Macleay, 39 miles; Shoalhaven, 22 miles). *See* also RICHMOND RIVER AND BASIN. The inward-flowing streams have been referred to. (*See* AUSTRALIA: *Rivers and Drainage.*) Of the Murray, 1,200 miles are within New South Wales. Recent measurements have given the following results: Darling, length 1,160 miles, drainage area 221,700 sq. miles; Murrumbidgee, 981 and 10,700; Lachlan, 922 and 10,420; Macquarie, 590 and 10,090; Namoi, 526 and 9,820.

Climate.—Situated wholly in the temperate zone, New South Wales has a generally moderate climate. Average temperatures are higher by 5°–7° F in the north than in the south, and the range increases towards the interior, the mean daily range on the coast being *c.* 19° F, in the western plains *c.* 26° F. The transition zone between summer and winter rains passes diagonally (north-west to south-east) through the State. The area south-west of the line Broken Hill-Wagga-Albury receives winter rains mainly from Antarctic depressions ("lows"); the area north-east of a sinuous line running from the north-west corner of the State to Newcastle receives summer rains from tropical (monsoonal) "lows"; the intervening belt receives rain from both quarters and, in the east, from the passage of anticyclones ("highs") also The east receives much more rain, and more uniformly, than the interior, the isohyetal lines except in the south and south-west running roughly parallel with the coast. The extremes are in the north-east corner (80 in. per ann.) and in the north-west (7 in.). Only 42% of the total area receives an average of over 20 in. per ann.; 15% receives less than 10 in. which is also more or less erratic. Heavy rains cause extensive flooding of the streams resulting often in serious loss; droughts are also a recurrent difficulty, especially in the interior. The rate of evaporation increases from *c.* 40 in. a year on the coast to *c.* 100 in. in the north-west with concomitant seasonal aridity and the drying up of streams. Four main climatic divisions, corresponding to the physiographic, may be distinguished: (i.) *Coast:* relatively high and regular rainfall coming mainly from the sea, with mild and humid conditions. Av. ann. temps., in the north 76°–57° F, in the south 68°–51° F; rainfall 30–80 in. per ann., greater in the north. (*See* LISMORE, NEWCASTLE, SYDNEY.) (ii.) *Tablelands:* cool and bracing climate with cold winters in the south; uniform and reliable rainfall. Average ann. temps.: in the north 70°–45° F; in the south 63°–38° F; av. ann. rainfall, 40 in. in the east to 30 in. in the west. (*See* BATHURST.) (iii.) *Western Slopes:* a drier, sunny and healthy climate with uniformly distributed rainfall. Temperatures are higher in the north, summer: 81°–73° F, winter, 53°–46° F; rainfall (av. ann.): 30 in. in the east, 20 in. in the west. North of the Lachlan the rains come from the north in February–May; the Riverina has light, but fairly reliable, winter showers. (*See* ALBURY.) (iv.) *Western Plains:* a dry climate, invigorating in winter, but liable to suffer from droughts, dust-storms and, more locally, from floods. Temperatures are higher in the north—av. ann.: summer 84°–75°; winter 54°–49° F. Av. ann. rainfall from 7 in. in the north-west; 10–15 in. along the Darling; 20 in.

in the east. (*See* BROKEN HILL.) (*See* AUSTRALIA.)

Economics.—The general facts relating to the distribution of minerals, soils and natural vegetation have been given under AUSTRALIA (*q.v.*). The clear physical differentiations indicated above, together with the stage of growth attained, give the economic development of New South Wales a marked regional character. Climate, relief, location of minerals and accessibility (*i.e.*, communications) are dominant factors in the distribution of the population. The following survey therefore proceeds upon the basis of four regions, viz., Western Plains; Central Plains; Tablelands; Coastal Lowlands. The last three occupy belts roughly parallel with the coast line and admit of subdivision into north, central and southern sections.

Western Plains, occupying the west and northwest portion (80,312,000 ac. = 125,487 sq.mi. or $\frac{2}{5}$ of the state) west of the courses of the Lachlan, Bogan, and Upper Darling (Barwon) rivers, has abundance of good soils but a poor and unreliable rainfall—8–19 in.; under 10 in. over $\frac{1}{3}$ of its area—and suffers occasionally from fierce heats, droughts, floods and always from introduced rabbits. Mining and pastoral pursuits alone have importance. In the northwest is Broken Hill (*q.v.*); the once-famous Cobar-Nymagee copper area, which is just included in the east, has suspended production, and opal mining (White Cliffs, etc., in the northwest; Lightning Ridge field—12,000 acres—in the northeast) is depressed (output 1926: £11,500). It is an area of isolation, "wide open spaces," large long-term leaseholds, over 63% of the total area being occupied by 196 holdings of over 100,000 acres each. The country produces fine-woolled merinos, but its carrying capacity varies greatly with the seasons and is generally low (40–130 sheep per sq.mi. according to season, or $\frac{1}{5}$ of that of the lands further east). The livestock (1939) consisted mainly of 5,966,000 sheep, 63,000 head of cattle and 25,000 horses. The total population was 44,500 (1 person per 3 sq.mi.; without Broken Hill, 1 per 7 sq. miles) or 1.9% of the population of the state, Broken Hill alone accounting for 26,925. Apart from this the settlements consist mainly of collecting and distributing centres for pastoral areas situated on railway lines (Cobar, etc.), on rivers (Wilcannia, Wentworth), or on both (Bourke, population [1933] 1,778; Walgett, Menindee, etc.) besides isolated stations and mining camps. Railways link Bourke, Cobar, Walgett and other towns on or near the eastern boundary—rivers with the eastern parts of the state and with Sydney, and the recently completed line from Sydney to Broken Hill (Condobolin-Ivanhoe-Menindee) traverses the heart of the area (east to west) and should help to develop much territory. Though increasingly tapped by railways the Darling still carries traffic (*e.g.*, wool to South Australia) in good seasons, and for the rest transport is by camel etc., train—increasingly by motor—over rough tracks.

The Central Plains form a natural extension of the western, large portions of them being little distinguished as regards relief from the latter. Thus in the northwest they comprise the low flat lands stretching east of the Barwon-Bogan rivers, and in the southeast the broad Riverina plains are only divided from the western plains by the Murrumbidgee and Lachlan rivers. Further east the land slopes gradually up, but, except in the centre (Cobar-Wyalong area) there is little above 1,000 ft. and few rugged features. But its rainfall, though rather scanty and unreliable, is better than that further west (15–24 in., the greater quantity in the north—18–28 in.—being balanced by greater evaporation). The rivers from the highlands further east stream across these lowlands but are of no great service, being irregular in flow, entrenched in places, and liable to flood. Artesian supplies have proved a great boon and have been extensively exploited, especially in the northwest and southwest. The soils, red-brown loams and black soils, are good but the latter are very heavy and have only recently begun to be worked. Of the total area (*c.* 41,420,000 ac. = 64,719 sq.mi.) some $\frac{9}{10}$ are occupied, of which 62% has been alienated from the crown, and though holdings of 10,000 acres and upwards account for 19% (89 over 50,000 ac. each), medium to small-sized holdings are common further east and particularly in the Riverina. The area, in fact, forms a climatic and economic transition zone. In the west pastoral pursuits; in the east, mixed agriculture and grazing; in the Riverina and a few other parts agriculture alone, or dairying alone, are practised. The area contains 40% of the agricultural lands of the state; and in the northwest and southwest portions are some of the best sheep-lands. Along the east the fringes of the wheat-belt are included. The 10-in. winter rainfall line (7 months: April-October, the growing season) runs roughly down the middle (north-northeast–south-southwest) of the area, and to this the wheat "frontier" approximates, falling behind it in the northeast but overstepping it to the extent of 5,000,000 acres and pushing forward into rainfall areas of 8–9 in. (April–Oct.) in the centre and particularly in the southwest (Riverina). Thus, while grazing, with a little mixed and other farming, predominates in the north, mixed farming—mainly sheep and wheat—arable farming, fruit-growing (vines, etc.) and dairying increase in importance in the south. A special place, in virtue of its irrigation areas, and its wider range of possibilities, is taken by the Riverina (*q.v.*). The total livestock amounted (1939) to 13,939,000 sheep, 200,000 cattle, 116,000 horses, 9,000 dairy cattle, but the numbers vary greatly according to season (*e.g.*, sheep: 1891, 25,000,000; 1921, 14,000,000; dairy cattle: 1911, 48,000). Similarly the sheep-carrying capacity, though high (266.6 per sq.mi.) varies from 351–205 per sq.mi. With a total population of 115,640, the area had (1926) a density of 1.8 persons per sq.mi. The chief settlements, apart from the pastoral river centres common to this and the Western Plains (Walgett, Hillston, Balranald, etc.), are centres of mixed pastoral and farming areas: Moree (4,355 in 1933), Narrabri—a railway junction town in a sheep, dairy, and fruit area, with butter factories and freezing works—and Coonamble in the north, Nyngan and Condobolin in the centre, and a large number of similar settlements in the Riverina.

The Western Slopes consist in the main of gently rolling country which rises from levels of under 1,000 ft. to elevations of over 2,000 ft. and merges into the plateaus to the east. It is essentially the zone of the upper, and fairly roomy, basins of the western rivers, but in the northwest and southwest the narrower head-water valleys and plateau margins are included in the administrative division. The rainfall is abundant and also fairly reliable (19–34 in.—rather more in the north, 24–33 in., more varied in the south where the Australian Alps are approached: 16–40 in.). The outcrops of ancient rocks along these slopes, as also the stream-beds descending over them, have yielded rich stores of minerals, and Forbes, Temora, Wyalong, Grenfell, etc., were once famous mining centres. Some gold-mining is still carried on, tin is obtained at Ardlethan, chrome iron at Gundagai, and a little coal is worked near Gunnedah. But in general mining has been succeeded by agriculture as the value of the red soils for wheat has become known. Out of the total area, 28,164,000 ac. (*c.* 44,000 sq.mi.), $\frac{9}{10}$ is occupied. Wheat, needing dry summers and an optimum growing season (April–Oct.) rainfall of 11–15 in., finds these conditions in a belt *c.* 500 miles long (northwest–southeast), about 100–130 mi. wide, and limited on the east by a line about 120 mi. from the coast, the coastal portions having proved too humid. Within this belt are 53,000,000 ac. of which about 26,000,000 ac. seem capable of cultivation, and of this $\frac{1}{5}$ would normally be used for growing wheat-hay (fodder). The area of possible wheat cultivation has greatly increased, nearly 20,000,000 additional acres having been occupied for this purpose in 1904–22. The total area actually cultivated to wheat (1939) is about 5,000,000 ac., about one-half of which is under wheat at any time. Fruit-growing and dairying are also carried on, and along some of the rivers irrigation also (*e.g.*, Forbes, Dubbo, Ardlethan). Grazing (mainly sheep) is everywhere important. The great bulk of the holdings within the area lie between 100 and 3,000 acres. Livestock total: sheep, 15,670,000 with the very high average density of 389 per sq.mi.; cattle, 361,000; horses, 159,000; dairy cattle, 55,000. In addition to primary production there are butter-factories, freezing works, flour and saw mills, etc., and in certain railway centres (*e.g.*, Junee, Quirindi) are large railway engineering works. The total population (1933) was 243,000 (5.5 per sq.mi.). The towns (Tam-

worth, 9,913 in 1933; Dubbo, 8,344; Forbes, 5,355; Parkes, 5,846; Junee, Cootamundra and Temora, 3,823) are centres for agricultural and pastoral producing areas, adding often the functions of railway junctions, mining, and (on a small scale) industrial centres.

The Tablelands extend to the east of the above division and are bounded on the east almost everywhere by abrupt and often rugged and precipitous declivities. They include much level or rolling country capable of cultivation but much, especially in the south (ALPS, AUSTRALIAN, *q.v.*), is too rough for anything but grazing. The climate is also cool or cold and, though bracing, tends to be wet. (Rainfall, 24–53 in.; in the north 30–38 in.; in the south 19–65 in.) Mining, formerly extensive, is still important. The tin resources of the Northern plateau (Tingha, Emmaville) are actively exploited; silver ores of high quality are mined at Yerranderie (Burragorang valley); gold is mined at various places: Bathurst, Uralla, etc.; the iron deposits of Cadia (reserves 10,000,000 tons) and Carcoar are utilized in the industries of Lithgow (*q.v.*) and smaller deposits exist at Goulburn and Queanbeyan, while the most westerly outcrops of the Sydney Basin coal deposits crop out and are worked at Lithgow. Of the total area (26,480,000 ac.=41,375 sq.mi.) about 77% (20,000,000 ac.) is occupied, but less than one-half is alienated from the crown. The climate is, in general, too damp for wheat but such as is grown is also found mainly in the central area. Sheep-grazing is carried on from north to south, though the central parts lead in this also. The highlands favour a different type of sheep from the plains—not so robust but of exceptionally fine and dense wool. The New England wool, being reputed to be one of the best of all spinning wools, and the Southern Tablelands (*e.g.*, Monaro district) are also noted. The area carried (1939) 12,122,000 sheep (292.9 per sq.mi.); 427,000 cattle; 94,000 horses, and 42,000 dairy cattle. Apart from Lithgow (*q.v.*) manufacturing industries (flour milling, tanning, soapmaking, railway engineering, etc.) are confined mainly to the larger towns, but the noted beauty of the scenery and the relative coolness of summer attract numerous visitors and in the areas within easy railway reach of Sydney and Newcastle the tourist industry is important. The towns and settlements are centres for pastoral, agricultural, and mining districts; many are tourist centres as well, while some are also railway-junction towns with a certain industrial activity. In the Northern Plateau, Armidale (*q.v.*: 6,794 in 1933), Glen Innes (5,352) and Tenterfield are on the main northern railway (Sydney to Brisbane) and combine most of these functions, serving as holiday centres especially for Newcastle and the north coast towns. On the highlands west of Sydney (Blue plateau) holiday and tourist resorts are more important—Katoomba (6,445); Goulburn (14,849), also an agricultural centre with some industries—while further west, Bathurst (*q.v.*, 10,413) and Orange (9,634) combine this with the other functions mentioned. Further removed, such towns as Cowra (5,056), Young (4,011), Mudgee (3,993), Wellington (4,320) are rather more agricultural and pastoral (wheat and sheep) centres and belong almost as much to the Western Slopes division. Lithgow (*q.v.*, 13,444) with its iron, steel and other industries stands rather apart as an outlier of the coastal industrial areas.

Production.—In 1926 production was: wool, 79,230,000 lb.; wheat, 2,100,000 bu.; butter, 4,136,000 lb.; minerals, £1,322,000; manufactures, £2,687,000. The Federal Capital territory falls within this area (*see* CANBERRA) and was formerly mainly devoted to grazing (sheep). On the edges of the southern tableland (west of Yass) is the famous Burrinjuck dam, the headworks of an important Riverina (*q.v.*) irrigation scheme.

The Coastal Lowlands, irregular, broken and detached patches or mere strips scattered and stretched along the eastern margins, are yet economically and in general social respects perhaps the most important regional element in the state. Relatively small in extent (22,237,000 ac.=34,745 sq.mi.) they contained about 1,770,000 persons (75.7% of the total pop., 1926; 43.4 per sq.mi.); the great majority of large towns, including the capital; nearly all the coal fields and manufacturing areas; all the sugar-growing, the bulk of the dairying and maize-growing areas, besides all the seaports, with the financial and commercial nerve-centres of the state. The largest, and also the most important, individual areas are the Sydney and Hunter river lowlands in the centre, the Clarence-Richmond-Tweed basins in the north, and the Illawarra district in the south (*see* SYDNEY; SINGLETON; RICHMOND RIVER AND BASIN; WOLLONGONG). The climate is mild and humid, and distinctly warmer in the north (rainfall: 30–62 in.; 35–76 in. in the north, 27-61 in. in the south). Apart from river bottoms and some coastal flats, the terrain is hilly or broken and the cultivable area is small, and of this area less than a quarter was cultivated in 1925–26. The broken lands—tableland scarps, valleys, foothills, etc.—are valuable for mining (*e.g.*, Clarence valley) and the intersection and laying bare of coal seams by river action and coastal faulting is a fact of importance. The extensive timber resources have been greatly depleted, though some timber is still cut in the Northern and Hunter valleys. In many parts the topography and climate offer facilities for water-power development (*cf.* Nymboida-Clarence scheme), while the rougher interior country is also used for cattle. Wheat and sheep are virtually excluded by the dampness of the climate, but 95% of the holdings used for dairying are in this area. All the sugar grown in the state is cultivated in the northern corner (1938: 21,000 ac.). Considerable quantities of fruit are grown—tropical fruits in the north, vines, oranges, etc., in the (northeast) Hunter valley and in the Sydney basin—and mixed agriculture is practised (maize, lucerne, potatoes in the north and centre). Livestock (1939): cattle, 695,000; dairy cattle, 962,000; horses, 154,000; sheep, 1,342,000. The holdings are comparatively small: 400–500 acres. The outcropping of coal in convenient positions has given rise to a coal-mining and coal-exporting industry (*see* BULLI; MAITLAND, WEST AND EAST [with CESSNOCK])—in 1938 very depressed—and more recently to growing manufacturing industries centred chiefly in or near Newcastle, Sydney, Port Kembla (*q.v.*). Here is the chief and growing industrial "hub" of the commonwealth. Here, also, are the financial and commercial headquarters —the central banking, wool-broking, railway and shipping, political and social organizations—of the state. Of ports, Sydney and Newcastle—the former good, the latter indifferent as a harbour—are the most important, but Grafton (a river port), Coff's Harbour and Byron Bay in the north have actual importance or possibilities as outlets for local trade and the same applies to Port Stephens as a possible outlet for the lower Hunter district. Jervis bay is the destined site for the port of the federal capital. Associated with the coasts are also fishing (mainly in the northern estuaries and lakes; 1938: £620,000), and the tourist and holiday-resort industries. Of the total population of the area (*v. sup.*) Sydney alone accounts for 1,235,267 (1933), and about 200,000 more inhabit the Sydney basin (Cumberland county). The lower Hunter valley and coasts immediately north of it (*i.e.*, substantially the Newcastle [*q.v.*]-Maitland [*q.v.*] district) count a further 280,000.

Of northern towns Lismore (*q.v.*, 11,762 in 1933), Grafton (6,411), Casino (5,287) are important centres, while in the south Nowra, Wollongong, Kiama are local exporting centres and health resorts.

Statistical Summary. *Area*—excluding Federal Capital Territory; including 176 sq.mi. of harbours—309,432 sq.mi., 10.40% of total area of Australia.

Population (June 1933): 2,600,847; 8.4 per sq.mi.; *c.* 48% of commonwealth; rate of increase (1926), natural 1.34%, natural+immigration 2.14%; metropolitan 45.6%; 99% of area contained (1926) only 655,300 inhabitants.

Occupations (Census 1933: total population 2,600,847; main classes only); *Breadwinners:* 46.5%; *Primary Producers:* 14.3% (agricultural with pastoral and dairying, 9.9%; mining, 3.8%). *Industrial,* 39.3%. *Commercial and Transport,* 26.7%.

Production (1938–39): Total, £165,165,000. *Primary Industries:* £74,899,000 (pastoral, £24,894,000; agricultural, £18,459,000; dairying—including pigs, bees, poultry—£16,359,000; mining, *c.* £11,700,000; forests, fisheries, etc., £3,485,000). *Manufacturing Industries:* £90,266,000. Production per head of population: *Primary:* £27.7.11 (pastoral, *c.* £9; agricultural, £7; dairy-

ing, £6.0; mining, £4.5.7). *Manufacturing:* £33.0.4. *Total:* £60.8.3.

Pastoral Industry (1939): *Sheep,* 48,877,000 (highest was in 1891, 61,831,000) including 40,861,000 merino; Wool, 437,000,000 lb. = £20,679,000 (at Sydney); average weight of clip, 7.8-8.8 lb. *Cattle:* 2,811,000 (including 1,068,000 dairy cattle). *Horses:* 548,000. *Milk:* 311,000,000 gal. *Butter:* 119,000,000 lb. *Cheese* c. 7,500,000 lb.

Agriculture: Area under cultivation (1939): *c.* 10,200,000 ac. (crops alone, 7,050,000 ac.). Wheat, 4,650,000 ac.; 59,898,000 bu.; £6,695,000 = 36.3% of total agric. produce. Hay, 973,000 ac.; 1,200,000 tons; £4,252,420 = 23%. Maize, 120,000–166,000 ac.; 3,280,000–4,600,000 bu.; £630,000–894,000 = 2–4%.

Mining: Total value of all minerals produced to end of 1938 = *c.* £513,000,000. Total output (1939), £12,000,000; (silver-lead, £3,520,000; zinc, £1,360,000); coal, £6,768,659 (northern fields, 7,000,000 tons; southern and western, etc., 3,800,000 tons).

Manufacturing Industries (1911 and 1939–40): Factories: (1911) 5,000; (1939–40) 9,458. Employees: 66,000 and 239,000. Raw materials and fuel: £15,600,000 and £134,453,000. Value of output: £25,700,000 and £239,000,000. Employees: Metallurgical and machinery, 184,000; clothing and textiles, 137,000; food, drink, etc., 87,000.

Communications—Railways: Total mileage open 1939 (including Federal and private lines), 6,210 miles (4 ft. 8½ in. gauge, 6,141) = 1 mi. railway per 400 inhabitants or per 50 sq.mi. Av. ann. increase of mileage, 155.38 miles. Total capital expended (1939), £149,238,000. Net earnings: £6,108,000 = 4.10% interest on capital invested.

Trade: Total (1935–39), £78,000,000–£112,000,000. (Imports £40,000,000–£63,000,000; Exports £37,000,000–£57,000,000.) Per head of population: £29–£41 (Imports: £15–£23; exports: £14–£21).

Exports: Wool: £17,000,000–£27,000,000 = 45–55% of total exports.

Wheat and Flour: £4,000,000–£7,000,000 = 10–14%. *Meat, hides, leather,* etc.: £5,500,000–£6,700,000 = 12–13%. *Butter: c.* £2,000,000 = 3–4%. *Coal:* £350,000 (falling) = 1.0%. *Other Minerals: c.* £3,000,000 = 5–6.5%. Total staple products £25,700,000 = 61% of total overseas exports.

Shipping (all classes): *c.* 3,300 vessels; 11,000,000 registered tonnage, discharging 6,100,000 tons and shipping 5,400,000 tons cargo.

Social Conditions: Hospitals: private: 549 (beds: 5,224); public, 207 (13,792). Total (government) expenditure on charitable relief (1938–39): £7,898,000 = £2.17.9 per head of population. (Maternity allowances: £167,000; State wards [children]: £760,000; Hospitals, asylums, etc.: £1,150,000; pensions: £6,400,000). State advances for building homes (1926): £1,620,000. Parks, recreation grounds, etc.: 240,000 ac.

Education: Schools (1938): public, 3,283; private, 746. Pupils: public, 367,052; private, 100,720 = 92% of those requiring instruction. (O. H. T. R.; G. TR.)

HISTORY

Early History.—New South Wales was discovered by Captain Cook on April 28, 1770 (*see* AUSTRALIA). On Jan. 20, 1788, the "Sirius," commanded by Captain Arthur Phillip, R.N., reached Botany bay with an armed trader, three store-ships and six transports. The persons on board the fleet included 40 women, 202 marines of various ranks under Major Ross, five doctors, a few mechanics, and 756 convicts. The livestock consisted of one bull and four cows, a stallion and three mares, some sheep, goats, pigs and a large number of fowls. The expedition was well provided with seeds of all descriptions. As Botany bay was found unsuitable, the settlement was transferred to Port Jackson, to the present site of Circular quay. Later, other convict-ships arrived; and, in 1793, came the first free settlers, who were presented with grants of land. By 1800 the population was 5,000.

In 1809 Captain Macquarie became governor, and, during his administration, New South Wales was transformed from a penal settlement to a colony. Schools and churches had already been erected, a newspaper, the *Sydney Gazette and New South Wales Advertiser,* had been started, and attempts made to acclimatize the drama. Macquarie was the first governor to open up the country. He formed roads and built bridges in the districts along the coast, and commenced a track across the Blue mountains. Attracted by the success of Captain John Macarthur with merino sheep, more free settlers began to arrive in 1817; but not until the governorship of Sir Richard Bourke (1831–37) did they obtain trial by jury, free press, a legislature with very limited representation, free grants of land, and religious equality. Settlement had progressed at a rapid rate. Parramatta, Richmond and Windsor were founded before 1798, and Newcastle, Maitland and Morpeth early in the 19th century; but the towns of the interior, Goulburn, Bathurst, and others were not begun till about 1835. Then, again, the explorations which followed the passage of the Blue mountains opened up a large portion of southeastern Australia. By 1840, owing to the formation of other colonies, New South Wales, which originally signified the mainland of Australia and the islands in the South Pacific, comprised only the three eastern states of today. Sale by auction of the public lands was now substituted for free grants; and squatters were allowed to occupy sparse areas on payment of a small annual licence. In 1851, when Victoria became a separate colony, the population of New South Wales had risen from the 76,793 of 1837 to 187,243, and the annual exports amounted to £2,399,580. In 1851 also, gold was discovered near Bathurst by E. H. Hargraves, and transportation was at last abolished.

The New Constitution bill was passed in 1853, and two years later, approved by the British parliament. The bill provided for an elected assembly and a nominated council; vote by ballot was introduced; the number of members in the assembly was increased to 80, and the franchise was granted to every adult male after six months' residence. The census of 1857 gave the population of Sydney and suburbs as 81,327. In 1859 Queensland was constituted a separate colony.

From 1861 to 1888.—After 1861 the land policy was entirely revised. Sir John Robertson, in his Land bill, introduced the principle of deferred payments for the purchase of crown lands. Residence and cultivation were considered more important than a sufficient price. After much opposition the measure was passed and the other colonies adopted similar legislation. The distinction between the descendants of convicts and the descendants of free settlers was now finally abandoned. In 1862 a large force, military and police, was despatched to Lambing Flat, in order to protect the Chinamen from ill-treatment by the miners. Bushranging became frequent, and only with great difficulty was stamped out.

H.R.H. the duke of Edinburgh visited the colony in 1868. An attempt was made upon his life by a man named O'Farrell, who was subsequently hanged. A census taken in 1871 showed that the population was 503,981, and the exports £11,245,032. During the governorship of Sir Hercules Robinson (1872–79) the Fiji Islands were annexed; telegraphic communication with England and mail communication with the United States were established, and a coalition between Sir Henry Parkes (premier and colonial secretary) and Sir John Robertson at length made it possible to develop some continuous policy. The census of 1880 gave the population of the colony as 751,468, of whom 411,149 were males and 340,319 females. In this year the railway to Melbourne was completed, and in 1883 valuable deposits of silver were discovered at Broken Hill. In 1885 the British government accepted the offer of a contingent from New South Wales to aid the imperial troops in the Sudan. The railway to Queensland was opened in 1888 by the new governor, Lord Carrington. In the same year the government prevented the landing of some Chinese passengers and passed laws practically prohibiting the immigration of Chinamen.

Federation.—In 1889, the premier, Sir Henry Parkes, gave his support to the movement for Australasian federation, and New South Wales was represented at the first conference held in Melbourne at the beginning of 1890 (*see* AUSTRALIA). Early in 1891 the great strike, which at one time had threatened to paralyse the trade of the colony, came to an end. A board of arbitration and conciliation to hear and determine labour questions and disputes

was formed, and by later legislation its powers were strengthened. (For labour legislation *see* AUSTRALIA.) The census of 1891 showed that the population was 1,134,207, of whom the aborigines numbered 7,705 and the Chinese 12,781. In 1893 a financial crisis resulted in the suspension of ten banks; but with two exceptions they were reconstructed, and by the following year the effects of the depression had passed away. In 1896 a conference of Australian premiers was held at Sydney to consider the question of federation. The then premier, G. H. Reid, was rather lukewarm, as he considered that the free-trade policy of New South Wales would be overridden by its protectionist neighbours. But his hand was to a great extent forced by a People's Federation convention held at Bathurst, and, ultimately, a considerable majority in favour of federation was obtained.

From 1899 On.—During the South African War (1899–1902) New South Wales sent 314 officers and 5,796 men, more than one-third of the total number raised by Australia. In spite of the great drought of 1902, the state made progress, and during the period 1901–14 the cultivated area was almost doubled. Scientific breeding of wheat and dry-farming were important factors in this increase.

The protectionist policy of the federal government helped the manufacturers, and the change from free trade did not appear to injure the prosperity of the country.

The influence of the Labour party was manifested in the adoption of laws extending the arbitration system, and from 1906 "assisted immigration" became its accepted policy. In 1912 fruit-growing began in the irrigation area of the Murrumbidgee. After 1918 a policy of closer settlement for ex-servicemen was initiated and further encouragement given to immigration from Great Britain.

The railway strike of 1917 had far-reaching effects: it raised legal and constitutional questions of importance and caused, ten years later, the downfall of the Labour ministry. In 1925, John T. Lang, the Labour premier, had instructed the railway commissioners to reduce in rank the men who had not taken part in the strike. The arbitration court forbade the commissioners to carry out the premier's instruction. Thereupon Lang introduced his Railway bill to annul the decision of the court. This was passed in the assembly but rejected by the legislative council. As the council is a nominated body, Mr. Lang recommended to the governor that 25 new members (all pledged to support the bill) should be added to its number. The recommendation was, after some demur, accepted, but, when a further bill was brought forward to abolish the council, some of the new councillors refused to die for the party and the bill was rejected by 47 to 41.

During the earlier part of this period there was a great deal of activity in railway circles. In 1926 the first section of the underground in Sydney was opened; and in 1932 the great bridge over the harbour, which had been started in 1925, was ready for traffic. In 1930 two important lines were opened; *i.e.*, in the far west to Broken Hill, which had previously been reached via Adelaide, and the Kyogle-Brisbane railway. By this route Brisbane was linked to Sydney and Albury by a complete standard-gauge railway in 1932, when the large bridge over the Clarence river was ready for use. In 1930 Kingsford Smith flew from England to Australia in less than 11 days, and in 1934 the airmail to England was inaugurated.

In 1933 there was a record wheat harvest, and the evils of the depression began to lessen. The decennial census was taken on June 30. In the same year the great Hume dam across the Murray river near Albury was completed. The year 1938 was the 150th anniversary of the foundation of Australia, and widespread celebrations took place, especially in Parramatta. In 1939 the Arbitration court adopted 44 hours as the standard working week. Baron Wakehurst became governor of the state in 1937, while in the state parliament A. Mair was premier in 1939, but gave place to Hon. William John McKell in 1941.

(H. D. N.; G. Tr)

NEWSPAPERS. A newspaper is an unbound serial publication issued at frequent intervals and devoted primarily to news. Most newspapers are issued daily or weekly. Some are published semiweekly, and there have been rare examples of fortnightly and monthly newspapers. The distinction between the newspaper and the magazine is sometimes a nice one, especially among weeklies; in general, the publication is called a magazine if it is bound within covers. Neither a page size nor a number of pages has ever been fixed for the newspaper, though before the advent of the cylinder press in the 1820s (*see* PRINTING), pages were necessarily accommodated to primitive presses which took sizes limited to 6 in. by 9 in. to 12 in. by 18 in.; after the 1820s until the advent of the tabloid, the large folio page was commonly considered the true newspaper form. In the 20th century the folio of about 16 in. by 23 in. and the "tabloid" of about half that size (or the folio folded once) became the common newspaper page sizes.

About 7,200 daily newspapers were published in the world at mid-20th century, one-fourth of them in the United States.

Early Examples.—As early as the 5th century B.C. there were writers of newsletters in Rome who furnished news to those who resided at a distance from the capital, and written news letters continued to be employed to supply intelligence to businessmen and political leaders until long after the invention of printing. Indeed, they have their modern counterparts in the "confidential newsletters" supplied to businessmen and others.

When Gaius Julius Caesar became Roman consul in 60 B.C. he immediately established the *Acta Diurna,* a daily bulletin posted in the forum and devoted chiefly to government announcements. Other forerunners of printed newspapers were the town criers (or bellmen), posted proclamations, controversial pamphlets, ballads, broadsides and news pamphlets. Many of the last-named appeared in Germany and other European countries in the 16th century and were sold at fairs and in shops; they usually dealt with a battle, a disaster, a marvel or a coronation.

In the first two decades of the 17th century, more or less regular papers printed from movable types sprang up in Germany, Austria, the Netherlands and Italy.

BRITISH NEWSPAPERS

Certain pamphlets may be taken as predecessors of the English newsbooks. *Newes concernynge the General Councell Holden at Trydent* (Thomas Raynalde, London, 1549), a translation from the German, was one of the earliest. They dealt with political matters, murders, wonders, etc., and were commonly published some time after the events they chronicled. They were not so much budgets of news as "relations" of a single event and matters connected with such an event. As a type of publication, they were modelled upon continental (especially German and Dutch) newsbooks, of which they were sometimes translations or adaptations. The German compilations of a half-year's events, called *Messrelationen* because they were sold at the fairs, clearly had an influence on later periodical development and were significant for England. Such a compilation in Latin by Micael ab Isselt, entitled *Mercurius Gallobelgicus,* continued 1594–1635, was widely popular in England, and brought the name *mercury* into use for newsbooks; some of the later issues were translated into English.

Doubtless under the influence of the *Messrelationen,* briefer compilations, many of which were translated or adapted for English readers, appeared from 1590 onward. When English editors took over the idea of the news budget in 1621, the publications were commonly called "corantos" to indicate current or running news.

The first English-language corantos were, however, small single-sheet (two-page) publications, and they were published in the Netherlands from Dec. 1620 to Sept. 1621. George Veseler published 15 of them and Broer Jonson 6 or 8 in Amsterdam; others were issued in Alkmaar and The Hague. Apparently the next step was the publication of the same type of coranto in London in Sept. 1621, under the title *Corante, or, Weekely Newes from Italy, Germany, Hungarie, Spaine and France.* Six of these were issued "for N. B." with slight variations in title through September and October. The title is nearly enough identical, and the weekly periodicity (though actually irregular) clear enough in intention, to support the claim for this series as the first English newspaper. "N. B." was probably Nicholas Bourne, though there is a possibility that it was Nathaniel Butter. The sheets were translations of Dutch or German corantos.

The next year the single-sheet corantos gave place to those in pamphlet form; and comparative regularity in periodicity, if not

in title, came with the *Weekly Newes,* issued by Nicholas Bourne and Thomas Archer beginning in May 1622. This series was generally referred to as composing the "first English newspaper" before the discovery in 1912 of the single-sheet corantos by "N. B." Continuity was by dates rather than identical title; for several years most coranto publishers depended upon changing headlines to sell their product and avoided identical titles. On Aug. 2, 1622, Nathaniel Butter began a *Newes,* "all of which do carry a like title . . . and have dependence upon one another" (Aug. 23). Butter, the son of a bookseller, became the most famous of the coranto publishers who flourished in the 1620s—a group including Bourne, Archer, William Sheffard, Bartholemew Downes and Nathanael Newbery. In Oct. 1622, with Bourne and Sheffard, Butter began *A Coranto,* with the introduction of serial numbering. In 1625 Archer founded *Mercurius Britannicus,* which probably lasted till the end of 1627. Butter and Bourne remained principal publishers of the corantos of various series until 1632, when all were suppressed because the Spanish ambassador had been offended by news they had published regarding the royal house of Austria. For six years thereafter there were no newsbooks in England, but in 1638 Butter and Bourne were given exclusive patent for publication of foreign news.

Freedom and Censorship.—The next step in the evolution of the newspaper was due to the abolition of the Star Chamber in 1641, and the consequent freeing of the press; and at last we come to the English periodical with domestic news. In Nov. 1641 began *The Head of severall proceedings in the present parliament* (outside title) or *Diurnal Occurrences* (inside title), the latter being the title under which it was soon known as a weekly; and on Jan. 31, 1642, appeared *A Perfect Diurnal of the Passages in Parliament.* These were printed for William Cooke, and were written apparently by Samuel Pecke, "the first of the patriarchs of English domestic journalism" (J. B. Williams). The weekly *Diurnals* were on the side of the parliament until in Jan. 1643 appeared at Oxford the first Royalist diurnal, named *Mercurius Aulicus, a Diurnal communicating the intelligence and affaires of the Court to the rest of the Kingdome* (continued till Sept. 1645, and soon succeeded by *Mercurius Academicus*), which struck a higher literary note. It was conducted by Sir John Berkenhead, a fellow of All Souls, whose style is said to reflect that of the parliamentary oratory of his day. He afterward became master of requests. *Mercurius Civicus,* the first regularly illustrated periodical in London, was started by the parliamentarian Richard Collings on May 11, 1643 (continued to Dec. 1646); Collings had also started earlier in the year the *Kingdome's Weekly Intelligencer,* which lasted till Oct. 1649. In Sept. 1643 appeared another Puritan opponent of *M. Aulicus* in the later *Mercurius Britannicus* of Capt. Thomas Audley, which in Sept. 1644 was taken over and continued for nearly two years by Marchamont (or Marchmont) Nedham. Nedham was a master of invective and one of the earliest to change sides when it suited him. From Oct. 1649 to June 1650, by a new act of parliament, the licensed press itself was entirely suppressed, and in 1649 two official journals were issued, *A Brief Relation* (up to Oct. 1650) and *Severall Proceedings in Parliament* (till Sept. 1655), a third licensed periodical, *A Perfect Diurnall* (till Sept. 1655), being added later in the year and a fourth, *Mercurius Politicus* (of which John Milton was the editor for a year or so and Nedham one of the principal writers), starting on June 13, 1650 (continuing till April 12, 1660). After the middle of 1650 there was a revival of some of the older licensed newsbooks; but the *Weekly Intelligence of the Commonwealth* (July 1650 to Sept. 1655), by R. Collings, was the only important newcomer up to Sept. 1655, when Oliver Cromwell suppressed all such publications with the exception of *Mercurius Politicus* and the *Publick Intelligencer* (Oct. 1655 to April 1660), both being official and conducted by Nedham.

Till Cromwell's death (Sept. 3, 1658) Nedham reigned alone in the press, but in 1659 a rival appeared in Henry Muddiman (a great writer also of "newsletters"), whose *Parliamentary Intelligencer,* renamed the *Kingdom's Intelligencer* (till Aug. 1663), was supported by Gen. George Monk. Nedham's journalistic career came finally to an end (he died in 1678) at the hand of Monk's council of state in April 1660. His successor, Muddiman, was supplanted in 1663 by Sir Roger L'Estrange, formerly a royalist cavalry officer who narrowly escaped execution during the commonwealth; he was appointed "surveyor of the press." On him was conferred by royal grant—as it proved, for only a short period—"all the sole privilege of writing, printing and publishing all narratives, advertisements, mercuries, intelligencers, diurnals and other books of public intelligence; . . . with power to search for and seize the unlicensed and treasonable schismatical and scandalous books and papers." L'Estrange discontinued *Mercurius Politicus* and *Kingdom's Intelligencer* and substituted two papers, the *Intelligencer* (Aug. 1) and the *Newes* (Sept. 3), at a halfpenny, the former on Mondays and the latter on Thursdays; they were continued till Jan. 29, 1666, but from the beginning of 1664 the *Intelligencer* was made consecutive with the *Newes,* numbered and paged as one.

The London Gazette.—The first number of the biweekly *Oxford Gazette,* licensed by Lord Arlington and written by Muddiman, was published on Nov. 16, 1665. It was a "paper" of news, measuring $5\frac{1}{2}$ in. by $9\frac{1}{2}$ in., and printed on both sides. With the publication of the 24th number (Monday, Feb. 5, 1666, O.S.) the *Oxford Gazette* became the *London Gazette,* which has appeared twice a week, on Tuesdays and Fridays, ever since as the official organ of government. After the Revolution of 1688 the press censorship was relaxed, being finally abandoned in 1693, and a number of newspapers came into being, including the *Universal Intelligence, English Courant, London Courant, London Mercury, London Intelligence, Orange Gazette, Flying Post, Post-Boy,* a daily which lasted only four days, and the *Lincoln, Rutland, and Stamford Mercury,* the oldest of the provincial papers, having been founded in 1695. In 1699 appeared the *Edinburgh Gazette,* a biweekly.

Elizabeth Mallet published the first English daily newspaper March 11, 1702. She abandoned it after a week or two, but it was resumed a month later by Samuel Buckley. It measured $6\frac{1}{4}$ in. by $11\frac{1}{2}$ in., printed on one side only, and strove to adhere to factual news rather than opinion.

Defoe and Lloyd.—Daniel Defoe was the first English journalistic writer of national importance. In Feb. 1704 he began his weekly, the *Review,* which eventually was printed three times a week and was a forerunner of the *Tatler* (started by Sir Richard Steele in 1709) and the *Spectator* (started by Steele and Joseph Addison in 1711). Defoe's *Review* came to an end in 1713, and between 1716 and 1720 he published a monthly with an old title, *Mercurius Politicus.* By some authorities Defoe is considered the originator of the serial story.

The *Examiner,* which was started in 1710 as the chief Tory organ, enjoyed as its most influential contributor Jonathan Swift, the father of the leading article. Edited by William King, afterward principal of St. Mary's hall, Oxford, this political journal had brilliant contributors in Henry St. John, Viscount Bolingbroke; Matthew Prior; Francis Atterbury; and John Arbuthnot. Swift had control of the journal for 33 numbers between Nov. 1710 and June 1711, but on becoming dean of St. Patrick's he gave up regular journalistic work. There followed a number of other political journals, such as the *Craftsman,* the *Whig Examiner* and the *Medley.*

In 1696 Edward Lloyd—the virtual founder of the famous "Lloyd's" of commerce—started a thrice-a-week paper, *Lloyd's News,* which had but a brief existence in its first shape, but was the precursor of the modern *Lloyd's List.* No. 76 of the original paper contained a paragraph referring to the house of lords, for the appearance of which a public apology must, the publisher was told, be made. He preferred to discontinue his publication (Feb. 1697). Nearly 30 years afterward he in part revived it, under the title of *Lloyd's List*—published at first weekly, afterwards twice a week (*see* F. Martin, *History of Lloyds,* 66–77 and 107–120). This dates from 1726. It later became a daily, published in several forms for diverse commercial interests.

Stamp Tax of 1712.—The increasing popularity and influence

of the newspaper press could not fail to be distasteful to the government of the day. The paper which seems to contain the first germ of the newspaper tax is still preserved among the treasury papers, and probably belongs to the year 1711. "There are published weekly," says the writer, "about 44,000 newspapers, viz., *Daily Courant, London Post, English Post, London Gazette, Postman, Postboy, Flying Post, Review* and *Observator*." ("A Proposition to Increase the Revenue of the Stamp-Office," Redington, *Calendar of Treasury Papers, 1708–1714*, p. 235.) The duty eventually imposed (1712) was a halfpenny on papers of half a sheet or less, and a penny on such as ranged from half a sheet to a single sheet.

Swift's doubt expressed in his *Journal to Stella* (Aug. 7, 1712) as to the ability of the *Spectator* to hold out against the tax was justified by its discontinuance in Dec. 1712, Steele starting the *Guardian* in 1713, which only ran for six months. But some of the worst journals that were already in existence kept their ground, and their number soon increased. An enumeration of the London papers of 1714 comprises the *Daily Courant*, the *Examiner*, the *British Merchant*, the *Lover*, the *Patriot*, the *Monitor*, the *Flying Post*, the *Postboy, Mercator*, the *Weekly Pacquet* and *Dunton's Ghost*. Another enumeration in 1733 includes the *Daily Courant*, the *Craftsman, Fog's Journal, Mist's Journal*, the *London Journal*, the *Free Briton*, the *Grub Street Journal*, the *Weekly Register*, the *Universal Spectator*, the *Auditor*, the *Weekly Miscellany*, the *London Crier, Read's Journal, Oedipus or the Postman Remounted*, the *St. James's Post*, the *London Evening Post* and the *London Daily Post*, which afterward became better known as the *Public Advertiser*. Part of this increase may fairly be ascribed to political corruption. Later toward the middle of the same century the provisions and the penalties of the Stamp act were made more stringent. Yet the number of newspapers continued to rise. In 1753 the aggregate number of copies of newspapers annually sold in England, on an average of three years, amounted to 7,411,757. In 1760 it had risen to 9,464,790, and in 1767 to 11,300,980. In 1776 the number of newspapers published in London alone had increased to 53.

18th-Century Journalists.—Thus the 18th century saw the gradual development of the purely political journal side by side with those papers which were primarily devoted to news, domestic and foreign, and commerce. It was left to Steele and Addison to develop the social side of journalism in their journals named above which found a permanent place in English literature. Nor must we omit Samuel Johnson's second biweekly, the *Rambler*, started in 1750, and his weekly, the *Idler* (1758). In 1761 the *North Briton* came out and it was largely a result of John Wilkes's determined fight for the liberty of the press that at length the last shackles on free expression of opinion in Britain were cut away, and by 1772 the right to publish parliamentary reports had been established.

The outstanding daily paper in the middle of the 18th century was the *Public Advertiser*, which for about 25 years had been called the *General Advertiser* (and for some time the *London Daily Post*). It was published with notable success by Henry Woodfall and his son Henry Sampson Woodfall, and it was in this paper that appeared the famous letters of Junius (*q.v.*), which have been attributed to Sir Phillip Francis. These papers led to a marked increase in its circulation, the monthly sale in Dec. 1771 being almost 84,000 as compared with 47,500 seven years previously. But in 1798 it was merged in the *Public Ledger*.

Early 19th Century.—In 1769 William Woodfall started the *Morning Chronicle*, whose daily circulation in 1819 reached 4,000, and in 1843, at a time when Charles Dickens was a contributor, 6,000. But in another six years the circulation had fallen to 3,000. For about five years it became the property of the duke of Newcastle, Gladstone and others, but finally ended insolvent, after a life of more than 90 years. Another long-lived daily paper, whose top circulation was about 6,000, was the *Morning Herald* (1781–1869). Two other important and long-lived dailies were started in the 18th century, the *Morning Post* and the *Times*; these are dealt with later, together with the *Morning Advertiser*, founded in 1794. It was William Cobbett who first attempted to reach the masses by his pen, and reduced the price of his *Weekly Political Register* from 1*s*. ½*d*. to twopence in his endeavour to appeal to the working classes for support of those principles of parliamentary reform dear to his heart. In 1808 Leigh Hunt brought out the *Examiner*, whose frank criticism of the prince regent landed him and a brother in prison. This weekly journal had quite a long lease of life and excelled in dramatic criticism, besides giving an excellent review of the events of the week in all branches of public affairs.

Abolition of "Taxes on Knowledge."—The development of the press was enormously assisted by the gradual abolition of the "taxes on knowledge," and also by the introduction of a cheap postal system. In 1756 an additional halfpenny was added to the tax of 1712. In 1765 and in 1773 various restrictive regulations were imposed. In 1789 the three halfpence was increased to twopence, in 1798 to twopence-halfpenny, in 1804 to threepence-halfpenny and in 1815 to fourpence, less a discount of 20%. As prosecutions multiplied, and the penalties became more serious, revolutionary tendencies increased in a still greater ratio. Blasphemy was added to sedition. Penny and halfpenny journals were established which dealt exclusively with narratives of gross vice and crime. Between 1831 and 1835 hundreds of unstamped newspapers made their appearance. The political tone of most of them was fiercely revolutionary. Prosecution followed prosecution, but all failed to suppress the obnoxious publications.

To Lord Lytton, the novelist and politician, and subsequently to Milner Gibson and Richard Cobden, is chiefly due the credit of grappling with this question in the house of commons in a manner which secured first the reduction of the tax to a penny in 1836, and then its total abolition in 1855. The number of newspapers established from the early part of 1855, when the repeal of the duty had become a certainty, and continuing in existence at the beginning of 1857, amounted to 107; 26 were metropolitan and 81 provincial. The duties on paper itself were finally abolished in 1861.

The abolition of the stamp taxes brought about such reductions in the prices of newspapers that they speedily began to reach the many instead of the few. Some idea of the extent of the tax on knowledge imposed in the early 19th century may be gathered from the fact that the number of stamps issued in 1820 was nearly 29,400,000, and the incidence of the advertisement tax, fixed at 3*s*. 6*d*. in 1804, made it impossible for the newspaper owner to pass on the stamp tax to the advertiser. In 1828 the proprietors of the *Times* had to pay the state more than £68,000 in stamp and advertisement taxes and paper duty. But after the reduction of the stamp tax in 1836 from fourpence to one penny, the circulation of English newspapers, based on the stamp returns, rose from 39,000,000 to 122,000,000 in 1854.

It is appropriate at this stage to sketch the history of the great English newspapers.

THE LONDON PRESS

The Times, occupying the premier position among British newspapers, was started by John Walter on Jan. 1, 1785, under the name of the *Daily Universal Register*. The founder promised the readers of the new journal that it would contain nothing to wound anyone's delicacy or corrupt the mind, that it would abstain from unfair partisanship and scandalous scurrility. On Jan. 1, 1788, its title was changed to the *Times*, and this great newspaper has ever since been the pre-eminent national journal and daily historical record. It came into existence when free expression of opinion in the press was still a thing of the future, and within a few years of the establishment of his paper Walter had several sojourns in Newgate and had to pay several fines for criticisms of the authorities. One of his offenses was the statement that the then prince of Wales and other royal princes had by their misconduct incurred the just disapprobation of George III.

John Walter II practically took over the reins in 1803, and he also had to encounter the active opposition of governments which he had occasion to criticize, including that of William Pitt. He introduced a better system of news transmission and steam printing (1814) with the result that he was able to make the proud

announcement that 1,100 sheets had been impressed in one hour. In view of the newspaper and advertisement tax and other disabilities, it was a considerable achievement when in 1815, the year of Waterloo, the daily circulation reached 5,000. In 20 years this was doubled, in 1851 it had reached 40,000 and three years later it was more than 50,000, when its most circulated rival, the *Morning Advertiser,* had a sale of fewer than 8,000 copies. When John Walter II assumed control the *Times* was a small four-page sheet. When he gave up control in 1847 it consisted of 12 large pages. Sir John Stoddart, later governor of Malta, was the editor for several years up to 1816. He was succeeded by Thomas Barnes, and when the latter's health began to fail much of the editorial work devolved upon Capt. Edward Sterling, whose pontifical and sometimes explosive style caused Thomas Carlyle to say: "He more than any other man was *The Times,* and thundered through it to the shaking of the spheres." Carlyle also called him "Captain Whirlwind," and the popular title of the "Thunderer" often given to the *Times* dated from his time. In those days the most powerful writer in its columns on foreign affairs was Crabb Robinson; his place was taken at a later date by Henry Reeve.

In 1841 on the death of Barnes the editorial chair was taken by a young man, John Thaddeus Delane, whose brilliant career in this capacity lasted until 1877. His place was taken by Thomas Chenery, who died in 1884 and was succeeded by George Earle Buckle. Meanwhile, since 1848 John Walter III had been in command. He died in 1894, and was succeeded by Arthur Walter.

About the beginning of the 20th century the *Times* had begun to feel the influence of the more go-ahead methods of the popular press, and there was a loss of circulation and revenue which became a grave source of anxiety to its owners. It was a period when another great London daily paper, the *Standard,* was *in extremis.* Finally, in 1908 Lord Northcliffe realized his ambition of long years and acquired the chief control of the "Thunderer." It cannot be said that Lord Northcliffe's administration was consistently successful but he thoroughly remodelled the organization and increased its efficiency in all departments.. On his retirement Buckle was succeeded as editor by George Geoffrey Dawson. In 1919 he retired from the editorship because of a difference of opinion with Lord Northcliffe and his place was taken by Henry Wickham Steed. In 1923 when, following the death of Lord Northcliffe, Major J. J. Astor, M.P., became its chairman and chief proprietor, Dawson again became editor. Major Astor secured the future independence of the paper by a deed establishing a body of trustees consisting of holders of various public offices whose consent would be required to validate any future transfer of ownership.

In 1941 Dawson retired from the editorship of the *Times* in favour of Robert M. Barrington Ward, who upon his death seven years later was succeeded by W. F. Casey. At the midcentury the *Times,* though it had fallen far behind most of its London competitors in circulation (240,000), still enjoyed a prestige and leadership in opinion which made it a national institution. Usually reflecting government views, it had a well-earned reputation for independence.

The *Times* excelled in many departments, mainly by employing experts in particular subjects. It specializes in its presentation of foreign affairs and early set up an able staff of correspondents in the chief capitals of the world. One of the most famous of these was Henri de Blowitz, who among his many "scoops" secured for the *Times* the privilege of publishing exclusively the text of the Berlin treaty of 1878 on the very day that it was signed.

The principal adjuncts to the *Times* are the literary supplement, which surveys the whole field of new literature every Thursday; the weekly edition, first published in 1877, containing a summary of the week's news; the *Times* law reports; the educational supplement and the trade and engineering supplement, which are weekly publications; and the index, an invaluable record of the events of the day recorded in the newspaper, which is published quarterly. In addition, the *Times* issues at intervals handsome supplements to its readers without any extra charge.

The Daily Telegraph & Morning Post, another great national daily, was first published as the *Daily Telegraph and Courier,* on June 29, 1855, a twopenny newspaper. It was owned by Colonel Arthur B. Sleigh, who transferred it to Joseph Moses Levy in the following September. Levy produced it as the first penny newspaper in London, the name *Courier* being subsequently dropped. His son Edward Lawson (later the first Baron Burnham) soon became editor, which post he continued to hold till 1885. A long list of distinguished members of the staff included Sir Edwin Arnold, George Augustus Sala, Edward Dicey, Sir J. M. Le Sage, Bennet Burleigh, the war correspondent, J. L. Garvin and H. D. Traill; and among dramatic and literary critics Clement Scott and W. L. Courtney. After 1890 the Hon. Harry Lawson, eldest son of the owner (later Viscount Burnham), assisted in the general control. The *Daily Telegraph* became the especial organ of the middle classes and shortly before the advent of the halfpenny daily newspaper had achieved so remarkable a success that it could claim the largest circulation in the world. It was consistently Liberal up to 1878 when it opposed Gladstone's foreign policy, and at the Irish Home Rule split in 1886 it became Unionist. Its enterprises included the financing of an important archaeological exploration in Nineveh resulting in the discovery of a number of fragments of the cuneiform narrative of the deluge, and the dispatch, in co-operation with the *New York Herald,* of Sir H. M. Stanley on his successful exploration of Africa.

Circulation by 1927, however, had declined to 84,000; and in 1928 Viscount Burnham sold the paper to the brothers Sir William Ewert Berry and Sir James Gomer Berry (later Viscount Camrose and Viscount Kemsley) and Sir Edward (later Lord) Iliffe. Circulation increased, doubling in 1930, when the price was reduced to a penny. The *Morning Post* was absorbed in 1937, and the *Daily Telegraph & Morning Post* was at mid-century a quality morning newspaper, well-balanced and independent Conservative in politics, with more than 900,000 circulation.

The *Morning Post* had been founded in 1772 as the *Morning Post and Daily Advertising Pamphlet,* mostly an advertising sheet including state lotteries, which were legal and popular at that time. It developed into a national newspaper under the ownership of Peter and Daniel Stuart after 1795, and attracted a wonderful galaxy of writers, including Sir James Mackintosh, Samuel Taylor Coleridge, Robert Southey, Arthur Young, the poet Thomas Moore, William Wordsworth and Charles Lamb. The *Morning Post* maintained a tradition of vigorous and unblenching criticism, and Nicholas Byrne, editor-owner who succeeded Daniel Stuart, was murdered in his office as the result of an article which had given offense. In 1850 the paper came under the control of Peter Borthwick, and on his death in 1852 he was succeeded by his son, Algernon (later Lord Glenesk). Among the editors of the *Morning Post* were Sir William Hardman, J. Nicol Dunn, Sir Fabian Ware, and H. A. Gwynne. In 1937 the paper, as noted above, was consolidated with the *Daily Telegraph.*

The News Chronicle resulted from the amalgamation of several papers, notably the *Daily News* and the *Daily Chronicle,* both of which will be discussed here separately.

The *Daily News* was founded in 1846 under the editorship of Charles Dickens, who soon retired and was succeeded for a year or so by John Forster, later his biographer. The original staff included Mark Lemon, afterward editor of *Punch,* and Douglas Jerrold. The *Daily News* acquired a consistent record as a champion of Liberalism; it led British public opinion in sympathizing with the north in the United States Civil War, in supporting the war of freedom in Italy and the emancipation of Bulgaria and the Armenians. Under the control of Sir John Robinson it attained a high reputation for its foreign correspondence, beginning with the celebrated Archibald Forbes in the Franco-German War of 1870–71.

The *Daily News* absorbed the *Morning Leader* and acquired the *Star* in 1909, absorbed the *Westminster Gazette* in 1928 and was amalgamated with the *Daily Chronicle* in 1930.

The *Daily Chronicle,* unlike the *Daily News,* which was started under distinguished auspices, was the outgrowth of a London

local daily, the *Clerkenwell News,* and was established in 1877. It consisted almost entirely of small advertisements and Edward Lloyd, the founder of *Lloyd's News,* turned it into a general morning London newspaper. During the Home Rule controversies of the '80s it was Liberal Unionist, but under the editorship of A. E. Fletcher (1895) it became Gladstonian Liberal. Fletcher was succeeded by Henry W. Massingham, who, while maintaining the literary features, made the paper a more robust political organ. Massingham was a Radical; he lost his position on the *Chronicle* because of his opposition to the Boer War. He was succeeded by W. J. Fisher and the paper pursued a humdrum career and was a declining property when in 1904 Robert Donald was appointed editor. The paper entered upon a new era of prosperity and prestige which reached its height during World War I.

The paper was sold to David Lloyd George and his friends in the autumn of 1918, when Sir Robert Donald retired from his position as editor. After several other changes in ownership and management, the *Daily Chronicle* was amalgamated with the *Daily News* in 1930 to form the *News Chronicle.* At mid-century it had a circulation of more than 1,500,000, with simultaneous publication in London and Manchester. An independent progressive paper, it emphasized features and sports.

The Daily Mail, started by Alfred and Harold Harmsworth in 1896 as a halfpenny daily newspaper, was a phenomenal success from the first number. By 1900 it had already reached the 1,000,000 mark in circulation and by 1929 it had 2,000,000. In 1905 Sir Alfred Harmsworth started in Paris the *Continental Daily Mail,* later the property of Lord Rothermere. The *Daily Mail* also established editions in Manchester, Eng., and Edinburgh, Scot.

Sir Alfred (later Viscount Northcliffe) was not only a brilliant organizer but a keen journalist; he pioneered in many enterprises of journalism and national interests, including invaluable help to aviation.

On the death of Lord Northcliffe in 1922, the paper came under the control of his brother, Lord Rothermere. Thomas Marlowe, who had long been editor, resigned in 1926, and was followed by a series of talented journalists. On the retirement of the owner in 1937 the management passed to his son, the second Lord Rothermere. In the late 1920s and early 1930s the *Daily Mail* had the largest daily circulation in the world. By mid-century it had a distribution of somewhat more than 2,000,000, but at that time it had been greatly exceeded in circulation by both the *Daily Express* and the *Daily Mirror.*

The Daily Express, which was founded as a halfpenny newspaper in 1900 by C. Arthur Pearson, passed the *Daily Mail* in circulation in the 1930s through the use of free-gift inducements. Following the lead of U.S. newspapers, the *Daily Express* struck a new note, later imitated by other London papers, of publishing its principal news on the front page, which became, so to speak, the shopwindow. In 1904 R. D. Blumenfeld became editor and in 1912 he formed a syndicate which acquired control. Lord Beaverbrook began to take an interest in the paper while it was financially in low water, and in 1922 he obtained complete control. He spent prodigious sums in developing the paper, which by mid-century had about 4,000,000 circulation and was being printed simultaneously in London and Manchester, Eng., and Glasgow, Scot.

The Daily Herald.—Founded in 1912 as a Labour organ, the *Daily Herald* was not taken over officially by the Labour party until 1923. In 1929 Lord Southwood, head of Odhams Press Ltd., large printing and publishing concern, arranged to take a 51% interest, while the party retained 49%. It was agreed that the paper should support the policy of the Trades Union congress. With the aid of free insurance and other inducements, the *Daily Herald* gradually built up a large circulation; in 1939 it made the claim, continued through mid-century, of daily sales in excess of 2,000,000.

The Daily Graphic.—The *Daily Sketch,* founded in 1909 as a halfpenny illustrated tabloid, absorbed the older and higher-priced *Daily Graphic* in the 1920s and was called for some years *The Daily Sketch and Graphic.* Coming into the hands of Lord Rothermere, it was later sold by him to Lord Kemsley. The name of the *Graphic* was then dropped, but in 1946 the *Daily Sketch* became *Daily Graphic.* At mid-century it had a circulation of about 775,000.

The Daily Mirror.—The *Daily Mirror* was originally issued in 1903 by Alfred Harmsworth, later Lord Northcliffe, as a women's paper to be edited by women. When it did not succeed in this field, its owner soon made it over into the first halfpenny illustrated tabloid. It retained a family flavour, however, with attention to women's interests. At mid-century it was second only to the *Daily Express* in circulation, selling 3,700,000 copies daily.

The Daily Worker.—Founded in 1932 as a Communist organ, the *Daily Worker* was suppressed in Jan. 1941 for opposing the national war effort and did not appear again until Sept. 1942 when the U.S.S.R. had joined the war against Germany. Its circulation at mid-century was somewhat more than 100,000.

London Evening Papers.—The above newspapers, all published in the morning, were selling for one penny at mid-century, except for the *Times* and the *Daily Telegraph & Morning Post* (threepence and one and one-half pence, respectively). One penny was also the price of the three afternoon papers, the *Evening Standard, Evening News* and *Star.*

The *Evening Standard* was begun in the 1870s as the afternoon edition of the *Standard* (*see* below) and was devoted largely to commercial news. In 1923 it became the property of Lord Beaverbrook, and later it absorbed the famous old *Pall Mall Gazette* (*see* below). Often called a "quality" evening newspaper, it had a circulation of nearly 800,000 at mid-century.

The *Evening News* was founded in 1881, and after many vicissitudes of fortune when in low water was acquired in 1895 by Alfred and Harold Harmsworth and Kennedy Jones. It was the Harmsworths' first incursion into daily journalism, and made a rich experimental field for the *Daily Mail.* One of the Associated Newspaper group, it had the largest circulation of any of the evening papers in the country at mid-century—approximately 1,750,000.

The *Star,* the only Liberal evening paper in London, was started by T. P. O'Connor in 1888 as a halfpenny journal in support of Gladstone. In 1909 it was acquired by the *Daily News* and had a circulation of more than 1,000,000 in the 1940s.

Great Papers of the Past.—Fleet street is crowded with the ghosts of journals which in their time have filled important places in the life of the country. There was the *Morning Chronicle,* which began its career in 1769 and had among its leading contributors Richard Brinsley Sheridan, Sir J. Mackintosh, John Campbell (afterward lord chancellor), Campbell, the poet, Thomas Moore, Lord Brougham, Byron, William Hazlitt, John Stuart Mill, Charles Lamb and William Makepeace Thackeray. John Black was its most famous editor. After a notable career the *Morning Chronicle* died in 1862.

The *Standard* was established as an evening paper in the Tory interest in 1827, its first editor being Stanley Lees Giffard. In the 1850s it was purchased by James Johnstone, who brought out the *Standard* as a morning paper (June 29, 1857) and increased its size from four to eight pages. One of its contributors in the 1860s was Lord Robert Cecil, later Lord Salisbury, the prime minister. Johnstone, to whose energy and perspicacity the paper owed so much, died in 1878, and under his will William H. Mudford was appointed editor and manager for life, or until resignation. Already a great property, the *Standard* in Mudford's hands entered upon a successful period. It had many famous war correspondents, foremost among whom were G. A. Henty, the famous author of boys' books; John A. Cameron, who was killed at Abu Klea, A.-E. Sud.; and William Maxwell. In Jan. 1900 Mudford retired, and was succeeded in the editorship by G. Byron Curtis (d. 1907). In Nov. 1904 the *Standard* was sold to (Sir) Cyril Arthur Pearson. In 1910 it passed into the control of Davison Dalziel (later Lord Dalziel) and disappeared during World War I.

A disastrous experiment in newspaper production was the *Tribune,* founded by Franklin Thomasson in 1906 as a solid penny

daily. After gathering a brilliant staff and expending very large sums he found it necessary to discontinue the paper in 1908. The unhappy enterprise was described in Sir Philip Gibbs's novel *The Street of Adventure.* The *Echo* was established by Cassell, Petter, Galpin and company in 1868 and afterward owned in turn by Albert Grant, the company promoter, Passmore Edwards, Andrew Carnegie and Sam Storey. The *Echo* perished in 1905.

The *Globe* was founded in 1803, and after many years as a leading Whig organ it turned Conservative in 1866 when it became the property of a syndicate which included Sir Stafford Northcote (Lord Iddesleigh). Two years later it assumed the deep pink hue which it kept until its demise after World War I. The first number of the *Pall Mall Gazette* (the name being borrowed from the incident in which Thackeray describes Captain Shandon in the Marshalsea prison drafting the prospectus of the *Pall Mall Gazette* as a paper "written by gentlemen for gentlemen") appeared in Feb. 1865. Its first editor was Frederick Greenwood, who gathered round him a brilliant array of talent in Sir Henry Maine, Sir J. Fitzjames Stephen, Anthony Trollope, Charles Reade, George Henry Lewes, George Eliot, Matthew Arnold and Richard Jefferies. In 1875 Greenwood was able to convey to Disraeli news of the French bid to secure control of the Suez canal, thereby enabling Britain to get in first. It had been a consistent supporter of Disraeli, and when on changing hands it became Liberal, John Morley (later Viscount Morley of Blackburn) became editor, with William T. Stead as assistant editor. When Morley exchanged journalism for politics in 1883, he was succeeded by Stead. Stead's adventurous career as the editor came to an end in 1889, in consequence of his publishing a series of articles called "The Maiden Tribute of Modern Babylon," purporting to further the Criminal Law Amendment bill. He was succeeded by E. T. Cook. The *Pall Mall Gazette* was now steadily Liberal and a strong advocate of Irish Home Rule. It had two distinguished editors at a later date in Sir Douglas Straight and J. L. Garvin, and finally passed through several hands before its consolidation with the *Evening Standard* in 1925.

Founded in 1880 by H. Hucks Gibbs (afterward Lord Aldenham) for Frederick Greenwood to edit when he had left the *Pall Mall Gazette,* the *St. James's Gazette* represented the more intellectual and literary side of Tory journalism in opposition to the new Liberalism of Greenwood's former organ. In 1888, the paper having been sold, Greenwood retired and was succeeded as editor (1888–97) by (Sir) Sidney Low, who in his turn was succeeded by Hugh Chisholm (1897–99). Among the contributors were Rudyard Kipling, Sir James Barrie and G. S. Street.

Toward the end of the 19th century it assumed a more popular style and shape, and for a year or two before its acquisition by Pearson in 1903 and its final merging in the *Evening Standard* it was edited by Ronald M'Neill (later Baron Cushendun).

When the *Pall Mall Gazette* was sold to Lord Astor in 1892 and converted into a Conservative organ, E. T. Cook, the editor, and most of his staff resigned; in 1893 they came together again on the *Westminster Gazette,* newly started for the purpose by Sir G. Newnes as a penny Liberal evening paper. It was printed on green paper. The paper was conducted on the lines of the old *Pall Mall Gazette,* and it had the advantage of a brilliant political cartoonist in F. Carruthers Gould. In 1896 Cook was appointed editor of the *Daily News,* and his place was ably filled by J. Alfred Spender. The *Westminster* became conspicuous for its high standard of political and literary criticism, and gradually became the chief organ of Liberal thought in London. In 1908 the paper was sold to a group of Liberal capitalists. It vanished after World War I to be replaced by a daily newspaper of the same name which was merged in the *Daily News* in 1928.

BRITISH PROVINCIAL PRESS

The first provincial paper in England was the weekly *Worcester Postman,* 1690, later the modern *Berrow's Worcester Journal.* In the first 20 years of the 18th century a number of other journals sprang up in country towns, practically all of them being weekly journals. Among them were the *Stamford Mercury* begun in 1713 and the *Northampton Mercury* begun in 1720. At the beginning of the 19th century the provincial press consisted of fewer than 100 journals, practically without influence. Benjamin Flower, printer of the *Cambridge Intelligencer,* was the first to introduce the leading article in the provincial press. The *Leeds Mercury,* founded in 1717, under the control of Edward Baines (1801) became the most important and influential of the north country papers in the first half of the 19th century. After the Reform Act of 1830 and the contemporaneous spread of self-education and establishment of reading circles and newspaper clubs, the country newspapers developed in importance and usefulness, being forced to assuage the public thirst for information and instruction. It was not, however, till the final removal of the taxes on knowledge, already described, that the provincial press came into its own.

Within ten years of the abolition of the paper duty, penny morning newspapers had taken up commanding positions in Edinburgh, Glasgow, Dundee and Aberdeen; in Liverpool, Manchester, Leeds, Bradford, Newcastle and Sheffield; in Birmingham and Nottingham; in Bristol, Cardiff and Plymouth; and across St. George's channel in Dublin, Cork, Belfast and Waterford. But any real importance as organs of opinion was still confined to only a few of the great penny provincial dailies, notably the *Yorkshire Post, Manchester Guardian, Birmingham Post* (1857), *Sheffield Telegraph* (associated with Sir W. Leng), *Liverpool Daily Post, Leeds Mercury* and *Western Morning News;* others too numerous to mention here were at the same time cradling journalists who were to become famous in a larger sphere, such as the *Darlington Northern Echo,* on which W. T. Stead made his debut, while Joseph Cowen for some years made the Newcastle *Daily Chronicle* a powerful force.

The first syndicate to send out war correspondents was formed by the *Glasgow News, Liverpool Daily Post, Manchester Courier, Birmingham Gazette* and *Western Morning News,* which dispatched two correspondents to Egypt. The Central News also sent out war correspondents to Egypt and the Sudan. During the South African War (1899–1902) the leading provincial newspapers, however, all formed syndicates to secure war telegrams.

At mid-20th century the leading English provincial daily papers were:

The *Manchester Guardian* was founded in 1821 as a weekly Whig organ and later became the chief exponent of Liberalism outside London. During the greater part of this period it was edited by C. P. Scott, and maintained a standard of excellence in all its branches that gave it a world-wide reputation. Apart from its vigorous politics it enjoyed an unrivalled literary prestige, and a dignity of expression and presentation. It became a penny paper in 1857, two years after it had been turned into a daily journal. Prominent names associated with it were C. E. Montague, C. P. Scott's son-in-law; Leonard T. Hobhouse; Andrew Lang; Richard Jefferies; Richard Whiteing; Sir Claude Phillips; George Saintsbury; Laurence Housman; G. W. E. Russell; and Spenser Wilkinson. In its book reviewing, its dramatic criticism and its foreign correspondence alone the *Manchester Guardian* exercised an unparalleled influence in provincial journalism, and came to be regarded as a national organ.

The *Manchester Evening News,* founded 1868, came under the same ownership as the *Guardian* in 1924. Its prosperity (circulation more than 300,000 at mid-century) became valuable to the *Guardian.*

The *Yorkshire Post* began in 1754 and became the principal Conservative newspaper outside London, enjoying national prestige extending far beyond the borders of Yorkshire. In its early years it devoted especial attention to racing, which was neglected by most local papers in the country in those days, and under the control of the Beckett family it rapidly attained a solid prosperity. It had talented editors in H. J. Palmer, J. S. R. Phillips, Arthur H. Mann and W. L. Andrews.

The *Yorkshire Evening Post,* founded 1890, became the popular evening paper for all Yorkshire, with a circulation of 250,000.

The *Birmingham Daily Post* was founded in 1857 by J. F. Feeney and John Jaffray (afterward made a baronet) and later was controlled by Sir Charles Hyde. It came to hold a position in the midlands analogous to that of the *Yorkshire Post* in the

north. It was purchased by Lord Iliffe after Hyde's death in 1942. Its evening associate, the *Mail,* had a circulation of nearly 300,000 at mid-century.

The *Liverpool Daily Post* was founded in 1855 as a Liberal paper, and for many years possessed as its editor Sir Edward Russell. In 1904 it absorbed the *Liverpool Mercury* (founded in 1811), and it assumed a pre-eminent place in the life of the great seaport. As with the other morning papers mentioned above, it was far exceeded in circulation by its afternoon associate—in this case, the *Evening Echo,* with a list of more than 380,000.

Other top-circulation provincial papers were the *Manchester Daily Dispatch,* morning, Conservative, a Kemsley paper, with more than 500,000 circulation; and the *Evening Chronicle* of Newcastle-on-Tyne, Conservative, founded 1885, with a list of 260,000.

Scotland, Wales and Ireland.—In Scotland the leading newspapers in 1950 were still the *Scotsman* and the *Glasgow Herald.* The former was started as a biweekly in 1817 and became a daily in 1855. It was Liberal until the Home Rule split in 1886 when it adopted the Unionist cause. Alexander Russel was its most famous editor in the 19th century (1848–76) and for many years it has been the only Edinburgh morning newspaper.

The *Glasgow Herald* dates from 1783, when it first came out with the extra name "*and Advertiser*" tacked on. It acquired a great literary reputation under an illustrious line of editors, including Samuel Hunter, George Outram, Sir Robert Bruce and Sir William Robieson.

The largest circulations in Scotland in 1950 were those of the *Glasgow Daily Record,* founded 1895, a Conservative morning paper under Kemsley ownership, 385,000; and the *Glasgow Evening Times,* founded 1876, nearly 300,000.

In Wales, the four Cardiff papers in 1929 were amalgamated into two, the *South Wales Echo and Evening Express* and the *Western Mail and South Wales News,* both Kemsley newspapers; at mid-century the former had the largest of Welsh circulations—about 170,000. In 1929 also the two Swansea papers were consolidated by Lord Northcliffe as the *South Wales Evening Post.*

Belfast, Northern Ireland, had four morning papers and one evening in 1950. The mornings were the *News-Letter* (1737), the *Northern Whig* (1824), the *Irish News* (1855) and the *Irish Daily Telegraph* (1904); the youngest had the largest circulation—about 120,000. The afternoon paper was the *Belfast Telegraph* (1870). In Ireland there were three morning and two evening papers published at Dublin and one of each at Cork. Of these, the oldest and largest were the *Dublin Evening Mail* (1823) and the *Cork Examiner* (1840, morning).

BRITISH ILLUSTRATED NEWSPAPERS

English papers carried news pictures as early as 1731, when the *Grub Street Journal* printed a woodcut depicting the lord mayor's show, but not until 1842 did England have a fully illustrated newspaper.

Herbert Ingram conceived the idea of "all the news in pictures" and he brought out the first number of the *Illustrated London News* on May 14, 1842, price sixpence, a weekly paper containing 16 printed pages and 32 woodcuts, one of which depicted the great fire at Hamburg in which 100 people lost their lives. The chief engravings, by Sir John Gilbert, illustrated the first *bal masqué* given by Queen Victoria at Buckingham palace. From that time onward the *Illustrated London News* continued to give a faithful representation of the events of the week. In 1860 Ingram was drowned in the disaster in Lake Michigan in the U.S. which overtook the steamer "Lady Elgin." Control of the paper passed to his son, afterward Sir William Ingram. Its editors included Charles Mackay (1848–59), John Lash Latey (1859–90) and Clement K. Shorter (1890–99). The *Illustrated London News* held the field alone in weekly illustrated journalism until in 1861 the first penny popular paper was started by the same proprietor, the *Penny Illustrated Paper,* edited by John Latey, Jr., who afterward for a period was editor of the *Illustrated London News.* In 1869 the first serious rival of the *Illustrated London News* was published, the *Graphic,* produced by W. L. Thomas. *Black and White,* a paper of the same class as the *Illustrated London News,* followed in 1891; and in 1892 the *Sketch* was started by Sir William Ingram, under the editorship of Shorter, as a social and theatrical illustrated weekly.

From this time forward, many illustrated weeklies were started in the fields of the theatre, sports, fashion and society. In 1926 William Harrison brought all the leading illustrated papers under the management of Illustrated Newspapers Ltd. In 1937 this concern was purchased by Sir John Ellerman and Lord Southwood, the former taking a controlling interest.

BRITISH SUNDAY NEWSPAPERS

The *Observer,* most powerful political organ among the Sunday newspapers, was founded in 1791. It reported the battle of Trafalgar, 1805, without headlines and ten years later Wellington's dispatch on the battle of Waterloo as if it were the heading of a parliamentary Blue Book. The *Observer* kept on its respectable but somewhat sombre career until it was acquired by Lord Astor and edited by J. L. Garvin, when it assumed a distinctive character, a virile independence in its political outlook while it made a strong feature of foreign correspondence, literature, the drama, etc. On Garvin's resignation in 1942 he was succeeded by F. D. L. Astor.

The *Sunday Times* was founded in 1822. Its course was not dissimilar to that of the *Observer* until 1915, when it was acquired by William Ewert Berry and James Gomer Berry (later Viscount Camrose and Viscount Kemsley). The former was editor-in-chief of the *Sunday Times,* 1915–37. Its circulation at mid-century was more than 500,000.

By far the largest Sunday paper, the *News of the World,* a sensational paper specializing in sports, crime, divorce cases, etc., was founded in 1843. Sir Emsley Carr was editor for half a century, from 1891 until his death in 1941. The paper passed the 1,000,000 mark shortly after the turn of the century, and by 1950 it had nearly 8,000,000 circulation—larger than that of any other newspaper in the world.

Next largest of the London Sunday papers at mid-century was the *People,* with 4,500,000, founded in 1881 and owned by Odhams Press Ltd., which also controlled the *Daily Herald.* The *Sunday Express,* founded in 1918 as the Sunday edition of the *Daily Express,* had about 2,700,000. The *Sunday Dispatch,* founded in 1801 as the *Weekly Dispatch,* became affiliated with the *Daily Mail* and had more than 2,000,000 circulation in 1950. The *Sunday Graphic,* founded 1915, became allied with the *Daily Graphic;* and the *Sunday Chronicle* became the London edition of a Manchester paper founded in 1885—each with more than 1,000,000 circulation. The *Reynolds News,* founded in 1850 and the organ of the co-operative movement, had 720,000 circulation in 1950. Finally, the *Sunday Pictorial* (1915), week-end edition of the *Daily Mirror,* was the third Sunday paper in point of circulation, with more than 4,000,000.

In the provinces, by far the largest was the *Sunday Empire News* of Manchester, founded 1884, with more than 2,000,000 circulation.

COMPETITION FOR BRITISH MASS CIRCULATION; WORLD WAR II AND AFTER

In the late 1930s, competition for the large circulations which had become necessary to attract advertising reached a climax in extravagant premium offers. Most popular were free insurance policies for readers and their families; but gifts of books, including complete sets of well-known authors, and suits of clothes, washing machines, etc., were among the subscription premiums offered. Chief competitors were the *Daily Express* and the *Daily Herald,* whose circulations, thus stimulated, soared into the millions.

By the end of the decade, the *Daily Express* had reached 2,500,000 and the *Daily Herald* 2,000,000 circulation; while the *People,* first Sunday paper to offer free insurance to its readers, had reached 3,500,000.

World War II brought this premium orgy to an end. Canvass-

ing for circulation was forbidden, and circulations were thus frozen at 1939 levels. Sizes of newspapers were drastically reduced by government order in 1940: twopenny dailies (the *Times* only) to 60 pages weekly, full-size penny dailies to 36 pages and tabloids to 72 pages.

By the end of 1940 the cost of newsprint had gone up 150% over the preceding year; before the end of the war it went up to about 165%, or £30 a ton. It was rationed on the basis of the 1939 consumption by individual newspapers. Despite paper shortage, circulations increased before the end of the war; readers maintained their demand for the four-page papers which were offered them. By 1948, British newspapers were using 7,000 tons of newsprint weekly—about one-third of the quantity used before the war. About 55% was manufactured in British mills from imported materials.

Arbitrary and erratic censorship, especially in the early months of the war, was a severe trial for the newspapers; but these conditions were improved. A code entitled *The Defense Notices* afforded a basis for a voluntary censorship program. The blitzkrieg also worked great hardships on newspapers in many ways; some of them set up duplicate press units in locations supposed to be relatively safe. There was also, of course, a crippling shortage of trained manpower.

But enforced economies in newsprint, promotion, labour, etc., together with government advertising and increased reader demand, made newspaper publishing profitable during the war period; and more concise reporting and closer editing improved some phases of journalism.

In 1949 the royal commission on the press, set up to investigate the newspaper situation, reported that there was "nothing approaching monopoly in the Press as a whole," but that "the gap between the best of the quality papers and the general run of the popular Press is too wide." It recommended the establishment of a general council of the press. According to its report, there were 130 daily papers in England in 1948, including 18 serving special interests.

BRITISH NEWS AGENCIES

Leading agencies serving the English press with news at the mid-century were the Press association (*q.v.*), with 1,500 correspondents in the British Isles; Reuters (*q.v.*), owned since 1941 by the Press association and the Newspaper Proprietors Association, Ltd., through the Reuters trust, and having about 2,000 full-time employees all over the world; Exchange Telegraph Company, Ltd., begun in 1872, with its specialized services; the Associated Press, Ltd., with its United Kingdom report; and the British United Press, Ltd., which since 1922 had bought the United States U.P. service for Britain and Canada.

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NEWSPAPERS IN THE BRITISH DOMINIONS

Canada.—The first Canadian newspaper was the *Halifax Gazette*, founded by John Bushell as a two-page weekly in 1751 (old style, still used in date line, 1752). In 1770 Anthony Henry combined this paper with his *Nova Scotia Gazette* and continued it for many years. First paper in Quebec was the *Quebec Gazette*, founded by William Brown and Thomas Gilmore in 1764, and printed in both English and French; it lasted for more than 100 years and was finally merged in the *Morning Chronicle* (1847), which after a combination in 1926 with the *Telegraph* (1872) became known as the *Chronicle-Telegraph*. First in Montreal was *La Gazette Littéraire*, founded in 1778 by Fleury Mesplet (a protégé of Benjamin Franklin) and Charles Berger; the modern *Montreal Gazette* is its descendant. First Ontario paper was another *Gazette*, Lewis Roy's *Upper Canada Gazette and American Oracle*, established in 1793 at Newark; later it was moved to York (Toronto).

At mid-20th century Canada had more than 100 daily newspapers and about 900 weeklies, semiweeklies and triweeklies. Leading English-language papers were the *Montreal Star*, founded in 1869 and acquired in its first year by Hugh Graham (later Lord Athelstone), who conducted it until his death in 1938; the *Toronto Daily Star*, founded in 1892 and purchased in 1900 by Joseph E. Atkinson, who brought it to the largest circulation in Canada, about 375,000; and the *Toronto Globe and Mail*, the result of a consolidation by C. George McCullagh, who bought the *Globe* (1844) in 1936 for $1,850,000 and a month later the *Mail and Empire* (1872) for $2,020,000, adding the evening *Telegram* (1876) to his holdings in 1948. The chief French-language paper, *La Presse* of Montreal, was founded in 1884 and conducted for many years by Trefflé Berthiaume. The French-language papers are found chiefly in the province of Quebec, which in 1950 had 12 of them published daily, including *Le Soleil* (1880) and *L'Action Catholique* (1907), important papers of the city of Quebec. The leading paper in the west at mid-century was the *Vancouver Sun* (1886). In 1949 the four Halifax papers were brought under one ownership, with the *Chronicle-Herald* as the morning, and the *Mail-Star* as the evening, edition.

The main groups of daily newspapers in 1950 were those headed by McCullagh, noted above; by William J. and Wilson M. Southam, who controlled the *Ottawa Citizen* (1884), *Hamilton Spectator* (1846), *Winnipeg Tribune* (1890), *Calgary Herald* (1883), *Edmonton Journal* (1903) and *Vancouver Province* (1898); and by Victor and Sir Clifford Sifton, who controlled the *Winnipeg Free Press* (1874), *Regina Leader-Post* (1883) and *Saskatoon Star-Phoenix* (1902).

The right to the distribution of Associated Press news was long held by the Canadian Pacific Railway company, but in 1910 Canadian Press Ltd. was formed as an affiliate of the A.P. Thereafter the Canadian Press added bureaus and affiliations of its own in other countries.

There were few Sunday editions of dailies in Canada at mid-century but some were issuing week-end papers; largest of these was the *Toronto Star Weekly*, with a circulation of 900,000.

Australia.—The first newspaper in Australia was George Howe's *Sydney Gazette and New South Wales Advertiser*, which was begun in 1803 and in 1825 altered its title to the *Tasmanian.* Hobart, the second Australian colony, had its first paper, the *Derwent Star*, in 1810, founded by G. P. Harris. Sydney and Hobart were the early newspaper centres; but Melbourne, with the founding of the *Herald* in 1840, the *Argus* in 1846 and the *Age* in 1854, as well as various shorter-lived papers, by the middle of the 19th century had come to share with Sydney the chief publication business in Australia.

Leading Australian journalists in the 100 years which followed were: John Fairfax, who in 1841 bought with his partner Charles Kemp the *Sydney Morning Herald*, founded in 1831 and the oldest of Australian dailies, among the half-dozen largest and still conducted by the Fairfax family at mid-20th century; David Syme, who with other members of his family conducted the *Melbourne Age* until its ownership was transferred to a public company in 1948; Sir Keith Murdoch, who with Theodore Fink developed the *Melbourne Herald* as the largest of the commonwealth's papers and the key property of a group in Sydney, Brisbane and Adelaide; Sir Langdon Bonython, who built up the largest paper in South Australia, the *Adelaide Advertiser* (1858); and Sir Winthrop Hackett, founder of the *West Australian*, Perth tabloid. Other important papers in 1950 were the *Daily Telegraph*, *Daily Mirror* and *Sun* of Sydney; the *Melbourne Sun News-*

Pictorial, Australia's only daily pictorial, which claimed 400,000 circulation; and the *Courier-Mail* and *Telegraph* in Brisbane.

The Australian Associated Press, using a variety of overseas services, furnishes its report of foreign news to most of the Australian dailies, some of which also have foreign correspondents.

New Zealand.—Pioneer English settlements in New Zealand made haste to establish newspapers even before many houses were built. Thus the Wakefield expedition of 1839 got out a paper (Samuel Revans, editor) at Port Nicholson, now Wellington; and a few months later, in 1840, the official Hobson expedition started the *New Zealand Advertiser* at its Bay of Islands settlement (now Kawakawa). These papers were all short-lived. At New Plymouth the evening *Taranaki Herald* and the morning *Taranaki Daily News* (long conducted by the well-known T. C. List) were established respectively in 1852 and 1857. The former at mid-20th century was the oldest paper in New Zealand.

In 1950 the largest paper of the dominion was the *New Zealand Herald* (1863). The *Wellington Evening Post* was founded by Henry Blundell in 1865; Wellington's morning paper, the *Dominion,* was founded in 1907 by C. W. Earle.

Christchurch journalism began with the *Lyttleton Times,* which was founded in 1857 within a month of the landing of the Canterbury settlers, and became the leading Liberal paper of New Zealand under Sam Saunders. In 1935 there was a bitterly competitive war among the four Christchurch papers, which ended by New Zealand Newspapers Ltd., already owners of the *Christchurch Star,* buying the *Sun,* and the *Press* absorbing the *Lyttleton Times.* At Dunedin, the *Otaga Daily Times* (1861), long edited by Sir James Hutchison, and the *Evening Star* (1863) became flourishing papers. The provincial press is strong.

The Press Association is the news agency in New Zealand; it receives most of its overseas news from the Australian Associated Press.

Union of South Africa.—The first South African newspaper was the *Cape Town Gazette and African Advertiser,* begun in 1800 by Walker & Robinson, a firm of merchants who had imported a press. Taken over by the government as an official bulletin, published during Dutch control 1802–06 as *Kaapsche Courant* and later resumed as an authorized paper with its former name, the *Gazette* had no competition until 1824. The *South African Commercial Advertiser* was begun by George Grieg Jan. 7, 1824, with John Fairbairn and the poet Thomas Pringle as editors. This paper was twice forcibly suspended, but appeals to England brought freedom from government control in 1829. A period of activity in Capetown journalism followed. *Die Zuidafrikaan* was founded in 1830, lasting until 1894.

Dutch and English and bilingual papers competed for favour, and the use of bilingualism persisted, among country weeklies especially. Eventually Afrikaans, as distinguished from Nederlands, came into use for the "Dutch" papers.

The first Natal paper was *De Natalier* (1844); first in the Orange Free State was *The Friend of Sovereignty and Bloemfontein Gazette* (1850); and first in the Transvaal, if we omit a *Government Gazette,* was *De Oude Emigrant* (1859), at Potchefstroom. The native Bantu press consisted in 1950 of about 25 papers in ten towns, some of them printed in three or four languages, or even more.

Johannesburg, largest city in the Union, had two morning papers at mid-century—*Rand Daily Mail* (1905) and *Die Transvaaler* (1937); and two evenings—*Star* (1887) and *Die Vaderland* (1905). Likewise, Capetown had the mornings *Cape Times* (1876) and *Die Burger* (1915), and the evenings *Cape Argus* (1857) and *Die Suiderstem* (1936). Durban had *Natal Mercury* (1853) in the morning and *Natal Daily News* (1919) in the afternoon. Pretoria had two evening papers—*Die Volkstem* (1873) and *Pretoria News* (1898). Bloemfontein had the morning *Friend* (1850) and the evening *Volksblad* (1915). Other cities with a single daily each were Queenstown, Port Elizabeth, Pietermaritzburg, Kimberley, East London and Grahamstown.

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NEWSPAPERS IN THE UNITED STATES

Although printing presses were established at Cambridge, Massachusetts Bay Colony, in 1638, at nearby Boston in 1674 and at Philadelphia in 1685, nothing that could properly be called a newspaper was published in the American Colonies until Benjamin Harris issued his *Publick Occurrences Both Forreign and Domestick* in 1690. Free speech and free printing had no legal standing in the Colonies in the 17th century. Royal charters commonly contained provisions for licensing the press, but the governors regarded printing as dangerous. Packets of newspapers were brought over from England, and at least two issues of the *London Gazette* were reprinted in the Colonies. A few professional newsletter writers did some business, and private letters of news were passed from hand to hand. Ballads, proclamations and pamphlets contained some news. In 1689 Massachusetts leaders compiled and published a news broadside entitled *The Present State of New-English Affairs* in order "to Prevent False Reports," and to tell of Increase Mather's efforts in behalf of a new charter following the overthrow of Gov. Sir Edmund Andros.

First Newspapers.—The next year Benjamin Harris, London bookseller and publisher who had fled England after imprisonment for printing a seditious pamphlet, issued in Boston No. 1 of *Publick Occurrences Both Forreign and Domestick,* to be "furnished once a moneth (or if any Glut of Occurrences happen, oftener)," on Sept. 25, 1690. Four days later the governor and council suppressed it. This first American newspaper, which was thus ended summarily with its first number, was a very newsy three-page paper (the fourth page being left blank for private correspondence), measuring 6 in. by 9½ in. when folded.

Fourteen years passed before the next venture in American newspaper publishing. In 1704 John Campbell, newsletter writer, bookseller and postmaster, established the *Boston News-Letter,* the first continuously published American newspaper, and issued it "By Authority" for 15 years. Thereafter it was published until the Revolution; then a Tory paper, it suspended shortly before the British evacuation of Boston. In 1719 William Brooker was appointed postmaster at Boston; and since Campbell refused to turn over the *News-Letter* to him, he founded the *Boston Gazette.* This paper had a long and influential career; during the struggle for independence it was edited by Benjamin Edes and John Gill, called "trumpeters of sedition" by their Tory enemies. It survived the Revolution but perished in 1798.

First printer of the *Gazette* was James Franklin, who had as apprentice his 13-year old brother Benjamin. When Brooker lost both post office and newspaper in 1721, and the new proprietor took the printing of the *Gazette* to another shop, Franklin started a new paper called the *New-England Courant.* During its five and one-half lively years, the *Courant* was a spectacular sheet, first as an opposition organ critical of the Mather regime, and later, after the council had banned James Franklin as publisher, as a repository of periodical essays. To evade the council's order, James put his brother Benjamin in as nominal publisher. The latter had already written his first satirical essays, the early "Dogood Papers," for the *Courant;* but his brother treated him ill, and he soon ran away to Philadelphia.

Early Papers in Philadelphia and New York.—The *American Weekly Mercury* narrowly missed being the third American newspaper; its first issue, Dec. 22, 1719, was only one day later than that of the *Boston Gazette.* It was founded by Andrew Bradford, son of the William Bradford who introduced printing into Pennsylvania but who by this time had moved his press to New York. The second Philadelphia newspaper was begun by Samuel Keimer with the extraordinary title, *The Universal Instructor in All Arts and Sciences, and Pennsylvania Gazette,* in 1728. The first part of the title was due to the project of Keimer, a scientific deist and an eccentric, to print Ephraim Chambers' *Cyclopaedia* serially in his paper. Benjamin Franklin,

now established as a printer in Philadelphia, helped to give the rival *Mercury* a competitive advantage in the town by writing his "Busy-Body Papers" for it, and in 1729 bought Keimer out. He abandoned the cyclopaedic serial, cut off the grandiloquent prefix of the paper's title, and made such a success of the *Pennsylvania Gazette* that he was able to retire with a competency at 42. He sold the *Gazette* in 1748 to David Hall, who, with his sons and grandsons and various partners, conducted it until its end in 1815.

Meantime, William Bradford had founded the first New York newspaper in 1725, under the title *New-York Gazette.* It was definitely an organ of government in that colony, and when the bitter contest between Gov. William Cosby and the popular party developed in 1733, John Peter Zenger was induced to start an opposition paper. His paper was supported by the contributions of James Alexander and other leaders of the popular party, much as James Franklin's crusading paper in Boston had been aided by a group of dissident writers there. When Zenger was jailed in 1734, Cosby disbarred the attorneys who were defending him, and Andrew Hamilton, a famous Philadelphia lawyer, was brought in to plead his case. Hamilton's masterly argument brought acquittal and was later reprinted as a pamphlet and did much for the cause of liberty in both England and America.

Other Colonial Beginnings.—The initial papers in other Colonies were *Maryland Gazette,* Annapolis, 1727, and *Virginia Gazette,* Williamsburg, 1736, both founded by William Parks, one of the best of the colonial printers; *Rhode-Island Gazette,* Newport, 1732, founded by James Franklin, who had moved his press there from Boston but was able to maintain the paper for only eight months; *South-Carolina Gazette,* Charleston, 1732, founded by one of Benjamin Franklin's printers, and carried on by another Franklin protégé, the talented Lewis Timothy; *North-Carolina Gazette,* New Bern, 1755, founded by James Davis; *Connecticut Gazette,* New Haven, 1755, founded by Timothy Green; *New-Hampshire Gazette,* Portsmouth, 1756, founded by Daniel Fowle, a paper which lived for 190 years; *Georgia Gazette,* Savannah, 1763, founded by James Johnston; *New-York Gazette,* 1776, by chance New Jersey's first paper, since Hugh Gaine moved this sheet to Newark when the British occupied New York. John Adams, a Wilmington printer, is reported to have published a paper called the *Courier* in that town for a few months in 1762, but the earliest Delaware paper of which we have definite knowledge is the *Delaware Gazette,* begun at Wilmington in 1785 by Jacob A. Killen. The *East-Florida Gazette,* published at St. Augustine in 1783–84 by the Tory editor John Wells, was the first paper in what was later the state of Florida. Timothy Green, fourth of that name in a long line of printers, established the first Vermont paper in collaboration with J. P. Spooner; it was the *Vermont Gazette and Green Mountain Post-Boy,* of Westminster. The first paper in what is now Maine was the *Falmouth* (Portland) *Gazette,* founded in 1785 by Benjamin Titcomb, Jr., and Thomas B. Wait.

Patriots and Tories.—Leading patriot newspapers during the period extending from the enactment in 1765 of the Stamp act, which taxed the newspapers and aroused them to bitter opposition and noncompliance, to the end of the American Revolution were: the *Boston Gazette,* to which Samuel Adams and his group contributed; the *Massachusetts Spy,* founded in 1770 by Isaiah Thomas, who was later a successful book publisher as well as journalist and the founder of the American Antiquarian society; the *Connecticut Courant,* of Hartford, founded in 1764 by Thomas Green; the *New-York Journal,* founded in 1767 by John Holt; the *New-York Packet,* founded by Samuel Loudon in 1775; the *Pennsylvania Journal,* founded in 1742 by William Bradford, grandson of the pioneer printer of the same name, himself an able editor and the outstanding soldier-editor of the Revolution; the *Pennsylvania Gazette,* conducted at this time by David Hall; the *Pennsylvania Packet,* founded in 1771 by John Dunlap, another soldier-editor, who later joined with David C. Claypool to make this paper one of the most successful in America during the years immediately after the war; and the *South-Carolina Gazette,* whose war editor was Peter Timothy. These papers had many bitter experiences during the war. While the British occupied Boston, the *Gazette* found a temporary home at Waterton, while the *Spy* moved permanently to Worcester. The New York papers had to find temporary homes in towns up the Hudson river when the city was lost to the patriots, and the patriot papers of Philadelphia were refugees during the shorter British occupation of their city. When Newport, R.I., was taken, Solomon Southwick buried his press and type; later he exhumed them to continue the long career of his *Mercury.*

Leading royalist papers were: the *New York Gazetteer,* founded in 1773 by James Rivington; the *New-York Weekly Gazette and Mercury,* founded in 1753 by Hugh Gaine; the *Royal American Gazette* of New York; the *Royal Pennsylvania Gazette* of Philadelphia, published briefly by James Robertson; and the *Pennsylvania Evening Post,* founded in 1775 by Benjamin Towne, who was later to make his paper the first American daily.

Characteristics of Colonial Papers.—American newspapers in the colonial period were modelled on those of the mother country. The common size was four pages, each about 10 in. by 15 in. Extra pages were sometimes issued to accommodate heavy advertising. Headings of news stories were little more than date lines. The successful papers had good advertising patronage; advertisements were set single-column with little display, so that a page of them resembled modern classified make-up. Paper was obtained chiefly from England until the tax on that staple stimulated American manufacture. The collection of rags from which paper was made was regarded as a patriotic duty during the Revolution.

Manufacture of ink, type and presses was also built up in America when importation was interrupted.

Chief news sources were the English newspapers, since interest in events in the homeland was paramount among the Colonists. The second important source was "exchanges"—papers published in other American towns. The rule was for an editor to cover any news of first-rate importance in his own neighbourhood for his own paper, and for other papers to clip it; thus all colonial papers were members of an informal co-operative news-gathering system. Local news coverage was not intended to be thorough, and small happenings were usually disregarded; there were no local reporters, and the editors were commonly imbued with the concept of news as historical record. Other sources than those mentioned were letters from other cities or from England brought in by friends of the editor; word-of-mouth reports by ship captains, postriders and travellers; and official documents and communications. With the coming of the war, English papers were cut off almost altogether, and military operations interfered with colonial communications; but patriot committees were active in sending news bulletins from one town to another.

There were no editorial pages, but editorial comment was interspersed with the news. Political and economic dissertations, satirical essays on social customs and poetry were common.

The Daily Newspaper.—A few semiweeklies and triweeklies had been published in the Colonies. For example, Benjamin Towne's *Pennsylvania Evening Post* had been established as a triweekly; in 1783 Towne made it the first American daily. Generally it consisted of only two pages, and was a rather shabby sheet. Towne was indicted for treason a few months after he made his paper a daily, and its 17-month existence in that status was shadowed by its editor's disrepute. John Dunlap and David C. Claypool's *Pennsylvania Packet and Daily Advertiser* began daily publication in 1784. It was very successful, as was the *New York Daily Advertiser,* founded in 1785 by Francis Childs; the latter was the first American paper to be founded as a daily.

Dailies came into the picture less for the purpose of giving timely news than because publishers wished to compete with the coffee-shop bulletins in giving reports to merchants of the offerings of importers just as soon as ships arrived in the harbours of Philadelphia and New York. The political papers of the cities also adopted daily publication rather generally by the end of the 18th century, leaving the weeklies to the smaller towns.

The Party Press.—As national issues developed, newspapers

took up the cudgels of partisan strife. From the second administration of George Washington until after the Civil War, ardent partisanship in journalism was the rule. The mercantile papers, as well as those confessedly established as political organs, took sides; and when the penny papers appeared in the 1830s, with their emphasis on local news and human-interest features, they, too, were soon involved in party controversy. At its height during the first two decades of the 19th century, this partisanship resulted not only in slanting and distorting news but in personal abuse and vilification of political figures, duels and assaults among editors and much prostitution of the newspaper's chief duty of disseminating the news accurately, fairly and fully. The situation improved in the 1840s and 1850s, but it was not until the doctrine of partisan independence made its great gains in the 1870s that biased reporting of public affairs was abated.

First national political organ was John Fenno's *Gazette of the United States* (1789–1818), Federalist, established at New York when the capital was situated there and later moved with the government offices to Philadelphia. Its great rival in the latter city was Philip Freneau's *National Gazette* (1791–93), Republican (Democratic). Alexander Hamilton and Thomas Jefferson, rivals in Washington's cabinet, were the respective sponsors of Fenno and Freneau in their editorial efforts. Supplanting the *National Gazette* as spokesman for the Jeffersonian Republicans was the Philadelphia *Aurora*, founded by Benjamin Franklin Bache, grandson of Benjamin Franklin, in 1790. Another notable political paper in that city was *Porcupine's Gazette* (1797–99), edited in vitriolic fashion by William Cobbett, at the time a refugee from England. In Boston Benjamin Russell's *Columbian Centinel* became a nationally recognized Federalist organ; founded in 1784, it was in many respects an excellent newspaper. Noah Webster, later famous as a lexicographer, founded the *American Minerva* in New York in 1793 as a Federalist organ; four years later this paper adopted the name *Commercial Advertiser*, which it kept for more than a century.

One cause of the Alien and Sedition acts (1798–1801) is to be found in the prevailing scurrility of attacks on public officers, but the immediate occasion was the threat of war with France and the consequent need to guard against disloyalty. There were about 25 arrests under the Sedition act and 11 trials resulting in 10 convictions. Actions under the common law brought total convictions to 15, of which 8 related to newspapers. But the censorship involved was greater than these figures indicate. The acts expired with the John Adams administration. Two years later Alexander Hamilton, in an argument for a new trial in the case of Harry Croswell, editor of the Hudson, N.Y., *Wasp*, advanced the "Hamiltonian doctrine," later made a part of most state constitutions, to the effect that evidence of the truth of statements published with good intentions may be introduced by the defense in a criminal libel suit.

The *National Intelligencer*, established in Washington in 1800 as the organ of the Jefferson administration by Samuel Harrison Smith, proved to be mild in partisanship and reliable in news. Conducted after 1810 by Joseph Gales, Jr., and W. W. Seaton, the *Intelligencer* was considered by other papers for many years as the authority on Washington news. It was displaced as the government organ, however, when Andrew Jackson became president. Duff Green's *United States Telegraph* (1825) was Jackson's first Washington paper; it was supplanted in 1830 by the *Washington Globe*, edited by Francis P. Blair. Associated with the *Globe* also were Amos Kendall, editorial writer, and John C. Rivers, business manager, who, with Blair, were members of Jackson's "kitchen cabinet" of political advisers.

Meantime, in New York, James Cheetham's *American Citizen* was the vituperative organ of the George Clinton faction of the Democratic party during the first decade of the 19th century. Established largely in order to combat Cheetham's sheet was the *New York Evening Post*, founded in 1801 by Alexander Hamilton and friends associated in a joint-stock company. William Coleman was its first editor; he was followed in 1829 by William Cullen Bryant, who edited the paper until his death in 1878.

The Penny Press.—The chief characteristics of the penny press of the 1830s were smaller size, a one-cent price in comparison with the six cents charged by the larger papers, and adaptation to lower economic and social levels of readership. The penny papers featured local and human-interest matter, preferred news above support of a party or mercantile class, exposed abuses of banks and churches and tended to give a realistic picture of the news scene despite taboos.

The first successful penny daily was the *New York Sun*, founded in 1833 by Benjamin H. Day. Most important of its rivals in this field was the *New York Herald*, begun two years later by James Gordon Bennett. Three New York printers, William M. Swain, A. S. Abell and A. H. Simmons, founded the *Philadelphia Public Ledger* in 1836 and the *Baltimore Sun* in 1837; Swain was chiefly responsible for the former and Abell for the latter over many years. In 1841 Horace Greeley founded the *New York Tribune* as a penny paper, and ten years later the *New York Times* was started by Henry J. Raymond, George Jones and Edward B. Wesley at the same price. All these New York papers except the *Sun* soon went to the two-cent price, enlarging their size and scope. The penny papers initiated what may be called modern journalism by their emphasis on local news and timeliness. They were leaders in the use of expresses and the telegraph for quick transmission of news, and their large circulation and advertising receipts enabled them to improve their news services and install fast cylinder presses.

Bennett and Greeley, rival editors through three decades (both died in 1872), were leading figures in a period of personal journalism. Bennett was one of the most original of editors, initiating financial and society departments and playing a part in many other innovations. Greeley was the great idealist, a crusader against slavery and intemperance and in favour of westward expansion. His hospitality to new ideas brought Fourierism, spiritualism, women's rights, Grahamism and many other reforms and fads into the columns of the *Tribune*. His alliance with Thurlow Weed, the political boss who was editor of the *Albany Journal*, 1830–63, and William H. Seward was dissolved in 1854 by a letter in which he showed his resentment because he had not been given political office; later he had much to do with the defeat of Seward for the Republican presidential nomination. The *Tribune* did not always support Lincoln during his administration, however.

In Springfield, Mass., the *Republican* was begun as a two-cent daily in 1844. Its weekly edition had been founded by Samuel Bowles 20 years earlier, but the daily was the project of a son, also called Samuel, aged 18. It became one of the most famous of small-city dailies, and exerted a wide influence, largely through its weekly edition, for many years. Following a printers' strike in 1947, it was reduced to the status of a Sunday paper.

In New Orleans, George W. Kendall and Francis Lumsden started the *Picayune* in 1836, and it soon gained a wide reputation not only as a good newspaper but as a repository for amusing sketches and witty paragraphs. During the Mexican War, Kendall became the first important and regular reporter of military actions from the field.

The war with Mexico was a great stimulant to speed in news transmission. The expense of efforts in this direction led to the first important effort in co-operative news gathering—the New York Associated Press, founded in 1848, forerunner of the present Associated Press. This group consisted of the *Sun*, *Herald*, *Tribune*, *Express*, *Courier and Enquirer* and *Journal of Commerce*—the leading papers of the metropolis. When the *Times* was begun, it was taken in. The *Express* (1836–81), conducted by James and Erastus Brooks, was a strong mercantile paper. The *Courier and Enquirer* was the result of a merger in 1829 of Mordecai M. Noah's *Enquirer* and James Watson Webb's *Morning Courier*. Under Webb's aggressive editorship it was bright, bellicose and enterprising. The *Journal of Commerce* was founded in 1827 by Arthur Tappan as a commercial paper with a strong religious bent; it soon became the property of Gerard Hallock and David Hale.

The Westward Movement.—The first newspaper west of the Appalachians was the *Pittsburgh Gazette* (*Gazette Times*,

1906; *Post-Gazette,* 1927), founded by John Scull and Joseph Hall in 1786. The following year the *Kentucky Gazette* was founded at Lexington by John Bradford. First paper in what is now West Virginia was the *Potowmac Guardian,* begun by Nathaniel Willis in 1790. Tennessee's first paper was the *Knoxville Gazette,* 1791, George Roulstone founder. Benjamin M. Stokes started the first Mississippi paper, the *Mississippi Gazette* (1799–1801) at Natchez. The first New Orleans paper was *Moniteur de la Louisiane,* 1794, by Louis Duclot, a sheet of four small pages in French. The earliest paper in what is now Alabama was the *Mobile Centinel* (1811–12) by Samuel Miller and John B. Hood.

First newspaper to be established in what is now Ohio was the *Centinel of the North-Western Territory,* founded at Cincinnati by William Maxwell in 1793. First in Indiana was Elihu Stout's *Indiana Gazette,* later *Western Sun,* at Vincennes in 1804. Joseph Charless founded the *Missouri Gazette* in 1808; it was the first paper printed wholly in English west of the Mississippi. Its name was later changed to *Missouri Republican* and in 1888 to *Republic;* it was merged with the *St. Louis Globe-Democrat* in 1919.

First Michigan paper was the *Michigan Essay,* produced briefly under the patronage of Gabriel Richard, a Catholic missionary; the first Michigan paper of longer life was the *Detroit Gazette* (1817–30). In 1814 Matthew Duncan brought his press up from Kentucky and founded Illinois' first paper at Kaskaskia, the *Illinois Herald,* which he later moved to the new capital at Vandalia and renamed the *Illinois Intelligencer.* The first Chicago paper was the *Democrat,* founded in 1833 by John Calhoun, later mayor of the city; it was merged with the *Tribune* in 1861. In 1819 the *Arkansas Gazette* was begun by William E. Woodruff at Arkansas Post; it was moved to Little Rock when that settlement was chosen as the capital.

First newspaper in Wisconsin territory was the Green Bay *Intelligencer* (1833–36). First in Iowa was John King's *Dubuque Visitor* of 1836, and first in Minnesota James M. Goodhue's *Minnesota Pioneer* of 1849, later famous as the *St. Paul Pioneer Press.* In 1854 the *Nebraska Palladium,* which had been begun in Iowa, was moved across the river to Belleview and published for several months in the new territory. First Kansas paper was a missionary sheet in an Indian language called in English *Shawnee Sun,* published in 1835 at the Baptist mission; first English-language paper in that territory was the *Kansas Weekly Herald* (1854–61), of Leavenworth. The pioneer Kansas papers were embroiled in the free-state war of 1855. The Lawrence *Herald of Freedom* office was destroyed by the proslavery faction, but it gave its type to be moulded into balls used for the attack on Fort Titus, so that the discharges of the antislavery cannon were called "new editions" of the *Herald.*

The *Sioux Falls Democrat* was first of South Dakota papers in 1858; its name was soon changed to *Northwestern Independent.* The Fort Union *Frontier Scout* of 1864 was North Dakota's first paper.

In the southwest, Oklahoma's first paper was a Baptist missionary organ, the *Cherokee Messenger,* printed in an Indian language, near the present site of Westville, in 1844–46. Pioneer Texas paper was the organ of the provisional revolutionary government at San Felipe called *Telegraph and Texas Register,* 1835; it had an adventurous career before it became the first Houston newspaper. A small campaign sheet called *El Crepusculo,* published in Santa Fe by Antonio Barreiro, was apparently the first publication in New Mexico; but the first real newspaper was the *Santa Fe Republican* (1847–49), with two pages in English and two in Spanish. The *Weekly Arizonian,* Tubac, 1859, was the first paper in Arizona.

California's first paper was founded in 1846. It was a small sheet printed on one side only at Monterey, and was called *The Californian.* It was soon moved to what is now San Francisco, where the *California Star* had been established in 1847. Both were absorbed into the *Alta California* when that famous paper was set up in 1849. The first paper printed in Nevada was the *Territorial Enterprise,* begun in 1858 at Genoa, but more famous as the Comstock Lode organ at Virginia City, where Mark Twain and Dan De Quille worked on it. Another gold rush brought Colorado's first paper, the *Rocky Mountain News,* founded in Denver by William N. Byers in 1859; it became a Scripps paper in 1926. Other western "firsts" were the *Oregon Spectator,* Oregon City, 1846; the *Columbian,* of Olympia, Wash., 1852; the *Deseret News,* famous Mormon paper in Salt Lake City, Utah, 1850; the *Golden Age,* Lewiston, Ida., 1862; the *Montana Post,* begun in 1864 at the Virginia City gold camp and moved to Helena in 1868; and the *Fort Bridger Daily Telegram* of 1863, first Wyoming paper and the only first paper in any state which began as a daily.

The Civil War and Reconstruction.—The Civil War was well covered by special correspondents in the field, more than 150 of whom served northern papers during the war. Military restrictions, government control of telegraph lines, and mob violence—all sporadic—curbed press activity; but there was no regular and consistent censorship. A number of papers were forced to suspend publication by military commands or the post-office department.

Among these were the *New York Daily News* and the *Chicago Times.* The *News,* founded in 1855, was a penny paper, organ of the Tammany Democracy; it had come into the hands of Benjamin Wood, brother of Fernando Wood, New York's mayor. The Woods were strongly proslavery, and a combined military and postal blockade forced the *News* to close down for 18 months in 1861–62. After the war, this paper won a very large circulation in the tenement-house districts as a penny sensation-monger. Wood lived until 1900, and the next year Frank A. Munsey bought the *News* from his widow for 340 thousand-dollar bills. Munsey improved it so much that it lost its public, and it perished in 1906. The *Chicago Times,* founded in 1854, had been bought by Wilbur F. Storey in 1861. Its verbal attacks on the union army caused Gen. A. E. Burnside to seize and suspend the paper, but after three days Pres. Abraham Lincoln requested that the order be rescinded. The *Times* became a successful sensation paper after the war, receding only as the *Tribune* came to control the Chicago morning field. It ended in a consolidation in 1895.

The *Chicago Daily Tribune* was founded in 1847; it had a difficult time until Joseph Medill and five partners (including Charles H. Ray and Alfred Cowles) took it over in 1855. After Medill gained control of the paper in 1874, he directed its destinies until his death 25 years later, making it a strong and successful paper.

A leading newspaper development of the 1870s was the rise of the *New York Sun* in prestige and influence. Purchased in 1868 by Charles A. Dana and associates, it soon became one of the best-written and edited papers in the country, independent in politics, bright and saucy, its human-interest stories of the great city one of its chief attractions. The *Evening Sun* was launched in 1887.

Notable in the 1870s also was the growing independence of the press from party control. Dating from the secession of Republican papers from the Ulysses S. Grant forces in 1872, what was sometimes called the "mugwump" movement gained in strength and caused the defeat of James G. Blaine in 1884. By 1880 one-fourth of American newspapers were listed in the directories as independent; by 1890 the proportion had reached one-third. By the 1940s, 48% of the daily papers listed themselves as "independent" and another 24% as "independent Republican" or "independent Democratic."

The "New Journalism."—Joseph Pulitzer, Hungarian-born immigrant who had made a success of the *St. Louis Post-Dispatch,* which he had formed in 1878 of the unimportant *Dispatch* (founded 1864) and John A. Dillon's *Post* (founded 1875), upset the New York newspaper situation in the 1880s and did more than anyone else to set the pattern of modern journalism. In 1883 he bought the *New York World* and soon made it the country's most successful newspaper.

The *World* had been founded in 1860 by Alexander Cummings as a religious daily, but it did not flourish and soon came into the hands of Democratic politicians and financiers. In 1869 Manton

Marble purchased majority control, and under his editorship the paper was influential and moderately successful. When he retired in 1876, the *World* came under the control of Thomas A. Scott, of the Pennsylvania Railroad, who unloaded it on Jay Gould in connection with a railroad deal. The paper had been losing $40,000 a year when Pulitzer bought it. The *Evening World* was established in 1887. The *Sunday World*, with a record-breaking circulation of 250,000, consisted of 26 to 44 pages, half advertising. The combined circulation of the dailies (374,000 by 1892) exceeded those of any two competitors. The *World* had become the most profitable paper published.

Other important New York papers in the 1870s and 1880s besides the *World, Sun* and *Daily News* were the *Herald*, under the control of James Gordon Bennett, Jr., 1872–1918, during which years he lived chiefly in Paris; the *Tribune*, under Whitelaw Reid 1872–1905; the *Evening Post*, under Edwin Lawrence Godkin 1883–99; the *Times*, under George Jones 1869–91; the *Commercial Advertiser*, descended from Noah Webster's *American Minerva*, under Hugh J. Hastings 1868–83; and the *Mail and Express*, a consolidation formed by Cyrus W. Field in 1882 and edited and published in the 1880s by Elliott F. Shepard.

In Philadelphia, a leading paper was the *Public Ledger*, published 1864–94 by George W. Childs. Later it came into the hands of Adolph S. Ochs, who sold it to Cyrus H. K. Curtis, the magazine publisher; Curtis made a great but unprofitable paper of it, and it perished in 1942. The *Record* was founded by William J. Swain in 1870 and published by William M. Singerly 1877–98. It was published by Thomas B. Wanamaker 1902–28, and by J. David Stern until it was sold to the *Bulletin* in 1947. The *Press* was founded in 1857 by John W. Forney, conducted in the 1880s by Charles Emory Smith, and merged in the *Public Ledger* in 1920. The *Inquirer*, founded in 1829, was long conducted by Jesper Harding and his son William W., and later by the Elverson family; it was bought in 1936 by M. L. Annenberg. The *Times* was founded in 1875 by Alexander K. McClure to become a great crusading paper. The *Evening Item*, founded in 1847 by Thomas Fitzgerald and conducted by him and his sons for nearly half a century, gained a large circulation. The *Evening Bulletin*, founded on the basis of the *American Centinel* (1816–46) by Alexander Cummings, was Philadelphia's first afternoon paper. In the 20th century, under William L. McLean and his sons, it gained the largest circulation in the city.

In Washington, D.C., the *National Republican* (1860–88) was edited by W. J. Murtagh. The *Evening Star*, established in 1852, was purchased in 1867 by a group headed by Crosby S. Noyes and later conducted by his sons Frank B. Noyes and Theodore W. Noyes. The *Post*, founded by Stilson Hutchins in 1877, was edited by him until 1889. After a varied career, the *Post* was bought at auction in 1933 by Eugene Meyer, who made it again a successful newspaper.

In Boston, the *Herald*, founded in 1844, was a leader under the editorship, 1862–87, of E. B. Haskell. In 1912 it bought the *Traveller*, founded in 1845, as its evening associate. The *Daily Advertiser*, founded in 1813, and made by Nathan Hale the first successful daily in New England, seemed moribund in the 1880s; but it lived to be made a tabloid by William Randolph Hearst in 1938, and later to become the *Sunday Advertiser*. The *Post*, founded by Charles G. Greene in 1831, also declined in the '80s, but had a rebirth under Edwin A. Grozier in 1891. The *Journal*, founded in 1833, was edited by W. W. Clapp in the 1880s in the sensational manner of the "new journalism." The *Transcript* (1830) was edited in this decade by Edward H. Clement; for many years it was the great newspaper organ of Boston culture, but it died in 1941. The *Globe* (1872) was highly successful under Gen. Charles H. Taylor, its publisher, 1873–1921.

In Atlanta, Ga., Henry W. Grady in 1880 bought a quarter interest in the *Constitution* (1868) and as its managing editor made it a great newspaper; he died in 1889 and was succeeded by Clark Howell. In Louisville, Ky., Walter N. Haldeman consolidated the *Courier* and *Journal* in 1868, and put in charge Henry Watterson, who made the *Courier-Journal* famous and remained in service until 1919. In Cincinnati, Murat Halstead became editor of the *Commercial* (1843) in 1865; it became the *Commercial Gazette* when it was consolidated with the *Gazette* (1815) and Halstead sold it in 1890. John R. McLean took over the management of the *Cincinnati Enquirer* (1842) in 1870, and bought it from his father in 1881; in 1895 he bought also the *New York Journal* and in 1905 the *Washington Post*. Cincinnati's evening papers, the *Times* (1840) and the *Star* (1872), were merged in 1880 by Charles P. Taft. The great San Francisco paper of the period 1870–90 was the *Chronicle*, founded in 1865 by two brothers in their teens, Charles and Michel H. de Young; it was a lively, fighting paper, and Charles de Young was shot and killed in 1880 in connection with a political fight. The *Call* (1856) and the *Bulletin* (1855) were under the same management; much later (1928) they were consolidated by Hearst. The *San Francisco Examiner* (1865) was bought by George Hearst in 1880 to further his political ambitions. The best-known editor in the Pacific northwest for many years was Harvey W. Scott, who edited the *Portland Oregonian* 1865–1910.

The great event in Chicago journalism in the post-Civil War period was the founding of the *Daily News* as a penny paper by Melville E. Stone in 1875. When the paper was on the verge of failure after a few months, Victor F. Lawson came in as partner, bringing needed capital. A liberal, crusading paper, the *Daily News* made a great success. In 1888 Stone sold out to Lawson, later becoming the first general manager of the reorganized Associated Press. The *Herald* was founded in 1881 by James W. Scott, who combined it with the *Times* in 1895. The *Times-Herald* became the *Record-Herald* when Herman Kohlsaat, its owner since the consolidation, bought the *Record*, morning edition of the *Daily News*, in 1901 and made a new combination; after Kohlsaat's *Inter Ocean* (1872) was merged in the *Record-Herald* in 1914, it became the *Herald* again, but four years later Hearst bought it and merged it with his *Examiner* as the *Herald-Examiner*, later the *Herald-American*.

In Kansas City, Mo., William Rockhill Nelson and Samuel E. Morss began the *Star* in 1880 as a small two-cent daily. Morss dropped out on account of ill health after a year or two, but Nelson made the *Star* a strong, crusading local newspaper, adding a Sunday edition in 1894, buying the *Times* (1868) for its morning edition in 1901 and starting the *Weekly Star* as a farm paper in 1890. Nelson died in 1915, and the paper was purchased by staff members for $11,000,000. Henry J. Haskell became editor in 1928.

Yellow Journalism.—William Randolph Hearst's first paper was the *San Francisco Examiner*, which his father, George Hearst, turned over to him. Successful in his management of that paper, he went to New York in 1895 and bought the *Journal*. With this paper he challenged the supremacy of Pulitzer's *World* in New York. Some of his staff he brought from San Francisco and some he hired away from the *World*. He outdid his rival in sensationalism, crusades and Sunday features. A comic picture series called "The Yellow Kid" was drawn by Richard F. Outcault for the *Sunday World* and later for the *Sunday Journal*, but after the departure of the originator to the rival paper it was drawn by George B. Luks for the *World;* these picture series excited so much attention that the competition between the two newspapers came to be called "yellow journalism." This all-out rivalry and its accompanying promotion developed large circulations for both papers and affected U.S. journalism in many cities. The "yellow journalism" formula, as it developed, was distinguished by (1) "scare heads" in large type, printed in black or red, (2) lavish use of pictures, (3) pseudoscientific articles, (4) the Sunday supplement, with coloured comics and sensational features, (5) ostentatious crusading for popular causes. The era of "yellow journalism" may be said to have ended shortly after the turn of the century, with the *World's* gradual retirement from the competition in sensationalism and the rise of the *Times*.

One of the phenomena of the era was the promotion of the war with Spain through hysterical propaganda against that nation based on exposures of Spanish atrocities in Cuba. This jingoism was not limited to the *Journal* and *World*, though they were leaders in it. Some techniques of the "yellow journalism" period

became more or less permanent and widespread, as banner headlines, coloured comics and copious illustration.

Adolph S. Ochs, publisher of the *Chattanooga* (Tenn.) *Times,* took over management of the failing *New York Times* in 1896. In 1898 Ochs reduced the price of the paper to one cent. Instead of getting into the "yellow" competition, the *Times* adopted the slogans "All the news that's fit to print," and "It does not soil the breakfast cloth." Ochs, who had actually put in only $75,000 in 1896, had a controlling interest by 1900. The *Times*'s success as a clean, conservative newspaper was one of the most striking phenomena of the new century.

"Chains" and Consolidations.—If we define a newspaper "chain" loosely enough to include affiliations formed by an uncertain degree of co-operation rather than common ownership, the groups of colonial papers of which Benjamin Franklin and Isaiah Thomas were patrons and sometimes part owners might be said to be the first American "chains." But modern "chains" began with the Scripps papers in 1878. By 1900 eight such groups could be listed, and ten years later there were a dozen and the number of papers in them had doubled. In the next decade the number of "chain" papers doubled again; and in the boom decade of the 1920s the number of "chains" reached more than 50, and the number of papers owned or affiliated in them about 300. Those statistics still held at the mid-century mark.

The first paper on which E. W. Scripps worked was the *Detroit News,* founded by his half brother James E. Scripps in 1873. The first paper he founded (with assistance from his half brothers James E. Scripps and George Scripps) was the *Cleveland Press,* begun in 1878 as a penny paper. Successful there, he persuaded his half brothers to buy the *St. Louis Chronicle* (1880–1905), with which he failed to overcome the dominant competition of the *Post-Dispatch* and *Globe-Democrat.* A little later he bought a controlling interest in the *Cincinnati Post,* and founded the *Kentucky Post* at Covington. By this time he had developed his formula, which was to establish papers in medium-sized cities with cheap equipment, put young men from his organization in charge with working partnerships, sell for a penny a copy and campaign for causes popular among the common people (often for organized labour). With Milton A. McRae as partner in the Scripps-McRae league, he bought or founded many papers in the midwest in the years 1897–1911. McRae dropped out in 1914, and in 1917, Scripps placed management in the hands of two sons, James G. Scripps and Robert P. Scripps. Three years later, a quarrel with James resulted in his being supplanted by Roy W. Howard, who had been general manager of the United Press associations, founded in 1907 as the Scripps news-gathering agency. In 1922 E. W. Scripps retired completely, turning over his newspaper properties to his son Robert, who formed the organization known as Scripps-Howard. Chief Scripps-Howard additions to the "chain" in the 1920s were the *Pittsburgh Press* (1884) in 1923 and *New York Telegram* (1868) in 1927. Most important of all was the purchase of the *New York World* in 1931, and its merger with the *Telegram.* To this combination the *Sun* was added in 1950.

The Hearst "chain" began with the *San Francisco Examiner* and the *New York Journal* and *Evening Journal.* In 1900 Hearst founded the *Chicago American* as an evening paper, and in 1902 the morning *Examiner.* In 1904 he started the *Boston American.* Beginning in 1917, he added many more papers to his list, buying as many as seven in one year (1922). He bought or established altogether more than 40 daily papers.

Though the Scripps and Hearst "chains" were the largest of such systems, there were many other groups, such as the Booth Newspapers, in Michigan, founded by George C. Booth; the Brush-Moore Newspapers, in Ohio, founded by Louis H. Brush and Roy D. Moore; the Lee Syndicate, in the upper Mississippi valley, founded by Alfred W. Lee; the Copley Press, in Illinois and California, founded by Ira C. Copley; the Speidel Newspapers, founded by Merritt C. Speidel and strung across the country from New York to California; the Frank E. Gannett Newspapers, chiefly in New York; the James M. Cox Newspapers, in Dayton and Springfield, O., Miami, Fla., and Atlanta, Ga.; Central Newspapers, founded by E. C. Pulliam, chiefly in Indiana; the H. C. Ogden Newspapers, in West Virginia; the John H. Perry Newspapers, chiefly in Florida; Stauffer Publications, Oscar Stauffer president, in Kansas, Missouri and Oklahoma; Ridder Publications, built up by the sons of Herman Ridder in New York, Minnesota and the northwest; and the Knight Newspapers, owned by John S. Knight, comprising the *Chicago Daily News,* the *Detroit Free Press,* the *Miami* (Fla.) *Herald* and the *Akron* (O.) *Beacon-Journal.*

Consolidations, like "chains," were not new in modern journalism. Ever since the consolidation of the *New-England Weekly Journal* with the *Boston Gazette* in 1741, weak papers had been absorbed by strong ones. But the large newspaper capital investments which, beginning in the 1890s, came to characterize the newspaper business of the 20th century, made the merger a recognized technique for "cleaning up" a ruinous competitive situation. Especially dangerous, it seemed to critics of the modern communications system, was the increasing number of large cities with only one newspaper ownership; by 1940 this was the case in more than one-fourth of American cities of more than 100,000 population. Moreover, the number of daily papers in the United States declined from a peak of 2,461 in 1916 to 1,744 in 1944. Slight increases marked the latter half of the 1940s, to 1,886, of which 1,490 were afternoon papers, 392 morning papers, 4 all-day papers. There were also approximately 9,700 weekly and 350 semiweekly papers.

Newspaper consolidation was dramatized about 1920 by Frank A. Munsey's activities. In 1916 Munsey bought the *New York Sun, Evening Sun* and *Press* and merged the *Press* in the *Sun.* Four years later he bought the *Herald* and its evening associate, the *Telegram,* and merged the *Sun* in the *Herald,* changing the name of the *Evening Sun* to *Sun.* His next move was to sell the *Herald* to the *Tribune* for another merger in 1924. Then he bought the *Globe,* which had been merged with the *Commercial Advertiser* in 1905, and merged it with the *Sun.* His last consolidation was that of the *Mail and Express* and the *Telegram* in 1924.

Varied Newspapers.—The *St. Louis Globe-Democrat* had been formed when J. B. McCullagh in 1875 bought the *Missouri Democrat* (founded 1852) and merged it with his *Globe* (founded 1872). The *St. Louis Star-Times* was formed in 1935 by the consolidation of the *Star* (founded 1878), which had absorbed the *Chronicle* (1905), and the *Times* (founded 1895).

The Denver *Post,* founded in 1892, was purchased three years later by Fred G. Bonfils and Harry H. Tammen and made an outstanding exemplar of the "yellow journalism" of the period. Tammen died in 1924 and Bonfils in 1933; in 1946 Palmer Hoyt became publisher, modifying the policy of the paper. Edgar Watson Howe founded the *Atchison* (Kan.) *Globe* in 1877, and made it a widely quoted paper. Another famous editor in a small Kansas city was William Allen White, who bought the *Emporia Gazette* when it was five years old in 1895 and soon achieved national fame through his editorial writings.

The *Christian Science Monitor* was established in Boston by Mrs. Mary Baker Eddy in 1908. A handsome and high-minded general newspaper, it fought "yellow journalism" and emphasized international news. The *Des Moines Register* was begun in 1856 as the *Iowa Citizen,* a Free Soil paper. From 1870 to the end of the century the *Register* was published by Coker F. Clarkson, followed by his two sons; in 1902 it absorbed the *Leader,* which had been begun as the *Iowa Star,* Des Moines's first newspaper, in 1849. The next year the combined paper was bought by Gardner Cowles, who in 1908 gave it the two-year-old *Tribune* as an evening associate. Following the retirement of Cowles, the *Register* and *Tribune* were conducted by his sons John Cowles and Gardner Cowles, Jr., who in 1935 purchased the *Minneapolis Star* and later the *Journal* and *Tribune* of that city. In 1949 the Minneapolis papers were reduced to two—the *Tribune* for morning and the *Star* for afternoon.

The *New Orleans Times-Picayune* was a combination of the two papers of that city which survived the Civil War period—the famous old *Picayune* and the *Times-Democrat* (founded

1863, 1875; merged 1881). The *States* became its evening associate in 1933. The *Item* (1877) and *Tribune* (1924) were sold in 1949 to David Stern, son of the former publisher of the *Philadelphia Record.* The *Washington* (D.C.) *Times-Herald* was formed in 1939 when Mrs. Eleanor Patterson, granddaughter of Joseph Medill, bought the two papers from Hearst. The *Herald* had been founded in 1906 by Scott C. Bone, who had been managing editor of the *Washington Post;* the *Times* (1894) had been under Munsey ownership 1901–17. Mrs. Patterson left the *Times-Herald* to seven executives of the paper on her death in 1948; but the next year they sold it to Robert R. McCormick, publisher of the *Chicago Tribune.*

The Tabloid.—The earliest American newspapers were all tabloids, if by that term only the small size of the pages is meant. The experimental Jan. 1, 1900, issue of the *New York World,* designed and edited by Alfred Harmsworth (later Viscount Northcliffe) and called by him a "tabloid newspaper" and "the newspaper of the 20th century," had the small-page size and an emphasis on condensation. Tabloid journalism had come to stand for three techniques by the 1940s: (1) the folded-in-half page size, as compared with that of the normal eight-column paper; (2) the devotion of a large proportion of the paper's space to pictures; and (3) a terse, condensed and lively presentation of the news.

Two grandsons of Joseph Medill, Robert R. McCormick and Joseph Medill Patterson, took over jointly the management of the *Chicago Tribune* in 1914. Five years later they formed a subsidiary of the Tribune company to publish the *New York Daily News* as a new morning tabloid. In 1925, when the paper had reached nearly 1,000,000 circulation—largest in the U.S.—Patterson left his executive position on the *Tribune* and until his death in 1946 devoted himself to the management of the *Daily News.*

The sensationalism of the *Daily News* in the 1920s brought it into competition with Hearst's morning *American,* and Hearst first tried out the form in Boston by "tabbing" the *Daily Advertiser* and then founded the tabloid *Daily Mirror* in New York in 1924. Three months later Bernarr Macfadden began the *Daily Graphic* in the same form. Thus began the "war of the tabs" in New York, in which the three competitors tried to outdo each other in sensationalism. The *Graphic* perished in 1932, the *Daily News* cleaned up its columns and prospered and Hearst sold the *Mirror* in 1928 (though he had to take it back later). Meanwhile, the success of the *Daily News* had tempted publishers of dailies in other cities to try the tabloid form: there were about a dozen in 1930, 50 in 1940 and 70 in 1950. Most important, besides those mentioned above, were the Chicago *Times* (1929), the Denver, Colo., *Rocky Mountain News, Los Angeles Mirror* (1908), *New York Post Home News* (1948 merger of the old *Evening Post* with the *Bronx Home News*), the *Philadelphia News* and the *Washington News.*

World Wars.—There were comparatively few U.S. correspondents abroad when World War I broke out in August 1914, and those who were rushed across found themselves hampered on all fronts by censorship. After the arrival of the American expeditionary force in 1918, several hundred U.S. newspaper, magazine and agency men covered the war in various foreign centres and on the several military fronts.

Censorship at the fronts, though often severe and stupid in the early years of the war, was somewhat more tenable after the arrival of the A.E.F. Maj. Frederick Palmer, Associated Press and magazine correspondent, wrote the section of the U.S. field service regulations dealing with war correspondents and was himself chief American censor for six months. Within the United States more than 75 papers had their mailing privileges withdrawn under the terms of the Espionage act. The German-language press declined about one-half. The Committee on Public Information, George Creel, chairman, participated in both propaganda and censorship, and presented to U.S. papers a "voluntary censorship" code.

Most famous of the many camp and field newspapers published by and for U.S. soldiers during World War I was *Stars and Stripes,* continued for 16 months from Feb. 1918.

When the United States entered World War II in Dec. 1941, there were more than 200 U.S. reporters gathering news abroad, mostly in belligerent countries. By the spring of 1943, the number had risen to 435. The U.S. war department accredited during the entire war, for longer or shorter periods, 1,186 American correspondents and news officials, representing all media, and the navy department 460 more. Besides the press associations, 30 individual newspapers and 12 magazines had their own correspondents at the war fronts. Photographers played a far larger part in war reporting than ever before. Most famous of war pictures was that of the flag raising at Iwo Jima in Feb. 1945, taken by Joseph Rosenthal of the Associated Press. Most famous of war correspondents was Ernest Taylor (Ernie) Pyle, who wrote from England, North Africa, Sicily, Italy, France and the Pacific; he was killed on Ie Jima in the Okinawa campaign. Casualties among writers, photographers and radiomen covering the war numbered 37 killed and 112 wounded, exclusive of combat correspondents. Among the best-known writers who perished were Raymond Clapper, of Scripps-Howard Newspaper alliance, and Webb Miller, of the United Press.

The U.S. Office of Censorship, with Byron Price as director, was created Dec. 19, 1941, and lasted throughout the war. It promulgated the "Code of Wartime Practices for the American Press," which formed the basis for a remarkable co-operative self-censorship. Field censorship on the war fronts varied greatly in efficiency and reasonableness. A number of home periodicals were suppressed, chiefly after convictions of publishers and editors under the Foreign Agents' Registration act. The Office of War Information, with Elmer Davis as director, was set up on June 13, 1942, and handled an immense amount of news and propaganda at home and abroad.

Thousands of army unit, camp and installation, ordnance plant and combat ship papers served the American soldiers in World War II. Of this "G.I. journalism," *Stars and Stripes* was the chief daily newspaper and *Yank* the chief magazine. The former was reborn in London in April 1942 and was later printed in many editions on various fronts. *Yank* was begun about the same time in New York, and came to have 22 editions and a circulation of about 2,500,000. Altogether there were said to be about 600 army unit papers and twice that many camp papers in the United States.

Marshall Field's Newspapers.—The New York tabloid *PM* was founded in 1940 by Ralph Ingersoll and associates as an adless daily of liberal opinions. Marshall Field III had some money in it at the start and later increased his holdings to a controlling interest. Sold in 1948, its name was changed to the *Star,* but it perished the next year. Ted O. Thackrey, former editor of the *Post* (later *Post Home News*), founded the *Daily Compass* in 1949, with the financial backing of Mrs. Anita McCormick Blaine, publishing from the *Star*'s former plant.

Marshall Field III founded the *Chicago Sun* in 1941 as a competitor for the *Tribune* in the morning field. Six years later he bought the *Times,* evening tabloid, and "tabbed" the *Sun;* in 1948 the two papers were combined as the *Sun-Times* with round-the-clock publication. In its competition with the *Tribune,* the *Sun* felt the lack of an Associated Press membership, which it did not obtain until the government had brought suit against the A.P. for violation of the Sherman Anti-Trust act. This suit, instituted in 1942, was decided in favour of the government in 1945 and caused the A.P. to amend its rules to forbid the "blackballing" of competitors.

American Newspaper Guild.—The American Newspaper guild was organized in 1933 "to preserve the vocational interests of its members and to improve the conditions under which they work by collective bargaining, and to raise the standards of journalism." First contract negotiated was with the *Philadelphia Record.* In 1936 the guild affiliated with the American Federation of Labor, and the next year with the Committee for Industrial Organization. By mid-century it had 23,000 members and had contracts in force on about 175 dailies and several independent newspapers, as well as on other periodicals and with the news-

gathering agencies. There were many strikes, some of which forced suspension of newspapers. One of the strikes, called by the International Typographical union (organized 1850) against the Chicago papers on Nov. 24, 1947, lasted 22 months. The papers resorted to "cold type" production methods, printing from plates made directly from typewritten ("varityped") copy.

Alaskan and Hawaiian Newspapers.—The first paper in what is now Alaska was *Esquimaux,* printed monthly at Port Clarence, Russian America, by John J. Harrington for the Western Union Telegraph expedition in 1866–67. The *Klondike Nugget* was published at Dawson 1898–99 by Eugene C. Allen, and was later established as a weekly at Nome. Anchorage, Juneau, Fairbanks and Ketchikan acquired small dailies, and by mid-century there were a dozen weeklies.

The first Hawaiian newspaper was the weekly *Sandwich Island Gazette and Journal of Commerce* (1836–39) by Samuel D. Mackintosh and Nelson Hall, which was continued monthly 1839–40 as the *Sandwich Island Mirror and Commercial Gazette.* Of longer life was James Jackson Jarves' *Polynesian* (1840–64). The first daily was the *Hawaiian Herald* (1866). The chief papers in Honolulu at mid-20th century were the *Star-Bulletin* and the *Advertiser.* The *Hawaiian Star* was begun in 1893 and the *Evening Bulletin* in 1882; they were merged in 1912 by Wallace R. Farrington, later governor of the territory. The *Advertiser* was founded as a weekly by Henry M. Whitney in 1856. The *Hawaii Times* was founded in 1885 and published in both English and Japanese. In Hilo, the daily *Tribune-Herald* was founded in 1895.

Appraisals of the Press.—Since the hostile criticism of the first American newspaper, *Publick Occurrences,* there has been a fairly steady stream of criticism of newspapers in books, magazines, public speech and the newspapers themselves. These criticisms, by such men as Charles Dickens, James Fenimore Cooper, Lambert A. Wilmer, David G. Croly, Edwin Lawrence Godkin, Oswald Garrison Villard, George Seldes, Silas Bent, Harold L. Ickes and Herbert Brucker, have ranged from angry invective to sober appraisal, from personal or partisan motivation to the scholarly and sociological attitude. Perhaps the most important investigation was undertaken by the Commission on Freedom of the Press headed by Robert M. Hutchins, chancellor of the University of Chicago. The report of the commission, entitled *A Free and Responsible Press* (1947), restated the principles of press freedom, emphasized dangers of mass publication and monopolistic control and made a series of recommendations some of which met with general acceptance.

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GERMAN NEWSPAPERS

The beginnings of news printing in Germany have already been referred to. It appears that not only was the first western printing from movable types done in that country, but some of the earliest news pamphlets and perhaps the first regularly published newspapers were issued in Germany. At any rate, there is a file of the *Avisa Relation oder Zeitung,* published at Augsburg in 1609, and one copy of the Strasbourg *Relation,* of that year. Their intelligence came from all over Europe by means of the newsletters. In the issue for Sept. 4 the Strasbourg paper tells of the construction of a new telescope by Signor Galileo, professor of mathematics at Padua.

These papers were followed by others, such as the *Frankfurter Journal,* of Egenolph Emmel, in 1615, and the *Frankfurter Oberpostamtszeitung,* begun in 1616 and continued until 1866 under the shortened title of *Postzeitung.* In the course of the 17th century, most German cities supported newspapers for shorter or longer periods; in the 18th century, despite the rigours of local and state censorships, the press multiplied throughout the country. Notable for its correspondence from abroad was the *Hamburgischer Correspondent,* founded in 1714 under the title *Holsteinische Zeitungs-Correspondenz.* The outstanding Berlin papers in the 18th century were two named, for their owners, *Vossische Zeitung* (1705) and *Spener'sche Zeitung* (1749); the latter was renamed *Berlinische Nachrichten* and lived until 1827. The venerable *"Voss"* was sold to the Ullsteins in 1913.

19th Century.—Under Napoleon, censorship merely changed hands; the German press became pretty thoroughly Gallic and the newspapers echoes of the Parisian journals. But when Germany was liberated, the old censorship reappeared. A resolution of the diet, Sept. 20, 1819, subjected the press to police supervision. Unsuccessful attempts for redress were made at the Congress of Vienna (1814–15), and the meetings of the ministers of the Great Powers at Johannisberg (1824) and Vienna (1834) only increased the strictness of the censorship.

The greatest German newspaper in the first half of the 19th century, and a famous paper until its death during the Hitler regime, was the *Allgemeine Zeitung.* It was founded at Tübingen by Johann Friedrich Cotta, later Baron von Cottendorf, in 1798. Censorship and other causes forced it to move successively to Stuttgart, Ulm, Augsburg and Munich.

The revolutionary movements of 1830 and 1848 gave impetus to a new German journalism which, though most of the papers were short-lived, brought in a new period of press enterprise. Many small papers were established throughout Germany and Austria, nearly all of them consistently partisan. Censorship varied in different states. Those best known throughout the nation, besides the *Allgemeine Zeitung,* were the *Augsburger Zeitung* (1689) and the *Kölnische Zeitung* (1804); the Augsburg paper was especially famed for its foreign news.

Bismarck had a high respect for the power of the press and kept a firm hand on its control. The Press law under which the German newspapers operated 1874–1919 was based on *Reichgesetz über die Presse vom 7 Mai 1874,* which "guaranteed" freedom of the press but actually retained strong government controls. These tactics were continued long after Bismarck's retirement, and even during World War I the government controlled a number of important newspapers. Following that war, besides owning Wolff's Telegraphic bureau, the leading news-gathering agency, the Prussian government secretly bought the *Deutsche Allgemeine Zeitung,* a Berlin paper founded in 1921 by the Stinnes interests, and later sold it to the government of the Reich.

Under the German Republic.—Under the Weimar constitution of 1919, German newspapers enjoyed a larger degree of freedom than they had ever before known. In the years 1919–32, the *Gruppenpresse* (newspapers representing political, social and religious groups), though composed of papers of small individual circulations, maintained dominance in the country's journalism. During the 1920s, however, a *Massenpresse,* composed of large-circulation dailies designed for the masses rather than for parties or factions, grew up in Berlin and other large cities; these papers, though more objective in reporting and comment, were commonly partisan in control and thus had notable alignments with the *Gruppenpresse.*

By 1932 there were 4,700 newspapers in Germany, 70% of them dailies. More than 100 different parties or group ideologies were represented. This multitude of small newspaper organs was served by central correspondence bureaus and by *Maternwesens* which prepared printed sheets (*Vordruckzeitungen*) and stereotyped plates carrying news and partisan propaganda.

The largest paper in the period was the *Berliner Morgenpost,* claiming 600,000 in 1932. It was founded in 1898 by the "house of Ullstein," which consisted of Leopold Ullstein and his five sons. The father had entered the newspaper field by purchasing the *Berliner Zeitung* in 1877 (later called *BZ am Mittag* and credited with 190,000 circulation in 1932), and had then added the weekly

Berliner Illustrirte Nachtausgabe in 1892. Both were successful, but the *Morgenpost* was modelled on the success of August Scherl's *Lokalanzeiger,* which had been founded in 1882, and which had achieved a considerable circulation in the 1890s through a new system of individual distribution and enterprising promotion. Other Ullstein dailies were the old "quality" *Vossische Zeitung,* acquired in 1913, but never a circulation leader; and *Tempo,* an evening paper started in 1930, which had 140,000 by 1932. Other large papers in Berlin were *Der Tag* (1900), claiming 100,000 in 1932; and *Berliner Nachtausgabe* (1924), with 180,000. These, with the *Lokalanzeiger,* were Scherl papers, backed by the Hugenberg *Konzern.* Alfred Hugenberg, leader of the People's National party, controlled the large Scherl dailies, as well as the weeklies and magazines of that chain, and the Telegraph Union (second only to Wolff's). Besides the Ullstein and Hugenberg combines, *Konzentrations A.G.* controlled about 200 Social-Democratic papers and owned a news agency; Rudolph Mosse controlled the *Tageblatt, Volkszeitung* and *Morgenzeitung* in Berlin; and there were many other organizations more loosely bound together.

A number of large papers, regarded as belonging to the *Massenpresse* because they each had 100,000 circulation or more, had by 1932 grown up in other large cities besides Berlin. Such were the *Anzeiger* (1887) and *Fremdenblatt* (1828) of Hamburg; the *General Anzeiger* (1887) of Dortmund; the *General Anzeiger* (1876) of Frankfurt; the *Neueste Nachrichten* (1888) of Breslau; the *Stadtanzeiger* (1876) of Cologne; the *Neueste Nachrichten* (1893) of Dresden; the *Nachrichten* (1876) of Düsseldorf; the *Anzeiger* (1892) of Hanover; the *Neueste Nachrichten* (1892) and *Neue Zeitung* (1806) of Leipzig; and the *Nachrichten* (1848) and *Zeitung* (1892) of Munich. And yet some of the most influential papers in Germany had only about 60,000 circulation, such as *Frankfurter Zeitung* (1856), *Kölnische Zeitung* (1804), Nürnberg *Fränkische Kurier* (1833) and *Hamburger Nachrichten* (1792). This quartette of famous old papers was long powerful in Europe. Bismarck once said of *Kölnische Zeitung* that it was "worth an army corps on the Rhine." Oldest of all German papers, with only a few thousand circulation in 1932, was the *Hartungsche Zeitung* of Königsberg, founded in 1640.

The Hitler-Goebbels Press.—Adolf Hitler's first task in connection with the group which was soon to become the National Socialist party was the direction of a press and news bureau in the district army command at Munich in 1919. After the military *putsch* of March 1920, sympathizers bought a newspaper for Hitler and his associates—Dietrich Eckart, the journalist, and Alfred Rosenberg, a young Russian refugee—to use in their propaganda for the new movement. This paper was the *Völkischer Beobachter,* which had been founded some years before World War I as a weekly gossip sheet. As the nazi influence expanded in the 1920s, its newspaper effort broadened; but the *Beobachter* remained Hitler's personal organ, and for the elections of 1932 he established a Berlin edition. In connection with those elections, also, Hitler's party established or acquired about 130 other newspapers distributed strategically throughout Germany, placing them under the direction of trusted subordinates.

When Hitler became chancellor in Jan. 1933, he immediately caused Pres. Paul von Hindenburg to invoke article 48 of the constitution in order to cancel the guarantee of freedom of the press. Some papers were stopped at once, and the press in general was muzzled. Within three months 200 papers had been suspended; within a year 600 had been killed, the Deutsche Nachrichtenburo (DNB) had been set up to supersede Wolff's Telegraphic bureau, and a journalists' registration system had been devised which made newspaper men "semi-official public functionaries." Max Amman, publisher of the *Völkischer Beobachter,* became president of the Reich Press chamber, a division of Josef Goebbels' ministry of public enlightenment and propaganda. Goebbels had founded the newspaper *Der Angriff* in 1927 and two years later became head of nazi propaganda activities. Amman's duties were largely on the business side, though he shared with Otto Dietrich the veto on new papers. Dietrich was Reich press chief and had charge of editorial policies and personnel. Eher Verlag was set up to handle nazi printing and publishing; operating chiefly in Berlin and Munich, it soon became the largest publishing concern in the world. It published the *Beobachter, Angriff, Schwartze Korps* (S.S. organ), *Arbeitsmann, Hitlerjugend* and other official newspapers and periodicals, as well as books, pamphlets, posters, etc.

Jewish newspaper owners—the Ullsteins, Mosse, etc.—were driven out. When Germany seized Austria in 1938, many of the old papers (including *Wiener Zeitung,* founded in 1703) disappeared, and the remainder of the Vienna papers were combined in one nazi organ. The number of newspapers in Germany was reduced from 4,700 in 1932 to about 2,000, and the press became, to use Goebbels' famous figure, an organ on which the minister of propaganda could play his own tunes.

The Occupation Press.—World War II annihilated the German press. New papers were licensed by the occupation powers in their various zones. The Soviet military government established *Tägliche Rundschau* in Berlin; the U.S. military government set up *Die Neue Zeitung* in Munich, designed as a model democratic newspaper; the British founded *Die Welt* in Hamburg; the French licensed *Der Kurier,* an afternoon Berlin paper. By mid-century there were 20 dailies in Berlin, of which the Soviet *Rundschau* had the largest circulation, said to be 800,000; while the British-licensed *Telegraf* and the U.S.-licensed *Tagesspiegel* each had around 500,000. The U.S. semiweekly *Neue Zeitung* was circulating more than 1,300,000 copies of each issue, including Berlin and Frankfurt editions; and the British triweekly *Die Welt* 700,000, also including a Berlin edition. Most papers outside Berlin were published only two or three times a week.

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FRENCH NEWSPAPERS

The French newspaper press from the first was characterized by a literary quality generally superior to that of the press of most other countries, by special attention to the arts and by alliances (sometimes amounting to subsidization) with political, social or literary groups. Parisian journalism frequently became a path to fame in both politics and literature.

Beginnings.—The first French newspaper was the *Gazette* (afterward called the *Gazette de France*), established in 1631 under the patronage and with the active co-operation of Cardinal Richelieu. The first editor and printer was Théophraste Renaudot The first weekly number apparently appeared in May 1631. So much, at least, may be inferred from the date (July 4, 1631) of the sixth number, which was the first dated publication. Each number of the paper, which cost six centimes, consisted of a single sheet (eight pages) in small quarto, and was divided into two parts—the first simply entitled *Gazette,* the second *Nouvelles ordinaires de divers endroits.* It commonly began with foreign and ended with home news. Much of its earliest foreign news came direct from the minister, and not seldom in his own hand. Louis XIII took a keen interest in the progress of the infant *Gazette,* and was a frequent contributor, now and then taking his little paragraphs to the printing office himself, and seeing them put into type. In Oct. 1631 Renaudot obtained letters patent to himself and his heirs, conferring the exclusive privilege of printing and selling, where and how they might please, "the gazettes, news and narratives of all that has passed or may pass within and without the kingdom." At his death in Oct. 1653 Renaudot left the *Gazette* to his sons in flourishing circumstances. Its place was later filled by the *Journal Officiel.*

In 1672 the *Mercure galant* was established by Donneau de Vizé. Its title was later changed to *Nouveau Mercure,* and in 1728 to *Mercure de France,* a designation retained, with slight modification, until 1853, when the paper finally ceased. It had

many prominent contributors. In 1790 its circulation rose very rapidly and reached for a time 13,000 copies. Mirabeau styled it in debate "the most able of the newspapers." Great pains were taken in the collection of statistics and state papers, the absence of which from the French newspaper press had helped to depress its credit as compared with the political journalism of England and to some extent of Germany.

Under Napoleon the organ of official information was the *Moniteur* (*Gazette nationale, ou le moniteur universel*), founded in 1789 under the same general management with the *Mercure*. The *Moniteur* kept step with the majority of the assembly, the *Mercure* with the minority. So marked a contrast between two journals with one proprietor gave too favourable a leverage to the republican wits not to be turned to good account. Camille Desmoulins depicted him as Janus—one face radiant at the blessings of coming liberty, the other plunged in grief for the epoch that was rapidly disappearing.

The only other newspaper of a date anterior to the Revolution which need be noticed here is the first French daily, the *Journal de Paris*, which was started on New Year's day of 1777 and lived till 1819. Its period of highest prosperity may be dated about 1792, when its circulation is said to have exceeded 20,000. The *Journal des débats* was founded in 1789 by François-Jean Baudouin.

19th Century.—The cheap journalism of Paris began in 1836 with the journal of Emile de Girardin, *La Presse*, and *Le Siècle*, under the management of Dutacq, to whom, it is said—not incredibly—the original idea was really due. The first-named journal attained a circulation of 10,000 copies within three months of its commencement and soon doubled that number. The *Siècle* prospered even more strikingly, and in a few years had reached a circulation (then without precedent in France) of 38,000 copies.

The rapid growth of the newspaper press of Paris under Louis Philippe will be best appreciated from the fact that, while in 1828 the number of stamps issued was 28,000,000, in 1836, 1843, 1845 and 1846 the figures were 42,000,000, 61,000,000, 65,000,000 and 79,000,000, respectively. At the last-mentioned date the papers with a circulation of around 10,000 were (besides the *Moniteur*, of which the circulation was chiefly official and gratuitous) as follows: *Le Siècle*, 31,000; *La Presse* and *Le Constitutionnel*, between 20,000 and 25,000; *Journal des débats* and *L'Epoque*, 10,000 to 15,000.

The impulse given to the growth of advertisements in the days which followed July 1830 became, as the years rolled on, sufficiently developed to induce the formation of a company—in which one of the Laffittes took part—to farm them, or rather to farm a certain conspicuous page of each newspaper, at a yearly rent of £12,000 sterling (300,000 francs), so far (at first) as regarded the four leading journals (*Débats, Constitutionnel, Siècle, Presse*), to which were afterward added two others (*Le Pays* and *La Patrie*). The combination greatly embarrassed advertisers, first, since its great aim was to force them either to advertise in all, whether addressing the classes to be canvassed or not, or else to pay for each advertisement in a selected newspaper the price of many proffered advertisements in all the papers collectively, and, secondly, because by many repetitions in certain newspapers no additional publicity was really gained, two or three of the favoured journals circulating mostly among the same class of buyers.

On July 16, 1850, the assembly passed what is called the "*loi* Tinguy" (from the name of the otherwise obscure deputy who proposed it), by which the author of every newspaper article on any subject, political, philosophical or religious, was bound to affix his name to it, on penalty of a fine of 500 francs for the first offense, and of 1,000 francs for its repetition. Every false or feigned signature was to be punished by a fine of 1,000 francs, "together with six months' imprisonment, both for the author and the editor." The practical working of this law lay in the creation of a new functionary in the more important newspaper offices, who was called *secrétaire de la rédaction*, and was, in fact, the scapegoat ex officio. The "*loi* Tinguy" had a permanent influence on French journalism in the continued prevalence of signed articles, and the consequent prominence of individual writers as compared with the same class of work in other countries.

In 1858 the order of the six leading Parisian papers in point of circulation was: (1) *Siècle*, (2) *Presse*, (3) *Constitutionnel*, (4) *Patrie*, (5) *Débats* and (6) *Assemblée*. The number of provincial papers exceeded 500. In 1872 the circulation of *Le Petit journal* (founded 1863), the pioneer of the French halfpenny press, was 212,500, and it went on rapidly increasing. In 1874 an elaborate return showed that in the 35 principal towns of France, comprising a population of 2,566,000, their respective journals had an aggregate weekly issue of 2,800,000 copies. In 1878 the total number of journals of all kinds published in France was 2,200. At that date *Le Figaro* had a circulation of about 70,000, *Le Petit journal* about 650,000. Moïse-Polydore Millaud, creator of the "journal à un sou," made a fortune from *Le Petit journal* and introduced a new era of cheap papers.

The newspapers of Paris, and similarly of France, practically doubled in number between 1880 and 1900. In 1880 there were about 120 Paris newspapers, in 1890 about 160 and in 1900 about 240. The total number of newspapers, as distinguished from periodicals, published in France during 1900 was in round numbers 2,400, of which about 2,160 appeared in 540 provincial towns.

The history of the French press during the last 20 years of the 19th century followed very closely that of the country itself, Boulangist and anti-Boulangist, Dreyfusist or anti-Dreyfusist, Republican or Nationalist; finally it became either Moderate Republican or Radical Socialist, with a sprinkling of Nationalist organs and a small minority of Royalist and Bonapartist sheets.

The French papers, of whatever party, took an increased interest during this period in foreign matters and much improved their organization for collecting news. *L'Eclair* gave less attention to the discussion of political questions from the party point of view than to the collection of news, and was followed by the *Echo de Paris* (1884) and *Le Matin*, which also dated from 1884, and which by an arrangement with the *Times* of London gave every day a translation of most of the telegrams published in that newspaper. The *journal d'information*, as these papers were called, took its place beside the journal properly so-called, more perhaps as a rival than as a complement. The natural result followed, and the more old-type newspapers took steps to provide their readers with news as well as with leading articles, current and literary topics, society gossip, dramatic criticism and law reports. Nothing perhaps was so striking after 1890 as the demand of the French public for foreign and colonial news, or the readiness of the papers to supply it by means of special representatives independent of the news agencies. An enlargement of the individual newspapers followed, accompanied by a reduction of price.

In home matters the French press made greater progress still in the rapid and accurate collection of news, and in this respect the provincial press showed more enterprise and more ability than that of Paris. Its development was remarkable, for whereas in 1880 the inhabitants of the departments had to await the arrival of the Parisian papers for their news, they now had the advantage of being supplied every morning with local newspapers inferior to none of the best organs of Paris. Among the best provincial papers may be mentioned *La Petite Gironde* (1872) of Bordeaux, *La Dépêche* (1870) of Toulouse, *Le Lyon républicain* (1878), *L'Echo du nord* (1819) of Lille and *Le Journal de Rouen* (1762), all of which had Paris staffs reporting parliamentary proceedings and law cases, telegraphed or telephoned during the night and published early the next morning in their respective localities. Being perfectly independent of purely Parisian opinion or even bias, the decentralization of the French provincial press became complete; it became also more independent politically than the Paris press. Several journals had national reputations: *La Dépêche* of Toulouse, with its 12 editions daily, *Le Progrès* of Lyons, *Le Petit marseillais* and *La Petite Gironde* of Bordeaux.

20th Century.—During World War I, French newspapers were under severe censorship, becoming more than ever servants of the government. Many disappeared for a time because of shortage of paper or manpower. Changes in the French press as a whole were temporary, and prosperity returned after the war.

In 1930 Paris had 23 morning dailies of general circulation, and ten afternoons, while there were 140 dailies in the provinces. Certain Paris papers had reached the 1,000,000-circulation class, thus leading the world, though soon to be followed into this bracket by Tokyo, Jap., and London dailies. Circulation of *Le Petit parisien,* founded in 1876 by Andrieux and Jules Roche, reached 1,000,000 in 1904; stimulated by its use of U.S. news methods, it distributed 1,700,000 copies daily by 1930. Next was *Le Journal* (1892) with 1,200,000, and third was *Le Matin* (1884), just at the 1,000,000 mark. Characteristic of the popular press were two serial stories, or *feuilletons,* in each issue; front-page opinion articles, signed by well-known contributing editors; and modest sizes of four to ten pages. Every phase of politics was represented, from Legitimist to Communist. The better-known political papers were *Le Temps* (1861), the venerable *Journal des débats* (1789), *La Liberté* (1864), *L'Oeuvre* (1893) and the Communist *L'Humanité* (1904).

One of the best-written and best-printed papers was *Le Figaro,* which had first appeared in 1826 and after an unstable and obscure early life had been made a leading journal by J. H. A. Cartier de Villemessant in the mid-19th century. *Le Figaro* was later directed by Francis Magnard, and in 1924 was bought by François Coty, famous manufacturer of perfumes, who became a successful journalist.

World War II.—It was clear that when Germany's blitzkrieg overwhelmed France in June 1940 the press bore no small part of the responsibility for the debacle. Misrepresentation of foreign affairs and of national preparedness were largely the result of government censorship, but submission to government policy and active propaganda for nazi and fascist doctrines were sometimes the result of bribery, according to the famous French journalist André Géraud ("Pertinax").

The 25 Paris dailies of general circulation were reduced during the German occupation to half a dozen: *Le Matin,* which was suspended only a few days when the Germans marched in, and then offered itself to the conquerors; *L'Oeuvre,* at this time in the hands of Marcel Déat, one of the nation's leading collaborationists; *Le Petit parisien,* which at first fled the city (as did other papers, such as *L'Oeuvre, Le Journal, Le Figaro* and *Le Temps*) but obeyed German orders to return; *Le Temps,* which the Germans brought back to Paris and rechristened *Les Nouveaux temps;* the newer *Paris midi;* and *Le Cri du peuple,* edited by the turncoat Jacques Doriot. Not all these were published during the entire occupation period, and they were supplemented by several short-lived newcomers.

Meantime, an irregular underground press opposing both the Germans and their collaborationists grew up not only in the southern zone, where the press operated under the information ministry, but also in the northern zone, where the papers were more strictly controlled by nazi directives. Among leading underground papers were *Le Franc-Tireur, Combat, Résistance, Libération* and *Défense de la France.* Some papers were no more than mimeographed sheets, and some were even copied by hand; it was not uncommon for a line to be appended to one of these papers saying, "Make 20 copies and distribute among friends." Editorial and mechanical staffs were sometimes caught and executed; *Résistance* ended after about a year because its staff was shot by the Germans.

Liberation.—When France was liberated in 1944, the only prearmistice papers allowed to resume were four which had refused collaboration—*L'Humanité, Le Populaire, Le Figaro* and *L'Aube.* The various resistance groups which had published outlaw papers during the occupation now had dailies to represent them in the Paris press, and all those named in the preceding paragraph became competitors for popular favour. Despite the paper shortage that limited each paper to two pages and kept circulations down to prescribed quotas, there was a great demand among French readers, resulting in a boom in the newspaper business and the establishment of more than a score of new dailies in Paris during the first year of the liberation. In July 1946 the size of the Paris papers increased to four pages. But two years later circulations had dropped, advertising had fallen off and costs had advanced alarmingly.

By mid-century more than half the 34 general dailies published in Paris shortly after the liberation had disappeared. Foremost among survivors was *France-Soir,* originally published as the underground *Défense de la France,* which used U.S. techniques in headlines, objective news, accent on crime and fresh feature material. It led Paris circulations, with about 700,000, and had several weekly and monthly periodicals which were equally successful. *Paris-Presse-Intransigeant,* representing a survival of the famous liberal *Intransigeant* founded in 1880; the Catholic *Figaro,* with its high literary standards; and *Le Parisien libéré,* favourite of the *petit bourgoisie,* were next in circulation.

Havas.—The Havas News Agency, founded by Charles Havas in 1835, achieved a virtual monopoly of foreign news by furnishing the most economical method for newspapers of the period to obtain such news and by cultivating close relations with government. Auguste Havas, Charles's son, took over l'Agence Havas in 1850 and six years later added an advertising agency, exchanging his news for advertising space. M. Lebey succeeded Auguste Havas as manager in 1873, adding a feature service and furnishing stereotyped plates to provincial papers. Baron d'Erlanger acquired Havas in 1879 and incorporated it with 8,500,000 francs' capitalization. The agency gained in power during the ensuing 40 years, and in the 1920s absorbed several other agencies, including Agence Radio.

For three-quarters of a century preceding World War II, Havas handled a very large proportion of French advertising, including *publicité d'influence* for government and finance. It handled large sums for the French government and also for certain foreign powers; thus it became, with its dominant news service, what Pertinax called the "hub" of French press corruption. In 1940 the Vichy government, having taken over the entire Havas business, divided the news and advertising services. The former was called Office Français d'Information; the latter, under the old name, became solely an advertising agency and continued after the liberation.

During the occupation, the Free French set up the Agence Française Indépendant, with headquarters in London, supported by Allied funds. After the liberation, this became Agence France-Presse.

Provincial and English-Language Dailies.—The number of provincial dailies at the mid-20th century was almost as great as before World War II—somewhat fewer than 200—while the number of provincial weeklies, semiweeklies and triweeklies exceeded 1,000. The largest provincial dailies were: *Ouest-France,* Rennes; *Le Sud-Ouest,* Bordeaux; *Le Progrès,* Lyon; *La Voix du nord,* Lille; *La Nouvelle république du centre-ouest,* Tours; *Les Allobroges,* Grenoble; and *L'Est républicain,* Nancy.

English-language journalism in Paris began with Sampson Perry's *Argus* (1809), a Napoleonic organ. This was followed by the more important *Galignani's Messenger* (1814–1904). In 1887 James Gordon Bennett, Jr., founded in Paris the European edition of his *New York Herald,* which became the leading English-language paper on the continent. The *Herald* absorbed the European edition of the *Chicago Tribune* (1917–35) and in 1935 changed its name to *Herald Tribune* to conform with the title of the parent paper in New York. The continental edition of the *London Daily Mail* was founded in 1905. The *Daily Mail* and *Herald Tribune* suspended their Paris editions during the German occupation. The *New York Post* had a Paris edition 1945–46.

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OTHER EUROPEAN NEWSPAPERS

Italy.—The name "gazette," which was for so long a more common generic designation of printed sheets or pamphlets of news than "newspaper," is believed to have been derived from *gazzetta,* a small coin used in Venice in the 16th century, which

may have been the price of early *fogli d'avvisi* or the admission to a group which listened to the reading of such newssheets. Venice was a chief centre for the written newsletters of the middle ages, and weekly printed newssheets appeared in Florence as early as 1636, the work of Amador Massi and Lorenz Landi. The first Italian paper with a continuous title appears to have been *Sincero,* published in Genoa in 1645.

The press of Italy, always subject to more or less severe government controls, lent itself to reform and even revolutionary movements. Giuseppi Mazzini was an active journalist; and Count Cavour's *Il Risorgimento,* which he founded with Count Cesare Balbo in 1847, was the great organ of the national movement. The constitution of 1848 declared for freedom of the press; yet "special laws," it stated, would "punish abuses." Accordingly, a set of press edicts was issued which retained effective political controls and remained in use until the sterner censorship of the fascist regime.

In 1920, according to *Annuario della stampa italiana,* there were 157 daily papers and 843 weeklies in Italy. Following Benito Mussolini's march on Rome in 1922, the national press regulations were adapted to the pattern of a totalitarian state, with very definite editorial policies prescribed for them almost day by day. Opposition papers were suppressed and their editors disposed of. Mussolini himself had been a journalist, editing the Socialist *Avanti* of Milan in 1912–14, and resigning that position to found his own *Il Popolo d'Italia,* which he edited until 1922. Under his dictatorship, Italian dailies were reduced to 50 or 60.

Much the oldest of the survivors was the *Gazzetta di Venezia,* which had been founded by Anton Piazza in 1787 under the name *Gazzetta urbana veneta,* changing title in 1814. In the hands of Gino Damerini it became in 1922 the strong fascist journal of Venice. *L'Osservatore romano* was founded as the papal organ in Rome in 1861.

The Agenzia Stefani was set up by Count Cavour in 1853 under the management of Wilhelm Stefani. It functioned as a government news agency in Rome under all changes and through the fascist era.

World War II put an end to many of the older newspapers, but peace brought forward many new ventures and in 1948 there were 119 dailies being published and about 700 weeklies. The *Corriere della séra* (1876) of Milan had a circulation of 450,000—the largest in Italy. Despite its name, it continued to be a morning paper; its evening associate, *Corriere d'informazione,* had 250,000 circulation. Half a dozen other papers claimed about 200,000, but only 20 Italian dailies had as many as 100,000. Two foreign-language dailies were published—the *Rome Daily American* and the German *Dolomiten* at Bolzano.

Spain.—The history of the Spanish press is chiefly a history of censorships, with intermittent eras of relative freedom. The first authorized papers appeared only after the declaration for liberty of printing by the *cortes* of Cadiz on Nov. 10, 1810; this was withdrawn in 1814, re-established in 1820 and then annulled 1823–34. The periods of authorized publication were too short to permit the development of important newspapers; their place was taken by such reviews as Bretón de los Herreros' *Correo literario y mercantil.* Exceptions to the short-lived nature of the newspapers before the constitution of 1869 were the government bulletin *La Gaceta de Madrid* (1661), begun as a monthly, later published weekly and made a daily in 1890; and *Diario de Barcelona* (1792), which, as the leading and semiofficial paper of Catalonia, was independent of the Spanish censorships. Spanish papers were generally political, often in revolt against the censorships and inadequately financed.

The civil war of 1936–39 reduced daily papers in Spain from about 250 to fewer than 100. In 1939, 39 republican editors were shot, and the remaining papers were thus effectively brought into line. Control of the press at mid-century was somewhat less strict than during the war, though the old system of the *"editores responsables"* approved by government, first set up in 1833 at the outbreak of the Carlist uprisings, was again in use, and the ministry of education exerted a precensorship and a control over newsprint.

The largest paper in Madrid in 1950 was *A.B.C.,* founded in 1904 by Don Torcuato de Tena as a monarchist journal. By the use of pictures and shrewd management, the paper became the most prosperous in the history of Spanish journalism, occupying a new printing establishment and obtaining a circulation of 225,000. During the civil war it was in republican hands, but the founder's son, Don Juan Ignacio Luca de Tena, published a monarchist *A.B.C.* in Seville. After the peace, the paper was forced into line by a refusal of paper quota and temporary suspension.

Agencia Telegráfica Fabra, the Spanish news service, was founded by Nilo Fabra in 1865 as Centro de Correspondencia.

The Balearic Islands and the Canaries, Spanish dependencies, each maintained five daily newspapers at mid-20th century.

Portugal.—Successive governments of Portugal allowed scant and temporary liberty of the press. The constitutional provisions of 1911, separating church and state, provided for press freedom, but the dictatorship which developed under the constitution of 1933 was unfriendly to independence of the press.

Thus no great newspapers have developed in this country. In 1950 there were ten dailies in Lisbon, three in Oporto, two each in Braga and Evora and one each in Beja and Coimbra. About 30 weeklies, semiweeklies and triweeklies were published in the country. There were four dailies in the Azores and five in Madeira. Angola (Portuguese West Africa) also had two dailies published in São Paulo de Luanda, and one in Benguela.

Largest of Portugese papers were *Diario de noticias* (1864) and *O Seculo* (1880), Lisbon morning papers each claiming 100,000 circulation.

Belgium.—Some of the earliest newssheets in Europe were printed in Belgium. It has been claimed that Abraham Verhoeven's newssheets, authorized for publication as *"Nieuwe Tydingen"* in Antwerp in 1605, constitute the first occidental newspaper, though the earliest extant copy is one for 1621. Newspapers were, of course, under the control of the various national authorities which ruled what is now Belgium over the long period before the constitution of 1831. That document declared for freedom of the press, and under such liberal provisions Belgium developed vigorous newspapers despite the competition afforded by the French press and the hardships suffered in two world wars.

In 1831 the 10 dailies in the country were all printed in French, and as late as 1848 there were 38 dailies, all in that language. But by 1860 there were 9 Flemish dailies, and by mid-20th century nearly one-third of the 60 dailies were published in that tongue. Most of the large Belgian papers had Sunday editions, and some published weekly illustrated supplements.

The largest papers were issued in Brussels: *Le Soir* (1887), with somewhat less than 300,000; *Het Laatste Nieuws* (1886), with 240,000; *La Dernière heure* (1906), with 225,000; and *La Libre belgique,* founded in 1885 as *La Patriote,* but taking the latter name when it went underground during the German occupation in World War I, with 140,000. The largest Antwerp paper was the *Gazet van Antwerpen* (1891), with 130,000. *Le Peuple* (1885), famous Social Democratic paper with which Emile Vandervelde was associated, perished during World War II.

The Netherlands.—Dutch printers were among the first Europeans to exercise the art, and such early printers as George Veseler, Broer Jonson and Adrian Clarke issued some of the corantos which were the forerunners of regularly published newspapers. Some such papers appeared in Amsterdam before 1620. In 1656 was founded what by 1950 was the oldest paper published in the Netherlands, the *Oprechte Haarlemsche Courant,* which became a daily in 1847.

The *Algemeen Handelsblad,* founded in 1828 as *Nieuwe Amsterdamse Courant,* was the first daily in the country. The largest circulation by 1950 was the 320,000 of *Het Vrije Volk,* a Socialist paper with editions in Amsterdam, Rotterdam, Groningen and Arnhem. The independent *Het Parool* and the antirevolutionary *Trouw,* which began as underground sheets during the German occupation, came next, with more than 200,000 circula-

tion each. As in France, collaborationist papers were suspended at the time of the liberation. *De Telegraaf,* founded in 1893 by H. M. C. Holdert, was suspended but allowed to resume in 1949. Holdert, who died in 1944, had made *De Telegraaf* a great and profitable paper.

Most famous paper outside Amsterdam was the *Nieuwe Rotterdamse Courant* (1843), founded and conducted by the Nijgh family. Other important papers were published in The Hague, Utrecht, Haarlem, etc.

The news agency, Algemeen Nederlandsch Persburo, was founded in 1935.

Denmark and Iceland.—Though various Danish newspaper efforts followed the "king's law" of 1665, government controls in this country were stern until the more liberal "June constitution" of 1849.

In 1749 Ernst Heinrich Berling, German-born book publisher began publication of the *Kobenhavske Post-Tidener* (*Copenhagen Post-News*). The name was changed several times, finally becoming *Berlingske Tidende.* It became a daily in 1841; three years later a morning edition was established, to become the major Berling paper, with *Berlingske Aftenavis* as the evening edition. The paper lost its position as government organ in 1901, but the Berling concern was enlarged by the addition of *B.T.,* a tabloid daily established in 1916, weekly and monthly magazines, etc. *Berlingske Tidende* was the largest Danish paper in 1950, with about 200,000 circulation.

Another daily founded in the 18th century and still published in 1950 was the *Stiftstidende* (1794) of Aarhus. Second largest Danish paper was the leftist Liberal *Politiken* (1884); *Ekstrabladet* was its evening associate. *Information* grew out of the Danish underground press during the German occupation.

Iceland had monthly periodicals as early as 1773. A weekly, *Thjodolfur,* was begun in 1848; and the first daily was *Dagskra* (1896). The oldest and largest paper in the island at mid-20th century was *Visir* (1910).

Norway.—The Norwegian press apparently began with the founding of the *Norske intelligenssedler* in Oslo in 1763, and two years later the *Efterretninger fra Addressecontoiret* in Bergen. The latter was a mercantile and labour bulletin which preceded the partisan political press that eventually came to be characteristic of Norway.

Shortly after the union with Sweden in 1814, a number of political papers were begun in Oslo, of which the *Morgenbladet,* still published at mid-20th century as a Conservative daily, became the best known both in and out of Norway.

Sweden.—Though a newssheet called *Hermes gothicus* is known to have been published as early as 1624 in Strängnäs, and similar corantos were published in other Swedish towns, the first paper published with regularity appears to have been the *Ordinari post tijdender,* begun in 1645 and, at mid-20th century, the oldest continuously published newspaper in the world, though little more than an official bulletin, under the title *Post och inrikes tidningar.* Its founder was Johan Beijer, Sweden's second postmaster general. It became a daily in 1820.

The oldest independent newspaper in Sweden in 1950 was the *Tidningar,* founded at Norrköping in 1758.

The *Handels- och sjöfarts-tidning* (1832) (*Trade and Shipping News*) of Göteborg maintained a liberal and democratic tradition.

The largest circulations at mid-20th century were those of three Stockholm papers, in the following order: *Stockholms-tidningen* (1824); *Aftonbladet* (1830), afternoon associate of the preceding paper; and *Dagens Nyheter* (1864). The last-named paper also owned the evening *Expressen* (1944). Tidningarnas Telegrambyra, the national co-operative news agency, was founded in 1867.

Finland.—The first newspaper in Finland was published in the Swedish language in 1771, and the first in Finnish appeared in 1776. The oldest paper still published at mid-20th century was the *Abo Underrättelser* (1824), of Turku, while the oldest in Helsinki, the capital, was *Uusi Suomi* (1847). Largest of the dailies was the *Helsigin Sanomat* (1889), with 150,000 circulation.

Poland.—The origins of the Polish press go back to 1661, when Johan Aleksander Gorczyn published his *Merkurjusz Polski.* The political history of Poland, however, made it difficult for newspapers to exist for long periods; an exception was the *Kurier Warszawski* (1820–1938).

World War II destroyed the Polish press, and only two of the prewar papers survived in the postwar period—*Robotnik* (1896) and *Polska Zbrojna* (1921), the Polish army paper. About 50 dailies were published in Poland in the late 1940s, a dozen of them in Warsaw. The largest daily was in Katowice, where the *Trybuna Robotnica* claimed 300,000 circulation. Second was Warsaw's *Express Wieczorny,* with 200,000.

Merger of the Communist and Socialist parties in 1949 reduced the number of papers.

Lithuania, Latvia, Estonia.—After the rebellion of 1863, all printing in Lithuanian was banned by the Russian rulers, though papers published in that language by refugees in near-by countries were secretly circulated in Lithuania. Examples were *Ausra* (*Dawn*), established in 1883 by the patriot leader Jonas Basanavicius; *Szviesa* (*Light*); and *Varpas* (*Bell*), published irregularly 1889–1904. Following the revolution of 1905, a national press was established which, by 1939, included considerably more than 100 periodicals in 17 languages. The official organ of the government, and the leading newspaper, was *Lietuvos Aidas* (*Lithuanian Echo*), which was begun at Vilnius in 1917.

The earliest Latvian newspaper was K. F. Watson's *Latweechu Awihaes* (*Latvian Gazette*), of Mitau, in 1822. Many papers were published in the 19th century, and the first daily appeared in Riga in 1877—*Rigas Lapa.* Following the establishment of the republic in 1918, a considerable number were founded, and by 1939 there were 15 dailies and about 200 other periodicals. Leaders of the Lettish press were *Briva Zeme* (1919), *Jaunakas Zinas* (1911) and *Rits* (1934); and there were also important dailies in German and Russian.

There were Estonian newssheets as early as the 17th century, but the modern press of that country may be said to have begun with J. W. Jannsen's *Perno Postimees,* begun in 1857 and continued until World War II. Estonia's most important period of journalistic development was in 1918–39; by the latter year the country had 15 dailies, 12 of them in the Estonian language, and 115 weeklies, semiweeklies and triweeklies. Leaders, besides *Postimees,* were three Tallinn papers—*Paevaleht* (1905), *Rahvaleht* (1927) and *Uus Eesti* (1934).

After the Russian occupation of these three states in 1939, their papers were adapted to the pattern of the soviet press.

Switzerland.—Newssheets known as *Ordinari Wochenzeitung,* published at Basel in 1610, have been cited as constituting a newspaper and thus the beginning of the history of the Swiss press. Political and religious struggles, however, allowed little opportunity for the development of a regular journalism until the "period of regeneration," which began about 1830 and was followed by the federation of 1848. The federal constitution provided for liberty of the press and, except for short periods during World Wars I and II, there was no administrative control of the press after 1848.

Of the 400 papers at mid-20th century, 68.5% were printed in German, 26% in French, 4.5% in Italian and 1% in Rumanian. The largest circulation was that of the *Tages Anzeiger* (1893) in Zurich, with 120,000 daily; all other papers had less than 100,000 circulation.

Austria.—At least three weekly newssheets are known to have existed in Vienna before 1620. Though limited in its development by the usual censorships of the 17th and 18th centuries, the Viennese press gained a wide reputation for good writing and criticism. The reign of Joseph II (1780–90) brought a helpful liberality in newspaper licensing, but the following reign and the rule of Metternich were less favourable. The revolutionary disturbances of 1848 brought a new severity into censorship and reduced the 200 papers then published in Austria-Hungary (90 of them dailies) by about half. Not until 1867 was there a relatively free press. Two newspapers which

The new tydings out of Italie are not yet com.

Out of Weenen, the 5 November.

THe French Ambaſſadour hath cauſed the Earle of Dampier to be buried ſtately at Preſburg In the meane while hath Bethlem Gabor cited all the Hungeriſh States , to com together at Preſburg the 5 of this preſent , to diſcourſe aboute the Crovvning & other cauſes concerning the ſame Kingdom

The Hungarians continue vvith roveing againſt theſe Lands. In like manner thoſe of Moravia , vvhich are fallen uppon the Coſackes yeſter night by Holleyn, ſet them on fire , and ſlaine many dead , the reſt vvill revenge the ſame

Heere is certaine nevves com , that the Crabats , as alſo the Lord Budean , are fallen unto Betlem Gabor.

The Emperour ſends the Earle of Altheim as Ambaſſadour to Crackovv in Polen, to appeare upon the ſame meeting-day.

Novv comes tidings, that Betlem Gabor is at Thurna, there doe gather to gether great ſtore of States.

The Emper Maj. hath appoynted heere a meeting-day upon the 1. of Decemb thereupon ſhould appeare the 4 Proclaimed States. The appoynted taxing ſhall bring up a great ſom of money.

Out of Prage, the 5 of November.

Three dayes agone are paſſed by, 2 mile from this Cittie 6000 Hungarians (choſen out Soldiers) under the General Rediſerens, vvhich are gon to our Head-camp, & the Enimie lieth yet near unto ours by Rackonits , though the crie goeth, that the enimie cauſed all his might to com togither, to com this vvayes againſt Prage, if that comes to paſſe, it ſhall not run of vvithout blovves, the vvhich might be revealed vvith in fevv dayes.

It coutinues, that in the Satſer Crais are gathered togither 10000 Contrie-men, moſt high-dutch-men againſt Meiſſen, & no Bohemians, they vvill help the King to drive the enimie out of the Land In like manner ſom certaine 1000 Contrie-men rebel in the LeutmaritſcherCrais, but it is feared that thoſe Countrie-men are ſtarred up , through practiſe of the Adverſarie , that the enimie in the meane vvhile might com to Prage Wee underſtand, that Bucquoy hath not been in the Camp but by the Duke of Saxen ſom certaine dayes , therefore vve are to looke to our ſelves, for feare of Tre herie. And it is thought that the Emperour vvill leave Auſtria to the Hungorians, & ſee to effect his intention only uppon Praghe

Out of Ceul.n, the 21. Novemb.

Writing from Marpurg in Heſſen , that the Earle of the ſame Land doth cauſe the foreſaid Cittie to be ſtrongly fortified , there on doe vvorke many 100 men dayly , and there is muſtered in the Earleſhip Zigenheym not long ſince 1. Governement of foote-men , & 6 Cornets of horſe-men , the foote-men are ſent to Marpurg & Ryntels But the horſe-men are lodged in the Villages about the Cittie , & thereafter are alſo muſtered the Duke of Saxen Lauvvenburgs Governement in Tries-Zigenheym, novv further vvhere they ſhallbe laid & uſed, is yet unknovvn The ſames Brothers Governement, there quarter is laid by Caſſel , the Souldiers vvhich are taken on about Hamburg, Lubeck, in the Dukeſhip of Holſteen , & Meckelenburg, ſhould alſo be muſtered about Caſſel , & be uſed vvhere neede ſhall require

Since the laſt vve cannot enquire, that there is any thing of any importaunce paſſed betvvixt the Marquis Spinola & the Vnited Princes We underſtand that the foreſaid Spinola vvil lay his Souldiers in Garniſſon vvith the firſt , & deale them unto divers places, on part to Oppenheym, Altzey, Ingelheym & Cruitſnach, the other part at Summeren & Bacharacht , the ſpeech goeth that there ſhalbe layed vvith in Ments a good Company in Garniſſon.

The Biſhop at Halberſtadt, Duke Chriſtiaen at Bruynſvvyck, doth cauſe to be taken on 2000 Muſquetters, to ſend to the Vnited Princes.

Heere is tydings , that betvveen the King of Bohemia & the Emperours ſolke hath beene a great Battel about Prage , but becauſe there is different vvriting & ſpeaking thereuppon , ſo cannot for this time any certainety thereof be vvritten, but muſt vvayte for the next Poſt As alſo of the Cittie Pilſen , vvhich the Earle of Mansfelt (ſo the ſpeech goeth) ſhould have delivered into the Emperours hands.

From Cadan in Bohemia , 4 mile from Raconits, the 12. November.

From Solts is certaine adviſe that the Emperours ſolk have made them ſelves with all theire might out of theire Camp, & taken their vvay to vvards Praghe, like as they vveare then com to the long mile , but as the King underſtand ſuch , he is broken up vvith his armey, and com to the lōg mile beforen the enimie, vvhere they have had a very ſtrong Battelle & on both ſides more then 6000 men ſlaine, though moſt on the Kings ſide , alſo hath the enimie gotten of the King ſom peeces of Ordenaunce and vvaggens vvith amunitie, ſo that the King muſt retire back to Praghe , and the enimie to the Weiſſenberg , there he lies yet and roves from thence to the Leut Maritſcher Crais unto Brix, hath taken in, Tiebnit Pielan & Dux alſo laid folk upon Leutmaritſcher Slauer , and Launer paſſages, that the Paſſage upon Prage is vvholy taken avvay, and this day is com heere in a certayn Perſon that brings tydinghs unto our Magiſtrat, that betvvixt Sonnevvald and Patronit, vvhere the enimie hath lien are found ſom certaine 1000 dead Bodies , & on the other ſide there King lay alſo ſom certaine 1000 dead bodies, vvhat is com to paſſe betvvixt both vve ſhal ſhortly heare.

Out of Amberghe, in the Vpper-Pallatine, the 17. dito.

Here hath beene a greate crie, that the Duke of Beyeren ſhould have taken in Praghe, and beaten our King out of the fielde, but is not certaine , for the Carle of Solms vvrites out of Waltſaxſen of the 14 of this preſent , that the Duke of Beyeren vvas broken up with his camp very ſtil & marched in al haſt to Prage, though they had left ſom 100 men vvhich lay in theire quarter ſoom houres , vvhich made fires there in, that on vvoulde not have thought but that the vvhole Armay had layen there ſtill , but as ours underſtood that they vvere gon followed they them preſently, though the Beyerens were com to Weiſſenberge before but the 8 of this preſent have ours ſett uppon the Beyerens by force, and fought the vvhole day togither , that on both ſides are ſlaine aboute 8000 men , and very many ſhould be hurt. Our King, vvith the Lord General the Earle of Hohenlo , alſo the vvhole army are vvith in Prage, & the Duke of Beyeren uppon the Weyſſenbergh & Stern ; vve hoope that they ſhall ſhortly be driven from thence What further is done betvvixt them, vve look for every houre to enquire further thereof & it ſeemes none can com from Prage, becauſe the paſſages are every vvhere ſhut

Out of Ceulen, the 24 of November.

Letters out of Neurenburghe of the 20 of this preſent, make mention , that they had adviſe from the Borders of Bohemia , that there had beene a very great Battel by Prage, betvveen the King & the Duke of Beyeren , & many 1000. ſlaine on both ſides, but that the Duke of Beyeren ſhould have any ſolke vvith in Prage, is yet uncertaine , there uppon under the Merchants vvith in Neurenberge are laid many 100. Florins that the Emperour , nor the Duke of Beyeren have no ſolke vvith in Prage. The cauſe that here comes no certainty thereof, is this; That all paſſages are ſo beſet, & ſo dangerous to travaile, that it is to vvondered at, & not enough to be vvrittē of, vvhat roveing, ſpoyling and killing is done dayly uppon all vvayes

Vppon the Schanſe Prieſls cap is ſtrongly builded, & buy dayly much vvood lime & ſtone, to make houſes there upon, and ſo provide them ſelves for the vvhole vvinter. And are not long ſince in the night 500 Souldiers paſſed by Dure out of Gulik, ſo the ſpeech goeth, there meaning ſhoulde be to build a nievv Schantſe by Flamersheym , to take avvay the paſſage from the Marquis Spinola.

Imprinted at Amſterdam by George Veſeler, A. 1620. The 2. of Decemember.

And are to be ſoulde by Petrus Keerius , dvvelling in the Calverſtreete , in the uncertaine time.

had been founded in Vienna within the first three years of the 18th century—*Posttägliche Mercurii Zeitung* and *Wiener Diarium* —were in 1780 combined as the *Wiener Zeitung*, long the government organ, and serving in that capacity at mid-20th century.

Nearly all the papers of the Austrian post-World War II daily press had been founded since the war. The chief exception, besides the *Wiener Zeitung,* was the *Arbeiter Zeitung* (1895), official Socialist organ, which with the *Tageszeitung* (1947), chief organ of the majority People's party, led the Vienna press. *Das Kleine Volksblatt* (1929), a tabloid, also represented the People's party. *Wiener Kurier,* published by the U.S. forces in Austria, had a circulation of 280,000; and the British forces published *Weltpresse* in Vienna. The provincial press increased in number and influence in the postwar period, partly because of the development of the party press. Many papers were owned by political groups. Austrian dailies commonly have no editions on Monday, but there are regular Monday papers published independently of the dailies.

Hungary.—First newspapers in what is now Hungary appeared in Budapest in the first two decades of the 18th century in the German language. The first Magyar journal consisted of the parliamentary reports of Lajos Kossuth, written out by hand under the title *Orszagyulesi Tudositasok* in 1832–34 and circulated underground. Later (1841–44) Kossuth became editor of the Liberal organ *Pesti Hirlap,* and, in the revolutionary year of 1848, of his own paper, *Kossuth Hirlapia.*

There was a remarkable development of the Hungarian press after 1867, with great latitude for free expression. The number of papers increased from 80 in that year to about 2,000 before World War I, nearly 200 of them dailies.

Despite the economic and political crises which followed World War I, the Hungarian press had been built up to about 75 dailies and 300 weeklies before World War II, nearly one-third of them published in Budapest, and many of them devoted to nazi propaganda.

During World War II all printing plants were placed under government ownership, where they remained in the postwar period. The 50-odd daily papers at mid-century represented political parties, though they all reflected the Communist views. Most of them were new since the war, though *Népszava* (1872), the oldest Hungarian paper, and a few others were exceptions. Some, such as *Szabad Nep,* were underground papers during the war. The largest morning circulation was that of *Friss Ujsâg,* and the largest among the evenings that of *Vilâgossâg;* each claimed 120,000.

Czechoslovakia.—Though German papers appeared in Prague in the early part of the 19th century, the Czech press did not develop until the middle of that century. One of the earliest Czech newspapers was *Narodni Listy* (1860), which lasted until World War II. Only a few of more than 100 dailies published in Czechoslovakia before the war survived; among survivors the oldest was *Právo Lidu* (1897), Social Democratic organ, while *Rudé Právo* (1920), official Communist organ, had the largest circulation (500,000). The German-language dailies of Prague, such as *Deutsche Zeitung Bohemia* (1827), disappeared at the end of the war.

After the Communist coup of Feb. 1948, the Czech press was completely controlled.

Yugoslavia.—The first Serbian paper was *Srpskija Novini,* founded in 1791 at Vienna; later Serbian journals appeared in Budapest and Venice. The first genuinely Croatian paper was *Narodne Novine,* founded by Ludwig Gaj in Zagreb in 1835.

Serbian papers, located chiefly in Belgrade, are printed in Cyrillic; Croatian and Slovene papers, chiefly in Zagreb, are printed in Latin characters. *Borba,* of Belgrade, is published in both languages.

After Marshal Josip Broz's (Tito) rise to power, newspapers were all published by the Communist party, the people's front, or one of the front organizations. There was rigid censorship, and the official news agency, Tanyug, provided uniformity in all except regional and occupational news.

Albania, Bulgaria, Rumania.—Strict censorship by Communist governments also prevailed in these countries after World War II. In Albania, *Bashkimi* and *Zeri i Popullit,* at Tirana, official organs of the democratic front and the Politburo of the Albanian Workers' party, respectively, were the dailies. Albanian papers had never enjoyed much freedom, though they were privately owned under the King Zog regime. There were five dailies in Sofia, Bulg., and five in the provinces in 1950. There were 14 papers in Bucharest, Rum., most of them dailies, and 28 in the provinces; 10 of the provincial papers were printed in Hungarian.

Turkey.—The earliest papers in Turkey were French journals published in the last decade of the 18th century. The first Turkish paper was *Takwimi Wekaji* (*Calendar of Events*), a translation of a French journal, *Moniteur Ottoman,* begun in the same year of 1831 by Alexandre Blac. This was a part of the westernization program of Mahmud II. No considerable development in Turkish journalism took place, however, until after the establishment of the republic in 1920 and the change from Arabic to Roman characters in printing.

Few papers published in the post-World War II period in Turkey were established before the war; the most notable exception was *Istanboul* (1868), a French-language paper. The Turkish language gained steadily in the press after 1920 until foreign-language papers were published only in Istanbul.

Greece.—Apparently the first Greek papers were published in foreign capitals by refugees from Turkish rule and propagandists for Greek freedom. These appeared in Vienna, Paris and London from 1790 to 1820. The first Greek paper in the homeland appeared immediately after the beginning of the Greek War for Independence—the *Salpinx Helleniki,* founded at Nauplia in 1821. An especially interesting journal was the *Hellenika Chronika,* edited 1824–26 at Missolonghi by the patriot Jacques Mayer.

The oldest Athenian daily at mid-20th century was the *Akropolis,* of Athens, founded in 1880 as *Mi Chanessai* by Vlassi Gabriilidis, a brilliant journalist, suspended after his death in 1919, but revived in 1928. The largest was the *Makedonia* (1908), of Salonika, which distributed about 120,000 copies daily in five editions, one of which was flown to Athens.

U.S.S.R.—The first Russian journal is said to have appeared in 1703, but the severe censorship imposed upon the press by the government prevented the development of a press adequate to the extent and population of the country. As newspapers developed in the 19th century, they came to emphasize literature and art and the political policies of government. Nicholas I permitted only 6 newspapers to be published at the mid-19th century, but Alexander II allowed more than 60 to be started in the first decade of his reign, 1855–65. These papers soon developed a radical individualism (known as Nihilism) which brought back strong repressive measures against the press, and these remained in effect past the end of the century. By 1910, however, there were about 800 papers in all of Russia, approximately 50 of them dailies. One-fourth of the daily papers were published in St. Petersburg, the capital. Among the latter were such famous papers as *Novoe Vrèmja* and *Retch.*

Meantime, the revolutionary press, now regarded as the forerunner of the modern Soviet Union press, began with *Kolokol* (*Bell*), founded first as a monthly by the refugee A. I. Herzen in London in 1857; it was soon made a fortnightly and lived for ten years, exerting a considerable influence on reforms in Russia. Similar revolutionary journals were set up by refugees in other capitals, such as Geneva and New York, and in the 1880s and 1890s there were many illegal sheets in St. Petersburg. The first legal bolshevist paper was *Nowaja Schisnj* (*New Life*), founded under Nicolai Lenin's leadership in 1905. In 1910 *Stern* (*Star*) was founded in St. Petersburg to combat other leftist groups, and two years later its place was taken by *Pravda* (*Truth*), which after the revolution of 1917 became the leading soviet organ and was published at Moscow.

In 1922 the periodical publications of the U.S.S.R. were placed in a carefully devised system which was enlarged to great proportions. Freedom of the press had been considered in most

parts of the world as meaning freedom from government dictation and censorship; in that sense, of course, no totalitarian state could possess freedom of the press. Lenin in 1920 made the definitive statement of autocratic government. "Why," he asked, "should a government which is doing what it believes to be right allow itself to be criticised? It would not allow opposition by lethal weapons, and ideas are much more fatal than guns." Propaganda for the economic, political and social building and maintenance of the U.S.S.R. thus became the dominant function of the soviet press.

The soviet publication scheme provided for a pattern in Moscow which was followed more or less closely in the other republics and to some extent in smaller units. This pattern placed at the top two daily newspapers, one representing the party and the other the government; at Moscow these were *Pravda* and *Izvestia*, respectively. Then under the party bracket were the papers designed for the political and economic indoctrination of the special groups—one for the Communist army, one for the peasants, another for industrial workers, special periodicals for youth and for younger children, and an increasing number of cultural periodicals in various fields. Under the government bracket were the organs of the commissariats of industry, economics, agriculture, etc., and the papers for trade unions and co-operatives. This pattern was repeated in the capitals of all the union republics and, with variations, in each regional and district centre.

Under this system, there were, according to reports in *Pravda* in May 1949, 7,200 papers in the U.S.S.R., with an aggregate circulation per issue of 31,000,000. Since it was impossible to draw a line between newspapers and other periodicals in this great outpouring of soviet publications, it was presumed that the above totals were inclusive. The soviet authorities did not break their totals down in terms of daily, weekly and monthly papers, but it seemed likely that little more than 5% of the total were dailies. Papers published three or four times a week were common.

Newspapers in the Soviet Union at mid-20th century were published in 80 languages, including 20 which did not exist as written languages before the revolution (Abazin, Tabasaran, Shorian, Lezghin, etc.). More than 800 papers were published in the Ukrainian S.S.R. There were papers in the Taimyr area beyond the Arctic circle, on Igarka and in the mountain villages of the Badakhshan highlands. Thousands of papers were being published on the state farms, at army installations, in schools and scientific institutions and in factories and mills. During the earlier development of the soviet press, there were many mimeographed and written papers; and "wall newspapers" in factories, on the farms and in barracks were common.

Pravda in 1950 had one of the world's largest circulations, reported at one time as high as 3,000,000 but reduced to 2,000,000 during World War II. It was a serious collection of official news, comment on foreign affairs and domestic operations, features and an occasional picture or cartoon, filling four pages. It sometimes ran a patriotic fiction serial. It was always sold out at 20 kopecks, and its circulation was limited only by available paper supply and official decisions. Its Moscow home was in two large and well-equipped buildings, in which its rotary presses could print 1,000,000 copies an hour. Leading party papers outside Moscow in 1950 included *Leningradskaya Pravda, Zvezda* (Minsk), *Pravda Vostoka* (Tashkent), *Zaria Vostoka* (Tiflis), *Vostochno-Sibirskaya Pravda* (eastern Siberia), *Kommunist* (Kiev) and *Tikhookeanskaya Zvezda* (Khabarovsk).

Izvestia (*News*) featured official documents and government statements, as well as foreign news. Its circulation was probably about half that of *Pravda*. *Krasnaya Zvezda* (*Red Star*), daily organ of the commissariat of the armed forces, was designed chiefly for officers and noncommissioned officers, but set the pattern for the local and regional army papers for the rank and file. Leading Moscow dailies of the co-operatives were *Gudok* (*Whistle*), organ of the transportation commissariat and the unions of railway workers; *Trud* (*Labour*), organ of the Central Council of Trade Unions; and *Stroitel'nyi Rabochii*, organ of the construction workers.

Among cultural papers published in Moscow were *Literaturnaya Gazeta, Kultura i Zhizn* (*Culture and Life*) and *Sovietskoye Iskusstvo* (*Soviet Art*). The youth daily was *Komsomolskaya Pravda* (*Young Communist League's Truth*) and the paper for children *Pionerskaya Pravda* (*Young Pioneers' Truth*).

The official news agency, Telegrafnoe Agentstvo Soyuza (abbreviated as Tass), was founded in 1925 to collect foreign as well as domestic news for distribution to soviet papers.

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ASIATIC NEWSPAPERS

China.—The first newspaper in China and, if we accept all the claims that have been made for it, the first newspaper in the world, was a court gazette which began during the T'ang dynasty (A.D. 618–907) and was used as a means of communication between officials. It was continued in the Sung dynasty (960–1279), and early in that period it began appearing at regular intervals and achieved a considerable circulation among Chinese scholars. For title it took the term *Ti-pao*, from *ti*, palace, and *pao*, report, a word which had been applied to the earlier bulletins; it was sometimes called *Ti-chan*, or "Court Reading-Matter." In the Ming dynasty (1368–1644) the title of this gazette was changed to *Tungchengsee*. In the last reign of the Ming dynasty, that of Zung Cheng (1628–44), the bulletins, which had hitherto been either handwritten or printed from blocks, began to be printed from movable wood types. During the Ching dynasty (1644–1911) the bulletins were continued under the name *King-pao* (*Peking Gazette*). The series was allowed to perish with the Manchus after 1911.

Similar official gazettes sprang up in the provinces under Manchu rule, and gazettes by the various ministries began in 1906. But newspapers for the general public, as apart from gazettes for officialdom, did not begin in China until the 19th century, and then they were translations or imitations of the English-language press which had been established in that country by commercial and missionary agencies.

James Matheson's *Canton Register* (1827–43) was the first English paper in China; when Hong Kong became British, it was transferred to that city and became the *Hongkong Register* (1843–59). Other papers were published in Canton and Hong Kong, and in 1845 the famous *China Mail* was founded in the latter city, with Andrew Shortrede as editor; it became a daily in 1876. The *North China Herald* was founded in Shanghai in 1850; in 1864 it was made a daily under the new title, *North China Daily News*. The *China Press* was founded in Shanghai in 1915 by a group of Americans, and was edited for a time by John B. Powell.

In 1858 Wu Ting-fang suggested Chinese translations of the *China Mail*; the result was the first Chinese paper for the general public, *Chung Ngoi San Pao*. The most important paper founded for the Chinese before the crisis of 1895 was *Shun Pao*, established at Shanghai in 1872 by Frederic Major, an English-

man. At the time of the Chinese revolution in 1911, it was sold to Sze Liang-zay, who made it prosperous and influential before his assassination in 1934. Sze also owned, after 1929, *Sin Wan Pao* (1893).

A period notable for the founding of many revolutionary journals representing various reform movements began in 1895, after the defeat of China in the Chino-Japanese War. These papers had much to do with bringing about the revolution of 1911. After that, the free speech guaranteed in the provisional constitution was an invitation to hundreds of young Chinese to start journals, many of which were short-lived. The severe press laws of 1914 cut off most of the newspapers, but in the years 1918–20 the "literary revolution" and the "student movement" again gave rise to a multitude of journals. In 1921 it was reported that more than 1,000 publications were appearing in China, about half of them daily newspapers.

Sun Yat-sen's regime in Canton was especially favourable to development of the press, and the nationalist revolution of 1927 marked the beginning of another new era in the publication of newspapers in China. By 1948 there were, according to government estimates, about 1,800 newspapers, more than half of them dailies, in the entire country.

Aside from a few well-established and influential papers, most of the dailies were small in size and circulation. Many were party organs, often representing small groups. No little venality and unreliability existed among such papers. The Press law of 1914 continued throughout Pres. Chiang Kai-shek's administration to impose a stern censorship; by 1948 it was almost equally severe on English-language and Chinese papers.

During World War II, Japanese occupation of the coastal cities drove most of the great Chinese papers inland, but they were quick to recover in 1945–48. *Shun Pao* (*Shanghai Gazette*) returned to Shanghai from Hong Kong; and its sister paper, *Sin Wan Pao* (the *News Gazette*), achieved an all-time Chinese circulation record of 350,000, largely through its commercial news. National circulations grew as never before, through the establishment of multiple-city editions. Thus the Kuomintang organ *Chung Yang Jih Pao* (*Central Daily News*) was published in Nanking, Shanghai, Chungking and several other cities. The excellent and reliable *Ta Kung Pao* (the *Impartial Gazette*), founded in 1902 in Tientsin and a refugee paper during the war, kept its far-flung chain in Chungking, Chansha, Hongkong, Shanghai and Tientsin. The Catholic *Yi Shih Pao* (*Social Welfare*), founded in 1915 at Tientsin, had editions also in Nanking and Shanghai. Sizes were reduced to four pages, with the customary weekly feature supplements.

The occupation of the country by the Communist armies had, at the mid-century mark, greatly reduced the number of papers in China. Chief journal was the Communist organ, *Chieh Fang Jih Pao* (*Emancipation Daily Gazette*), of Hankow. In Manchuria the only large paper was the Mukden Chino-soviet *Daily News*.

India.—Though printing from movable types was done in India in the 16th century, and there were written newsletters during the Mogul dynasty in that century, the first newspaper attempted in the country appeared Jan. 29, 1780. This was *The Bengal Gazette or Calcutta General Advertiser*, better known as "Hickey's Gazette." James Augustus Hickey's attacks on the government and on private individuals resulted first in barring his paper from the post office and then in his arrest and imprisonment and the seizure of his paper. The second paper was Peter Reed's *Indian Gazette or Calcutta Advertiser*, begun later in the year 1780 and devoted largely to the business of the East India company; it lasted for more than 50 years. Bombay journalism began with the *Bombay Herald* in 1789, and the first in Madras was the *Madras Courier* of 1785.

The first periodical in a vernacular language was the monthly *Digdarshan* of 1818, in Bengali, by J. C. Marshman, a Baptist missionary, which soon became a weekly newspaper with the title *Samachar Darpan* (*Mirror of News*). In 1829 it became bilingual, with local and foreign news in both English and Bengali. In the early 1820s many vernacular papers appeared in Gujarati and Bengali; active in this journalism was the religious leader, Rama Mohan Roy, founder of the first Persian weekly, *Mirat-ul-Akhbar*, in Calcutta—papers which were suspended under the John Adam Press regulations. Later Roy was associated with *Banga Dutt* (*Bengal Herald*), printed in Bengali, Persian, Hindi and English. Most famous of Bengali papers was *Ananda Bazaar Patrika*, founded in 1878, and enjoying by mid-20th century the third largest circulation of all Indian dailies—50,000. This paper and the other leading daily in Bengali, *Jugantar* (1937), were both published in Calcutta.

The leading English-owned papers in India at mid-20th century were: the *Statesman* of Calcutta (with a New Delhi edition), founded by Robert Knight in 1875, which absorbed the *Englishman* (1821) and *Friend of India;* the *Times of India,* of Bombay, founded in 1838 as *Bombay Times* and long regarded as the chief newspaper in India; the *Civil and Military Gazette,* founded in Simla in 1872 but later moved to Lahore (now in Pakistan); and the *Pioneer* of Allahabad, founded in 1865, and famous for the service on its editorial staff of Rudyard Kipling for a few years in the latter 1880s.

Half a dozen leading Indian papers in the English language were owned by Indians at mid-century. The *Hindu,* Madras, began as a mimeographed journal of a literary society, became a regular weekly in 1878 and a daily in 1889. The *Tribune* of Ambala Cantt, East Punjab, founded in 1881 and made a daily in 1906, became a modern and influential paper. *Amrita Bazaar Patrika,* founded in 1860 in a village near Calcutta, was in 1871 moved to that city and was made a bilingual paper. After the Vernacular Press act of 1878, it was made an English paper and gained the largest circulation of any newspaper in India. The *Bombay Chronicle* was founded in 1913 by Sir Pherozeshah Mehta. The *Free Press Journal* of Bombay was founded in 1930 by S. Sadanand, the outgrowth of a news agency; the *National Standard,* Bombay, became the nationalist outgrowth of the antinationalist *Morning Standard.* The *Hindustan Times,* founded in 1923, was edited for a number of years by Devadoss Gandhi, son of Mohandas K. Gandhi.

The daily press of India in 1950 consisted of more than 300 papers with an aggregate circulation of probably 1,250,000. About 40 papers might be said to have national circulation, nearly all of them published in Calcutta, Bombay, Madras or New Delhi. About half the papers in these four cities were printed in English..

Indian newspapers in 1948 formed their own co-operative news agency under the name of the Press Trust of India Ltd., taking over the 50-year-old Associated Press of India Ltd., which was a Reuters subsidiary. The Indian press at the same time joined that of the United Kingdom, Australia and New Zealand in the general management of Reuters, being represented in that organization by a trustee and a director.

Pakistan.—Following the birth of this new state in 1947, a number of new journals were established. Pakistan lost some of its papers by their removal to India, but gained its largest daily, *Dawn,* which removed from Delhi to Karachi, where it continued to publish editions in several languages. Leading English-language papers in 1950 were the *Civil and Military Gazette* and *Pakistan Times* at Lahore, and the *Daily Gazette* and *Sind Observer* at Karachi. Leading vernacular papers were *Anjam* and *Jang,* two Urdu dailies at Karachi, and *Al Wahid,* chief Sindhi daily of that city.

Japan.—Newssheets called *yomiuri* appeared in Japan late in the 17th century. They were printed from blocks and were sold by vendors who attracted customers by reading the news aloud; hence the name, which means "selling by reading aloud," and later became the title of one of the greatest of Japanese newspapers.

The first newspaper in Japan was the English-language *Shipping List and Advertiser* (1861) of Nagasaki, which was soon moved to Yokohama to become the *Japan Herald.* Several other papers in English were begun in the 1860s. The first periodical in the Japanese language was a series of official translations of foreign news, issued monthly, of which the earliest was *Batavia Shimbun* (1862), derived from a Dutch paper in

Java. The first Japanese newspaper for general circulation was the *Shimbunshi* (1864), established by an adventurous sailor named Joseph Hikozo, who had become a naturalized U.S. citizen but had later returned to Yokohama. This paper was followed by other Yokohama papers in Japanese, published by Englishmen and Americans.

But it was in 1868, the year of the Meiji restoration, that Japanese journalism really began. In that year 16 papers, in Tokyo, Osaka, Kyoto, Yokohama and other cities, were founded. This development continued despite strict censorship, many imprisonments of editors and occasional forcible suspensions.

The *Tokyo Nichi-Nichi* was founded in 1872, with the famous Genichiro Fukuchi, dramatist and educator, as its editor. In 1906 Hikoichi Motoyama, manager of one of the great industrial syndicates which were growing up in Japan, bought the *Nichi-Nichi* and made it an associate of the *Osaka Mainichi*, which he had owned for many years. The latter paper was founded as *Osaka Nippo* in 1876, but Motoyama rechristened it *Mainichi* when he bought it in 1888. These two papers set a great pace in enterprise, foreign correspondence and a degree of sensationalism. Each paper ran its circulation to more than 1,000,000 before World War II. Provincial papers were founded or purchased, including *Kyushu Mainichi* at Moji. In the war consolidations of 1942–43, these were all lost except the Kyushu paper. From the ordeal, however, the Tokyo and Osaka papers emerged with nearly 1,500,000 circulation each, and the one in Kyushu with more than 500,000.

The *Osaka Asahi* was founded in 1879 by Ryuhei Murayama, one of the greatest journalists of the Meiji era. It flourished, winning respect for its careful news coverage and progressiveness, and in 1888 the *Tokyo Asahi* was begun. Establishing connections with the *Times* of London, the *New York Times* and the Associated Press, these papers built up circulations of more than 1,000,000 each, covering the island of Honshu; in 1935 the Asahi company established the *Seibu* (Kokura) *Asahi* on the southern island of Kyushu. In the postwar period the Tokyo and Osaka papers each had about 1,500,000 circulation, and the Kyushu paper more than 500,000.

Founded in 1874, the *Yomiuri* of Tokyo had made a success in the 1930s by its emphasis on sports, finance and politics. In the combinations of 1942 it was consolidated with *Hochi*, founded in 1872 by friends of Marquis Okuma and later owned by Seiji Noma, the "magazine king." In the war years it gained on its competitors, reaching nearly 2,000,000 circulation in 1944.

By 1937 the Japanese press, despite a period of stern repression preceding the constitution of 1889, had reached a very prosperous position. Beginning about 1889, it had largely changed over from the system of party journals to that of more or less independent mass-circulation papers. In 1937 there were 1,200 dailies and 600 weeklies in Japan. In the next two years, as the government tightened its control, there was a small decline; in 1940–41 came a reduction of 36% annually; in 1942, at government "suggestion," wholesale combinations were made which left one daily in each *ken*, or district, outside the largest cities. This brought the total down to 53. After the end of the war in 1945, the number soon advanced to about 130, and it remained in that neighbourhood at mid-century.

Many newspapers suffered damage to plants during the war. Under the administration of the supreme commander for the Allied Powers (S.C.A.P.), newspaper management was "purged," and a precensorship set up which operated until July 1948. Some papers have reduced the 9,000 ideographs known to the learned to fewer than 2,000 used in their columns, in order to bring their articles and editorials within the reading knowledge of the masses, using the syllable alphabet known as *kana* as an aid.

Nearly half the daily circulation of Japanese newspapers at mid-century was concentrated in Tokyo and Osaka, with 17 papers in the former city and 10 in the latter. The "Big Three" in Tokyo—*Yomiuri, Asahi* and *Mainichi*—sold only about 5% of their copies on the street, while *Tokyo Shimbun* (representing a wartime consolidation of *Miyako Shimbun*, 1884, and *Kokumin Shimbun*, 1890) sold most of its nearly 500,000 circulation from pavement "stands." Two other notable Tokyo papers were *Nippon Keizai Shimbun* (1876), the "*Wall Street Journal* of Japan"; and *Nippon Times*, an English-language daily edited by Japanese. The latter paper was a war consolidation of the *Japan Times* (1897) and the *Japan Advertiser* (1890).

Osaka, besides its *Asahi* and *Mainichi* and a few less important papers, had the *Osaka Shimbun*, a 1942 combination of the *Jiji* (1905) and the *Yukan-Osaka* (1922). Papers with circulations of more than 500,000 outside Tokyo and Osaka were: *Chubu Nihon Shimbun*, Nagoya; *Hokkaido Shimbun*, Sapporo; *Mainichi Shimbun, Nishinihon Shimbun* and *Asahi Shimbun*, Fukuoka. Kyoto had four dailies and Nagoya six.

A feature of the Japanese newspaper is the employment of a large staff. The *Osaka Mainichi* in 1950 employed 2,300 men, about one-third of them on the editorial side. Employment on a newspaper was generally a lifetime position. Newspaper labour unions had become strong, though the attempt made by the Yomiuri union in 1946 to seize editorial management was defeated.

The leading news agency at mid-20th century was Kyodo Tsushin Sha (Mutual Wire-Service company), the lineal descendant of the old government-subsidized Domei, founded in 1936.

The Republic of the Philippines.—The pioneer of the Philippine press was *Del Superior gobierno*, a sheet devoted to European news, published in Manila 1811–12. Occasional brief experiments in journalism, often encountering government censorship, appeared up to the U.S. occupation in 1898. The first daily was *La Esperanza* (1846–49). The government's official gazette was founded in 1848 as *Diario de Manila*. The leading paper for many years was *El Comercio* (1858–1925). After 1888 a greater liberality in the censorship and the development of political groups, chiefly nationalist in character, resulted in the establishment of a large number of papers, most of which were small and short-lived. The first paper in the Tagalog language was *Patnubay Nang Catolico* (1890).

For the first year or two after the U.S. occupation, there was an orgy of newspaper founding. The *Manila Times*, first U.S. daily in the islands, was founded by Thomas Cowan in 1898; it later passed into Filipino hands and became a leading paper in circulation and influence. The *Manila Daily Bulletin* was established in 1900 as an advertising give-away paper, but was placed on a subscription basis four years later. *La Independencia* (1898) became the leading organ of the Emilio Aguinaldo insurrection and was moved from place to place until captured by the U.S. forces.

In World War II all Manila newspaper plants were destroyed or looted by the Japanese. Following the liberation from Japanese rule in 1945 and the establishment of the republic in the following year, the Manila and provincial press was greatly expanded.

Burma; Singapore; Federation of Malaya.—Only about a dozen daily newspapers were published in Burma before World War II, but that number had quadrupled by 1948. The oldest paper was *Hanthawaddy* (1889). The Burmese press, stimulated by national independence, became concentrated in Rangoon. Other languages were represented in the provincial press of lower Burma.

The crown colony of Singapore had 16 daily papers in 1948. They circulated not only in the city but largely also in the Federation of Malaya. The *Straits Times* (1845) had a special Malayan edition. There were papers in English, Chinese and the Indian and Malayan languages.

Newspapers in the Federation of Malaya (formed in Feb. 1948) were likewise in English, Chinese and Indian and Malayan languages. After the federation, the Malay press tended to increase. A leading paper in the capital was the *Malay Mail* (1896).

Indonesia.—A newspaper called *Batavaise Nouvelles* was published in Batavia, Java, as early as 1744–46 as a small two-page weekly. Other government gazettes appeared as the colony passed from the French to the Dutch, and then to the English

and back to the Dutch. The *Bataviasche Courant* was begun in 1816, changed to *Javasche Courant* in 1828, and continued for more than a century. Continuous struggles with censorship marked the development of the press in the Netherlands Indies. An outstanding paper was founded in Semarang, Java, in 1852 by P. J. de Groot called *Semarangsh Neuws- en Advertentie-blad,* but changed in 1863 to *Locomotief;* in 1870 it became a daily. At mid-20th century it was still respected and influential.

At the time of the inauguration of the Republic of the United States of Indonesia in 1949 there were 35 dailies in the islands, printed in Nederlands, Chinese and the various native tongues; nearly half were in Nederlands. *Sin Po,* of Batavia, had one edition in Malayan, founded in 1909, and one in Chinese, founded in 1921.

Iran; Iraq.—Though there were earlier newssheets concerned with court events, the first regular newspaper in Persia was *Rúznáma,* an official gazette established in Tehran in 1851. With some changes in title, this journal continued for many years, and the modern official daily *Iran* may be said to be descended from it. The first Persian daily was *Khulásatul-Hawádith* (1898), a small two-page paper, printed on one side from type and lithographed on the other. Though typography had been introduced into Persia as early as 1817, it was superseded by lithography during most of the last half of the 19th century. After the revolution and during the constitutional period 1906–12, there were many new papers.

In the years when arbitrary censorshp existed, not a few papers were printed in Persian in Calcutta, Constantinople, and other cities and circulated widely in Persia. One of the most famous of these was Aqa Muhammad Tahir's *Akhtar* (*Star*), published in Constantinople 1875–96.

Many brief political papers were published during the chaotic war period in Iran, some of which continued after the re-establishment of the national sovereignty in 1947. Among survivors from a somewhat earlier period were such papers as *Ettelaat* (1924), *Kooshesh* (1922) and *Setareh* (1928); these were all in Tehran. The daily press was also represented in Tabriz, Shiraz, Isfahan and Meshed.

Political papers abounded in Baghdad after release from Turkish rule and the beginnings of Iraqi nationalist movements about 1920. The *Iraq Times* was founded in 1914 as the *Bagdad Times,* printed in English, except for one page in Arabic. *Al Akhbar* was the leading Baghdad daily printed in Arabic in 1950.

Israel.—First Hebrew daily paper in Palestine was E. B. Yehudah's *Haheruth* (1909–15). With the establishment of Israel in 1947, its capital, Tel Aviv, became an active newspaper centre. Two years later it had seven morning and three evening dailies, all in Hebrew. The largest of these papers (circulation 35,000) was a four-page "tabloid" called *Mariv* (1948). Oldest of them was *Ha'aretz,* founded in Egypt in 1918 and the next year moved to Jerusalem, and later to Tel Aviv. The others were party papers, most important of which was *Davar* (1925), an administration spokesman. The *Palestine Post* (1932), only English-language daily in Israel, was published in Jerusalem.

Lebanon.—Not a few of the Lebanese newspapers were established before 1900, but all were small in circulation. There were about 40 dailies at mid-century, mostly published in Arabic. The largest daily was *L'Orient* (1925), one of several French-language papers in Beirut. The largest in Arabic was *Al Ammal.*

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LATIN-AMERICAN NEWSPAPERS

Mexico.—A Mexican newssheet published in 1541 constituted the earliest printed news in the western hemisphere. It was published by Juan Pablos and was an account of the Guatemalan earthquake of the preceding year, entitled *Relacion del terremoto de Guatemala.* The first regular newspaper came nearly two centuries later, *Gaceta de México* (1722). The first dailies were *Diario de Mexico* and *Diario de Veracruz,* both begun in 1805. Arbitrary censorship was the rule and tradition in Mexico. The constitution of 1857 was liberal in language, but did not in practice afford any considerable freedom of the press. In the long presidency of José de la Cruz Porfirio Díaz, however, economic stability was favourable to the development of the newspaper industry. The "insurgent press," beginning with *El Despertador americano* (1810–11), from time to time played an important part in national affairs. Papers in Indian languages were established in the 1880s, as *Purepe* of Quiroga, in Tarascan; *Mor* of Tepoztlán, in Aztec; and others in Maya and Zapotecan in Yucatán and Oaxaca.

Daily newspapers in Mexico in 1950 numbered about 100, of which one-fourth were published in the federal district. Nearly all had been founded since 1920, and many since 1940. The only important daily dating back to the 1880s was *El Correo de la tarde* (1885) of Mazatlán. The largest papers in Mexico City were: the established and respected *El Universal* (1916), with its evening tabloid edition, *El Universal gráfico* (1922); *Excelsior* (1917); and *Novedades* (1932). These journals had large Sunday editions and affiliated radio stations. There was one paper owned and operated by the government, *El Nacional* (1929). Guadalajara and Monterrey, the next largest cities, had four dailies each.

The circulation of Mexican dailies, regional rather than national, virtually doubled in the decade 1940-50.

Central America.—The earliest printing in Central America was at Antigua, in the colony of Guatemala; but it was in the town of Guatemala that a monthly *Gaceta* was established in 1729. The country's oldest daily in 1950 was *Diario de Centro-America,* founded the year after the adoption of the constitution of 1879 as *El Guatemalteco.* There were seven Guatemalan dailies—four in Spanish, two in English and one in Chinese. *El Imparcial* (1922) had the largest circulation.

In Honduras the first paper was the *Gaceta de Honduras* (1830), in Comayagua; the first daily was *El Diario* (1897), in Tegucigalpa, the capital. In 1950 Honduras had 2 dailies in the capital, as well as 5 which appeared three or four times a week, and 24 weeklies and semiweeklies.

British Honduras had the *Belize Daily Clarion* (1897) and three weeklies.

Nicaragua's first paper was *El Telégrafo nicaragüenese* (1835) of León, and its first daily was the *Diario de Nicaragua* (1884) of Granada. In 1948 there were nine dailies in Managua (including the government's *Gaceta*), two in León and one in Bluefields.

El Salvador had a paper at San Sebastian called *Liberal guipuzcoano* in 1820. In 1948 there were seven dailies in the capital, San Salvador, of which *Diario oficial* (1847), the government gazette, was the oldest, and *La Prensa gráfica* (1915) and *El Diario de hoy* (1936) foremost in circulation and influence.

El Noticioso universal, established by Joaquin Bernardo Calvo at San José in 1832, was Costa Rica's first newspaper. There were four dailies in that city in 1948, each claiming 10,000 to 20,000 circulation.

In what is now Panamá, *Miscelanea del Istmo* was established in 1822, and short-lived political papers appeared from time to time; but modern Panaman journalism began with the founding of the *Panama Star* by a group of American "forty-niners" bound for California but temporarily detained awaiting ship. Their main purpose appears to have been to publish an account of their celebration of Washington's birthday, and the paper was begun Feb. 24, 1849. The paper soon came into other hands, and when Panamá seceded from the Colombian federation in 1853 it was made a daily and given a Spanish section, which eventually became a separate edition called *Estrella de Panamá.* The *Panama Herald* (1851) was absorbed in 1854, and the English edition became *Panama Star & Herald.* The

Panama American and its associate *El Panamá-América* began in 1925, and the *Nation* and *La Nación* in 1944.

West Indies.—In 1764 the printer Olivos was ordered by the captain general of Cuba to issue a monthly *Mercurio,* and other official gazettes were published later; but the first general newspaper in the island was *Papel periódico de la Habana* (1790). Strict censorship was the rule under the Spanish government, and even after independence there was occasional interference with the press, especially during the Gerardo Machado regime, 1925–33. The chief paper with a national circulation in 1950 was *Diario de la marina* (1832), much the oldest of Cuban papers. There were 50 dailies in the island, almost half of them published in Havana. *Diario de la marina, El Pais* (1921) and *Prensa libre* (1941) were the largest. There was one daily in English, the *Havana Post* (1895), and three in Chinese.

The *Gazette du Cap,* of uncertain history, is said to have been Haiti's first paper. The *Gazette politique et commerciale d'Haiti* (1804) was the first government organ of the new republic. In 1948 Haiti had six daily papers, all published at Port-au-Prince.

Somewhat larger in circulation were the two dailies at Ciudad Trujillo in the Dominican Republic, *La Nación* (1940) and *El Caribe* (1947).

La Gaceta was founded as the official organ of the Spanish government of Puerto Rico in 1807 and continued until the occupation of the island by United States forces in 1898. In 1949 there were three dailies in San Juan, one in Ponce and one in Arecibo. *El Imparcial* (1917) and *El Mundo* (1919) claimed more than 50,000 circulation each.

Robert Baldwin began the *Weekly Jamaica Courant* in 1718 at Sant' Jago de la Vega, the capital until 1872. In 1950 the morning *Daily Gleaner* (1834) was the chief paper of Kingston, and the evening paper was the *Daily Express* (1940).

Colombia.—Manuel del Socarro Rodriguez was the publisher of the earliest papers issued in what was then called Santa Fé de Bogotá; they were the *Gaceta* (1785) and the *Papel periódico* (1791–95). In 1948 Bogotá had 10 dailies and other Colombian cities 29. *El Tiempo* of Bogotá was the largest, claiming 100,000 circulation.

Ecuador.—The first-known newspaper in Ecuador was the *Gaceta de Santafé* (1785) of Quito. No further paper was printed in the country until after the revolution of 1809, when the *Gaceta de la corte de Quito* was begun. *El Telégrafo* (1884) was Ecuador's oldest daily in 1950. *El Comercio* (1906) was the most important of Quito's seven dailies; it also owned *Ultimas noticias* (1938), the capital's only evening paper.

Venezuela.—The first Venezuelan newspaper was the *Gaceta de Caracas* (1808). The oldest daily in Venezuela in 1950 was *La Religión* (1890) of Caracas. Of the 27 dailies in the country, 10 were published in Caracas, the capital. Only one of these, however, *El Nacional* (1943), with about 50,000 circulation, had a national distribution.

Peru.—Probably the earliest newssheet printed in South America described the capture of the pirate Richard Hawkins off the Peruvian coast; it was issued by Antonio Ricardo at Lima in 1594. The first titled and numbered paper was *Gaceta de Lima* (1744). Peruvian newspapers, both under Spanish rule and after establishment of the republic in 1822–23 were firmly controlled by government.

Except for the government gazette, *El Peruano,* which was founded in 1820, the oldest newspaper in 1950 was *El Comercio* (1839) of Lima, which was also the largest, having a combined morning and evening circulation of more than 100,000.

Bolivia.—In 1825, the year in which the name of Alto Peru was changed to Bolivia, the *Gaceta de Chuquisaca* and the *Cóndor de Bolivia* were founded in the capital, Chuquisaca, later renamed Sucre. Bolivian newspapers, chiefly owned by political factions, were unstable until some time after the adoption of the Press law of 1925. The oldest daily in 1950 was *El Diario* (1905) of La Paz. *La Razón* (1917), also of La Paz, was the largest.

Brazil.—Brazil's first weekly newspaper was the official *Gazeta do Rio de Janeiro* (1808), which in 1823 became *Diario do govêrno.* The country's oldest paper in 1950 was *Diario de Pernambuco* (1825) of Recife. Founded in 1827 was *Jornal do comercio* of Rio de Janeiro, which, though its circulation was less than those of most other papers in the capital in 1950, had long enjoyed a high reputation and influence as a conservative journal.

With the fall of the empire in 1889, there was a rapid development of newspapers, and in the next 20 years the number of papers and periodicals increased from about 600 to 1,000. By 1950 there were more than 300 dailies, of which 22 were in the capital and 20 in São Paulo.

The largest paper in Brazil in 1950 was *O Globo* (1925) of Rio de Janeiro, which claimed 140,000 circulation. Perhaps the outstanding paper in São Paulo was *O Estado de São Paulo* (1875). *A Noite* (1911) had long been a leading paper in Rio. Diarios Associados had become a strong group of 24 daily papers and 14 radio stations spread widely over the country and including such large papers as *Diario da noite* (1929) and *O Jornal* (1919) in Rio, *Diario da noite* (1925) in São Paulo and *Diario de Pernambuco* in Recife.

Argentina.—*El Telégrafo* (1801-02), the first newspaper published in Argentina, came from the Buenos Aires press of Francisco Cabella y Mesa, a printer who had already engaged in journalism in Lima, Peru. It was followed by a few other papers in the first decade of the century, and, after the first national government was established in 1810, by an official *Gaceta* (1810-21). The chaotic period which preceded the Juan Manuel de Rosas regime (1829-52) brought out many small, vituperative political sheets, but Rosas limited the regular Argentine press to a few papers which were forced to confine themselves to commercial news and official documents. Meantime, Argentine journalists took refuge in other South American countries, there to spread their doctrines of liberty and reform. After the fall of Rosas, many of these men returned and renewed the conflicts of political journalism.

The modern Argentine press began in the 1860s. *La Nación Argentina* was founded in 1862 and became one of the great South American newspapers. In 1869 José Clemente Paz founded *La Prensa,* which was to win even greater fame. The *Standard,* English-language daily still published in 1950, was begun in 1861; and the oldest Spanish-language daily, *La Capital,* was begun in Rosario in 1867.

About 180 dailies were published in Argentina in 1949 and more than 80 cities had at least one daily. A considerable foreign-language press existed in Buenos Aires.

La Prensa, long considered one of the world's great newspapers, had the largest circulation (385,000) of any Spanish-language newspaper in the world at mid-20th century. Still owned by the Paz family, it had become famous for its voluminous world-news report, for its remarkable classified advertising section, for its editorial independence and for its special public services.

La Nación also had strong international news coverage, and gave much attention to technical and transportation problems. Its circulation in 1950 was more than 300,000. *Critica* (1913), long the third paper in Buenos Aires, had fallen behind *Democracia* (1945) and *La Razón* (1905) during the newsprint crisis at the mid-century mark.

Uruguay.—The publication of Uruguay's first paper was occasioned by the brief British occupation of Montevideo in 1807; it was an English-Spanish sheet called *La Estrella del Sur.* Many papers, chiefly political, appeared during the troubled history of the country; probably the longest life was that enjoyed by *El Telégrafo* (1850–1931). José Batlle y Ordóñez founded *El Dia* in 1886.

The above-mentioned papers were published in Montevideo, where 15 of the 31 daily papers (with more than nine-tenths of the circulation) in Uruguay were still situated in 1950. Leading morning papers were *El Dia* and *El Pais* (1919), and the chief evenings were *El Diario* (1923) and *El Plata* (1915), affiliated with *El Dia.*

Paraguay.—Journalism in Paraguay dates from the middle of the 19th century, though it was irregular until about 1898. There were never more than six dailies in the country at once; there were three at mid-20th century, all published at Asunción—*La Tribuna* (1925), *El Pais* (1923) and *La Unión* (1949).

Chile.—The earliest of Chile's papers was *La Aurora de Chili,* issued in 1810 at Santiago. *El Mercurio* was founded at Valparaíso in 1827 and *La Unión,* another important paper, was established in the same city in 1885.

In 1902 Augustin Edwards, owner of Valparaíso's *El Mercurio,* founded another morning paper of the same name in Santiago; this chain eventually came to include two evening papers in the capital and one in Valparaíso. The Santiago *Mercurio* had the largest circulation of any Chilean daily in 1950—about 100,000. *La Nación* (1917) of Santiago was government-owned.

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NORTH AFRICAN NEWSPAPERS

Egypt.—The first Egyptian paper was *Le Courrier de l'Egypte,* issued by Napoleon's forces at Cairo in 1798. This and the similar *La Décade egyptienne,* of the same year, were temporary; but an official gazette established in 1828 as a part of Mohammed Ali's program of national development, and printed in both Turkish and Arabic, lasted. With the establishment of the Egyptian post office in 1865, and under the encouragement of Ismail's government, a dozen or more papers sprang up in Cairo in the next decade, with two in Alexandria and one in Port Said. With British rule, the Egyptian press developed under a licensing system.

The oldest of the daily newspapers in Egypt at mid-20th century was *Al Ahram* (the *Pyramid*), a survivor from the Ismail regime. Founded in Alexandria in 1875, it was moved to Cairo in 1899. Long published by Gabriel Takla Pasha, *Al Ahram* introduced linotypes with Arabic characters and rotary presses into Egypt in 1904, employed correspondents abroad and achieved a circulation which exceeded 100,000 in its best years.

There were more than 50 daily newspapers in Egypt in 1950, and about 200 weekly publications. There were 22 dailies in Arabic, 14 of them published in Cairo, as well as 13 in French, 7 in Greek and 2 each in English and Armenian.

Morocco.—The oldest Moroccan daily (founded as a triweekly) in 1950 was the sultan's organ, *Es Saâda* (1905), of Rabat; the oldest privately operated paper was *La Vigie morocaine* (1907) of Casablanca. The latter paper was the largest evening paper in Morocco at mid-century, with somewhat less than 50,000 circulation, while *Le Petit morocain* (1921) was the largest morning journal; both were published in Casablanca.

Algeria.—The oldest and largest Algerian daily in 1950 was the *Echo d'Oran* (1844), published in that city. Nearly all the Algerian papers were still published in French, though there were three Arabic weeklies. There were in 1949 ten dailies in the country—four in Algiers, three in Oran, two in Bona and one in Constantine.

Tunisia.—The press of this country was concentrated in Tunis, where there were in 1949 nine daily newspapers, six of them in French and three in Arabic. The oldest was *Ez-Zohra* (1886); next came the largest Tunisian newspaper, *La Dépêche tunisienne* (1888), with 33,000 circulation.

Other African States.—In Portuguese East Africa (Mozambique) there were in 1949 three daily papers at Lourenço Marques. Rhodesia had one daily at Salisbury and one at Bulawayo, with several weeklies in Afrikaans and native languages. The Gold Coast had four dailies, three at Accra and one at Kumasi. In Nigeria there were eight daily papers, five of them published at Lagos. Sierra Leone had three dailies at Freetown, and one weekly. At Nairobi, in British East Africa, there were two dailies and six weeklies, while Mombasa had three dailies. Tanganyika Territory had two dailies, both at Dar es Salaam. Four dailies were published at Khartoum, in the Sudan, two in Arabic and two in English. There were also two daily papers at Antananarivo, Madagascar.

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NEWT, the name applied to the small salamanders of the genus *Triturus,* represented in Europe, temperate Asia and Japan, and in North America north of the tropics. All of the species are aquatic during the breeding season and as larvae. After transformation, the adults of some species, like the common crested newt of Europe, take up life on land, while others, like the North American red-spotted newt, live permanently in water. All feed on small insects and other invertebrates.

Newts exhibit considerable differences between the sexes, associated with an elaborate courtship. Fertilization takes place by the deposition of a spermatophore, which is taken up by the female after the courtship stimulation. The male sexual characters are much more pronounced during the breeding season; they consist in ornamentation with brighter coloration and higher crests on back and tail; and the hind limbs are provided with strong horny ridges.

Newts in general lay their eggs singly and these are attached to water plants. They hatch in about two weeks, and the aquatic larval gilled stage lasts for about three months. Under certain conditions some newts may fail to transform, becoming sexually mature as larvae (*see* Metamorphosis). The red-spotted newt of eastern North America (*Triturus viridescens*) is remarkable for a coral-red land stage that lasts for three years after loss of the gills, after which, with transformation of the skin texture from rough to smooth and change of colour to green, the adult permanently aquatic stage is attained.

Three species, the crested, common and palmated newts, are found in Great Britain. The newts of eastern North America include three races of the spotted newt and two less well-known forms.

The newts of the Pacific states have been much studied by embryologists, with the result that their distribution, breeding behaviour and development are exceptionally well known.

The best known of the Asiatic newts is the Japanese fire-bellied newt, *Triturus pyrrhogaster,* which is often to be seen as an aquarium animal in Europe and North America.

See H. F. Gadow, "Amphibia and Reptiles," *Cambridge Natural History* (1901); F. Werner, "Die Lurche und Kriechtiere," in A. E. Brehm, *Tierleben,* 4th ed. (1914); S. C. Bishop, *Handbook of Salamanders* (1943). (K. P. S.)

NEW TESTAMENT: *see* Bible.

NEW THOUGHT, the general name for idealistic tendencies of thinking which arose in the United States, and especially in New England, about the middle of the 19th century. These tendencies were akin to the transcendentalism of the Concord school of Ralph Waldo Emerson, Henry D. Thoreau, Margaret Fuller and Amos Bronson Alcott, and have affinities with Plato, Neoplatonism and the Vedanta philosophy of India.

Beginning with the omnipresence and immanence of the Divine, the followers of this school taught a progressive conquest of human ills by re-establishing harmony between the Divine and the human spirit.

See R. W. Trine, *In Tune with the Infinite* (1921).

NEWTON, ALFRED (1829–1907), English zoologist, was born at Geneva on June 11, 1829. In 1854 he was elected travelling fellow of Magdalene college, Cambridge, and subsequently visited many parts of the world, including Lapland, Iceland, Spitsbergen, the West Indies and North America.

In 1866 he became the first professor of zoology and comparative anatomy at Cambridge, a position which he retained till his death on June 7, 1907. His services to ornithology and zoogeography were recognized by the Royal society in 1900, when it awarded him a Royal medal.

He wrote many books, including *Zoology of Ancient Europe* (1862), *Ootheca Wolleyana* (begun in 1864), *Zoology* (1872) and a *Dictionary of Birds* (1893–96), an amplification of the numerous articles on birds which he contributed to the ninth edition of the *Encyclopædia Britannica.*

NEWTON, SIR CHARLES THOMAS (1816–1894), British archaeologist, was born on Sept. 16, 1816, at Bredwardine in Herefordshire, and educated at Shrewsbury schools and Christ Church, Oxford. He entered the British museum in 1840 as an assistant in the antiquities department. In 1852 Newton left the museum to become vice-consul at Mitylene, with the object of exploring the coasts and islands of Asia Minor. Aided by funds supplied by Lord Stratford de Redcliffe, then British ambassador at Constantinople, he made in 1852 and 1855 important discoveries of inscriptions at the island of Calymnos, off the coast of Caria; and in 1856–57 achieved the great archaeological exploit of his life by the discovery of the remains of the mausoleum of Halicarnassus, one of the "seven wonders" of the ancient world. He was greatly assisted by Murdoch Smith, afterward celebrated in connection with Persian telegraphs. The results were described by Newton in his *History of Discoveries at Halicarnassus* (1862–63), written in conjunction with R. P. Pullan, and in his *Travels and Discoveries in the Levant* (1865). These works included particulars of other important discoveries, especially at Branchidae, where he disinterred the statues which had anciently lined the Sacred way, and at Cnidus, where R. P. Pullan, acting under his direction, found the colossal lion now in the British museum.

For 25 years, 1860–85, Newton was keeper of Greek and Roman antiquities in the British museum. He was Yates professor of classical archaeology at University college, London, (1880–88). His collected *Essays on Art and Archaeology* were published in 1886.

Newton died at Margate on Nov. 28, 1894.

NEWTON, SIR ISAAC (1642–1727), English natural philosopher, was born at Woolsthorpe near Grantham on Dec. 25, 1642. His father had died the previous October and his mother, Hannah, daughter of J. Ayscough of Market Overton, married again in 1645 Barnabas Smith, rector of North Welham, Leicestershire.

After his mother's second marriage her son had lived with his grandmother, Mrs. Ayscough, at Woolsthorpe, but on his stepfather's death his mother returned to her former home and her boy rejoined her.

For about two years he had attended the grammar school at Grantham, then kept by Stokes. He is said to have made little progress with his books until a successful fight with another boy aroused a spirit of emulation and led to his becoming head of the school.

At the age of 14 on his mother's return (1656) he was taken from school to assist her on her farm. This, however, was not

a success; he occupied himself with mathematics when he ought to have been attending to his work. His uncle, William Ayscough, rector of Burton Coggles, was a member of Trinity college, Cambridge, and in 1660 by his advice Newton was sent back to school to prepare for Cambridge. On June 5, 1661, he was matriculated as a subsizar at Trinity college. Three years later he was elected as scholar and in Jan. 1665 proceeded in due course to the degree of Bachelor of Arts. In 1667 he was elected a fellow of the college.

In the early part of 1665 he discovered what is now known as the binomial theorem, and a little later came the elements of the differential calculus which he called fluxions. In May of the following year he writes "I had entrance into the inverse method of Fluxions" (in modern terms the principles of the integral calculus and the method for calculating the area of curves or the volume of solids) "and in the same year [1666] I began to think of gravity extending to the orb of the Moon . . . having thereby compared the force requisite to keep the Moon in her orb with the force of gravity at the surface of the Earth and found them to answer pretty nearly All this was in the two years 1665 and 1666 for in those years I was in the prime of my age." The same period saw the commencement of his work on optics and colour.

The account of Newton's colour experiments was sent to the Royal society in 1672. He had been elected a fellow on Jan. 11 of that year and soon got into correspondence with Henry Oldenburg, the secretary. "I shall endeavour," he wrote, "to show my gratitude by communicating what my poor and solitary endeavours can effect towards the promoting of philosophical design." His "New Theory about Light and Colours" was read on Feb. 8.

The experiments he described showed conclusively, he claimed, that "Light consists of Rays differently refrangible"; that "Colours are not qualifications of Light derived from refractions of natural bodies as is generally believed but original and connate properties which in divers Rays are divers . . . to the same degree of refrangibility ever belongs the same colour and to the same colour ever belongs the same degree of refrangibility." During the period covered by this work he had become Lucasian professor of mathematics. Barrow resigned in his favour in 1669, and Newton's first course of lectures dealt with optics; hence his renewed interest in the subject, and the experiments with the prism bought at Stourbridge fair in 1666, culminating in the Royal society paper of 1672. But the paper led to controversy. The Royal society solemnly thanked the author "for his ingenious discourse" and he was to be informed "that the society think very much of it."

Robert Hooke, along with Seth Ward, bishop of Salisbury, and Robert Boyle, were desired to peruse the discourse and report. Hooke in his *Micrographia* (1664) had described an experiment which was fundamentally the same as Newton's with the prism, but he had made no use of it; the theory of colours he attempted to deduce was valueless; however, while admitting the truth of Newton's observations, he declined to accept any of the conclusions drawn from them. The paper, when published, at once attracted attention, and others abroad joined in the discussion, the most important issue of which was Newton's assertion that the length of the band of colours produced at a given distance from the prisms was the same for prisms of any substance provided their angles were such that the deviation for the mean ray of the band was the same in all.

In this, as was learned later, Newton was wrong; the length of the band, the spectrum, is not proportional to the average or mean deviation; it is possible to have two spectra of the same length in which the deviations are markedly different; thus, if two such prisms are mounted with their vertices in opposite directions, the light emerging from the second will be achromatic, largely free from colour, but will be deviated from its original path.

Newton's experiments on colour, made in all probability in order to study a defect of the telescope, led him to the belief that the defect was incurable. By putting a divergence lens behind the converging lens of the object glass the colours could again be combined, but, so he concluded, his rays would all be made parallel to their original direction, and would no longer converge to form a real image, which could be magnified by the eyepiece; the telescope could not be made to give a colourless (achromatic) image. This belief he retained throughout his life, but it was wrong. Dispersion and the separation of the colours are not proportional to deviation.

Shortly after Newton's death Chester Moor Hall invented an achromatic telescope and by 1733 had made several, and in 1758 John Dollond the optician took up the matter and constructed satisfactory achromatic lenses.

But his mistake had important consequences. A real image (one, that is, through which the light actually passes) of a distant object can be formed by reflection at a concave mirror, and since the laws of reflection, unlike those of refraction through a transparent medium, are independent of colour, the reflected image is the same colour as the object—the rainbow band is there no longer. Chromatic aberration, as it is called, is no more a disturbing factor. This then led Newton to make his reflecting telescope in which a concave mirror takes the place of the object glass; the first telescope was made in 1668; the second was sent by him to the Royal society in Dec. 1671 shortly before his election as a fellow.

Discussions as to the optics paper lasted until 1675. "I was so persecuted," he writes in December of that year, "with discussions arising out of my theory of light that I blamed my own imprudence for parting with so substantial a blessing as my quiet to run after a shadow." But they had their advantage. They led him to investigate other effects of colour, to inquire how light was produced and to develop the emission or corpuscular theory of light, according to which light is caused by the emission by a luminous body of a host of tiny particles travelling in empty space with a speed of 190,000 mi. per second; the laws of reflection and refraction were developed on mechanical principles, aided only by a supplementary hypothesis as to why, when falling on a transparent surface, some of the particles are reflected—bent back into the medium from which they have come—and others are refracted, along a new path inclined to the old, into the medium toward which they are travelling. It is a consequence of this theory that light travels more quickly in a dense medium such as glass than in air. The theory was also applied to explain the colours seen when light is reflected from a thin film, a soap film or the thin layer of air between a convex lens of large radius and a flat reflecting surface on which it rests; in this case, when viewed in reflected light of a definite colour a series of dark and light rings circling round a central black spot is seen. Newton determined the law connecting the radius of a bright ring and the colour of the light and since the radius depends on the colour, the bright rings for the various colours, when white light is used, will be different and the observer will see a series of coloured rings surrounding the black central spot.

Hooke was again a critic; in his *Micrographia* he had adopted the wave theory of light, due originally to Christiaan Huygens, according to which light is energy transmitted by wave motion through a medium pervading space, the universal ether, and had endeavoured to explain, but without success, rectilinear propagation, reflection and refraction as well as dispersion and the colours of thin plates. Hooke's arguments were vague and carried no conviction to a mind like Newton's; the latter sought a mechanical explanation for all he observed. Newton in his explanation of the reflection and refraction of the corpuscles of a light centre made use of the idea of a wave in an ethereal medium; he rejected Huygens' theory and thought little of Hooke's attempts at explanation, and so for 100 years or more Newton's theory held the field. In 1804 Thomas Young, professor at the Royal institution, London, established the principle of interference by which he showed that under certain conditions two parcels of light from identical sources falling on a screen could produce a series of bright and dark bands. Along certain lines on the screen there is a maximum of brightness; along others intermediate between these there is darkness. From this and the brilliant work of the French genius Augustin Fresnel, a few years later, came the explanation on the wave theory of all the phenomena of light as then observed.

"In the fourth place," says Newton, writing in 1675, "I sup-

pose light is neither aether nor its vibrating motion but something of a different kind propagated from lucid bodies. . . . Fifthly it is to be supposed that light and aether mutually act upon one another." Did he here build more truly than he knew? Who can say, but we must revert to other work, to other discoveries on which his fame will rest secure till time shall end.

In 1666, when at Woolsthorpe on account of the plague at Cambridge, he "began to think of gravity extending to the orb of the Moon," though of this nothing was published for 18 years.

Discussions went on in London at the Royal society or in the houses of the members, Sir Christopher Wren; Seth Ward, bishop of Salisbury; Robert Boyle; Hooke; Edmund Halley; and the others who were active in the society, until one Wednesday in Jan. 1684 Halley met Wren and Hooke and the latter declared "that he had demonstrated all the laws of the celestial motions." Halley confessed his ignorance and Sir Christopher "to encourage enquiry said he would give Hooke or me"—the quotation is from a letter of Halley to Newton—"two months to bring him a convincing demonstration." Sir Christopher offered to give "a book of 40 shillings" to the one who first found the solution. He was not convinced of Hooke's assertion that he had done it, but wished to conceal the result "that others trying and failing might know how to value it when he would make it public." So it remained till August, when Halley visited Newton at Cambridge and put the question, what would be the path of a body moving under the action of a central force which varied as the inverse square of the distance from the centre. "I then learned," writes Halley in the same letter, "that you had brought this demonstration to perfection." Newton promised to look for the old proof already mentioned but could not find it, "and not finding it did it again and reduced the work into the proposition," which he sent in November to Halley, who immediately returned to Cambridge and persuaded Newton to put them in form for the Royal society.

On Dec. 10, 1684, Halley informed the society that he had lately seen Newton at Cambridge who had showed him a curious treatise, *De Motu,* which, upon Halley's desire, was sent to the society to be entered on their register, "and a tract, *Propositiones de Motu,*" was registered in Feb. 1685 with the date in the margin, Dec. 10, 1684.

But the early months of 1685 were fertile with a new discovery. Newton was away from Cambridge; hitherto his calculations had proceeded on the assumption that the sun and the planets could each be treated as though they were points, concentrated at their respective centres, though which the various forces were assumed to act; but was this true or was it merely an approximation resulting from the fact that the planetary distances were so immense that even a great sphere like the sun could in comparison be treated as a point? What will be the force with which the sun attracts an exterior particle?

Newton proceeded to work this out, on the assumption that each particle of the sun attracted the external particle with a force which was proportional to the product of the masses of the two and inversely proportional to the square of the distance between them and found (we know he had no expectation of the result until it emerged from his calculations) that if the sun were of uniform density, or consisted of a series of concentric shells each of uniform density, then the resultant force on the external particle was the same as that which would be exerted by the whole mass of that concentrated at the centre.

It was no approximation; the sun and the planets, considered as spherical, really behaved as point centres of force.

In the opinion of Professor Adams, it was the difficulty of solving this problem and not the uncertainty as to the moon's distance which caused Newton in 1665 to lay aside his astronomical calculations, which were now resumed with a more correct knowledge of the moon's distance. Newton returned to Cambridge and the writing of the *Principia* was begun in March 1686.

The work is entitled *Philosophiae Naturalis Principia Mathematica.* It is in three books; the first, *De Motu Corporum,* was finished on April 28, 1686, and exhibited to the Royal society on that day. On June 20, 1687, Newton wrote that the second book was ready. "The third I now design to suppress. Philosophy is such an impertinently litigious lady that a man had as good be engaged in lawsuits as have to do with her." Halley was able to prevent this, and on Sept. 6, 1687, the third book, described as *De Systemate Mundi,* was presented; the whole was published about midsummer 1687.

We owe much to Halley; at the time the Royal society was in difficulties as to funds he took the whole cost on himself. Hooke, when the first book was presented, claimed that he had forestalled Newton in a great part of it, and in the correspondence which followed Halley did all he could to smooth over the difficulties and persuade Newton to continue his work. Newton's letter quoted above indicates his own feelings and in a letter to Halley of July 14, 1686, he had written, "I have considered how best to compose the present dispute, and I think it may be done by the enclosed scholium to the fourth proposition."

In a corollary to the fourth proposition Newton showed that Kepler's third law was a consequence of the elliptic path of a planet under an inverse square law; the scholium runs:

"The case of the sixth corollary applies to the heavenly bodies as our friends Wren, Hooke and Halley have already inferred and therefore I have decided to develope fully all the consequences of a force decreasing as the inverse square." The great work did this: the *Principia* established Newton's fame; some little time elapsed before it was fully accepted on the continent but for more than 200 years it reigned supreme, and all theories of cosmogony were based on the principles laid down by Newton. His mechanics guided astronomers and men of science in their search for natural knowledge. And if in later years Einstein carried us some steps further and picked up some few more of the jewels of truth which Newton sought on the shore, Newton's laws remain, included it may be, in a more comprehensive statement of the truth.

In 1687 James II tried to force the university to admit as a Master of Arts Father Alban Francis, a Benedictine monk, without taking the oaths of allegiance and supremacy. Newton was one of those who led the resistance to the royal action, and appeared before Lord Jeffreys to argue the case for Cambridge. In the end the deputies were reprimanded and Pechell, the vice-chancellor, was deprived of his office. Newton's share in the affair led to his being elected member of parliament for the university in 1689, retaining the seat till the dissolution next year. He was elected again in 1701, but he never took any prominent part in politics.

On the dissolution of Parliament in 1690 he returned to Cambridge and continued for a time his mathematical work; this was interrupted in 1692–94 by a serious illness. He was suffering from insomnia and nervous trouble. There was a report that he was going out of his mind. Huygens in June 1694 wrote to G. W. Leibniz, "I do not know if you are acquainted with the accident to the good Mr. Newton, namely, that he has had an attack of phrenitis which lasted eighteen months and of which they say his friends have cured him by means of remedies and keeping him shut up." For some time his friends had been anxious to obtain for him some recognition of his work; this came in 1695. Charles Montague, later earl of Halifax, a former fellow of Trinity who was chancellor of the exchequer, offered him the post of warden of the mint. This he accepted and four years later became master. In the same year he was elected one of the eight foreign associates of the French Academy of Science.

In 1696 John Bernoulli addressed a letter to the mathematicians of Europe challenging them to solve two problems and giving six months for the solution. On Jan. 29, 1697, Newton received from France two copies of the printed paper containing the problems and the following day sent the solution to Montague, then president of the Royal society. They were transmitted anonymously to Bernoulli, who recognised the author in his disguise *"tanquam ex ungue leonem."*

As warden of the mint Newton had retained his Cambridge offices, but soon after his appointment as master he named William Whiston as deputy, and in 1701 he resigned his professorship and the fellowship at Trinity. Whiston became Lucasian professor. Newton had moved to London, and continued his duties as master

with marked efficiency until his death in 1727.

The remainder of his life calls for little notice; in 1703 he became president of the Royal society and was re-elected annually until his death. Queen Anne visited Cambridge in 1705 as the guest at Trinity lodge of the master, Richard Bentley, and on this occasion Newton was knighted. About the same time the controversy with Leibniz as to the invention of the differential calculus began. It is now generally admitted that Leibniz invented the calculus later than, and independently of, Newton.

In the middle of 1708 Newton, at the urgent request of Bentley, consented to let Roger Cotes, a fellow of Trinity, edit a second edition of the *Principia;* the volume was published in 1713 and a third edition by Pemberton appeared in 1726.

Early in 1727 Newton, whose health had been failing for some time, was taken seriously ill; he died on March 20, 1727, and was buried in Westminster abbey on March 28.

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The standard biography is *Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton,* by Sir David Brewster, 2 vol. (Edinburgh, 1855); it was reprinted in 1860. Brewster also wrote a short *Life of Sir Isaac Newton,* 2 vol. (1831), of which a new edition appeared in 1908. Valuable critical commentaries are to be found in *Essays on the Life and Work of Newton,* by Augustus de Morgan, edited with notes and appendices by P. E. Jourdain (1914). A brief account of Newton's life and works is given in *Sir Isaac Newton,* by S. Brodestsky (1928). Of great value to students of Newton is the *Catalogue of the Portsmouth Collection of Books and Papers Written by or Belonging to Sir Isaac Newton* (1888), which describes the great mass of Newton's papers which came at his death into the hands of Conduitt. *Correspondence of Scientific Men of the 17th Century, etc., from the Originals in the Collection of the Earl of Macclesfield,* by S. P. Rigaud (1841) and *Correspondence of Sir Isaac Newton and Professor Cotes, Including Letters of Other Eminent Men,* by J. Edleston (editor of the 2nd ed. of the *Principia*) (1850) contain many Newton letters, and the latter volume includes a synoptical view of Newton's life. Among general commentaries must be mentioned: H. Pemberton, *A View of Sir Isaac Newton's Philosophy* (1728); Colin Maclaurin, *An Account of Sir Isaac Newton's Philosophical Discoveries* (1775); and F. Rosenberger, *Isaac Newton und seine Physikalische Principien* (1895).

The *Opticks,* first published in 1704, went through three editions in Newton's lifetime; the last (4th) edition appeared in 1730. Of great importance for the controversy with Leibnitz is the report drawn up by order of the Royal Society, published under the title *Commercium Epistolicum* (1712), of which editions appeared in 1722 and 1725.

Since the first issue in 1687 there have been many editions of the *Principia,* including two others in Newton's lifetime. The Geneva reprint of 1739–42 contains a voluminous commentary by Le Sueur and Jacquier, and was long used. Lord Kelvin and H. Blackburne edited a good edition (Glasgow, 1871). The first three sections of Book I of the *Principia* have been edited by, among others, J. Carr (1821), J. H. Evans (1838), G. L. Cooke (1850), P. Frost (4th ed., 1883). An English translation of the *Principia* was first published by Andrew Motte in 1729; the best edition is that of 1803. *See* also S. P. Rigaud, *Historical Essay on the First Publication of Sir I. Newton's Principia* (1838); W. W. R. Ball, *Essay on Newton's Principia* (1893); J. W. L. Glaisher, *Bi-Centenary of Newton's Principia* (1888); P. G. Tait, *Newton's Laws of Motion* (1899); *Isaac Newton, 1642–1727,* a memorial volume (1927); History of Science Society, *Sir Isaac Newton, 1727–1929* (1928); L. T. More, *Isaac Newton* (1934); W. Stukeley, *Memoirs of Sir Isaac Newton's Life, 1752* (1936); J. Dougall, *Sir Isaac Newton* (1939); J. W. N. Sullivan, *Isaac Newton, 1642–1727* (1938); H. W. Turnbull, *Mathematical Discoveries of Newton* (1945); Royal Society of London, *Newton Tercentenary Celebrations, 15–19 July 1946* (1947). (R. T. GL.; X.)

NEWTON, JOHN (1725–1807), English divine, the friend of William Cowper, was born in London on July 24, 1725 (O.S.). His father, who for a long time was master of a ship in the Mediterranean trade, became in 1748 governor of York Fort, Hudson bay, where he died in 1751. The lad had little education and served on his father's ship from 1737 to 1742; shortly afterward he was impressed on board a man-of-war, the "Harwich," where he was made a midshipman. For an attempt to escape while his ship lay off Plymouth he was degraded, and treated with so much severity that he exchanged into an African trader. He made many voyages as mate and then as master on slave-trading ships, devoting his leisure to the improvement of his education. He left the sea in 1755, when he was appointed tide surveyor at Liverpool. He began to study Greek and Hebrew, and in 1758 applied to the archbishop of York for ordination. This was refused him, but having had the curacy of Olney offered to him in April 1764 he was ordained by the bishop of Lincoln. In Oct. 1767 William Cowper settled in the parish. An intimate friendship sprang up between the two men, and they published together the *Olney Hymns* (1779). In 1779 Newton left Olney to become rector of St. Mary Woolnoth, London. He died on Dec. 31, 1807.

Like Cowper, Newton held Calvinistic views, although his evangelical fervour allied him closely with the sentiments of Wesley and the Methodists. His fame rests on certain of the *Olney Hymns* (*e.g.,* "Glorious things of Thee are spoken," "How sweet the name of Jesus sounds," "One there is above all others")

His prose works include an *Authentic Narrative of some Interesting and Remarkable Particulars in the Life of John Newton* (1764); *Omicron* (a series of letters on religion, 1774); and *Cardiphonia* (1781). His *Letters to a Wife* (1793) and *Letters to Rev. W. Bull* (posthumous, 1847) illustrate the frankness with which he exposed his most intimate personal experiences. A *Life* of Newton by Richard Cecil was prefixed to a collected edition of his works (6 vol., 1808; 1 vol., 1827). *See* also T Wright, *The Town of Cowper.*

NEWTON, JOHN (1823–1895), U.S. general and engineer, was born in Norfolk, Va., on Aug. 24, 1823, and graduated from the U.S. Military academy in 1842. From 1842 to 1861 he was engaged in coast defense constructions and waterway improvements; he was assistant professor of engineering in the Military academy from 1843 to 1846, became a captain in 1856 and was chief engineer in the Utah expedition of 1857–58. He served in the Virginian campaign of 1861, and was promoted brigadier general, U.S. volunteers. He distinguished himself in the Seven Days' battle and at Antietam, and after the battle of Fredericksburg was made major general, U.S. volunteers. In the Chancellorsville campaign Newton took part in the storming of Marye's heights at Fredericksburg, on May 3, 1863, and at the battle of Gettysburg he was for a time in command of the 1st corps. Later in Gen. W. T. Sherman's army, as a division commander under Gen. Oliver O. Howard, he took part in the Atlanta campaign For gallant conduct at Peach Tree creek he was made brevet brigadier general, and at the close of the war was made brevet major general, U.S. army. In 1884, he became chief of engineers, and held this position until his retirement in 1886. In 1887–88 he was commissioner of public works in New York, and from 1888 until his death on May 1, 1895, was president of the Panama railway.

See Gustavus Smith, *In Memoriam of General John Newton* (1895).

NEWTON, a city of Iowa, U.S., 32 mi. E. of Des Moines, on federal highway 6 and state highway 14. It is the judicial centre of Jasper county. It is served by the Rock Island, the Minneapolis and St. Louis railways and by a bus line. The population of Newton in 1950 was 11,723 and in 1940 was 10,462. It is a manufacturing town, and two leading washing machine manufacturers have plants there. Other products manufactured are trench excavators, highway equipment, advertising specialties and caskets.

The city was founded in 1846 and incorporated in 1857.

NEWTON, a city of Kansas, U.S., 160 mi. S.W. of Kansas City, in the fertile Arkansas river valley, on federal highways 50S and 81, and served by the Missouri Pacific and the Santa Fe railway systems; the county seat of Harvey county. The population was 11,590 in 1950, and in 1940 (federal census) 11,048.

It is the seat of Bethel college, founded (1887) and still supported by the Mennonites; a division point on the Santa Fe, and an important shipping point for grain, milk and other agricultural products. Its principal manufactures are flour (1,400,000 bbl. a year), bread, potato chips, ice, poultry products and trailer coaches.

Newton was founded in 1871 and chartered in 1872. For several years, beginning in 1873, it was the focus of a large immigra-

tion of German Mennonites from Russia and various parts of the United States. These immigrants played an important part in building up the city and developing the surrounding country. They brought from Russia the Crimean wheat seed from which was grown the first crop of hard winter wheat in Kansas.

In 1927 Newton adopted a commissioner-manager form of government.

NEWTON, a city of Middlesex county, Mass., U.S., 8 mi. W. of Boston, on the southern bank of the Charles river, and served by the Boston and Albany railroad. The population was 81,994 in 1950, 69,873 in 1940 and 65,276 in 1930 by the federal census.

The city has 11 mi. of river front and a land area of 17.4 sq.mi. Within its boundaries are 14 villages and 34 parks, including parts of the metropolitan park system. It is primarily a residential suburb, but has a variety of manufacturing industries, with an output in 1947 valued at $23,666,000. The assessed valuation for 1950 was $182,827,850.

Newton was incorporated as a separate town in 1688 and received its present name in 1691. In 1873 it was chartered as a city. A monument marks the site of Waban's wigwam, where John Eliot, on Oct. 28, 1646, founded the first Indian church. At Newton Centre is the Newton Theological institution, the first Baptist theological seminary established in the U.S. (1825).

NEWTON ABBOT, a town and seaport of Devonshire, England, 20 mi. S. by W. of Exeter on the Western region railway route. Population (1951) 16,393. Area of urban district, 6.5 sq.mi. Situated at the head of the Teign estuary, the town grew rapidly in the 19th century. The two parish churches, St. Mary's in Wolborough and All Saints' in Highweek, are Perpendicular in style. St. Mary's contains a Norman font. The Jacobean Forde house was visited by Charles I and William of Orange, who first read his declaration to the people of England at Newton Abbot market cross. The portion of Newton Abbot in the parish of Highweek was formerly a separate town known as Newton Bushel. Agriculture is the chief industry, but the locomotive and carriage works employs many men and there are a foundry and malthouses.

NEWTON-IN-MAKERFIELD or NEWTON-LE-WILLOWS, an urban district in Lancashire, England, 15½ mi. W. of Manchester on the London Midland region railway route. Population (1951) 21,862. Area 4.9 sq.mi. Newton-in-Makerfield gave its name in Saxon times to one of the hundreds of Lancashire. The barony was held by the Banastres from the Conquest to 1286 and passed successively to the Langtons, Fleetwoods and Leghs. The barons were not summoned to parliament, and the title fell into disuse after the abolition of feudal tenures. Near the town is a moated Elizabethan half-timbered house and also an ancient barrow. The industrial establishments include foundries, printing and stationery works, paper mills and glassworks. Coal abounds in the neighbourhood. Newton was anciently a borough and sent two members to parliament from 1559 to 1832.

NEWTOWN, a market town of Montgomeryshire, Wales, situated on the Severn in a narrow part of the valley near the eastern border of the county. Pop. of urban district of Newtown and Llanllwchaiarn (1951) 5,427. Area 11.3 sq.mi. It shares with Welshpool the privilege of being the administrative capital of the shire. We first hear of it as a Llan (church settlement), known as Llanfair Cedewain, in the 13th century. The presence of water power was probably a factor in the origin and growth of the settlement at this time. The Norman Mortimers established there the market of their new territories on the border. In the 15th century the New Town received a municipal charter with a constitution modelled upon that of Hereford and Breteuil, but the corporation was abolished in the days of Charles I. Through the early 19th century the flannel factories of the town were of great importance, but the flannel industry is no longer carried on, though there are still distributing warehouses. In the days of coach roads Newtown was a route centre, for the old road from Ludlow via Bishops' castle and Kerry had to drop into the Severn valley and so reached Newtown.

The old church, now in ruins, is superseded by the modern St. Mary's, with the font and rood screen of the old building.

NEWTOWNARDS, a municipal borough of County Down, Northern Ireland, near the northern extremity of Strangford lough, on a branch of the Belfast and County Down railway, 9½ mi. E. of Belfast. Pop. (1951) 12,237. Area .74 sq.mi. The town owes its origin to a Dominican monastery founded in 1244 by Walter de Burgh. It received a charter from James I. The ruined abbey of Movilla, 1½ mi. N.E., is attributed to St. Finian (*c.* 550). One of the two Ulster civil airports is there. Linen is the principal trade.

NEW ULM, a city of southern Minnesota, U.S.A., on the south bank of the Minnesota river, 88 mi. S.W. of Minneapolis; the county seat of Brown county. It is on federal highway 14 and is served by the Chicago and North Western and the Minneapolis and St. Louis railways. The population was 9,348 in 1950; it was 8,743 in 1940 by the federal census. It is an important trading centre in a rich agricultural region; has a large milling industry (particularly rye) and is the seat of Martin Luther college (1884). New Ulm was founded in 1854. During the Sioux uprising of 1862 it was twice attacked and almost destroyed.

NEW WASHINGTON, a municipality of the province of Capiz, island of Panay, Republic of the Philippines, on the north coast about 17 mi. W. of Capiz, the provincial capital. Pop. (1939) 12,192 (a gain of 2,315 since 1918); there were no whites. New Washington is the port for the Aklan valley. The principal crops are palay (rice), abacá (Manila hemp), maize (corn) and sugar. Cattle and horses are bred for export as well as for domestic use, and household industries are numerous. The vernacular is Panay-Bisayan. Of the inhabitants aged 6 to 19, inclusive, 40% were reported in 1939 as attending school, and 40% of the population 10 years old and over was reported as literate.

NEW WESTMINSTER, city on the north bank of the Fraser river, 17 mi. from the mouth, and British Columbia's largest freshwater port. Pop. (1951) 28,390. Founded in 1859, it was the capital of British Columbia when the British possessions on the Pacific coast formed two colonies; *i.e.,* British Columbia (the mainland portion) and Vancouver Island. The city has a fine harbour with 30 to 40 ft. of water, modern terminal facilities and a cold storage plant and has a large trade, particularly in timber. It is a manufacturing centre, fish, fruit and vegetable canning, iron founding, oil refining, shingle and lumber mills and shipbuilding being among the industries; fruitgrowing, dairying and mining are carried on in the district. The city is on the Canadian Pacific, Great Northern and Canadian National railways, and is connected with Vancouver, 12 mi. distant, by electric railway. St. Ann's academy and St. Louis college are located there.

NEW YEAR'S DAY, the first day of the year. In the Gregorian calendar this date occurs 12 days earlier than in the Julian; thus New Year's day is the English Jan. 13.

The ancient Egyptians, Phoenicians and Persians began their year at the autumnal equinox (Sept. 21) and the Greeks until the 5th century B.C. at the winter solstice (Dec. 21). The ancient Romans once celebrated the beginning of the year on Dec. 21, but Caesar by the adoption of the Julian calendar postponed it to Jan. 1. The Jews have always reckoned their civil year from the first day of the month of Tishri (Sept. 6–Oct. 5), but their ecclesiastical year begins at the spring equinox (March 21). March 25 was the usual date among most Christian peoples in early mediaeval days. In Anglo-Saxon England, however, Dec. 25 was New Year's day. At the Norman Conquest, because, it is believed, of the coincidence of his coronation being arranged for that date, William the Conqueror ordered that the year should start on Jan. 1. But later England began its year with the rest of Christendom on March 25. The Gregorian calendar (1582), which restored Jan. 1 to its position as New Year's day, was accepted by all Catholic countries at once; by Germany, Denmark and Sweden about 1700, but not until 1752 by England.

NEW YORK, one of the original 13 United States of America, situated between approximately 40° 30′ and 45° N. and between 71° 51′ and 79° 46′ W. Although one of the smaller states in the union, being 29th in area, New York ranks first in population and in wealth, and has won for itself the name "Empire

state." Its northern boundary is, for the most part, formed by Lake Ontario and the St. Lawrence river, which separate it from the province of Ontario, Can.; but north of the Adirondacks the boundary line leaves the St. Lawrence, extending in a due east direction to the lower end of Lake Champlain. Thus the boundary between New York and the province of Quebec, Can., is wholly artificial. Vermont, Massachusetts and Connecticut bound New York on the east; the Atlantic ocean, New Jersey and Pennsylvania on the south; and Pennsylvania, Lake Erie and the Niagara river on the west. The state has a triangular outline, with a breadth from east to west of 326.46 mi. and from north to south, on the line of the Hudson, of 300 mi. In addition, it includes Long Island and Staten Island on the Atlantic coast. Its land area is 47,944 sq.mi. and the area of the inland waters is 1,632 sq.mi., giving a total area of 49,576 sq.mi. In addition to this, New York includes 3,140 sq.mi. of water in Lake Ontario and Lake Erie.

Physical Features.—The most notable topographic feature is the roughly circular mountain area of northeastern New York, known as the Adirondack mountains (*q.v.*). This is a very ancient mountain mass of Pre-Cambrian rocks resembling more the Laurentian mountains of Canada than the Appalachians. Indeed, it is commonly considered to be an extension of the Canadian mountains. Parts of this crystalline area are worn down to a condition of low relief, but in the main mountain mass, although greatly worn, there are still elevations of truly mountainous proportions. The highest peak is Mt. Marcy (5,344 ft.), though associated with it are several other peaks with elevations from 4,000 ft. to 5,000 ft. Even the higher summits are worn to a rounded condition, and are therefore for the most part forest-covered up to the timber line which, on Mt. Marcy, is at an elevation of about 4,900 ft. From the crest of the dome of the Adirondacks proper the surface slopes in all directions to surrounding lowlands; to the St. Lawrence valley on the north; the Champlain-Hudson lowland on the east; the Mohawk valley on the south; and Lake Ontario on the west. The Adirondack area proper, and much of the surrounding ring of more recent rocks, is either too rugged or has a soil too thin and rocky for extensive agriculture. It is, therefore, a sparsely settled region with lumbering and mining of iron (magnetite) and titanium as the leading industries. Because of the varied and beautiful scenery, this is a favourite summer resort; the game of the forest and the fishing in the streams and in the multitude of lakes serve as further attractions. In the peripheral ring farming increases, especially dairying; and manufacturing industries connected with the products of forest, farms and mines are developed. These and other manufacturing industries are greatly aided by the extensive water power furnished by the mountain streams which flow out radially from the central area.

South of the Adirondack region, and south of the Mohawk valley, rises a high-level plateau which extends westward to the Pennsylvania boundary. Here the rocks are all essentially horizontal and of the Palaeozoic age, mainly Devonian. This plateau province, which includes more than half the state, differs greatly from place to place. Its elevation decreases toward the north by a series of steps, the lowest elevation being on the Ontario plain which skirts the southern shore of Lake Ontario. Similar to this is a narrow plain along the southern shore of Lake Erie, which, in fact, lies in a shallow depression in this Erie plain. Both these plains are so level, and have so fertile a soil, that they are the seats of extensive agriculture, especially fruit raising, which is further encouraged by the influence of the large bodies of lake water that moderate the heat of summer and the cold of winter, and tend to check the late frosts of spring and the early frosts of autumn. Elsewhere in the plateau province the land is higher and the surface far more irregular, increasing in ruggedness toward both the south and the east. Elevations of 1,500 ft. and 2,000 ft. are common in this region all the way from Chautauqua county in the extreme west to the Catskill mountains in the east; and in places the surface becomes so rugged as to simulate the features of mountains and locally to win the name of mountain. Valleys are deeply sunk in the plateau, the largest with bottom lands of sufficient width to give rise to strips of fertile farmland. The valley walls rise to undulating and often fairly level uplands, which are, in large part, cleared of forest. In the main they are grazing lands—the seat of important dairy and sheep-raising industries. In lakeside areas, grapes are grown. Since the plateau region is a northward extension of the Allegheny plateau, which skirts the western base of the Appalachian mountains, it rises as the mountains are approached. Thus, in southeast New York, where the Appalachians enter the state, the plateau becomes much higher than in the west, reaching its culmination in the Catskills. Here, partly because of elevation, and partly because of the resistant nature of the Catskill sandstone, dissection has so sculptured the plateau as to carve it into a mountainous mass generally known as the Catskill mountains (*q.v.*). In this part of the plateau, summit elevations of from 3,000 ft. to 4,000 ft. are common, the highest point being Slide mountain (4,204 ft.). Like the Adirondacks, this region is largely forest covered, and is a favourite summer resort; but it is far less a wilderness than the Adirondacks, and in places is cleared for farming, especially for pasturage. In the plateau province there are other areas known as mountains, of which the Helderberg mountains are the most conspicuous. This formation is really an escarpment facing the lower Mohawk and the Hudson river, south of Albany, where there is a downward step in the plateau. The steeply rising face of the plateau here is a result of the resistance of a durable layer of limestone, known as the Helderberg limestone. Of other lower escarpments the most notable is the Niagara which extends eastward from Canada, past Lewiston and Lockport—a downward step from the Erie to the Ontario plain.

South and southeast of the Catskills, although including only a small portion of the state, there are a number of different topographic features, caused by the belts of different rock structure which cross the state from southwest to northeast. The most pronounced of these upfolded strata in New York form the low Shawangunk mountains, which descend, toward the southeast, to a lowland region of folded strata of limestone, slate and other rocks in Orange and Dutchess counties. This lowland area, as a result of the nonresistant character of the strata, is a continuation of the Great Valley of the Appalachians, and extends northeast into Vermont and southwest across New Jersey, Pennsylvania, Maryland and Virginia. It is bounded on its southeast side by the Highlands, a belt of Pre-Cambrian crystalline rocks extending northeast into Connecticut and Massachusetts, and southwest into the highlands of New Jersey and thence to the Blue ridge. South of the Highlands, in New Jersey, but extending to the very banks of the Hudson, is a belt of Triassic sandstone with intrusions of trap rock, which, on account of its peculiar columnar jointing, has developed a palisade structure—the famous Palisades of the lower Hudson. Long Island, though modified by extensive glacial deposits, may be considered a northeast extension of the coastal plains which attain a much more perfect development in New Jersey and the states farther south.

The entire surface of New York, with the exception of a very small area in the extreme west, in Chautauqua and Cattaraugus counties, was covered by the continental glacier. It broadened and deepened many of the valleys; rounded the hills; turned aside many streams, causing changes in drainage and giving rise to innumerable waterfalls and rapids; and it formed the thousands of lakes, large and small, which dot the surface. As the ice receded, it halted at various points, forming moraines and other glacial deposits. Thus the soil of almost the entire state has been derived by glacial action.

The drainage of New York finds its way to the sea in various directions. The St. Lawrence system receives most, mainly from short streams from the plateau province and from the Adirondacks. A small part of the state, in the west, drains to the Ohio, and thence, by way of the Mississippi, to the Gulf of Mexico; and a much larger area drains into the Susquehanna, entering the head of Chesapeake bay. A part of the Catskills, and the region farther south, drains into Delaware bay through the Delaware river. Thus, New York is pre-eminently a divide region, sending its drainage, by various courses, into widely separated parts of the

ocean. Only the Hudson (*q.v*) and a few streams in the extreme south have independent courses to the sea within the state itself The Hudson is by far the most important river in the state, for, because of the sinking of the land, which has admitted the tide as far as Troy, it is navigable for 151 mi. from the sea. It is noted for its remarkable scenery, especially where it crosses the highlands. Westward from Troy, the Mohawk valley furnishes a highway which is followed by canal, railway and motor road. Thus there is here a gap, easily traversed, across the Appalachian mountains and plateaus to the more level and fertile plains beyond.

There are about 8,000 lakes and ponds in the state, most of them small and all, including Lakes Erie and Ontario, the result of glacial action. The largest lake apart from Erie and Ontario is the beautiful Lake Champlain, on the eastern boundary. Into this drains Lake George, known as the "Lake Como" of America. The largest lake entirely within the state is Oneida lake. In the central part of the state is a series of peculiar, nearly north-and-south elongated lakes, known as the Finger lakes. The largest are Cayuga, Seneca, Keuka, Canandaigua, Owasco and Skaneateles. Here too is Watkins Glen State park. In the extreme western part of the state is Chautauqua lake, beautifully situated in the plateau of western New York. New York is noted for its many falls and rapids, some of them of great beauty. Of these the largest is the cataract of Niagara, about 1 mi. wide and 167 ft. high. The American fall is entirely within the state; but the Canadian boundary line passes down the centre of the Horseshoe or Canadian fall. Other notable falls are those of the Genesee at Portage and at Rochester, the falls in the Cayuga and the Seneca valleys, Trenton falls, the Falls of Ticonderoga, and a multitude of falls and rapids in the Adirondack region.

New York has an extensive coast line along the Great Lakes, 75 mi. on Lake Erie and more than 200 mi. on Lake Ontario. The largest of the lake ports is at Buffalo at the head of Niagara river, where, because of the Niagara cataract, lake boats from the west must transfer their goods to rail or canal. Buffalo lies at the lower end of natural lake navigation, though by the building of a ship canal in Canada, lake steamers can proceed into Lake Ontario and thence to the St. Lawrence. The ocean coast line, though of limited extent, is by far the most important in the United States. The greater part of the sea coast is on Long Island—a low, sandy coast, the seat of numerous summer resorts and of some fishing. The mainland, opposite the western end of Long Island, is traversed by the lower Hudson and other channels—submerged valleys—which form a branching bay with several islands, the largest of which are Staten and Manhattan Islands. This bay makes an excellent protected harbour, with 600 mi. of water front, at the outlet of the chief natural highway from the east to the interior of the country.

Climate.—In general the climate of New York is typical of that of northern United States, a climate of extremes, hot in summer, and cold in winter, and yet healthful, stimulating, and, on the whole, not disagreeable. The average mean annual temperature is not far from 45° though it varies from over 50° near New York city, and 48° near the Lake Erie shore, to less than 40° in the high Adirondacks. The average maximum summer heat is about 93°, a temperature of 100° being rarely reached. In the winter the temperature descends below zero during exceptionally cold spells. Most of the rivers and smaller lakes freeze over completely in winter. The average rainfall is between 40 and 45 in. but it is less than 30 in. in the Lake Champlain valley and more than 55 in. north of New York city. In the Adirondack region the snowfall is heavy, the winter long and severe. In central New York it is not uncommon for snow to accumulate to the depth of 3 or 4 ft. and yet this is not persistent. About New York city, and on Long Island, the snow rarely exceeds 1 ft. in depth. The climate is variable because of the frequent passage of cyclonic storms from the west and southwest, bringing warmer weather with rain and snow in winter, and causing days of great heat and humidity, with thunderstorms, in summer. About New York city, and on Long Island, the ocean softens the rigours of winter, and through the influence of cold surface waters off the coast, tempers the heat of summer.

Soil.—The soil is mostly glacial drift, but its depth and composition often vary greatly even within small areas. The most widely distributed soil, especially in the west half of the state, is mainly a clay which was formed by the glacial pulverizing of limestone and shale and is still forming from the decomposition of fragments of these substances. In the larger valleys and along the shores of lakes alluvium is mixed with this clay.

History.—The aboriginal inhabitants of New York had an important influence on its colonial history. Within its limits from the upper Hudson westward to the Genesee river was the home of that powerful confederacy of Indian tribes, the Mohawks, Oneidas, Onondagas, Cayugas and Senecas, known to the French as the Iroquois and to the English as the Five (later Six) Nations. When supplied with firearms by Europeans they reduced a number of other tribes to subjection and extended their dominion over most of the territory from the St. Lawrence to the Tennessee and from the Atlantic to the Mississippi. They were at the height of their power about 1700. Of much less influence in New York were several Algonkin tribes in the lower valley of the Hudson and along the sea coast.

Colonial Period.—New York bay and the Hudson river were discovered by Giovanni da Verrazano in 1524; for many years following, French vessels occasionally ascended the Hudson to trade with the Indians. In July 1609 Samuel de Champlain discovered the lake which bears his name and on its shores led his Algonkin Indian allies against the Iroquois, thus provoking against his countrymen the hostility of a people who for years were to hold the balance of power between the English and the French in America. On Sept. 3, 1609, Henry Hudson, in the employ of the Dutch East India company, entered New York bay in the "Half Moon" in search of the "northwest passage." He conceived that a vast trade with the Iroquois for furs might be established. His report aroused great interest in Holland, and the United Netherlands claimed the newly discovered country. In 1610 a vessel sailed with merchandise suitable for traffic with the Indians, the voyage resulted in profit, and a lucrative trade in peltries sprang up. Early in 1614 Adriaen Block explored Long Island sound and discovered Block Island. The merchants of Amsterdam and Hoorn soon formed themselves into the New Netherland company, and on Oct. 10, 1614, received from the states-general a three years' monopoly of the Dutch fur trade in New Netherland; *i.e.*, that part of America between New France and Virginia or between latitudes 40° and 45° N. Late in 1614 or early in 1615 a stockaded trading post called Fort Nassau was erected on Castle Island, now within the limits of Albany, and a few huts were raised on the southern extremity of Manhattan Island; but no effort at colonization was as yet made. When the charter of the New Netherland company expired in 1618, renewal was refused, and only private ventures were authorized until 1621. When the West India company was first chartered for a term of 24 years, it was given a monopoly of Dutch trade with the whole American coast and authorized to plant colonies and to govern them under a very limited supervision of the states-general. In June 1623, however, New Netherland was formally erected into a province and the management of its affairs assigned to the chamber of Amsterdam, which in March 1624 dispatched the "New Netherland" with the first permanent colonists (30 families, mostly Walloon), under Cornelis Jacobson Mey, the first governor or director of the colony. Arriving at Manhattan early in May, a few of the men remained there, but more than one-half of the families proceeded up the Hudson to Fort Orange, and there founded what is now Albany. Three more vessels arrived in 1625, and when in that year Mey was succeeded as director by William Verhulst the colony had a population of 200 or more. The government of the province was fully established in 1626 and was vested mainly in a director-general and council. Peter Minuit, the first director-general, arrived with more colonists in May 1626, and soon afterward Manhattan Island was bought from the Indians, Fort Amsterdam was erected at its lower end and the settlement there was made the seat of government.

In 1629, mainly to promote agriculture, the company issued its famous charter of privileges and exemptions, which provided tha'

any member might have anywhere in New Netherland except on Manhattan Island his choice of a tract of unoccupied land extending 16 mi. along the seacoast or one side of a navigable river, or 8 mi. along the river on both sides "and so far into the country as the situation of the occupyers will permit" by purchasing the same from the Indians and planting upon it a colony of 50 persons, within four years from the beginning of the undertaking, and that any private person might with the approval of the director-general and council take up as much land as he should be able to improve. The founder of a colony was styled a patroon, and, although the colonists were bound to him only by a voluntary contract for specified terms, the relations between them and the patroon during the continuance of the contract were in several important respects similar to those under the feudal system between the lord of a manor and his vassals. The single colony of Rensselaerwyck, established by Killian van Rensselaer on both sides of the Hudson and extending in all directions from Fort Orange (Albany), was the only one that prospered under the patroon system. Director-General Minuit was recalled in 1632 on the ground that he had been partial to the patroons; and Wouter van Twiller, who arrived in 1633, tried to promote only the selfish commercial policy of the company; at the close of his administration (1637) the affairs of the province were in a ruinous condition.

William Kieft was appointed director-general late in 1637, and in 1638 the company abandoned its monopoly of trade in New Netherland. The director-general was instructed to issue to any immigrant applying for land a patent for as large a farm as he required for cultivation and pasturage, to be free of all charges for ten years and thereafter subject only to a quitrent of one-tenth of the produce. Two years later the charter of privileges and exemptions was revised to permit manufactures and extend the privileges of the original charter with respect to patroons to "all good inhabitants of the Netherlands"; the estate of a patroon was limited to four miles along the coast or a navigable river and eight miles back into the country. These inducements encouraged immigration from the fatherland, New England and Virginia. But the freedom of trade promoted dangerous relations with the Indians, and an attempt of Kieft to collect a tribute from the Algonkins in the vicinity of Manhattan Island and other indiscretions provoked Indian hostilities (1641–45), during which most of the outlying settlements were laid waste.

Out of this warfare arose an organized movement for a government in which the colonists should have a voice. In 1641 Kieft frustrated an attempt of a board of 12 men to attain some reforms, and in 1644 a board of 8 sent a petition to the states-general for his recall, and this was granted. Peter Stuyvesant (*q.v.*), his successor, arrived at Fort Amsterdam in May 1647. Under his rule there was a return of prosperity; from 1653 to 1664 the population of the province increased from 2,000 to 10,000. Stuyvesant was, however, extremely arbitrary. Although he permitted the existence of a board of nine men to act as "tribunes" for the people, he treated it with increasing contempt.

Notwithstanding the good claim to their province which the Dutch had established, Great Britain, basing its claim to the same territory on John Cabot's discovery (1498), the patent to the London and Plymouth companies (1606), and the patent to the Council for New England (1620), contended that the Dutch were intruders, and by the treaty of Hartford (1650), the commissioners of the United Colonies of New England forced Stuyvesant to agree to a boundary which on the mainland roughly determined the present boundary between New York and Connecticut and on Long Island extended from Oyster bay to the Atlantic ocean. In 1653 the Dutch, fearing an English attack, built a wall, from which the present Wall street was named, across Manhattan Island at what was then the northern limits of New Amsterdam. In March 1664 Charles II formally erected into a province the whole territory from the west side of the Connecticut river to the east side of Delaware bay together with the whole of Long Island and granted it to his brother James, the duke of York and Albany, as its lord proprietor. The duke named Col. Richard Nicolls governor, in command of an expedition to conquer it. Nicolls won the burgomaster of New Amsterdam and other prominent citizens by offering favourable terms, and Stuyvesant was forced, without fighting, into a formal surrender on Sept. 8. The duke's authority was proclaimed; New Netherland became New York and Fort Orange became Fort Albany. A treaty of alliance procured for the English the same friendly relations with the Iroquois that the Dutch had enjoyed. The transition from Dutch to English institutions was effected gradually and the private rights of the Dutch were carefully preserved. The introduction of English institutions into settlements wholly or largely English was begun in 1665 by the erection of Long Island, Staten Island and Westchester into an English county named Yorkshire, under a code known as the "Duke's Laws." It gave the freeholders of each town a voice in town government through the election of a board of eight overseers and a constable. The board sat as a court for the trial of small causes. Nicolls resigned the governorship in 1668, but his successor, Francis Lovelace, continued his policy—autocratic government, arbitrary in form but mild in practice, and progressive in the matter of religious toleration.

In Aug. 1673, Holland and England being at war, a Dutch fleet surprised and captured New York, restored Dutch authority and names. But the treaty of Westminster, Feb. 1674, extinguished the Dutch title, and in November the English again took possession. In 1675 Gov. Edmund Andros established at Albany a commission for Indian affairs which long rendered important service in preserving the English-Iroquois alliance. Some of Andros' many enemies preferred charges against him and he was called to England in 1681 to answer these. During his absence the demand for a representative assembly was accompanied by a refusal to pay the customs duties and so much other insubordination that the duke appointed Col. Thomas Dongan to succeed Andros and call the desired assembly. It met in New York city on Oct. 17, 1683, and in about three weeks passed 15 acts. The first, styled a charter of liberties and privileges, required that an assembly elected by the freeholders and freemen should be called at least once every three years; vested all legislative authority in the governor, council and assembly; forbade the imposition of any taxes without the consent of the assembly; and provided for religious liberty and trial by jury.

The king, trying to strengthen the imperial control over New England and to erect a strong barrier against the French, in 1688 consolidated New York, New Jersey and the New England colonies into the dominion of New England under the viceregal authority of Sir Edmund Andros as governor general. News of the English revolution of 1688 caused an uprising in Boston, and in April 1689 Andros was seized and imprisoned. His fall encouraged restless spirits in New York city and on Long Island to act on their own. A German merchant, Jacob Leisler (*q.v.*), became their leader On May 31, 1689, the militia captains seized Fort James and Leisler assumed command later. In June Francis Nicholson, the lieutenant governor, deserted and sailed for England, and Leisler easily gained possession of the city. He called an assembly which conferred upon him the powers of a dictator. Following receipt of the order of William and Mary to continue all Protestants in their offices in the colonies, Leisler falsely announced that he had received a commission as lieutenant governor. Albany recognized him only when it was necessary to present a united front against the French and their Indian allies who, in Feb. 1690, had surprised and burned Schenectady. French attacks had at the same time been directed against New England, and to meet the dangerous situation Leisler performed his one statesmanlike act, notable in American history as the first step toward colonial union. At his call, delegates from Massachusetts, Plymouth, Connecticut and Maryland met in New York city with delegates from New York on May 1, 1690, to consider concerted action against the enemy, although the expedition which they sent out was a failure. Later Leisler was enraged when he learned that he had been ignored in the appointment of the new governor, Col. Henry Sloughter. Leisler refused to give up the fort, and after some bloodshed was arrested and executed.

Governor Sloughter, as his commission directed, re-established in 1691 the assembly which James II had abolished in 1686, and throughout the remainder of the colonial era the history of the

province relates chiefly to the rise of popular government and the defense of the northern frontier. In 1706 the assembly won the right to appoint its own treasurer to care for money appropriated for extraordinary purposes, and in 1737 the custom of continued revenue acts was replaced by annual appropriations.

In 1733 a popular organ, the *New York Weekly Journal*, was established under John Peter Zenger (1697–1746), and in 1735 both the freedom of the press and a great advance toward the independence of the judiciary were the outcome of a famous libel suit against Zenger. He was arrested for libel in Nov. 1734 for printing criticisms of the administration. The jury quickly agreed on a verdict of not guilty, and the acquittal was greeted by the populace with shouts of triumph. The further independence of judges became a leading issue in 1761 when the assembly insisted that they should be appointed during good behaviour, and refused to pay the salaries of those appointed during pleasure; but the home government met this refusal by ordering that they be paid out of the quitrents.

The defense of the northern frontier was a heavy burden to New York, but by its problems the growth of the union of the colonies was promoted. The main effort of the French, however, was, by diplomacy, to destroy the English-Iroquois alliance. To counteract the influence of French priests dwelling among the Iroquois the English, in 1701, prevailed upon the chiefs to deed their territory, said to be 800 mi. in length and 400 mi. in breadth, to the king of England. The English, also, frequently distributed presents. But the success of the French at the close of the 17th century and the early portion of the 18th was prevented only by the ceaseless efforts of Peter Schuyler (1657–1724) whose personal influence was for years dominant among all the Iroquois except the Senecas. When they had assumed a neutral attitude, he persuaded a number of them to join troops from New York, New Jersey and Connecticut in the unsuccessful expeditions of 1709 and 1711 against the French at Montreal. In order to regulate the trade with the Iroquois, Gov. William Burnet established a trading post at Oswego in 1722 and fortified it in 1727 and thereby placed the Iroquois in the desirable position of middlemen in a profitable fur trade with the "far Indians." In King George's War New York was left alone to protect its own frontier and while the assembly was wrangling with Gov. George Clinton for the control of expenditures the French and their Indians were burning farmhouses, attacking Saratoga (Nov. 17, 1745), and greatly endangering the English-Iroquois alliance. A reconciliation was effected, however, by Col. (later Sir William) Johnson (*q.v.*), a former agent of Indian affairs. Largely to secure the cooperation of the Iroquois the home government itself now called the most important assembly of colonial deputies that had yet gathered to meet at Albany (*q.v.*). This body, consisting of 23 commissioners and representing seven colonies, met in June 1754, and, besides negotiating successfully with the Iroquois, it adopted, with some modifications, a plan of colonial union prepared by Benjamin Franklin; the plan was not approved, however, either by the home government or by any of the colonies. In the first year of the French and Indian War (1755) Maj.-Gen. William Johnson defeated a French and Indian force under Baron Ludwig Dieskau in the battle of Lake George. In Aug. 1756 marquis de Montcalm took Oswego from the English and destroyed it, and in 1757 he captured Fort William Henry; but in the latter year the elder William Pitt assumed control of affairs in England, and his aggressive, clear-sighted policy turned the tide of war in England's favour. Victory followed victory, Ticonderoga, Crown Point and Niagara were wrested from the French and New York was freed of its foes.

The Revolutionary War.—England's attempt to make the colonies pay the expenses of the war by means of the stamp tax thoroughly aroused the opposition of commercial New York, already chafing under the hardships imposed by the Navigation acts and burdened with a war debt of its own exceeding £300,000. The assembly authorized its committee, which had been appointed to correspond with the New York agent in London, to correspond also with the committees in the other colonies and this committee represented New York in the Stamp Act congress, which met in New York city in Oct. 1765. In the series of events which followed important changes were made in party lines. The court party and propertied classes became the Loyalist party, standing for law as against rebellion, monarchy and the union of the empire as against republicanism; the popular party became the Patriot party, determined to stand on its rights at any cost. The Stamp act was repealed in March 1766, but the Townshend acts were met in New York by fresh outbursts of the Sons of Liberty and by an association of merchants, the members of which pledged themselves not to import anything from England until the duties were repealed. New York had also been requested to provide certain supplies for the British troops quartered in the city. This the assembly refused to do but parliament answered (1767) by forbidding it to do any other business until it complied. It was under these conditions that the Loyalists, in the elections of 1768 and 1769, gained control of the assembly and in the latter year passed an act granting the soldiers' supplies. The moderate Loyalists joined in the election of delegates to the first continental congress; but the great body of Loyalists in New York strongly disapproved of the "dangerous and extravagant" measures adopted by that body, and the assembly, in Jan. 1775, refused to approve its acts or choose delegates to the second continental congress. The Patriots met this refusal by calling a provincial convention to choose the delegates. Scarcely had they done this when news of the encounter at Lexington produced a strong reaction in their favour, and in May 1775 they called a provincial congress which usurped the powers of the assembly. Still, conditions were such in New York that a fight for independence was not to be lightly considered. In the south the chief city was exposed to the British fleet, and the northern border was exposed to attack from the British and their Iroquois allies. In various sections, too, considerable numbers of Loyalists were determined to aid the British. When, in June 1776, a vote on the Declaration of Independence was pending in the continental congress, the New York provincial congress refused to instruct its delegates in the matter; but a newly elected provincial congress, influenced by a Loyalist plot against the life of George Washington, adopted the Declaration when it met, July 9.

It was a settled point of British military policy throughout the war to hold New York city, and from it, as a base, to establish a line of fortified posts along the Hudson by means of which communication might be maintained with another base on Lake Champlain. Such a scheme, if successfully carried out, would have driven a wedge into the line of colonial defense and cut off communication between New England and the southern colonies. A few days after the fight at Lexington and Concord, Connecticut authorized an expedition under Ethan Allen which surprised and captured Ticonderoga and Crown Point. In the following year (1776) the British began their offensive operations for the control of the Hudson. Sir William Howe, with a force of British and Loyalists vastly superior in equipment and numbers to Washington's untrained militia, landed in July on Staten Island and late in August defeated Washington at the battle of Long Island within the present limits of Brooklyn borough. In the following month Washington withdrew from New York city which the British entered and held until the close of the war. Washington prepared to withstand the British behind fortifications on Harlem Heights, but discovering that Howe was attempting to outflank him by landing troops in the rear he retreated to the mainland, leaving only a garrison at Fort Washington, and established a line of fortified camps on the hills overlooking the Bronx river as far as White Plains. This brought on the battle of White Plains late in October, in which Howe gained no advantage; and from there both armies withdrew into New Jersey, the British capturing Fort Washington on the way. In 1777 Gen. John Burgoyne succeeded in taking Ticonderoga, but in the swampy forests southward from Lake Champlain he fought his way against heavy odds, and in the middle of October his campaign culminated disastrously in his surrender at Saratoga. Col. Barry St. Leger led an auxiliary expedition from Oswego against Fort Stanwix on the upper Mohawk, and on Aug. 6 he fought at Oriskany one of the most bloody battles of the war, but a few days later, deserted by his terror-

stricken Indian allies, he hastened back to Montreal. Early in October Howe sent an expedition up the Hudson under the command of Sir Henry Clinton. Clinton met with little difficulty from the principal American defenses of the highlands, consisting of Forts Montgomery and Clinton on the western bank, together with a huge chain and boom stretched across the river to a precipitous mountain (Anthony's Nose) on the opposite bank, and ascended as far as Esopus (now Kingston) which he burned, but he was too late to aid Burgoyne. The year 1778 saw the bloody operations of the Tory Butlers and their Loyalist and Indian allies in the Mohawk and Schoharie valleys and notably the massacre at Cherry valley. In retaliation a punitive expedition under Generals John Sullivan and James Clinton in 1779 destroyed the Iroquois towns, and dealt the Indian confederacy a blow from which it never recovered. The American cause was strengthened this year also by several victories along the lower Hudson of which Gen. Anthony Wayne's storming of the British fort at Stony Point was the most important. The closing episode of the war as far as New York was concerned was the discovery of Benedict Arnold's attempt in 1780 to betray West Point and other colonial posts on the Hudson to the British. On Nov. 25, 1783, the British forces finally evacuated New York city, but the British posts on Lakes Erie and Ontario were not evacuated until several years later.

Post-Revolutionary Period.—New York ratified the Articles of Confederation in 1778, and was the first state to surrender any claims to territory west of the Mississippi. Led by George Clinton, governor in 1777–95, the state jealously guarded its commercial interests. This led to determined opposition to the new federal constitution. In support of the constitution, however, there arose the Federalist party under the able leadership of Alexander Hamilton. When a majority of the Constitutional Convention of 1787 had approved of the new constitution, Hamilton alone of the three New York delegates remained to sign it; and when, after its ratification by eight states, the New York convention met at Poughkeepsie (June 17, 1788) to consider ratification, two-thirds of the members were opposed to it. But others were won over by the news that it had been ratified by New Hampshire and Virginia or by the telling arguments of Hamilton, and on July 26 the motion to ratify was carried by a vote of 30 to 27.

The constitution having been ratified, personal rivalry among the great families—the Clintons, the Livingstons and the Schuylers—again dominated political affairs. The Livingstons, piqued at Washington's neglect to give them the offices they thought their due, joined the Clintons, but the federal patronage was used against the Anti-Federalists or Republicans with such effect that in 1792 John Jay received more votes for the governorship than George Clinton, although the latter was counted in on a technicality. Jay was elected in 1795 and re-elected in 1798, but in 1801 the brief Federalist regime in the state came to an end with the election of George Clinton for a seventh term. The Republican leaders straightway quarrelled among themselves, thus starting the long series of factional strifes which have characterized the party politics of New York state. The leaders of the several Republican groups were Chancellor Robert R. Livingston, Aaron Burr, then vice-president, Gov. George Clinton and his nephew, De Witt Clinton, who in 1802 was elected United States senator. The first break came in the spring of 1804 when Burr, who had incurred the enmity of his Republican colleagues in 1800 by seeking Federalist votes in the electoral college at Jefferson's expense, became an independent candidate for the office of governor against Morgan Lewis. Hamilton's action in counselling Federalists not to vote for Burr, just as he had counselled them not to support Burr against Jefferson in 1800, was one of the contributory causes of Burr's hostility to Hamilton which ended in the duel (July 1804) in which Burr killed Hamilton. Hamilton's death marked the end of the Federalists as a power in the state. New York, whose growing shipping interests had suffered by the embargo of 1807, was as a commercial state opposed to the War of 1812 with Great Britain. Politically this opposition had the effect of temporarily reviving the Federalist party, which secured control of the legislature, and gave the electoral vote of the state in 1812 to De Witt Clinton, whom the Federalists had accepted as a candidate to oppose Madison for re-election on the war issue. During the war New Yorkers served with the regular troops at Niagara, Plattsburg and other places on the western and northern frontiers of the state. For several years after the war political contests in New York state as in the rest of the country were not on party lines. De Witt Clinton was elected governor and, largely through his efforts, the Erie canal was begun.

The election of Martin Van Buren as governor in 1828 marked the beginning of the long ascendancy in the state of the "Albany Regency," a political coterie in which Van Buren, W. L. Marcy, Benjamin Franklin Butler (1795–1858) and Silas Wright were among the leaders. Thurlow Weed, their bitterest opponent and the man who gave them their name, declared of them that he "had never known a body of men who possessed so much power and used it so well." Thurlow Weed owed his early political advancement to the introduction into state politics of the anti-Masonic issue (*see* ANTI-MASONIC PARTY), which also brought into prominence his co-worker W. H. Seward. As the anti-Masonic wave subsided, its leaders and most of its adherents found a place in the newly organized Whig party which was powerful enough in New York to elect William H. Seward governor in 1838, and to re-elect him and to carry the state for W. H. Harrison against Van Buren in 1840. It was during the first administration of Governor Seward that the antirent agitation in the Hudson river counties began. Vast estates in Albany, Rensselaer, Columbia, Schoharie, Delaware, Sullivan and other counties were the seats of disturbance. Besides rent, many of the tenants were required to render certain services to the proprietor, and in case a tenant sold his interest in a farm to another he was required to pay the proprietor one-tenth to one-third of the amount received as an alienation fine. Politically, the antirent associations which were formed often held the balance of power between the Whigs and the Democrats, and in this position they secured the election of Gov. John Young (Whig) as well as of several members of the legislature favourable to their cause, and promoted the passage of the bill summoning the constitutional convention of 1846. In the new constitution clauses were inserted abolishing feudal tenures and limiting future leases of agricultural land to a period of 12 years. The courts pronounced the alienation fines illegal. Under the pressure of public opinion the great landlords rapidly sold their farms. Up to the election of Seward as governor, New York had usually been Democratic, largely through the predominating influence of Van Buren and the "Albany Regency." After the defeat of Gov. Silas Wright in 1846, however, the Democratic party split into two hostile factions known as the "Hunkers," or conservatives, and the "Barnburners," or radicals. The factions had their origin in canal politics, the conservatives advocating the use of canal revenues to complete the canals, the radicals insisting that they should be used to pay the state debt. Later when the conservatives accepted the annexation of Texas and the radicals supported the Wilmot proviso the split became irrevocable. Only once between 1846 and the Civil War did the Democratic party regain control of the state—in 1853–55 Horatio Seymour was governor for a single term. A succession of Republican governors then held office until 1862 when discouragement in the north with respect to the Civil War brought a reaction which elected Seymour governor.

With the exception of New York city the state was loyal to the Union cause during the war and furnished more than 500,000 troops to the federal armies. Certain commercial interests of New York city favoured the Confederate cause, but Mayor Fernando Wood's suggestion that the city (with Long Island and Staten Island) secede and form a free city received scant support, and after the sanguinary draft riots of July 1863 (*see* NEW YORK [CITY]), no further difficulty was experienced.

Post-Civil War Period.—After the Civil War the state began to reassume its pivotal position in national politics, and the high political tension emphasized the evils of the "spoils system." In 1868 John T. Hoffman, a favourite of Tammany Hall, was chosen governor on the Democratic ticket. Tammany and Hoffman were again victorious in 1870; but in 1871 the *New York Times* dis-

closed the magnitude of the "Tweed ring's" thefts, amounting in the erection of the New York county courthouse alone to almost $8,000,000, and William Marcy Tweed and his "ring" were crushed in consequence. The Republicans carried the state in 1872, but in 1874 Samuel J. Tilden, a Democrat and the leading prosecutor of Tweed, was elected governor. The Republican legislature had in 1867 appointed a committee to investigate the management of the canal system, but the abuses were allowed to continue until in 1875 Governor Tilden disclosed many frauds of the "Canal ring," and punished the guilty. In 1882 the Republicans, having split over a struggle for patronage into the two factions known as "Halfbreeds," or the Administration party, and "Stalwarts," of whom the leader was Roscoe Conkling, were defeated, and Grover Cleveland was chosen governor. Hostility to free silver and "Bryanism" in the large financial and industrial centres again put the state strongly in the Republican column in the state elections from 1894 to 1910.

Twentieth Century.—In the election of Nov. 1910 the Democrats carried not only the state but also the legislature, and John A. Dix was elected governor. The Democrats again carried the state and the legislature in Nov. 1912, and William Sulzer became governor.

In April 1913 Governor Sulzer sent a special message to the legislature urging a direct primary law that would abolish party conventions. The legislature refused to enact the primary bill, and the governor vetoed the legislative substitute. When the legislature recessed on July 23 the governor declared the special session adjourned, but the legislature reassembled on Aug. 11. Two days later the assembly voted to impeach the governor; on Oct. 17 he was removed from office and Martin H. Glynn, lieutenant governor, succeeded.

The Republicans were successful in the elections of Nov. 1914, and Charles S. Whitman became governor, and in 1916 was re-elected. In the November election, 1918, Alfred E. Smith (Democrat) was elected governor by a small plurality of about 15,000. Most of the other state officers and the legislature, however, remained Republican. One of the most important laws of the year provided for an income tax of from 1% to 3%. Shortly after his inauguration Smith appointed a nonpartisan reconstruction commission to investigate the problem of a fundamental reorganization of the state government, and to consider other important problems of reconstruction resulting as an aftermath of World War I. This commission recommended an executive budget and the consolidation of the numerous administrative agencies.

In 1920 the direct primary was abandoned and the convention system restored for the nomination of state and judicial officers. The 1922 legislature authorized life-insurance companies to invest 10% of their assets in new buildings for dwelling purposes; extended the emergency rent laws to 1924 and fixed assessments as the basis for determining the reasonableness of rents. Women were given representation on county party committees. A home rule amendment was adopted. The 1922 election resulted in the selection of Alfred E. Smith as governor by an absolute majority of 269,609 votes.

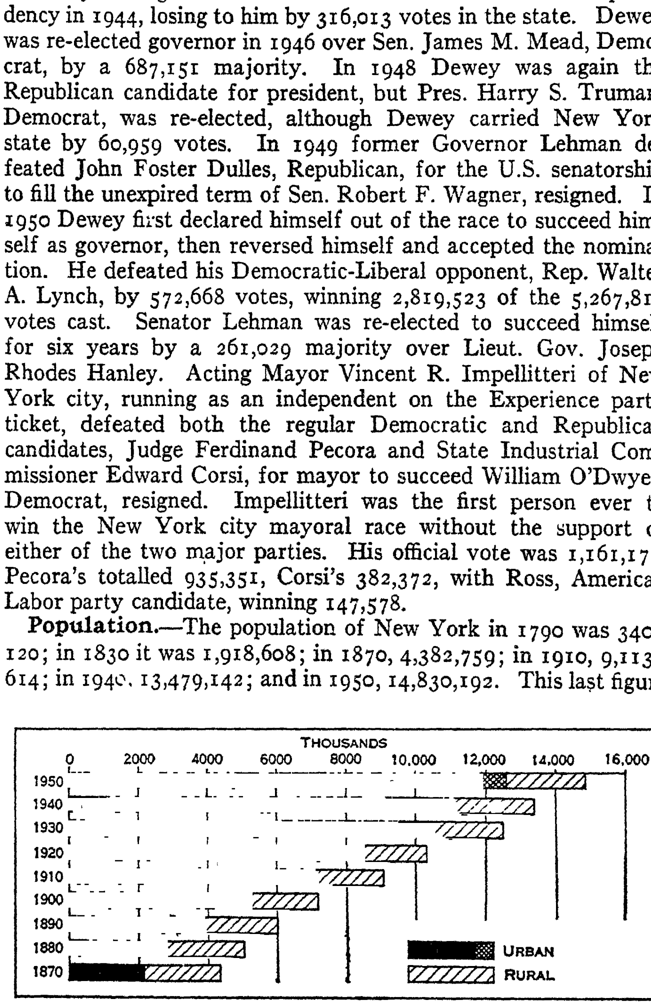
In the autumn elections (1923) the voters approved an amendment extending to cities a large measure of home rule. An important measure of the 1924 session of the legislature was the Home Rule Enabling act, designed to carry out the amendment. In 1924 Governor Smith was re-elected but the Republican candidates for the other six elective state offices were successful, and the legislature became more strongly Republican. In the fall election of 1925 the voters approved four constitutional amendments. The most important provided for the governor's plan of consolidating the numerous state administrative agencies into 19 departments. In 1926 the Democrats succeeded in re-electing Governor Smith though the legislature remained Republican. Again in 1928 they won the governorship for their candidate, Franklin D. Roosevelt. Herbert H. Lehman, another Democrat, was elected governor in 1932 and was re-elected in 1934, 1936 and 1938, the last time for a term of four years.

In 1942 Thomas E. Dewey, Republican, was elected governor. Legislation enacted by the Dewey administration, supported by a continuously Republican majority in the legislature, included laws providing: that employers could not discriminate against employees because of race, creed or colour; disability insurance for unemployed; a state youth commission to reduce juvenile delinquency; the school of industrial and labour relations at Cornell university; materially increased state aid to localities; increased slum clearance and low-rental housing; expanded health services with special attention to tuberculosis eradication and cancer and cerebral palsy clinics; a materially increased construction program for highways, state institutions and conservation projects; and a $400,000,000 bonus for veterans of World War II.

During World War II the state government acted through the state war council and other agencies to prepare the public for civilian defense, to increase the number of war material contracts awarded to manufacturers in the state, to train more than 1,000,000 war production workers and to set up agencies to handle agricultural, business and individual problems created by war's dislocations.

Dewey ran against Pres. Franklin D. Roosevelt for the presidency in 1944, losing to him by 316,013 votes in the state. Dewey was re-elected governor in 1946 over Sen. James M. Mead, Democrat, by a 687,151 majority. In 1948 Dewey was again the Republican candidate for president, but Pres. Harry S. Truman, Democrat, was re-elected, although Dewey carried New York state by 60,959 votes. In 1949 former Governor Lehman defeated John Foster Dulles, Republican, for the U.S. senatorship to fill the unexpired term of Sen. Robert F. Wagner, resigned. In 1950 Dewey first declared himself out of the race to succeed himself as governor, then reversed himself and accepted the nomination. He defeated his Democratic-Liberal opponent, Rep. Walter A. Lynch, by 572,668 votes, winning 2,819,523 of the 5,267,816 votes cast. Senator Lehman was re-elected to succeed himself for six years by a 261,029 majority over Lieut. Gov. Joseph Rhodes Hanley. Acting Mayor Vincent R. Impellitteri of New York city, running as an independent on the Experience party ticket, defeated both the regular Democratic and Republican candidates, Judge Ferdinand Pecora and State Industrial Commissioner Edward Corsi, for mayor to succeed William O'Dwyer, Democrat, resigned. Impellitteri was the first person ever to win the New York city mayoral race without the support of either of the two major parties. His official vote was 1,161,175. Pecora's totalled 935,351, Corsi's 382,372, with Ross, American Labor party candidate, winning 147,578.

Population.—The population of New York in 1790 was 340,120; in 1830 it was 1,918,608; in 1870, 4,382,759; in 1910, 9,113,614; in 1940, 13,479,142; and in 1950, 14,830,192. This last figure represented an increase of 10.0% over the population in 1940. The population per square mile in 1950 was 309.3, as compared with 281.2 in 1940, and with 50.7 for the U.S. in 1950.



BY COURTESY OF THE U.S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF NEW YORK: 1870 TO 1950

The crosshatched part of the 1950 bar represents the population of the additional areas counted as urban under the new 1950 definition

The urban area of New York in 1940 comprised all incorporated places of 2,500 or more plus 1 town (township) classified as urban under special rule. The population of this area was 11,165,893, or 82.8% of the state total. The population in 1950 of all incorporated places of 2,500 or more plus the 1 special-rule town was 11,889,008, or 6.5% more than in 1940, and represented 80.2% of the state total.

The entire urban population, under a new definition set up for 1950, which included also the thickly settled suburban area, or "urban fringe," adjacent to the 13 cities which had a population of 50,000 or more in 1940, and 18 unincorporated places of 2,500 or more outside this fringe, amounted to 12,682,446, or 85.5% of the state total.

The number of households in 1950 was 4,329,327, as compared with 3,662,113 in 1940.

The average population per household had declined from 3.7 in 1940 to 3.4 in 1950.

Area	Population			Per cent of increase	
	1950	1940	1930	1940–50	1930–40
The state	14,830,192	13,479,142	12,588,066	10.0	7 1
Urban	12,682,446*	11,165,893	10,521,952	13.6	6.1
Rural	2,147,746*	2,313,249	2,066,114	−7.2	12.0
Per cent urban	85 5	82.8	83.6	.	
Principal cities					
New York city	7,891,957	7,454,995	6,930,446	5 9	7.6
Buffalo	580,132	575,901	573,076	0 7	0 5
Rochester	332,488	324,975	328,132	2 3	−1.0
Syracuse	220,583	205,967	209,326	7.1	−1.6
Yonkers	152,798	142,598	134,646	7 2	5 9
Albany	134,995	130,577	127,412	3 4	2 5
Utica	101,531	100,518	101,740	1 0	−1.2
Schenectady	91,785	87,549	95,692	4 8	−8.5
Niagara Falls	90,872	78,029	75,460	16 5	3 4
Binghamton	80,674	78,309	76,662	3 0	2 1
Troy	72,311	70,304	72,763	2.8	−3.4
Mount Vernon	71,899	67,362	61,499	6.7	9.5
New Rochelle	59,725	58,408	54,000	2 3	8.2
Elmira	49,716	45,106	47,397	10 2	−4.8

*Final figures for 1950 based on new definition. *See* comment in text.

The population of the state was distributed by colour and nativity in 1950 as follows: 76.7% native white; 16.9% foreign-born white; and 6.4% nonwhite, practically all Negro. There were 95.4 males per 100 females in the 1950 population, as compared with 98.5 in 1940; 8.5% of the population was 65 years old or over; and 54.5% of the population 14 years old and over was in the labour force. Of the total number of employed males, 3.9% was engaged in agriculture, 7.3% in construction, 29.5% in manufacturing, 10.6% in transportation, communication and other public utilities, 21.6% in wholesale and retail trade and 20.2% in service activities of all kinds, including public administration.

Government.—Since becoming a state, New York has been governed under five constitutions, adopted in 1777, 1821, 1846, 1894 and 1938 respectively. The constitution of 1938 may be amended by a majority vote of the members of two successive legislatures and approval by the electorate.

Suffrage is bestowed on all citizens who have attained the age of 21 years and have been inhabitants of the state for one year, but for the protection of the ballot, citizenship for 90 days, residence in the county for four months and in the election district for 30 days next preceding the election are required. Prospective absentee voters must register in person before leaving the state, except for persons away on military service.

The executive and administrative department of New York state functions under a reorganization plan authorized by a constitutional amendment approved in Nov. 1925, and reapproved in Nov. 1938. Under this system there are 19 major departments to which have been allocated the duties of more than 180 commissions and bureaus. Only the governor, lieutenant governor, comptroller and attorney general are elected. They are elected quadrennially (in even-numbered years). The 19 state departments consist of the executive department, the departments of audit and control, taxation and finance, law, state, public works, conservation, agriculture and markets, labour, education, health, mental hygiene, social welfare, correction, public service, banking, insurance, civil service and the department of commerce.

The governor submits to the legislature, not later than Jan. 15 (except in the case of a newly elected governor, when the date is extended to Feb. 1), a budget containing a complete plan of proposed expenditures and estimated revenues for the next fiscal year. The budget also contains recommendations of the governor for new taxes, loans or other appropriate actions to meet any estimated deficiency for the ensuing fiscal year which runs from April 1 to March 31 of the following year. A bill that has been vetoed by the governor can become law only with the approval of two-thirds of the members elected to each house of the legislature. The salaries of the governor and of the lieutenant governor are $25,000 and $10,000 respectively. The legislative power is vested in a senate of 56 members and an assembly of 150 members, each chamber elected biennially. Since the year 1846 both senators and assemblymen have been elected by single districts, and ever since the state government was established they have been apportioned according to population, but the constitution of 1938 limited the representation of New York city in the senate by declaring that no county shall have more than one-third of all the senators, nor any two adjoining counties more than one-half of them. The legislature meets in annual sessions, beginning on the first Wednesday in January. Money bills may originate in either house, but at the final vote on such a bill in either house three-fifths of the members elected to that house must be present and the yeas and nays must be recorded; bills entailing appropriations for local or private purposes must receive a two-thirds majority to pass. The legislature appoints the board of regents of the University of the State of New York. The judicial system comprises a supreme court of 127 justices, four appellate divisions of the same, a court of appeals, a court of claims and local courts. The highest judicial court in the state is the court of appeals which consists of a chief judge and six associate judges elected from the state at large for a term of 14 years. Its jurisdiction is limited, except where judgment is of death, to a review of questions of law. Vacancies are temporarily filled from among the justices of the supreme court by the governor. To expedite business, at the request of the court, the governor may designate not more than four justices of the supreme court to act temporarily as additional associate judges of the court of appeals. The salary of the chief judge is $28,500, of the associate judges $28,000 a year. The justices of the supreme court are elected for 14 years from the ten districts into which the state is divided. The jurisdiction of each justice extends over the entire state. Vacancies are temporarily filled by the governor. The supreme court has general jurisdiction in law and equity, including both civil and criminal actions. The salary of each justice is $18,000 except in the 1st, 2nd and 9th districts where $10,000 more is raised from local sources. Presiding judges receive an additional $2,500 and all assigned to appellate work an extra $2,000. The state is divided into four departments for each of which there is an appellate division consisting of seven justices each in the 1st and 2nd departments and five each in the others. The justices and presiding justices are designated from among the justices of the supreme court by the governor; the presiding justice and a majority of the other justices of each department must be residents of the department. The court of claims consists of six judges, one presiding, appointed by the governor for a term of nine years. It has jurisdiction to hear and determine private claims against the state. New York city (*q.v.*) has an extensive judiciary system of its own.

Of the 19 department heads, 17 are appointed by the governor and confirmed by the senate. The commissioner of education and the commissioner of social welfare are appointed respectively by the board of regents and the board of social welfare. Salaries for the 19 vary from $15,000 to $20,000 a year.

Local Government.—The state is divided into 62 counties, each (unless wholly included in a city) having a county board of supervisors elected for two years, one from every town or city ward. This board has certain administrative and legislative powers. Other county officers are a county judge and a county surrogate elected for a term of six years, except in New York and Kings counties where the term is 14 years, a treasurer, a clerk, a district attorney, a sheriff and from one to four coroners elected for a term of three years. Cities are of three classes, those having a population of: (1) 175,000 or more; (2) between 50,000 and 175,000; and (3) less than 50,000. The classification is according to the latest state enumeration. All city elections are held in odd-numbered years. The organization of cities and villages is provided by the legislature, which may restrict their powers of

taxation and of contracting debts and may fix salaries. Town (or township) government in New York somewhat resembles that of New England; the chief executive officer of the town is a supervisor, who represents his town in the county "board of supervisors."

Finances.—The aggregate assessed value of real property in the state on June 30, 1949, was $28,396,149,141, which under the system of assessment represented an actual value of more than $30,528,000,000. The assessed valuation was $2,644,128,000 greater than that of 1940. For many years the state levied an annual tax on real estate. In 1925 it yielded $28,460,190, but was soon after abolished. It was levied for the last time in 1928, when it yielded only $12,666,314 out of total receipts of more than $330,000,000 for that year. Special taxes were for years the chief source of revenue, but after 1928 they were virtually the only source. The total receipts of the state for the year ending March 31, 1950, were $857,354,503, and the total appropriations by the legislature amounted to $866,438,840. Of state receipts, $366,-202,625 went to state purposes and $491,151,877 to local assistance purposes. Receipts from the principal special taxes were: personal income, $262,915,861; corporations, $193,452,285; motor vehicles and motor fuel, $167,116,004; alcoholic beverages and licences, $64,584,159; cigarettes, $56,388,910; estates, $22,155,-402; pari-mutuel, $26,571,524; utilities, $25,727,372; and stock transfers, $19,869,934. Bonded debt on April 1, 1950, was $681,-013,685.

In 1851 a state banking department was created, and at the head of this is a superintendent of banks. The superintendent—or examiner appointed by him from a civil service list—is required to examine every bank, trust company and other financing institution within the state, national banks excepted. At the end of 1949 there were 773 banks in the state. The deposits in all these institutions were $41,919,595,235. The total resources were $46,-800,670,576. The 130 savings banks held deposits of $11,105,358,-361 and their assets totalled $12,326,940,063.

Education.—The first school was established by the Dutch at New Amsterdam (now New York city) as early as 1633, and at the close of the Dutch period there was a free elementary school in nearly every settlement. King's college was founded in 1754; and from 1704 to 1776 the other schools were principally those maintained by the Society for the Propagation of the Gospel in Foreign Parts. Hardly any schools remained in operation throughout the Revolutionary War. In 1784 the legislature established a state university of which Columbia college, formerly King's, was the "mother" portion. In 1787 a second university law restored to Columbia college the substance of its original charter and made the University of the State of New York an exclusive executive body with authority to incorporate new colleges and academies and to exercise over them the right of visitation. The functions of the university were extended to include an oversight of the professional, scientific and technical schools, the administration of laws relating to admission to the professions, the charge of the state library at Albany, the supervision of the local libraries, the custody of the state museum and the direction of all scientific work prosecuted by the state. In 1812 a separate system for common schools was established. This dual system was consolidated by the Educational Unification act of 1904, in conformity with which the university regents became a legislative body, subordinate to the state legislature, for determining the general educational policy of the state. The commissioner of education acts as the chief executive, advisory and supervisory officer of the whole educational system.

The regents of the university are chosen by the legislature, one retiring each year; and an act of 1909 requires that their number shall at all times be three more than the number of judicial districts. All elementary and secondary schools outside of cities and villages are under the general control of district superintendents. Two or more contiguous school districts may unite to form a central school district, to provide improved and diversified educational facilities, elementary and secondary, for all children in the merged districts.

The total public-school enrolment in 1949 was 1,944,676; 1,316,940 in 5,159 elementary schools; 137,833 in 162 junior high schools; and 489,903 in 831 high schools. Enrolment in 1,110 private and parochial schools totalled 463,104. In the 114 colleges and universities, 261,045 were enrolled.

In 1948 the legislature established the State University of New York, operating almost autonomously but legally responsible to the board of regents. This university assumed responsibility for all state-financed institutions of higher education, including 11 state teachers' colleges, at Albany, Brockport, Buffalo, Cortland, Fredonia, Geneseo, New Paltz, Oneonta, Oswego, Plattsburg and Potsdam; the state colleges of agriculture, home economics and veterinary at Cornell university (*q.v.*); of forestry and medicine at Syracuse university; the college of medicine at Brooklyn; Champlain college at Plattsburg; Triple Cities college at Endicott; the New York State Maritime college at Fort Schuyler; the school of industrial and labour relations at Cornell; the six agricultural and technical institutes; and the five institutes of applied arts and sciences established on an experimental basis for five years in 1946.

Among the larger institutions of higher learning in the state, besides Columbia university (*q.v.*), New York city, and Cornell university (*q.v.*), Ithaca, are: Rensselaer Polytechnic institute, Troy; New York university, New York city; Fordham university, New York city; City college, New York city; University of Rochester, Rochester; Polytechnic Institute of Brooklyn, Brooklyn; Niagara university, Niagara University; St. Bonaventure university, St. Bonaventure; Long Island university, Brooklyn; Manhattan college, New York city; St. John's university, Brooklyn; Canisius college, Buffalo; Syracuse university, Syracuse; Adelphi college, Garden City; Clarkson College of Technology, Potsdam; Hofstra college, Hempstead; Pratt institute, Brooklyn; Rochester Institute of Technology, Rochester; Siena college, Loudonville; University of Buffalo, Buffalo; Cooper union, New York city; Hunter College of the City of New York; and Brooklyn college, Brooklyn. The U.S. Military academy (1802) is at West Point.

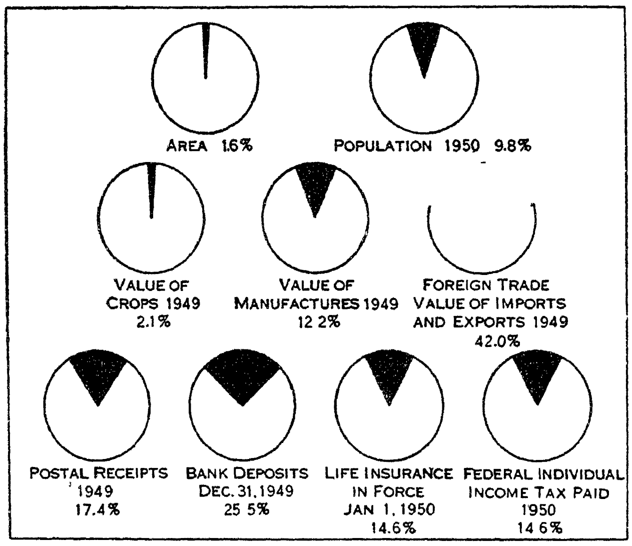
Charities and Corrections.—Penal institutions are under the supervision of the department of correction; schools for mental defectives and hospitals for the insane, except for the criminal insane, are under the supervision of the department of mental hygiene; and all other charitable and correctional institutions, maintained wholly or in part by the state, except the state camp for veterans at Bath which is under the control of the executive department, are under the supervision of the department of social welfare. Heading the department of corrections is the commissioner of correction. The division of parole, a branch of the executive department, consists of five members appointed by the governor for terms of six years each. The duties of visitation and inspection are vested in a commission of correction composed of seven members appointed by the governor and confirmed by the senate. The institutions under this department in 1950 included: Attica prison at Attica; Auburn prison at Auburn; Clinton prison at Dannemora; Great Meadow prison at Comstock; Green Haven prison at Green Haven; Sing Sing prison at Ossining; Walkill prison at Walkill; hospitals for the criminal insane at Dannemora and Matteawan; a reformatory at Elmira; a training school at Albion; a reformatory for women and the Westfield state farm at Bedford Hills; institutions for defective delinquents at Napanoch and Woodburne; a vocational institution at West Coxsackie.

At the head of the department of mental hygiene is the commissioner of mental hygiene. In 1950 the department of mental hygiene had supervision over the following institutions: state schools for mental defectives at Newark, Rome, Syracuse, Thiells, Wassaic; the Craig colony (epileptics) at Sonyea; hospitals for insane at Binghamton, Brooklyn, Buffalo, Central Islip, Helmuth, Wingdale, Poughkeepsie, Kings Park, New York city, Middletown, Rochester, Ogdensburg, Utica, Queens Village, Marcy, Brentwood, Orangeburg and Willard; a psychiatric institute at New York city and a psychopathic hospital at Syracuse.

The state department of social welfare consists of a state board of social welfare of 15 members, one member from each of the nine

judicial districts and six additional members for the state at large, all appointed by the governor with the consent of the senate for a term of five years. The board appoints the commissioner of social welfare. In 1950 the state charitable institutions were as follows: state training school for girls, Hudson; state agricultural and industrial school, Industry; Thomas Indian school, Iroquois; State Woman's Relief Corps home, Oxford; and the Training School for Boys at Warwick. The State Tuberculosis hospital at Raybrook; the State Rehabilitation hospital at West Haverstraw; tuberculosis hospitals at Oneonta and Mount Morris; the State Institute for the Study of Malignant Diseases at Buffalo, the Hermann M. Biggs Memorial hospital at Ithaca; the Onondaga sanatorium at Syracuse; Broadacres sanatorium at Utica and the J. N. Adam Memorial hospital at Perrysburg are under the control of the department of health. Facilities for educating the blind are provided by the state school for the blind at Batavia and by private institutions where pupils are maintained on a per capita basis. The deaf and dumb are educated in private institutions. Such pupils as are appointed by the commissioner of education are maintained by the state.

Agriculture.—In spite of its large urban population and its prominence as an industrial area, New York state stood 11th among the 48 states in 1949 in the value of its agricultural products. Gross sales of farm products in 1949 totalled $841,561,000. Federal government payments in 1949 comprised an additional $4,475,000. The dairy industry, including the production of milk



RELATIVE IMPORTANCE OF NEW YORK STATE IN CERTAIN ASPECTS OF THE NATIONAL LIFE

and cream and meat from cattle, accounted for more than half the gross total. The sale of milk and cream in 1949 totalled $348,032,000. Principal farm products in 1949 and the quantities produced were: milk, 8,708,000,000 lb.; eggs, 2,324,000,000; corn, 29,610,000 bu.; potatoes 30,660,000 bu.; apples, 20,090,000 bu.; oats, 22,591,000 bu.; wheat, 11,760,000 bu.; hay, 4,878,000 tons; onions, 6,205,000 sacks.

Harvested acreage in 1949 totalled 6,396,000, exclusive of land devoted to orchards and vineyards. Livestock and poultry on farms on Jan. 1, 1950, were valued at $440,168,000 and included 1,483,000 head of milch cows, 145,000 horses, 2,000 mules, 212,000 hogs, 178,000 sheep and 17,759,000 chickens. In 1949 farms in the state raised 809,000 turkeys. The value of land and buildings of all farms in the state in 1945 was $1,087,522,090 and of implements and machinery, exclusive of automobiles, $239,291,278.

The character of New York state farming is determined largely by the demands of urban areas for milk and poultry products, fruit and vegetables. Specialties for which the state is famous include wines from central New York, ducklings and oysters from Long Island, cheeses from northern New York, table grapes from the Hudson valley and apples from the Hudson and Champlain valleys and from the Lake Ontario area. Before prohibition in 1920, the Schoharie valley was famous for its hops, but this industry was not revived there following repeal in 1933.

Mining.—New York is seldom considered an important state in the production of minerals, yet since 1880 it has been the leading producer of talc in the nation and of gypsum in the world. It is the only state producing emery and wollastonite, and at Gore mountain in the Adirondacks has maintained the world's largest mine for producing garnet for abrasives. New York is the leading producer of salt for domestic, industrial and chemical uses, from huge beds underlying the central part of the state.

Because of the rapid drain upon the deposits of richer iron ore in the Mesabi region of Minnesota, New York state's beds of iron ore (magnetite, Fe_3O_4) began in the early 1940s to assume importance in the economy of the state and as a source of high-grade iron ore for the nation. The principal deposits exploited have been in the Adirondacks. In 1948, 7,865,937 long tons of magnetite ore were mined, valued at $24,384,648.

New York also became the nation's principal source of titanium in 1940. This is mined at Sanford lake near Tahawus in the Adirondacks. Magnetite is a by-product. The titanium oxide (TiO_2) is separated from the iron at the mine. Titanium oxide is used as a nondarkening pigment for white paint. At mid-century, industrial uses for metallic titanium were being developed because of its light weight in structurally strong alloys. Zinc mining is also under expansion in northern New York.

In 1948, the production of minerals in New York state attained a value of $156,140,000. The principal minerals, excepting iron, contributing to this total are shown in the following table:

Mineral	Production	Value
Portland cement	12,299,226 bbl.	$26,071,417
Crude gypsum	1,228,358 short tons	3,294,973
Lead	1,231 "	440,698
Natural gas	4,705,000,000,000 cu.ft.	1,040,000
Petroleum	4,621,000 bbl.	22,975,000
Salt	3,065,831 short tons	13,056,542
Sand and gravel	16,369,303 "	13,382,370
Limestone	11,140,000 "	14,367,974
Zinc	34,566 "	9,194,556
Talc	119,716 "	2,613,935
Titanium concentrates	*	*
Silver	18,788 troy ounces	17,004
Miscellaneous		29,808,161

*Figures withheld.

Other minerals produced in appreciable proportions include diatomite, feldspar, garnet (abrasive), lime, graphite, slate, granite, marble and wollastonite.

After 1945, aerial, magnetic surveys located large, new deposits of magnetite in the northern Adirondacks. Several steel companies began to conduct intensive surveys by borings in the area.

Manufactures.—The establishment of a great highway of commerce through the state from New York city to Buffalo by the construction of the Erie canal, opened in 1825, and later by the building of railways along the line of the water route, made the state's manufactures quite independent of its own natural resources. Thus it happens that from Buffalo to New York city there is a chain of busy manufacturing centres; but away from the great natural route of commerce New York manufacturing and the density of population decrease. In these areas, farming and resort business prevail.

New York state has ranked first in the union in the value of its manufactures since 1830, and this value rose to $21,700,000,000 in 1949. The manufacture of clothing, begun in New York city about 1835, is not only the city's chief product but is also the principal product of the state. Buffalo, the city second in manufactures, produces flour, iron and steel products, industrial chemicals, rubber and electronic products and motor vehicles. Rochester, the city third in manufactures, is first among the cities of the United States in the manufacture of photographic materials and apparatus, optical instruments and men's clothing. Niagara Falls and New York city manufacture a large part of the chemicals. Other prominent manufacturing cities are Albany, Binghamton, Schenectady, Syracuse, Troy, [illegible].

The ten leading manufactures in New York state in 1947, rated by value added by manufacture and listing their employee totals, were:

Manufacture	Value added by manufacture	Number of employees
Apparel	$2,009,000,000	382,486
Printing and printing products	1,128,000,000	166,492
Food products	977,000,000	135,296
Primary metals	830,000,000	165,858
Machinery (except electrical)	679,000,000	137,556
Chemicals	596,000,000	69,066
Electrical machinery	459,000,000	101,861
Textile-mill products	429,000,000	89,803
Paper and paper products	374,000,000	65,026

There were an estimated 580,000 business firms of all kinds and sizes in 1950, with 5,502,800 nonagricultural employees. Average factory earnings of workers in 1949 were $57.47 a week. During World War II, manufacturers in New York state produced total goods valued at $23,048,000,000 on war contracts, leading every other industrial state for the period.

Transport and Commerce.—From the very beginning of the occupation of New York by Europeans, commerce was much encouraged by the natural watercourses. The Erie canal was opened to boats of about 75 tons burden in 1825. The Champlain canal, connecting the Erie with Lake Champlain, was completed in 1823. The Oswego canal, connecting the Erie with Lake Ontario, was begun in 1825 and completed in 1828. Several other tributary canals were constructed during this period, and between 1836 and 1862 the Erie was sufficiently enlarged to accommodate boats of 240 tons burden. In 1918, the Barge canal was completed, incorporating the earlier canals and providing navigation for barges of 1,000 tons burden. Total canal and navigable river mileage in 1950 was 800.

The first railway in the state and the second in operation in the United States was the Mohawk and Hudson, opened from Albany to Schenectady in 1831. The first great trunk line in the country was that of the Erie railway, opened from Piermont, on the Hudson river, to Dunkirk, on Lake Erie, in 1853. The New York Central railway, nearly parallel with the water route from New York city to Buffalo, was formed by the union, in 1869, of the New York Central with the Hudson River railway. In 1886 the New York Central Railroad company leased the West Shore railway for a term of 475 years, and this company operates another parallel line from Syracuse to Buffalo, a line following closely the entire north border of the state, and several crosslines. Other important railways are the Lehigh Valley, the Delaware, Lackawanna and Western, and the Pennsylvania in the central and western sections, the Delaware and Hudson, the Rutland, the Boston and Maine, the Central New England and the New York, Ontario and Western in the east, and the Long Island on Long Island. In 1950 the operated mileage of the 41 railroads in New York was 7,639. In the same year there were 86,552 mi. of highways, 66,013 mi. of which were classified as improved and 14,300 mi. under state control.

In 1948, construction of a 535-mi., multiple-lane motor "Thruway" was begun, to connect New York city, via Albany, to Buffalo and the western edge of the state. Airport development progressed after World War II to provide 259 airports and 62 seaplane bases in 1950. Air traffic in 1949 included 66,039 tons of air cargo and 4,341,000 passengers.

The port of New York city is the greatest port in the world. Approximately 50% by value of the exports from the U.S. and imports into it pass through the New York customs district.

Retail trade of the state in 1949 was estimated at $13,365,-097,000. Income payments to all individuals in that year totalled $26,346,000,000.

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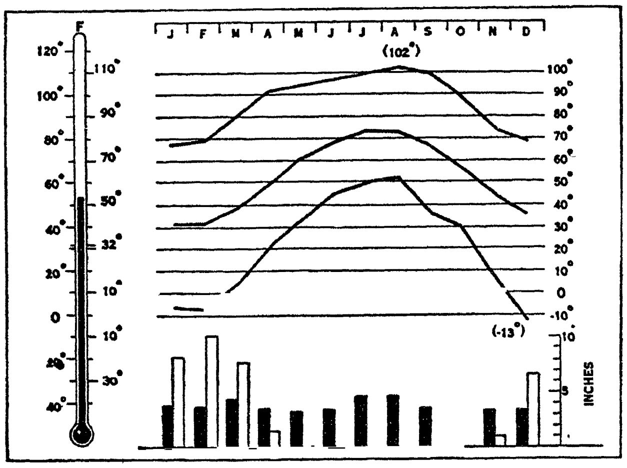
(A. E. SM.; A. R. T.)

NEW YORK (CITY), the largest city in the United States, is situated at the mouth of the Hudson river, there sometimes called the North river. The five boroughs comprising the city are: the Bronx (Bronx county), 41.4 sq.mi., on the southeasternmost part of the mainland adjoining Westchester county and separated from the borough of Manhattan by the Harlem river (a canalized waterway connecting the Hudson and East rivers); Manhattan (New York county), 22.3 sq.mi., on Manhattan Island between the Hudson and East rivers; Queens (Queens county), 118.6 sq.mi., adjoining Nassau county and separated from the Bronx and Manhattan by the East river; Brooklyn (Kings county), 81 sq.mi., on the western end of Long Island; and Richmond (Richmond county), 57 sq.mi., on Staten Island southwest of Brooklyn and separated from it by the Narrows (a strait connecting Upper and Lower bays) and from the mainland of the state of New Jersey by tidal estuaries known as Kill van Kull and Arthur Kill. The city hall, near the southern end of Manhattan Island, is in lat. 40° 42′ 43″ N., and long. 74° 0′ 29″ W. The greatest width of the city, east and west, is 24 mi. and the greatest length, northeast and southwest, is 35 mi. The land area is 320.3 sq.mi. The city's more important small islands are: North and South Brother, Riker's, City, Hunter, Hart, Governor's (occupied by a U.S. military reservation), Welfare (formerly Blackwell's), Ward's, Randall's (the latter three occupied by state and city institutions) and numerous islands in Jamaica bay. Bedloe's Island (on which stands the F. Bartholdi Statue of Liberty) and Ellis Island (occupied by the federal government as

an immigrant station) are in Upper bay, within the bounds of New Jersey.

The total water front is 578 mi., of which Manhattan has 43 mi.; Brooklyn, 201 mi.; the Bronx, 80 mi.; Queens, 197 mi.; and Richmond, 57 mi.

In 1626 there were fewer than 200 inhabitants, 1,000 in 1656, and but 14,000 in 1760. About 1783 New York began its rapid growth as the leading port. Between 1786–96 the population had nearly doubled, and by 1871 it was 1,000,000. In 1898 five boroughs were united to form greater New York. In 1920 the total population was 5,620,048; in 1940, 7,454,995; in 1950, it was 7,891,957, divided as follows: Manhattan 1,960,101; the Bronx 1,451,277; Brooklyn 2,738,175; Queens 1,550,849; Richmond 191,555. This was an increase of 6% in the decade 1940–50. Almost every national and racial group in the world is represented among the people in the city.



WEATHER GRAPH OF NEW YORK CITY. THE THERMOMETER INDICATES NORMAL ANNUAL MEAN TEMPERATURE. THE CENTRE CURVE SHOWS NORMAL MONTHLY MEAN TEMPERATURE; THE CURVES ABOVE AND BELOW, THE HIGHEST AND LOWEST EVER RECORDED IN EACH MONTH. THE COLUMNS INDICATE THE NORMAL MONTHLY PRECIPITATION; THE SHADED COLUMN, TOTAL PRECIPITATION (INCLUDING MELTED SNOW); THE WHITE COLUMN, SNOWFALL

The Negro population (458,444 in 1940) had for years been centred in the Harlem district, roughly between 110th street on the south and 150th street on the north, in an area bounded on the east by Fifth avenue and on the west by St. Nicholas avenue. The sharp growth in Negro population after 1940, coupled with an immigration of about 300,000 Puerto Ricans (the new economic and social marginal group) into the east Harlem and Bronx slum areas, led to movements of Negroes into areas in Brooklyn, the Bronx and Queens which formerly had only a small Negro population, and in Manhattan to a broadening and lengthening of the Harlem district. The Chinese quarter is in the neighbourhood of Chatham square, on Mott, Pell and Doyers streets. The city of New York has more Jews than any other city, the estimates ranging in 1950 from 1,800,000 to 2,000,000. The Jewish population has tended to centralize in Brooklyn and the Bronx.

Important changes in the distribution and concentration of population occurred during 1940–50. Queens, relatively sparsely populated in 1940, increased its population by 19.2%, with one area, Flushing, whose birth rate increased 144%, showing a gain of more than 50%. The declines in population in the old marginal slum areas that sprouted in the centre of industrial sections of Brooklyn, and in the Brownsville and Bushwick districts almost counterbalanced gains in other areas so that Brooklyn's population increased by only 0.7%. The Bronx's population showed a similar pattern of declines in the older areas and growth in the new less-crowded areas, with a net gain of 3.6%. Manhattan, the most densely populated borough in the city, increased its population by 2.5%; the relatively high income area in mid-Manhattan, bounded by Central park on the east and the Hudson river on the west, showed the largest gain, 5.6%. The lower east side, once the home of most of New York's foreign-born, increased by 5.5%. The latter gain was caused by the rapid growth of new housing developments and their occupation by younger people whose higher fertility rates accounted for an increase in birth rate of 116% since 1940.

The New York metropolitan district, as defined by the U.S. census bureau, includes 17 counties in New York and eastern New Jersey (19 counties including a part of Connecticut were included in 1940). This land area had a population of 12,911,994 according to the 1950 census. In addition to New York city, it includes such important centres of industry and population as Newark, Paterson, Elizabeth, Bayonne, Hoboken, Passaic, Union City, East Orange, Perth Amboy, Orange and New Brunswick in New Jersey; and Yonkers, Mount Vernon, New Rochelle and White Plains in New York.

HISTORY

New York bay and the Hudson river were probably first discovered by Giovanni da Verrazano, an Italian navigator, in 1524, and seen also by Estéban Gómez, a Portuguese, in 1525. It is commonly stated that the first competent exploration of New York bay and its environs was made by Henry Hudson in the "Half Moon" in Sept. 1609. But there is in Paris a map dated 1570 which shows in considerable detail the topography near the mouth of the Hudson. In 1611 Adriaen Block came to Manhattan Island and returned to trade for furs with the Indians. In 1614 he explored the harbour of Manhattan and its adjacent waters and was probably the first European to enter Long Island sound. The states-general of Holland granted a charter to the New Netherland company giving it the exclusive right to trade in New Netherland for four voyages, to be made within three years from Jan. 1, 1615. In 1615 the company built a storehouse and fort on the south end of Manhattan and a few huts sprang up around it. On Jan. 1, 1618, the charter expired. In June 1623 New Netherland was formally established as a province of the West India company. The next year a party of about 30 Protestant Walloon families arrived. Of these colonists only about eight men remained on Manhattan, the remainder going to establish Fort Orange where Albany now is. The next year more colonists came, and when Director Mey gave way to Director Verhulst, the colony numbered almost 200 persons. The government of the New Netherland province was vested in a director-general and a council. These officers, though formally appointed by the company, were subject to the approval of the states-general. The first director-general, Peter Minuit, arrived with additional colonists in 1626, purchased Manhattan Island from the Indians with pieces of bright cloth, beads and other trinkets to the value of 60 guilders or about $24, erected Fort Amsterdam at the lower end of the island, and made New Amsterdam the seat of government. Wouter van Twiller, who succeeded him in 1633, was recalled in 1637 because of his mismanagement. Under the wise rule of Peter Stuyvesant (*q.v.*) the province prospered and, at the time of the transfer of New Netherland to English control, the population stood at about 10,000 (*see* NEW YORK [STATE]: *History*). In 1658 Stuyvesant established a "rattle watch" of eight men which may be called New York's first police force. The strife between the English and Dutch went on until 1664, when Col. Richard Nicolls took possession of the city without bloodshed on Sept. 8, 1664. The English flag was raised over the fort, which was renamed Fort James, and New Amsterdam became New York.

The rights of the Dutch settlers were carefully maintained at first, and established institutions changed only gradually. The English reorganized the city government (1665) with a mayor, aldermen and sheriff to be appointed by the governor of the province for a term of one year, and also extended the city limits to include all of Manhattan Island. The Dutch reoccupied the city from July 30, 1673, to Nov. 9, 1674, when Colve surrendered to Sir Edmund Andros, the new English governor. Andros restored the English form of city government. The next 100 years is in the main a record of continuous struggle for control of the

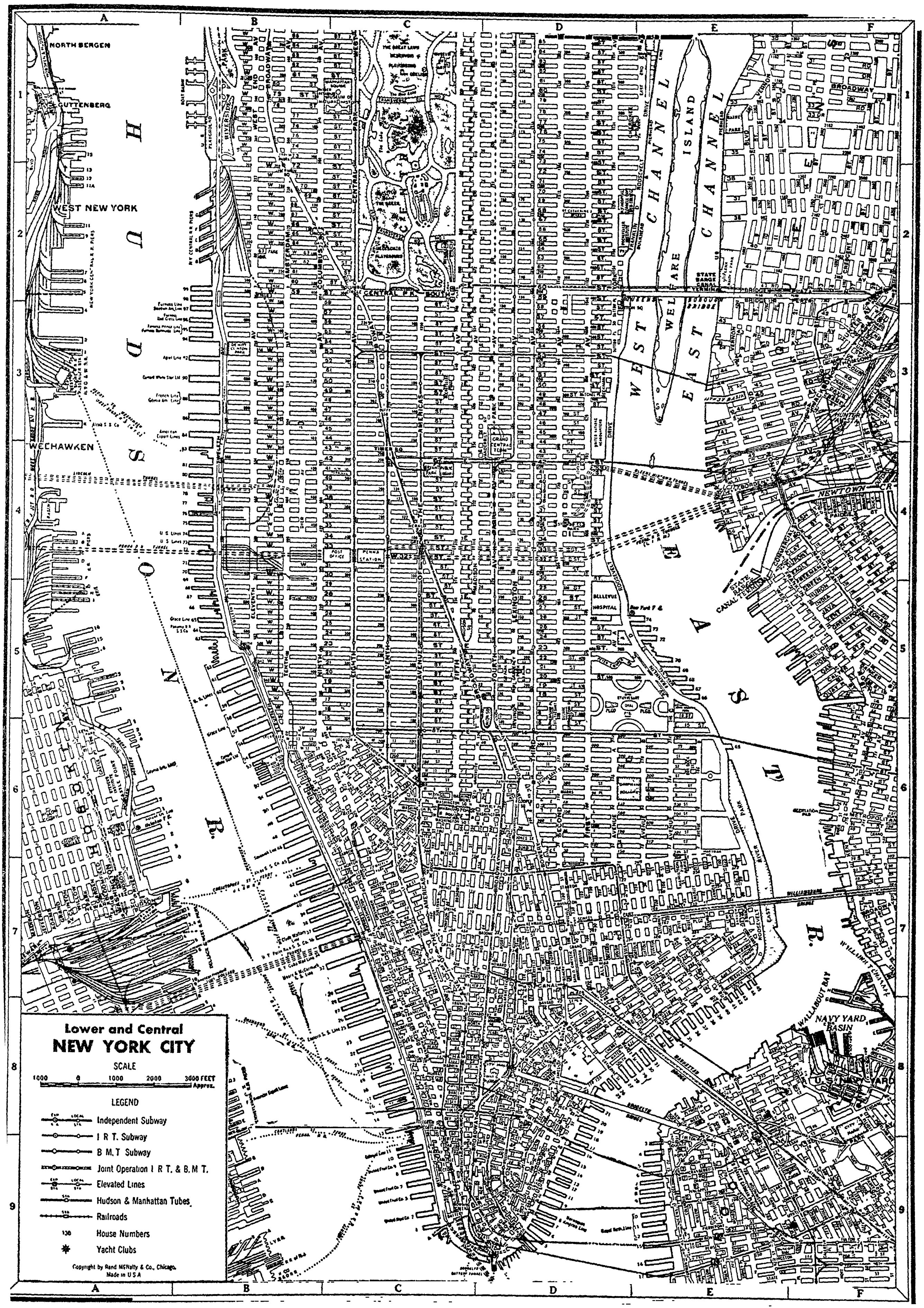
city government between the royal agents and the inhabitants. There were good and bad governors, but none was capable of stemming the tide of popular demand for greater freedom of self-determination. The first serious break in English resistance came with the refusal of the merchants of New York and other parts of the province to pay certain duties exacted by the "Duke's Laws." Gov. Thomas Dongan called the first New York assembly on Oct. 17, 1683, and to this body freemen were permitted to elect representatives. Dongan's regime is notable also for "Dongan's charter," which was granted the city in April 1686 and whereby sources of income were vested in the city corporation, all previous rights and privileges being confirmed and conveyed to the corporation, including the proprietorship of the city hall, the market houses, bridges, wharves, docks, cemeteries, ferries, unoccupied lands and the waters within the city. The city seal presented to the corporation the same year is that which it now employs with its motto *Sigillum Civitatis Novi Eboraci,* except that an eagle was substituted for the royal crown in 1784. Under the rule of Jacob Leisler (1689–91) the people were permitted, for the first time, to elect their own mayor, Peter de Lanoy, a privilege that lapsed until 1834. Henry Sloughter, Leisler's successor, appointed as mayor Abraham DePeyster, a young, cultured and popular man of irreproachable character. He was effective in conciliating the warring factions, and responsible for many public improvements. The old "rattle watch" or police of the city was reorganized by DePeyster in 1697, and placed again under civil control. DePeyster built new wharves, provided the first system of poor relief and instituted sanitary betterments. Business prospered in spite of the unrest in the province as a whole. Pirates in and about New York were a source of constant irritation, and Gov. Benjamin Fletcher, who had succeeded Sloughter, was even suspected of being in league with them. They were finally dispersed by Lord Bellomont, Fletcher's successor, and a measure of confidence in the government restored. But the incompetence of governors Lord Cornbury and Francis Lovelace increased resentment against English government; and its appointed mayors, though in the main men of good standing, were so frequently changed that none except William Peartree (1703–09) made noticeable impressions upon municipal affairs. Peartree established the first free grammar school and a school for Negro slaves. He also improved the jail and provided a debtor's prison in the city hall. Gov. Robert Hunter, a cultured gentleman, who took office in June 1710, was more tactful than his predecessors; but his regime was ten years of turmoil. In April 1712 insurgent Negroes massacred nine white men and wounded many more. Twenty-one Negroes were legally executed, some in a most barbaric manner, and many others, innocent as well as guilty, were imprisoned. Broadway was graded from Maiden lane to the commons, under Mayor Caleb Heathcote, and a new Presbyterian church was built.

By the middle of the 18th century New York city was regarded as the focal point of resistance to royal authority. A majority of its leading citizens were descendants of the Dutch patroons, intelligent men and women who, though loyal to the English government, were fully aware of its incompetency in America. Gov. George Clinton, who returned to England in 1753 after a stormy rule of ten years, turned over the government to Sir Danvers Osborn on Oct. 7. The next day, Osborn's body was found hanging in the garden of his home. Chief Justice James DeLancey took oath as lieutenant governor and became acting governor. On Oct. 31, 1754, DeLancey signed the charter of King's college (now Columbia university, *q.v.*), which had been established in 1753 in the vestry room of Trinity church. News of the capture of Quebec by James Wolfe in 1759 was hailed in New York with great enthusiasm. Causes of resentment against English rule were soon supplied by the imprisonment of New York sailors by British men-of-war in the very harbour of the city. When copies of the Stamp act reached New York it was denounced by the newspapers. On Oct. 7, 1765, the Stamp Act congress was called at the city hall, with representatives from all provinces. While the congress was still in session on Oct. 23, a British ship arrived loaded with stamps, and in the face of the resistance of the people the fort prepared itself for defense. On Nov. 1, 1765, a band of the Sons of Liberty hanged Gov. Cadwallader Colden in effigy at the very door of the fort, and then burned the houses of several prominent officials. Mayor John Cruger finally induced Colden to turn over the stamps to the city corporation; but the Sons of Liberty were firm in their resistance to the enforcement of the Stamp act and it was finally repealed on March 18, 1766. New York went wild with excitement and the Sons of Liberty on June 4 erected a liberty pole in the "Fields" (City Hall park), where a replica now stands. Rioting between the Sons of Liberty and the British soldiers was of almost daily occurrence and finally, in 1770, Mayor Whitehead Hicks issued a proclamation forbidding soldiers to leave the barracks unless accompanied by an officer. The liberty pole, which had been erected and cut down several times, was finally put up on the commons and inscribed "Liberty and Property." But with the arrival of Sir William Tryon as governor, in July 1771, it became apparent almost at once that the temporary peace would shortly end. News that a tea ship was on its way to New York to carry out Lord North's purposes of taxation was received with violent expressions of defiance throughout the city. The Sons of Liberty reorganized to stir up resistance. When the ship reached New York, on April 7, 1774, its landing was refused, a few chests of tea were thrown into the bay by a committee of the Sons of Liberty previously appointed and the ship sent home to England. The closure of the port of Boston was the signal for the calling of a meeting at Fraunces' tavern and the election of a committee of 51, which issued the call for the first congress of the Colonies. The committee of 51 was dissolved with the election of a new committee of observation to enforce in New York the Nonimportation act of the first congress. From this time on events moved swiftly. On April 23, 1775, news of the battle of Lexington reached New York. A mob took possession of city hall and seized munitions stored there. Two British ships in the harbour were seized and their cargoes unloaded. The committee of 60 called for the election of a new committee of 100 to arrange for calling a war congress of deputies from all New York counties. The provincial congress met in New York and declared obedience to the Continental Congress, while reserving their right of internal control. On June 25 Gen. George Washington arrived in New York with his staff on the way to Boston and the same day Governor Tryon returned from England. Each was received with official ceremony, but Washington's reception as he passed up Broadway was an ovation. On April 4, 1776, New York was put under military rule by Gen. Israel Putnam, and batteries were installed along the East river and other strategic points. On the evacuation of Boston, Washington moved his headquarters to New York. The news of the Declaration of Independence came to New York on July 9, 1776, and was read to the soldiers who immediately thereafter tore down the equestrian statue of George III in Bowling Green, an act denounced by Washington in the next day's general orders. On July 12 Adm. Richard Howe appeared with his fleet in the harbour, but not until Aug. 22 were troops landed at Gravesend bay. On Aug. 27 the advance of British troops toward the American lines on Brooklyn heights was begun, and by 2 o'clock the same day the heights were taken by the British. On the evening of the 29th Washington withdrew all his troops from Long Island without interference and reorganized in New York. The British then undertook to cut off the American army, on Sept. 15, by throwing a line of troops across Manhattan at about 34th street. But the Americans got to Harlem heights, where Washington again reorganized. On Sept. 16, the British attacked unsuccessfully at Harlem heights. About a week later, a fire broke out at Whitehall slip and almost completely destroyed the lower part of the city. Trinity church was burned but St. Paul's and King's college were miraculously saved by a shifting of the wind. On this same evening Nathan Hale, a spy for the American army, was captured on Long Island and tried in New York by Gen. William Howe. He admitted that he was a spy and was condemned and hanged at a spot near 45th street and First avenue. New York was held by the British troops for the remainder of the war. During British occupancy, it was used largely as a prison camp. Churches, warehouses, jails and stores were packed with men sick and well. On the site of the fire, a village of huts and tents had

sprung up which was called "Canvas Town," and occupied by bandits and "roughs." Robberies were a daily occurrence and citizens could expect no relief from the British soldiers. In Wallabout bay, on the East river, an old hulk, the "Jersey," was used by the British as a prison ship and there more than 11,000 men died. The city was in desperate straits for want of supplies, and sickness ravaged the people. There was no government except military rule, and the oppression of civilians by the soldiery was the cause of frequent riots. Justice was not to be had and the revenues of the city corporation were appropriated by the military for their private uses. After the surrender of Lord Cornwallis at Yorktown, however, Sir Guy Carleton, a humane and honest officer, succeeded the intolerant Sir Henry Clinton in May 1782, and immediately undertook the restoration of law and order. By the time of the evacuation, Nov. 25, 1783, confidence in government was in a fair way to restoration.

The parting of Washington with his troops came on Dec. 4, 1783, at Fraunces' tavern. After the departure of Washington, James Duane was appointed mayor by Gov. George Clinton. Business slowly revived with freedom from restrictions of trade. King's college, by act of legislature, May 1, 1784, became the state university, and its name was changed to Columbia college. At this time, the population of the city was about 24,000. Congress made New York the capital. On April 30, 1789, Washington was inaugurated at Federal hall at the corner of Broad and Wall streets, and a day of celebration followed. There was still intense feeling against the loyalists, but commercial interests soon erased the memories of personal conflict. The rise of commerce and wealth drew many people to New York, and it began to take on the appearance of a metropolis. As capital, the city was continually gay with festivities, public and private. But on Aug. 12, 1790, Washington made his last official visit to Federal hall and went to the new capital, Philadelphia. Edmond Charles Genet, on his arrival with the secret purpose of embroiling the U.S. in a war with England, was received in New York at first with great enthusiasm but, with his recall, interest in French affairs grew cool. Men were too busy with their own affairs. Since 1786 the population had doubled and new streets and public utilities had been laid out. Collect pond, later the site of the Tombs (city prison), was the scene of the first trials of John Fitch's steamboat in 1796. New York ceased to be state capital in 1797. On July 11, 1804, the death of Alexander Hamilton in his duel with Aaron Burr threw the city into mourning and Burr was so execrated he left in the night of July 21. This year the New York Historical society was founded. With the help of Mayor DeWitt Clinton and of several of the founders of the society, there was organized, in 1805, the Society for Establishing a Free School in the City of New York. Under Clinton schools were built and Columbia college improved, philanthropic organizations increased in number, and arts and letters were stimulated. In 1807 there were 19 newspapers, of which 8 were dailies. Although the Embargo act of that year struck New York trade a serious blow, it was not without benefit in stimulating home industry. Finally, the Non-intercourse act relieved the situation somewhat. The city hall was completed in 1812, and there was at this time a very considerable advance both in architecture and building construction. Many new buildings, chiefly churches, were built, new streets were graded and swamps were filled in along the water front. Collect pond was filled in and the hills and valleys of lower Manhattan were rapidly levelled for homes and other structures. In the midst of this prosperity, war was declared against Great Britain. The toll exacted from New York was tremendous; the burning of Washington, D.C., by the British resulted in a great concentration of troops in New York. New fortifications were thrown up along the water front and the old ones strengthened. But on Feb. 11, 1814, the ship "Favorite" arrived at New York under flag of truce with British and American messengers and the treaty of peace. A jubilee followed and Sunday was a day of fervent thanksgiving. New York was then transformed almost overnight. DeWitt Clinton was again mayor, and under his guidance the services of government were everywhere improved. Cadwallader D. Colden succeeded Clinton and likewise advanced all governmental and private services for public welfare. Great numbers of immigrants from Europe arrived and the problems of dealing with this great mass of new residents taxed the city to its limits. Yellow fever broke out in 1819, 1822 and 1823, and hundreds died daily until the epidemics were checked with the coming of cold weather; others occurred ten years later with similar loss of life, but the city continued to grow with amazing rapidity. The opening of the Erie canal on Nov. 4, 1825, began a three days' celebration. At this date, the modern history of New York begins.

Under Mayor Philip Hone (1826) fine dwellings, public buildings and mercantile establishments multiplied; wealth increased and the continuing influx of immigrants made evident the need for greater educational opportunities. The University of the City of New York was established in a splendid new building opened in 1835. There were now more than 200,000 people in the city, and transportation was a pressing problem, only partly solved by the horse-drawn street cars. Another great fire broke out below Wall street on Dec. 16, 1835, and the succeeding months saw great distress. Croton water was furnished the city July 4, 1842. Blackwell's (now Welfare) Island, purchased in 1828 for $50,000, was made the site of the city's correctional institutions and hospitals. The *New York Sun*, whose issue by Benjamin H. Day was begun in 1833, sold for a penny. The *Herald* of James Gordon Bennett appeared in 1835, the *Tribune* of Horace Greeley in 1841, Henry J. Raymond's *Times* in 1851. The theatre was thriving, business was rapidly spreading uptown, and Union square was the residential centre. Beyond Union square, there was little but open fields at the middle of the century. The World's fair at the Crystal palace on Murray Hill was the outstanding event of 1853; in 1856 Central park was purchased. But in 1857 business was paralyzed, thousands thrown out of work, and more than 900 merchants failed; riots and disturbances of all kinds ensued. The same year, the state legislature laid the basis for the modern metropolitan police force, and a new regime of law and order was begun. The city recovered quickly from the depression of 1857, and at the outbreak of the Civil War was again thriving; it authorized a loan of $1,000,000 for defense of the Union, and hundreds of thousands more were privately pledged. New York was again filled with soldiers. Rioting broke out in July 1863 as a protest against army drafts and for five days there was turmoil. More than 50 buildings were burned and several hundred people killed or wounded. Mayor George Opdyke, in 1863, reported that the people of New York had contributed up to that time $300,000,000 for war purposes, and had furnished more than 80,000 men. During the war, the establishment of schools, scientific and literary associations, libraries, museums, and clubs went on apace, and at its end New York was still able to find resources for great public works. Brooklyn bridge was begun in 1870, and sanitary conditions, which in 1865 had been thoroughly studied by a citizens' committee and found deplorable, were on their way to betterment. New public improvements opened fresh opportunities for graft by public officials. Under the Tammany mayor, A. Oakey Hall, in 1872, a gigantic conspiracy for looting the city, known as the "Tweed ring," was exposed by the *New York Times* and a citizens' committee. The thefts of the ring ran into hundreds of millions, the graft in the erection of the county courthouse alone amounting to about $8,000,000. "Boss" William Marcy Tweed and many of his followers were tried and sent to prison, and Tweed died there. Then followed a reform administration, but in 1874 Tammany regained control. The corporate limits of the city were extended in 1874 to include about 13,000 ac. across the Harlem river, in the Bronx, and in 1895, a still further extension in the same county was made which brought the city limits to the southern boundaries of Yonkers and Mount Vernon. In this same year, Col. George E. Waring, representing a reform administration under Mayor William L. Strong, was made commissioner of street cleaning and with his "white wings" inaugurated the modern system of street cleaning and refuse collection. The city was still further increased in 1898 by the annexation of Kings, Richmond and a part of Queens counties, and a new charter was enacted for the greater New York. During all this period of administrative


Lower and Central
NEW YORK CITY
SCALE
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LEGEND
Independent Subway
I R T. Subway
B M.T Subway
Joint Operation I R T. & B.M T.
Elevated Lines
Hudson & Manhattan Tubes
Railroads
130 House Numbers
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NORTH BERGEN
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EAST CHANNEL
WELFARE ISLAND
CENTRAL PK. SOUTH
GRAND CENTRAL TERM.
PENN. STATION
POST OFFICE
BELLEVUE HOSPITAL
NEWTOWN CR.
NAVY YARD BASIN
WALLABOUT BAY
STATE BARGE CANAL TERMINAL
WILLIAMSBURG BRIDGE
MANHATTAN BRIDGE
BROOKLYN BRIDGE
QUEENSBORO BRIDGE
BROADWAY
HOLLAND TUNNEL

reconstruction, Tammany hall continued the great political power, although occasionally defeated for the mayoralty. In 1897 Tammany again got control of the mayor's office by the election of R. A. Van Wyck, but was defeated in 1901, because of its abuse of power. Seth Low, a reform mayor, served during 1902 and 1903 when Tammany regained control. During the next 30 years Tammany generally maintained its political power. Mayors George B. McClellan (1904–10) and William J. Gaynor (1910–13) were both elected by Tammany and both were able men and strove to give the city good government, even under the handicaps of the Tammany political system. In Mayor McClellan's administration, however, a citizens' civic agency, the New York Bureau of Municipal Research (organized in 1906), disclosed and published a report on irregularities in the administration of the office of Borough President Ahearn of Manhattan. Mayor McClellan appointed as a special counsel John Purroy Mitchel, who secured sufficient evidence of these irregularities to warrant Gov. Charles Evans Hughes in removing Borough President Ahearn for incompetency. In Mayor Gaynor's administration, a police lieutenant was arrested, tried and later found guilty of complicity with gangsters in the murder of a New York merchant, who was on the point of making disclosures of police corruption to the district attorney. Mayor Gaynor, wounded in an attempt upon his life, failed in health and died Sept. 10, 1913, almost at the end of his term. The police scandals of Gaynor's administration swung popular sympathy against Tammany, and John Purroy Mitchel, candidate for mayor on a "fusion" ticket, was elected and took office in 1914. In Sept. 1914 a special aldermanic committee of investigation undertook a complete survey of police administration and methods. The facts finally brought out by this committee furnished clear evidence of police incompetency and corruption. Mayor Mitchel's administration from 1914 to 1918 was regarded as exceptionally efficient because of the administrative reforms which he instituted.

Yet in the next election Mitchel was defeated by an overwhelming vote, and John F. Hylan, another Tammany mayor, took office in 1918, on a platform of outspoken repudiation of the Mitchel administration. Mayor Hylan held office for two terms during which time there was continuous wrangling among the superior officers of administration to the extent that little of importance for the city's betterment was accomplished. One of the outstanding features of government in the period covered by the administrations of Gaynor, Mitchel and Hylan was the enormous increase of budget from $163,130,270.37 in 1910 to $345,530,039.77 in 1921. In 1925, Mayor Hylan, denounced by many of his own Tammany supporters, was refused party support, and James J. Walker, a representative of the "new Tammany," who had made a good record in the state senate, received the Democratic nomination. He was well supported by Gov. Alfred E. Smith who was everywhere recognized as the actual leader of Tammany hall, and, without much opposition from the Republicans, Walker was elected with the endorsement of a great popular vote. The great issues of the Hylan administration, rapid transit and subway fares, continued paramount under the new mayor without, however, reaching a satisfactory solution. In 1932 Walker was summoned before Gov. Franklin D. Roosevelt to answer charges of graft brought by Samuel Seabury, counsel for the Hofstadter committee; and failing to halt these proceedings for his removal, he chose to resign from office. After an interim under Joseph V. McKee (Sept. 1–Dec. 31, 1932) and John P. O'Brien, during which the city's credit became badly strained, a reform candidate on a fusion ticket, Fiorello LaGuardia, was elected mayor in 1933 and re-elected in 1937 and 1941. The LaGuardia administration was marked by such events as the unification of the transportation system under city operation, the completion of the Triborough bridge and Lincoln tunnel and Queens Midtown tunnel, development of the Delaware water supply system and the World's fair of 1939 and 1940. The wave of civic regeneration set in motion by the Seabury investigations was carried forward by District Attorney Thomas E. Dewey and John H. Amen, with a series of political and gangster prosecutions and convictions. Though Tammany hall strengthened its shattered position with each election, the voters were twice given an opportunity, in 1936 and 1938, to vote on proportional representation and each time voted in its favour.

LaGuardia did not run for re-election in 1945, and William V. O'Dwyer, a Democrat, former patrolman, district attorney and military government officer with the rank of brigadier general was elected mayor.

O'Dwyer proved a generally vigorous and effective administrator and political leader though not always equally popular. The notable achievements of his administration included an extensive building program, with great emphasis on schools, hospitals, traffic speedways and public housing, in connection with which more than $1,000,000,000 was spent or committed during his term of office. As a result of these greatly increased facilities and generally rising costs, O'Dwyer brought in the largest annual budget in the history of the city, exceeding $1,250,000,000 for the year 1950–51. The mayor also instituted a far-reaching program of administrative reform, creating the executive committee on administration in his own office, composed of top career administrators; the division of analysis in the bureau of the budget, a management survey unit; corresponding methods analysis units in 24 of the major city departments; and finally the mayor's committee on management survey. This committee was composed of 29 members including the city's chief financial official, the elected comptroller, as chairman, the deputy mayor and several other career city employees, a number of business and professional leaders, representatives of organized labour and the presidents or secretaries of leading civic organizations. This committee was authorized to initiate extensive management surveys, utilizing leading firms of consultants and engineers. Approximately $2,000,000 was earmarked for this purpose when the work was initiated in March 1950, with the expectation that the project would be completed in 1952.

Among the major political issues of the period were the abolition of proportional representation as a means of electing the 25 city councilmen and the consequent reduction of the opposition and reform element of the council to a minority of one.

Other notable political decisions involved the adoption of a ten-cent fare for the transit system (July 1948), the acceptance of collective bargaining with subway unions, the refusal to deal with so-called "Communist unions," the transfer of the city's airports to the Port of New York authority on a 50-year lease and the sharp increase of salary rates for top elected officers which placed the mayor at $40,000 per year, the comptroller at $30,000 and the president of the city council and the five borough presidents at $25,000.

The first serious water shortage in the history of the city, during the winter, spring and summer of 1949–50, resulted in vigorous conservation measures, the use of harbour water for street flushing, the construction of an emergency pumping plant designed to use Hudson river water and the stimulation of construction to increase the water supply from upland sources.

O'Dwyer was re-elected to office in Nov. 1949, but resigned on Sept. 1, 1950, to accept the less strenuous assignment as United States ambassador to Mexico. He was succeeded under the charter by the president of the city council, Vincent R. Impellitteri, a regular Democrat who, running as an "independent," was elected mayor in the special election of Nov. 1950 without Tammany nomination and support.

Impellitteri appointed a new commissioner of police to stamp out police connections with gambling as disclosed by the district attorney's investigations in Brooklyn, and a new commissioner of fire to reorganize the fire department. He replaced the chairman of the city planning commission, but otherwise appeared to be continuing the general policies and programs of the prior administration. (R. B. F.; L. Gu.)

COMMERCE AND INDUSTRY

Harbour.—The port of New York has the greatest harbour in the world. The harbour is naturally divided into several parts. At the entrance from the Atlantic is the outer harbour (about 122 sq.mi.), known as Lower bay. Raritan bay lies adjacent to the Lower bay on the west and the Raritan river and the Kill van Kull flow into the west side of Raritan bay. The Ambrose channel is the

chief of several channels crossing the broad bar at the entrance to the outer harbour. It leads northwestward and then northward into the inner harbour, through the Narrows, a neck about one mile wide between Long Island and Staten Island. The inner harbour consists of the Upper bay, four miles long and four miles wide, the lower Hudson river, the East river, Long Island sound and tributary waterways. The tributary waterways to the east are Gowanus creek, Newtown creek, the Harlem river, the Bronx river, Westchester creek, Flushing bay and creek and Eastchester creek. Tributaries to the west are Kill van Kull, Arthur Kill, Newark bay, the Passaic river and the Hackensack river. Anchorage channel, an extension of Ambrose channel, extending through the Upper bay to the mouth of the Hudson river at the Battery, affords a depth of 40 ft. at mean low water for a width of 2,000 ft. Within the port are 42 channels, from 38 to 45 ft. deep. The port of New York has a total length measured around piers and shore lines of about 755 mi., 460 mi. in New York and 295 mi. in New Jersey. The developed frontage measured along bulkheads is approximately 520 mi., of which 320 mi. are in New York. The mean tidal range is 4.6 ft. in the Lower bay and 4.5 ft. in the Upper bay. The harbour also has two northern entrances: the northeast entrance from Long Island sound by the East river, principally used by New England coasting vessels; and the North (lower Hudson) river, by which the inland waterborne traffic of the Hudson river and Erie canal is brought to the port of New York.

About 80,000,000 tons of rail-borne commerce passed through the port in 1949. Of this about 1,000,000 were transshipped from vessels. A total of 7,789 vessels of 34,019,513 net registered tons entered and 7,758 vessels of 34,095,879 net registered tons cleared the port in foreign trade.

In 1921 the states of New Jersey and New York entered their port treaty that established the principles under which the Port of New York authority was established; its purpose was to coordinate the terminal, transport and other facilities of commerce in and about the port of New York. This agency and the department of marine and aviation operate most of New York city's port facilities; most of the docks are controlled by the latter, most terminal, transport and other facilities are controlled by the former. The area of the port of New York district within the jurisdiction of the Port authority is about 1,500 sq.mi., extending from below Sandy Hook on the south to Tarrytown on the north.

Serving this area is the first of the projected belt lines, a consolidation of short transfer lines, extending along the west bank of the Hudson and connecting all the trunk lines entering the Jersey side of the port. The Holland vehicular tunnel, opened in 1927, was brought under the Port authority's control in 1930. The Lincoln vehicular (mid-town) tunnel opened in 1938.

Two bridges across the Arthur Kill, one from Perth Amboy, N.J., to Tottenville, S.I., and the other from Elizabeth, N.J., to Howland Hook, S.I., were opened to traffic on June 29, 1928. A third, the magnificent George Washington bridge across the Hudson at 178th street, was opened on Oct. 25, 1931, and a fourth, the Kill van Kull arch between Staten Island and Bayonne, N.J., was opened on Nov. 25 of the same year. The suspension span of the George Washington bridge, measuring about 3,500 ft., is more than twice as long as any such span previously constructed. The Port authority completed in 1933 the 16-story inland freight terminal occupying the entire block between 8th and 9th avenues and 15th and 16th streets.

In 1949 a union motor truck terminal was opened; this four-block-long terminal, built near the Holland tunnel, provided a consolidation and interchange point for over-the-road trucks. In 1950 a $24,000,000 union bus terminal designed to provide facilities for all commuted and long-distance bus traffic entering into New York city was completed. This block-long terminal extends from Eighth to Ninth avenues and from 40th to 41st streets; it is connected directly with the Lincoln tunnel by ramps.

Banking, Exchange and Insurance.—Since the beginning of the city's history, the financial district of New York has been at the end of Manhattan Island, below Fulton street. Here are the largest banks and trust companies, the exchanges and many insurance headquarters. In 1784 Alexander Hamilton wrote the constitution for the Bank of New York, the first bank to be established in the city, in operation five years before the U.S. constitution was adopted. This bank was originally at 67 St. George's square, now Pearl street, and was later moved to 48 Wall street. The first bank of the United States was established in 1791, and a branch known as the office of discount and deposit was opened in New York in the same year. The Bank of the Manhattan company was the third bank to be organized in the city and its charter is notable as being the first to enable a public utility company to engage in banking. The Manhattan company furnished New York with water for 43 years. The Bank of the Manhattan company is still at its original location at 40 Wall street. It continues to operate under its original charter, through the expedient of maintaining a water tower. The Merchants and Mechanics and Metals National banks, the Bank of America, the Phenix and City (now the National City bank), all date from the early 19th century. When the Chemical National bank was organized in 1823 there were already 12 others, having an aggregate capital of more than $15,000,000.

The subtreasury of the United States, formerly on Wall street, was abolished in 1914. On Feb. 21, 1940, it became a national monument—Federal Hall memorial. A part of the functions of the subtreasury are carried on by the U.S. assay office at 32 Wall street. The New York clearinghouse, located on Cedar street, was established in 1853. Bank clearings for the fiscal year ending Sept. 30, 1950, totalled $383,731,184,075. New York is the centre of the federal reserve district no. 2 (*see* Federal Reserve System, The). The number of savings banks in greater New York in 1950 was 54; deposits held were $8,920,198,421. The New York Stock exchange (*see* Stock Exchange) occupies a building designed by James Rennick and had, in 1951, 1,375 members.

The New York Curb market was formerly an open-air market for unlisted securities. It is housed in its own buildings at 78 Trinity place, completed in 1921.

Wholesale Trade.—New York city, the largest wholesale trade centre in the country, in 1949 employed 360,000 people in the more than 35,000 wholesale establishments; more than 80% of this business is concentrated in the borough of Manhattan.

The clothing industry is chiefly centred in Manhattan, between Washington square and 42nd street, and in cross streets between 7th avenue and Broadway. Silk establishments have two principal centres, one bounded roughly by 23rd and 34th streets and Third and Fifth avenues; the other, on or adjacent to Broadway between Canal and Eighth streets. Fur establishments are sharply localized between Broadway and Eighth avenue and 26th and 30th streets. The millinery business, formerly chiefly along Broadway, between Canal and 14th streets, moved to a centre between Broadway and Fifth avenue above 34th street. Boot and shoe establishments are almost exclusively in lower Manhattan between Broadway and West Broadway below Canal street. Jewellery, formerly concentrated in and about Maiden lane, later became distributed in smaller groups between Maiden lane and 50th street along Broadway and Fifth avenue, with large and growing centres at and about the intersection of Canal street and the Bowery and on 47th street between Fifth and Sixth avenues. Fruit and produce markets are centralized in Manhattan between Canal and Cortlandt streets, and West Broadway and the North river. The fish, butter, egg and cheese markets are highly concentrated on the lower west side between Harrison and Greenwich streets and meat establishments centre at West 14th street and the North river. The coffee, tea and spice markets are mainly in a small area on the lower east side about Water and Front streets. Hardware houses are around Warren and Chambers streets, west of Broadway; paper and stationery are much more widely scattered than formerly, largely because of the uptown movement of printing and publishing establishments, one great centre being at or near Park row and the other in the neighbourhood of the new post office about 34th street. Drug establishments are chiefly in lower Manhattan, while leather dealers are just below Brooklyn bridge. Total value of wholesale trade for the city for 1948 was about $38,488,056,000.

Retail Trade followed the northward movement of population.

In 1850 it was at Canal street and by 1880 at 14th street. At mid-20th century it was between 31st and 59th streets, and Third and Eighth avenues. Fifth avenue was formerly exclusively residential but later was given up to retail trade as far north as 59th street. Beyond that a zoning ordinance reserved it for residence. Some of the largest department stores are still on 34th street, and the greatest volume of trade is done there. But the northward trend of the residential section affected the character of the trade, and the more expensive shops, including some of the oldest retail firms, are farther up Fifth avenue, continually pressing on toward the most exclusive residential quarters of the city which are now on Park and Fifth avenues, above 60th street. The dressmakers, milliners and tailors for this district are on the side streets leading off Fifth avenue. Madison avenue, because of its situation between Park and Fifth avenues, rapidly took on the aspect of the latter, and is lined with shops from 42nd street to the Eighties. The art and antique dealers are on 57th and adjacent streets, and on Madison and Lexington avenues. There are a number of small antique shops on Eighth street. Automobile houses are near Columbus circle and up Broadway from 55th street for more than ten blocks. Brooklyn and the Bronx have important shopping and financial districts of their own. The growth and decentralization of population precipitated a trend among large department stores toward building branches of their stores in suburban areas of the city and in many cases in the neighbouring counties. The decline in the number of retail establishments from 135,100 to 103,933 in the 1939–48 period was caused by greater concentration of ownership. The total value of retail trade for the city in 1948 was $8,019,696,000.

Building Construction.—In 1949 the total number of buildings constructed in the five boroughs was 10,300, at an estimated cost of $261,794,990. Modern building construction in New York dates from the erection of the ten-story Tower building in 1889. The loftiest edifice in the world at mid-20th century, the Empire State building on Fifth avenue at 34th street, rises to a gross height of 1,250 ft. from the street level and has 102 stories. A 50-mi. panorama is visible from its tower. Rockefeller centre, largest privately owned business and amusement centre in America, begun in 1931 and completed in 1947 with the addition of a new building to the group completed before World War II, covers almost 13 ac. between Fifth and Sixth avenues from 48th to mid-51st streets. There are 15 separate buildings and the 5 edifices of the western section of the centre comprise Radio City. The estimated daily population of the centre was 160,000 in 1950.

In 1938, under a new charter, a department of housing and buildings, directed by a commissioner, took control over enforcing the multiple dwelling law, the labour law and the building code. Laws affecting building in the city date back to 1647. Early laws dealt primarily with fire prevention. In 1867 a law dealing with fire and ventilation was passed; in 1899 a new building code was adopted; in 1901 a tenement house law was enacted. After 1935, through the activity of the New York City Housing authority, the federal government, private enterprise and the department of housing and buildings, great strides in modern housing were made.

At the end of World War II these groups greatly expanded the scope and tempo of construction activities so that by the end of 1950 about 59,000 apartments had been constructed for middle and low income families under federal, state and local auspices. These were mostly modern, fireproof multifamily dwellings designed to include ample recreational facilities. Added to these more than 50 permanent and 8 temporary housing projects constructed with public funds were such vast projects as Stuyvesant Town, Cooper Village and Fresh Meadows, constructed with funds supplied by large institutional investors.

Manufacturing.—New York city is the leading manufacturing city in the nation, a position it has held since 1824. In 1947 the city accounted for more than a third of the industrial production of the country's 11 largest industrial areas. The total value added by manufacture was $5,520,425,000. There were 741,247 manufacturing production workers in the city (about 100 in every 1,000 population) and 37,870 factories. The average annual wage of the city's industrial wage earner was $2,732.47. The ten leading manufacturing industries in terms of the number of workers they employed in 1949 (total 971,700), according to New York state department of labour estimates, were: apparel and other finished fabric products, 342,800; printing, publishing and allied industries, 118,700; food and kindred products, 79,900; fabricated metal products (including ordnance), 47,600; leather and leather products, 37,900; chemicals and allied products, 34,600; textile-mill products, 34,600; electrical machinery, equipment and supplies, 34,100; machinery (excluding electrical), 31,700. More than 78% of the total manufacturing employment was in these industries. In the period 1939–47 employment rose 45% and value added in manufacture rose 195%.

TRANSPORTATION AND COMMUNICATION

Rapid Transit.—The problem of transportation and communication in New York city is unique, not only because of the extraordinary concentration of people in certain areas at a given moment, but also because of the rapid growth and shifting areas of population that must be served. Getting people to and from work and goods and produce to market with speed and safety is one of the city's major problems.

On almost any weekday morning from 7 to 10 A.M., more than 1,600,000 people ride the subways to work. At the peak of the day's rush, between 5 and 6 P.M., more than 800,000 passengers enter the subways on their way home from work. The vast 242-route-mile city-owned rapid transit system had its beginnings with the primitive steam locomotives that pulled cars along the Ninth avenue elevated railway, extending from Battery place near the southerly end of Manhattan to 30th street. This construction, slightly more than three miles in length, was opened for traffic in 1870. The next decade witnessed its growth to 32.5 route miles of track, forming four separate transit lines extending north and south on Manhattan; three reached the Harlem river and one ended at 59th street. These lines were entirely private enterprises, built and operated over the public streets under perpetual franchises granted by the state legislature. For the next 20 years there were no extensions to the rapid transit lines on Manhattan, but some progress was made in other boroughs—the Third avenue "L" in Manhattan was extended across the Harlem river as far as 169th street by 1888, to 177th street by 1891, to Fordham road by 1901 and to its terminus at Bronx park by 1902. In the borough of Brooklyn the first elevated, the Lexington avenue line, having a route length of about six miles, was opened in 1885. This line was extended and other lines built until by 1900 the Brooklyn system had a route length of 62 mi. In 1902 the motive power of these elevated lines was changed from steam to electricity. In 1900 the first subway was planned and finally extended from the Bronx through Manhattan and under the East river to Brooklyn. This rapid transit system was a municipal undertaking, its construction cost being entirely defrayed by the sale of bonds issued by the city of New York. Between 1908–10 two tubes under the Hudson river connecting Manhattan with Hoboken (terminus of the Delaware, Lackawanna and Western) and Jersey City (terminus of the Erie, Pennsylvania and Central of New Jersey railways) and a connecting tube which extends up Sixth avenue from Cortlandt street to 33rd street were completed. In 1913 the city entered into contracts to create two interborough rapid transit systems, each comporting extensions to the existing lines; the one provided for a new Lexington avenue line and the extension of the west side subway down Seventh avenue to lower Manhattan and thence under the East river to Brooklyn. Another contract included a four-track subway on Broadway and Seventh avenue, Manhattan, extending through tunnels to Brooklyn and Queens. The operating contracts made with the two companies were to run for 49 years, dating from Jan. 1, 1919, and from Aug. 1, 1920, respectively. In 1925, the city began building an independent subway system, the main unit of which, the Eighth avenue line, commenced operation in 1932. With the beginning of the LaGuardia administration and the aid of WPA funds, work was pushed rapidly and many more miles of track were opened on the Independent subway, and the new Sixth avenue line was completed. The

Sixth avenue "L" was razed, and buses rapidly replaced surface cars. Unification of the transit system of the city was accomplished in June 1940. The city purchased the two privately owned transit companies for $326,248,187; through condemnation proceedings it acquired title to "L" lines in Brooklyn and Manhattan which with the exception of the Third avenue line in Manhattan were abandoned. Transit facilities, when acquired, were in serious need of modernization to meet the needs of a growing city. At the end of World War II a program costing more than $200,000,000 to modernize and extend subway services began. A board of three members, one of whom is chairman, appointed by the mayor at salaries of $20,000 a year, control the transit system. Thus the New York city transit system, including surface transit, became the largest municipally owned and operated transit property in the United States. The subway system is divided into three divisions, the Interborough Rapid Transit, the Brooklyn-Manhattan Transit and the Independent.

Railroads.—Trains carrying passengers and freight from all parts of the country enter into the terminals in or around New York city. The New York Central and Hudson River and West Shore railways follow closely the Erie canal route to Buffalo. The Erie, the Lehigh Valley, the Pennsylvania and the Delaware, Lackawanna and Western railways reach Buffalo by routes across New Jersey, Pennsylvania and western New York. The New York, New Haven and Hartford railway affords communication with New England; and the Pennsylvania and the Baltimore and Ohio railways with the middle western and southeastern parts of the country. The Central railroad of New Jersey and the Long Island railway (belonging to the Pennsylvania) are primarily local. The New York Central and the New York, New Haven and Hartford railways have a common terminal in Manhattan (Grand Central station), at 42nd street and Park avenue, and the Pennsylvania has its terminal at 32nd street and Seventh avenue, with tunnels to Long Island and New Jersey. The Pennsylvania terminal is used also as a terminal by the Long Island railway which has another terminal at Atlantic and Flatbush avenues in the borough of Brooklyn. The other railway terminals are on the New Jersey bank of the Hudson and are reached either by tunnel, ferry or subway.

Streets.—The first comprehensive street plan was made in 1811; with few changes, notably the laying out of Madison avenue, midway between Fourth and Fifth avenues, north of 23rd street, and Lexington avenue between Third and Fourth avenues, north from 21st street, it is the street plan of Manhattan today as far north as 155th street. The 120,000 population at that time was concentrated south of Houston street. The plan provided straight line "avenues," with a uniform width of 100 ft. extending longitudinally along the island and separating block lengths ranging from 610 to 920 ft. At right angles thereto, "streets," usually 60 ft. wide, were laid out, but 15 were made 100 ft. wide. These streets were separated by a block depth of 200 ft. The plan included the extension of Broadway, which has a general direction diagonally across Manhattan to 79th street, whence it parallels the other avenues. This system was later called upon to perform duties hardly foreseen at that time. The rapid growth of the city, the skyscraper and the use of motor vehicles produced serious traffic congestion in many sections of the city; and this necessitated extensive street widening and the development of new thoroughfares. In an attempt to unsnarl the vexing traffic problem, the city established a department of traffic with power to make traffic rules and regulations, design traffic signals and recommend to the mayor programs designed to effect the movement of pedestrian and vehicular traffic. Among its first major proposals were that an authority be created to establish off-street parking facilities, and that an improved traffic control system be installed to effect smoother, more rapid and safe vehicular and pedestrian traffic.

A new bus terminal designed to keep intercity transport off crowded streets; and early morning truck loadings in crowded industrial areas were among the other measures designed to loosen up traffic snarl.

Notable improvements were the two partially elevated highways for motor vehicles. One, on the west side, provided a 13-mi. nonstop drive from one end of the borough to the other; the other, along the East river, a nonstop drive from the Battery to 125th street and then into the Harlem River drive. These highway systems were to be linked at the southern end by the Battery park underpass. Other improvements were the three-mile viaduct on the Jersey side of the river, leading from the Holland tunnel to the main highway to Trenton; the extension of the Hutchinson River parkway, the Henry Hudson parkway and the beautiful Bronx River parkway, extending for 15 mi. through Westchester county; the bridges and highways in the Triborough bridge project, opened in July 1936; and the Belt parkway, primarily a three-lane superhighway, which from the Brooklyn-Manhattan tunnel rims the boroughs of Brooklyn and Queens for a distance of more than 40 mi.

The more notable streets include Wall street, on lower Manhattan, the heart of the financial district; Fifth avenue with its fine shops, residences, clubs, library and museum; Riverside drive, overlooking the Hudson; Park avenue, which continues Fourth avenue above 32nd street to the Grand Central terminal and thence from 45th street to the Harlem river, and is lined with fine apartment houses in the middle section above 45th street; the Bowery, which runs diagonally through the east side of lower Manhattan from the Brooklyn bridge to intersect Fourth avenue at Eighth street; and Broadway, which extends more than 18 mi. from the southern tip of Manhattan to the northern limits of the city. In its middle part, from 10th to 79th streets, it cuts through the heart of the business and amusement centre. This street owes its name to the Dutch, who called it the "breede weg." It is no longer a "broad way," but quite narrow, particularly in the lower downtown section. From 34th street to Columbus circle at 59th street it forms the centre of the automobile, theatre, moving picture, restaurant and night life district. Subways follow the course of Broadway for the greater part of its extent.

The programs of replacement and modernization of surface cars with bus lines was begun in the mid-1930s and continued after World War II. With only a few exceptions, surface cars had been displaced by bus lines in 1950. Only in Brooklyn, where new high-speed trolleys and trolley coaches were installed, do they play an important part in surface transportation. Manhattan abandoned all its trolley lines. The city acquired a large portion of surface transportation, about 575 route miles, in 1950. A rapid expansion of population into suburban areas necessitated the expansion of surface transport in these areas.

Bridges and Tunnels.—There were in 1951 seven bridges spanning the East river. One completed in that year links the east Harlem area with a large playground and park on Ward's Island. The George Washington bridge, crossing the Hudson river, extends from a point near 178th street, Manhattan, to Fort Lee, N.J. The span is 3,500 ft., tower height 600 ft. The Brooklyn, Manhattan and Williamsburg bridges have their Manhattan terminals at Park row, Canal, Clinton and Delancey streets, respectively. All are suspension bridges and connect Manhattan Island with Brooklyn. The Brooklyn bridge, the first to span the East river, was opened to traffic on May 24, 1883. The Manhattan bridge was opened to traffic on Dec. 31, 1909, the Williamsburg bridge on Dec. 19, 1903, and the Queensboro bridge on March 30, 1909. All of these are municipally owned and operated for highway, trolley or bus, elevated railway and pedestrian traffic. The Hell Gate bridge over the East river is owned by the New York Connecting Railroad company and is exclusively for railway traffic. The Triborough bridge over the East river, which opened in 1936, actually consists of four bridges over water and 12 on land, its arms extending into Manhattan, the Bronx and Queens. The vertical lift bridge between Randall's Island and Manhattan is one of the largest of that type in the country. The Bronx-Whitestone bridge, opened in 1939, connects the Bronx with Queens.

The Harlem river is crossed by 13 bridges of various types and designs. The most notable is the famous High bridge (1848) which carries an aqueduct of the city water supply. This was rebuilt in 1928 to improve navigation.

Transportation of passengers by rail between the boroughs of

Manhattan, Brooklyn, the Bronx and Queens and New Jersey is provided by means of tunnels constructed well below the beds of the East, Hudson and Harlem rivers. Vehicular transportation between Manhattan and Jersey City was made possible by the opening to traffic of the Holland vehicular tunnel in Nov. 1927, a twin-tube highway, 9,250 ft. in length. In Dec. 1937 the Lincoln tunnel, connecting 39th street in Manhattan with Weehawken in New Jersey, was opened to traffic. A north-south avenue, midway between Ninth and Tenth avenues, permits entrance to this tunnel at 34th, 35th, 36th, 40th, 41st and 42nd streets (*see* HOLLAND AND LINCOLN VEHICULAR TUNNELS). The Queens Midtown tunnel, finished in 1940, connects Manhattan on the east side at 36th and 37th streets with Long Island City. It is a twin-tube highway, 7,500 ft. long. The Brooklyn-Battery tunnel was opened to traffic on May 25, 1950. This twin-tube 11,000-ft. structure was the longest underriver ventilated vehicular tunnel in the country at the time of its completion. This tunnel connects the southern tip of Manhattan with Gowanus parkway, which branches into the Belt system or into downtown Brooklyn. The Pennsylvania railroad has four tubes across the East river and two across the Hudson. The Hudson and Manhattan Railroad company has two systems, each comprising two single-track tubes from Jersey City, one to the downtown section of Manhattan looping around Fulton and Cortlandt streets at Church street, the other entering at Morton street and extending to 33rd street. The Brooklyn-Manhattan Transit system has six rapid transit tubes under the East river, laid in pairs leaving Manhattan at Whitehall, E. 14th and E. 60th streets. The Interborough Rapid Transit system also has three pairs of transit tubes leaving Manhattan at Whitehall street, Old Slip and E. 42nd street. Practically all of the railroad and rapid transit tunnels were completed between 1900 and 1920. In connection with the Independent subway system, the board of transportation designed five new tunnels, four of which were opened for service in 1933 and one in 1936. Of the three under the East river, one extends from 53rd street, Manhattan, to Mott avenue, Queens, connecting the Sixth and Eighth avenue trunk lines and the lines from Jamaica and central Brooklyn at Queens Plaza station in Long Island City; the other runs from Fulton street, Manhattan, to Cranberry street, Brooklyn. The third tunnel runs from Rutgers street in Manhattan to Jay street in Brooklyn. Under the Harlem river a three-track tunnel connects the Washington Heights line with the subway under the Grand Concourse in the Bronx. This extends from the Polo Grounds at 156th street and Eighth avenue, Manhattan, to 161st street and Jerome avenue, the Bronx. The fifth tunnel under Newtown creek extends from Manhattan avenue in Brooklyn to Jackson avenue, Queens.

Ferries.—The city department of marine and aviation, two federal agencies, the railroads with terminals in New Jersey and a number of private companies operate ferries in and about New York harbour. The city in 1950 operated one major ferry line, shuttling seven boats between Manhattan and Richmond, and three small ferries serving islands in the East river and Long Island sound where city institutions are maintained. The Staten Island ferry ride is one of the city's recreational features, offering a ten-mile, one-hour round trip through the busy New York harbour, and affording a magnificent view of the New York sky line, the Statue of Liberty and Governor's Island.

Airports.—In 1947 four airports in the metropolitan area were combined into a single integrated air terminal system under the control of the Port of New York authority. Studies made after World War II indicated that postwar growth of air transport could not be met with the existing terminal facilities operating in an unorganized fashion. Included in this system was LaGuardia field, Queens, covering more than 550 ac.; opened in 1939, this field is one of the busiest airports in the world. It handled an average of 437 incoming and outgoing flights a day in 1949. Built at a cost of about $28,000,000, it was improved by the addition of an excellent air-ground communication system. Although it had handled most overseas and long-distance domestic traffic it was being prepared at mid-century to handle short-haul domestic travel within about a 500-mi. radius of New York city. New York International airport, the world's largest at mid-century, covered about 4,900 ac. and had seven 200-ft.-wide runways up to 9,500 ft. in length. Still in the process of being constructed in 1951, it was to have the largest and most complete airport facilities, designed to serve overseas air traffic. In 1949, 14 air lines operated from this field.

Newark airport on the New Jersey side of the river, expanded to 2,200 ac. with reconstructed terminal facilities, was also being prepared in 1951 to handle long-haul domestic air travel. Teterboro airport in Bergen county, N.J., handled charter service, executive and private planes and other nonscheduled flights, but was to be developed to handle regular commercial flights when the need arose.

Telephone and Telegraph.—In 1950 there were in greater New York city 3,059,579 telephones as compared with 1,713,521 in 1940. Telegraph and cable service is supplied mainly by Western Union which in 1951 maintained 192 branch offices; in addition about 2,600 business concerns had installations which enabled them to send wires directly from their establishments by facsimile or printing telegraph. Fifteen cables touched New York, five owned by Western Union, five by Commercial, four by All America and one by a French company.

Postal Service.—The post office of New York city in 1827 was located in a small two-story frame building on Garden street (now Exchange place), and the entire force consisted of about eight clerks and six letter carriers. Fifty years later the city hall station at Park row and Broadway was the general post office. In 1914, the present general post office building was opened on Eighth avenue from 31st to 33rd streets, containing 500,000 sq.ft. of floor space. There were in addition 100 classified stations and 8 contract stations in the city in 1950 and a total of 33,101 employees. The transportation of mails is expedited by means of an underground pneumatic tube system consisting of 27 mi. of double-line eight-inch tubes, with a carrying capacity of approximately 200,000 pieces of mail per hour. In the year 1827 the postal receipts amounted to about $125,000; in the year ending June 30, 1950, they were $166,175,527. On an average the post office received, delivered and dispatched daily 31,658,000 pieces of ordinary mail; weighed and dispatched 370,000 lb. of newspapers and periodicals and 200,000 insured and C.O.D. parcel post packages.

GOVERNMENT

The city's form of government was inaugurated by the greater New York charter of 1897. It provided for a mayor elected at large, five borough presidents, chosen by the voters of their respective boroughs, a board of aldermen of 65 elective members, one from each aldermanic district, with a president of the board of aldermen, elected at large. A controller, elected at large, was head of the department of finance. The mayor, controller, president of the board of aldermen and the five borough presidents were designated as members of the board of estimate and apportionment.

A new city charter, adopted by popular referendum on Nov. 3, 1936, became effective on Jan. 1, 1938. To replace the board of aldermen it provided for a city council, elected by a system of proportional representation, whose membership varied in rough proportion to the voting population of the boroughs; that is, one councilman for every 75,000 votes cast therein, with an additional member for any fraction of that number above 50,000. The proportional representative system of electing councilmen was abolished by popular referendum in the 1947 election. Under a new law one councilman is elected for each of the state senate districts wholly within the city for a term of four years, by a simple majority vote. Beginning in 1949, 25 councilmen were elected, 9 from Brooklyn, 6 from Manhattan, 5 in the Bronx, 4 in Queens and 1 in Richmond. The board of estimate continued with little change beyond the substitution of the president of the council for the president of the board of aldermen. It constitutes the general administrative branch and has limited control over legislation. In the case of local laws directly affecting the organization and administration of the government and amendments to the

charter its approval is required. The board of estimate has exclusive authority to grant franchises, but no franchise may be for a longer term than 25 years, except that a tunnel railroad franchise may be for a period not exceeding 50 years. With respect to all local laws, however, the mayor retains his veto, which can be overridden only by a two-thirds majority of the council. A city treasurer appointed by the mayor heads the department of finance.

In addition to these major divisions, there is a department of public works responsible for the municipal plant and structures; a department of housing; a city planning commission; a department of investigation; and various other departments and bureaus, including departments of education, marine and aviation, correction, health, hospitals, law, parks, police, public welfare, purchase, sanitation, a fire department and a civil service commission. Among its functions, the planning commission has control of zoning and the drawing up of the capital budget.

The mayor, as chief executive, appoints the heads of all departments except those under the exclusive direction of the borough presidents. All purely local improvements, such as streets and sewers, continue in the hands of local improvement boards and the borough presidents, while improvements affecting broader areas such as intercepting sewers and sewage disposal plants are under the control of the central department of public works.

An amendment to the state constitution, approved by the voters in Dec. 1935, provided for a reform of the county government within the city of New York. There are five county governments within greater New York, namely, New York, Bronx, Kings, Queens and Richmond. The officers of the five different counties function almost independently of the city officers and often in duplication of the activities of the latter. Under the amendment the city has the theoretical power through the enactment of local laws to abolish any county office within its limits except that of judge, county clerk or district attorney; or it may reassign the functions of county officers, with certain exceptions, to city or other county officials or to the courts. The county clerks are appointed and removable by the appellate division of the supreme court in the judicial department in which their respective counties are located.

Civil service regulations apply to all officers and all employees of the city except those who are elected by the people, legislative officers and staffs of those educational institutions which have special professional standards. The civil service commission of the city consists of three members appointed by the mayor, not more than two of whom may be of the same political party. Salary of the president at mid-century was $10,000 a year; of the commissioners, $9,000.

In 1920 the New York city employees' retirement system was put into effect. All persons in city service, whether appointive or elective, who entered or re-entered the city service after Oct. 1, 1920, and who had completed six months of city service became eligible to the benefits of this retirement system, except those entitled to share in the police pension fund, the fire department relief fund, the teachers' retirement system or the department of street cleaning relief and pension fund.

FINANCE AND TAXATION

The city's budget is far from being a comprehensive financial plan. The executive or expense budget prepared by the mayor for the fiscal year beginning July 1, 1950, totalled more than $1,232,000,000. This amount represented anticipated expenditures by the agencies of city and county government plus state and federal aid to welfare and education. An estimate of the amounts of revenue by source was also included in this document. Debt service, including the debt cost of the city-operated transit system, accounted for about 20% of the total expenditures. The largest single item in the budget, education, accounted for slightly less than 20%, while welfare needs took more than 15% of the total. In June 1940 the city government acquired and unified its rapid transit system, which thereafter operated practically on an independent budgetary basis. The budget of the system is prepared by the board of transportation. The transit system's total debt service, including unification bonds, ran close to $57,000,000 for the first year; this had increased to $68,649,000 in 1950, primarily because of postwar rehabilitation and expansion of services.

Other city utilities are included in the current budget, their earnings being merged in the general fund revenues. Expenditures for capital improvements are considered separately. The so-called capital budget, prepared by the city planning commission, applies to the calendar rather than the city's fiscal year. It does not include capital expenditures to be paid for by special assessments. For the year 1951 the capital budget was about $467,000,000. The total cost of the city operations, including an estimate of debt costs of capital budget expenditures applicable to the same period, is included in the expenditure budget. The cost of government almost doubled in the decade 1940–50. The city's financial difficulties appeared to grow more perplexing with each passing year.

The assessed valuation of taxable real estate in the city (including special franchises and the real estate of corporations) for 1950–51 aggregated $18,396,000,000. A peak of $19,600,000,000 was reached in 1932. The basic tax rate of the city for the fiscal year 1950–51 was $3.08 for each $100 of assessed valuation.

The city charter, which became effective Jan. 1, 1938, made numerous changes in the fiscal organization and procedure of the city government. It changed the beginning of the fiscal year from Jan. 1 to July 1, and bridged the gap by a six-months' budget. The current or "expense" budget operates on the basis of the fiscal year, while the capital budget follows the calendar year. A bureau of the budget, under a director appointed by the mayor, is established to assist the mayor in preparing the current budget. The budget goes to the board of estimate, then to the council, which must act upon it by May 21, otherwise it is deemed to be adopted as passed by the board of estimate. Finally, the mayor may veto any changes made by the council. The capital budget is prepared by the city planning commission and is completely separated from the current budget.

Under the new charter, the controller, who is elected at large, is the chief financial officer of the city government. It is his business to advise the board of estimate, to approve the disbursement of funds, to audit the accounts of the city departments and agencies and to manage the sale and retirement of the city's securities.

There is no independent audit of the decisions, books, records and reports of the controller. Aside from the office of controller and the bureau of the budget mentioned above, there is a department of finance, headed by the treasurer (formerly the city chamberlain), who is appointed by the mayor. This department includes the bureau of city collections and the bureau of receipts and disbursements.

Four agencies handle the tax and licence work of the city: the tax department, the board of assessors, the board of revision of assessments and the department of licences. The financial organization of the city also includes a department of purchase, headed by a commissioner appointed by the mayor. The department has sole authority to purchase supplies and equipment for all departments and agencies of the city government except the institutions and offices of the board of higher education and the department of education.

Police.—The police force of the city of New York, including uniformed, nonuniformed, extra and special personnel, numbered about 20,000 in 1950. It is under the direction of a commissioner, appointed and removable by the mayor, at a salary of $15,000 a year. The headquarters of the police department are in Manhattan. There are 35 precinct station houses in Manhattan, 34 in Brooklyn, 16 in Queens, 13 in the Bronx and 4 in Richmond.

The administrative activities of the department are carried on through the commissioner and six deputy commissioners, while a uniformed force is under the supervision of a chief inspector.

A significant feature of the police department is its academy for training, through which all recruits must pass. Two thousand men drawn from the ranks of patrolmen form the detective division. The budget appropriation for 1950–51 was $106,490,907.48, the great bulk of which was allotted to personal service. The total number of arrests on criminal charges and summonses served in

1949 was 963,745.

Fire.—A fire commissioner with a salary of $15,000 a year, appointed and removable by the mayor, heads the fire department, which in 1950 had 11,000 employees, including full-time paid firemen, officers and civil employees. At the head of this force and in charge of fire fighting is the chief of the department. In 1940 the three-platoon system and the eight-hour day were put into effect.

There were, in 1949, 221 engine companies, 127 hook-and-ladder companies supplemented by 58 special units consisting of 9 fireboats and 1 auxiliary fireboat, 6 water towers, 5 rescue units, 3 ambulances and various other special fire-fighting and service units. The department budget figure for 1950–51 was $59,672,-276.86 In 1949 there were 44,407 fires in the city, resulting in losses amounting to $20,249,930. For the five boroughs this loss amounted to: Manhattan, $8,663,325; Brooklyn, $4,493,195; Queens, $1,676,145; Bronx, $4,469,965; Richmond, $239,615. Deaths from fire totalled 128.

Health.—The department of health is under the direction of a commissioner appointed by the mayor at an annual salary of $15,-000. He has two deputy commissioners. The 1950–51 budgetary appropriation for the department was $13,769,287. It had a personnel of about 5,500 employees at that time. Within the department is the board of health, consisting of the commissioner, who is chairman, and four other members, appointed for a term of eight years, to serve without salary. The main office is in Manhattan, but the department operates offices, health centres and health stations in each borough.

Beginning in 1933, with the Central Harlem Health centre, which was housed in rented quarters, the department divided the city into 30 health districts, each with a population of about 250,000 and representing 20 administrative units; 12 districts function as individual units and 8 other units represent the 18 remaining districts. In 1950 there were 19 district health officers directing the 20 administrative units. Fifteen modern health centre buildings, one remodelled building and four in rented quarters were in operation in that year.

The major bureaus in the department are: administration, public health education, tuberculosis, nursing (1,200 nurses), child health, social hygiene, preventable diseases, laboratories, records, sanitation and food and drugs.

The board of health is responsible for matters of public health policy and for drafting the city's sanitary code. The department exercises sanitary supervision over about $3,000,000,000 worth of food supplies each year and regulates the sanitary conditions in about 100,000 establishments manufacturing, handling or storing food or patent medicine products; including bakeries, milk stores, restaurants and food stores.

In 1950 the city equalled its lowest recorded death rate of 1938, 10.0 per 1,000 population; in 1940 there had been a slight rise, to 10.2 per 1,000. Diphtheria deaths decreased from 86 in 1933 to 2 in 1950; diphtheria cases from 1,891 in 1933 to 58 in 1950. Tuberculosis mortality decreased from 64 per 100,000 in 1933 to 29.2 per 100,000 in 1950. Pneumonia mortality declined from 108 per 100,000 in 1933 to 32.3 per 100,000 in 1950. Typhoid fever had practically disappeared, with no deaths recorded from that cause in 1950. New low mortality rates were recorded for whooping cough, measles and other diseases. The birth rate in 1950 was 19.5 per 1,000. The lowest recorded was that for 1936, 13.6.

The U.S. public health service maintains general offices in the city under a medical director and consulting health specialists. It manages the U.S. quarantine station at Rosebank, Staten Island, and provides for inspection of ships' cargoes and all persons on board ships for quarantinable diseases, and for the medical inspection of immigrants at Ellis Island, where a U.S. marine hospital is maintained. Other U.S. marine hospitals are at Stapleton, Staten Island and 67 Hudson street, New York city.

The federal food and drug administration maintains its eastern district office and respective services and laboratories in the city.

About 40 voluntary health agencies operate in the city and co-operate with the health department. Among the more important of these are: New York chapter of the American Red Cross, American Social Hygiene association, New York Cancer committee, Brooklyn Tuberculosis and Health association, Committee on Neighborhood Health Development, Community Service Society of New York, Committees on Health of New York Academy of Medicine, New York Tuberculosis and Health association, New York Heart association, New York Diabetes association, State Charities Aid association.

Hospitals.—The department of hospitals was established in 1930 by the consolidation of the general and special hospitals of the departments of health and welfare, and Bellevue and allied hospitals. The head of the department is the commissioner, appointed by the mayor at an annual salary of $10,000; there are also two deputy commissioners at salaries of $9,000 each. Thirty-two municipal hospitals are maintained and operated by the department, which is the second largest of the city departments in number of employees (department of education is the highest). The department's appropriation for 1950–51 was $80,198,831.50.

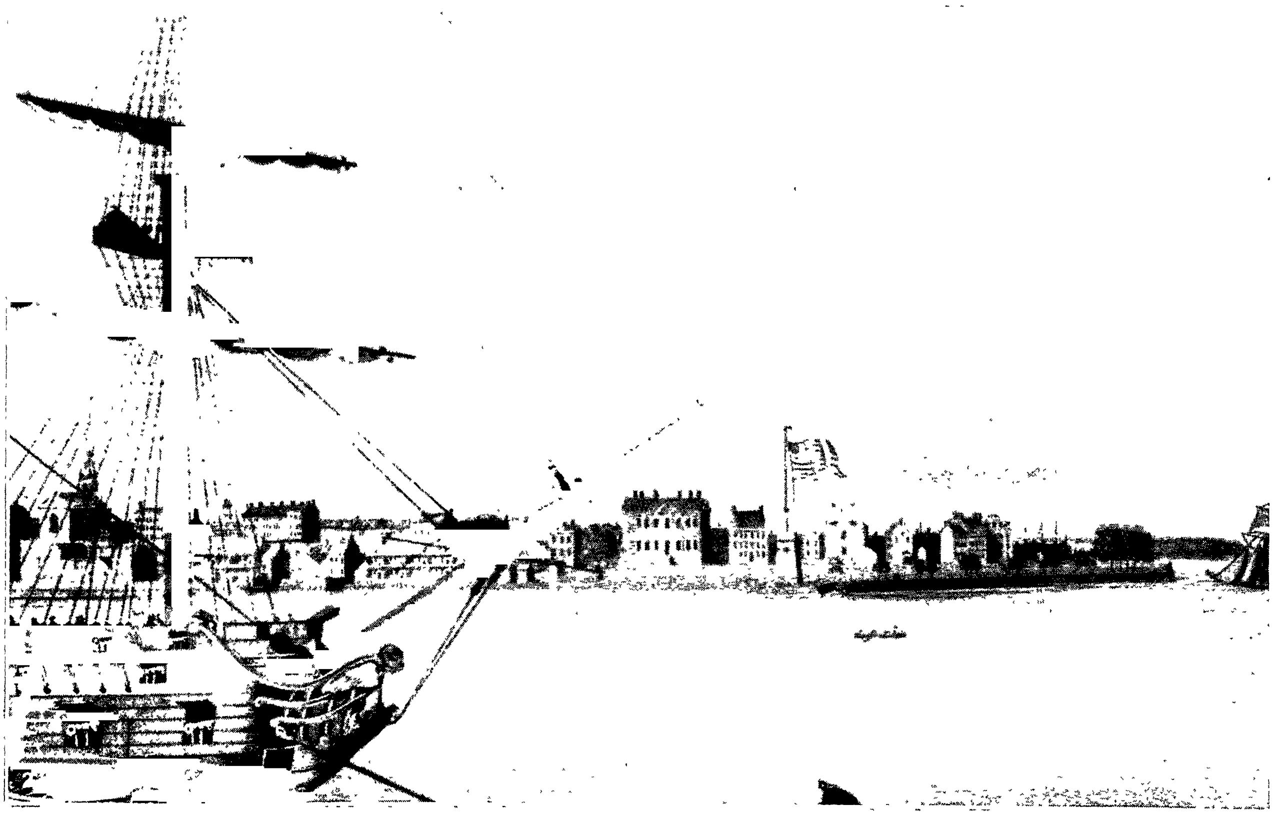
The total number of city and voluntary hospitals in 1950 was about 1,251 including approximately 100 general hospitals, ranging in size from 3,000 beds to 50 beds or less. These 1,251 hospitals provided about 140,000 hospital beds and cared for nearly 800,000 patients annually. The municipal hospitals provided, in 1950, 20,000 beds and cared for about 280,000 persons. The voluntary hospitals of the city supplied approximately one-fourth of the city's care of medical indigents. Persons approved by the city were cared for in these hospitals at city expense at varying per diem rates fixed in the city budget. Eighty of the larger voluntary hospitals, not including convalescent homes, were members of the United Hospital fund, an association for co-operative hospital financing and financial reporting.

Among the chief private general hospitals are Mount Sinai, St. Luke's, Presbyterian, New York, Roosevelt, Lenox Hill and the Post Graduate. All of these hospitals are in the borough of Manhattan. In Brooklyn are the Long Island College hospital, Jewish, Brooklyn and Methodist Episcopal. Of the private special hospitals for women and children, the Lying-in, Sloane Maternity, Nursery and Child's, Woman's and Misericordia are the largest. Other special hospitals of note are the Joint Diseases, Special Surgery, New York Eye and Ear infirmary, Manhattan Eye, Ear and Throat hospital, Skin and Cancer hospital and Neurological institute.

The larger municipal hospitals, each providing 1,000 beds or more, are Bellevue, Kings County, City, Metropolitan, Seaview and Triboro. Among the events of interest in connection with the private hospital services of the city was the establishment of the Columbia-Presbyterian Medical centre and the New York Hospital Medical centre. In upper Manhattan are clustered the buildings of five separate units: the Presbyterian hospital (including the Presbyterian hospital, the Sloane hospital for women, the Vanderbilt clinic, the Squier urological clinic, the Stephen V. Harkness private patient pavilion and the Presbyterian hospital school of nursing); the Columbia university group (including the college of physicians and surgeons, the school of dental and oral surgery, the school of oral hygiene and the DeLamar Institute of Public Health); the Babies' Hospital of the City of New York; the Neurological Institute of New York; and the New York State Psychiatric institute and hospital. The New York Hospital Medical centre includes the Lying-in hospital, the Manhattan maternity and dispensary, the Nursery and Child's hospital, Payne Whitney psychiatric clinic, and is associated with Bloomingdale hospital for mental diseases and the convalescent hospital for children at White Plains, N.Y. All above services are affiliated with the Cornell university medical school.

Public Assistance.—Assistance and care for the needy are provided mainly by the city's department of welfare. The principal forms of public aid administered by the department are: home relief, cash grants, medical aid, etc., to individuals or families unable to support themselves; aid to dependent children and child care, for at home or outside their own homes; assistance-aid to veterans and dependents or survivors unable to assist themselves; old-age assistance, cash, medical and other aid to needy persons

1



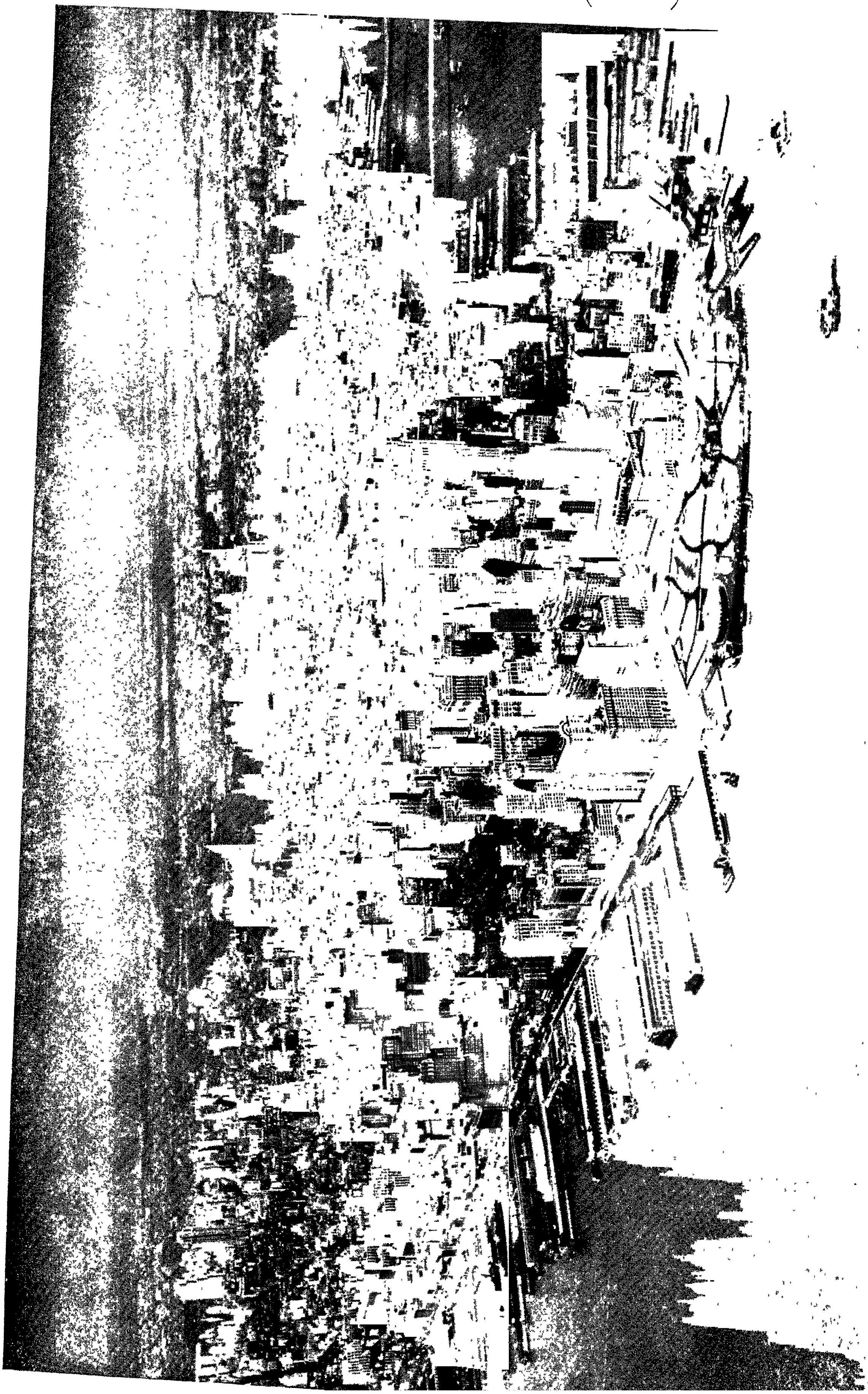
(2) KEYSTONE VIEW CO.

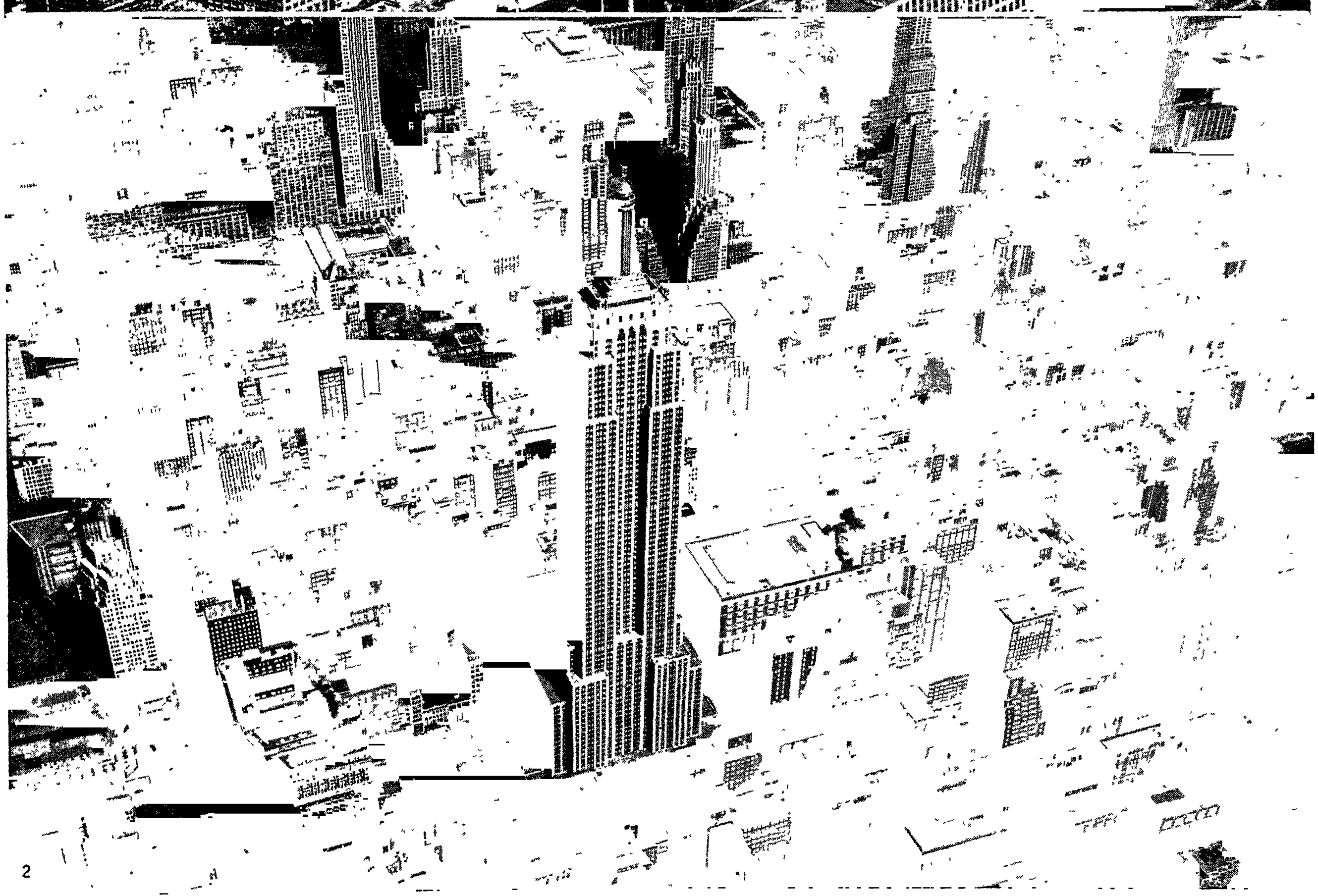
NEW YORK HARBOUR, IN 1690 AND 1794

1. The town of New Amsterdam in 1690; an etching by Anton Schutz 2. The Battery in 1794, as seen from the Hudson river

Plate II

NEW YORK (CITY)





2

PHOTOGRAPHS, FAIRCHILD AERIAL SURVEYS, INC.

NEW YORK'S MIDTOWN SKYSCRAPERS

1. Aerial view of New York City showing 42nd St. section with the RCA Building at the upper left and the spire of the Chrysler Building and the Queensboro Bridge in the background at the upper right

2. Aerial view of New York City showing 34th St. neighbourhood with the Empire State Building in the centre. The street slanting across the lower left is Broadway

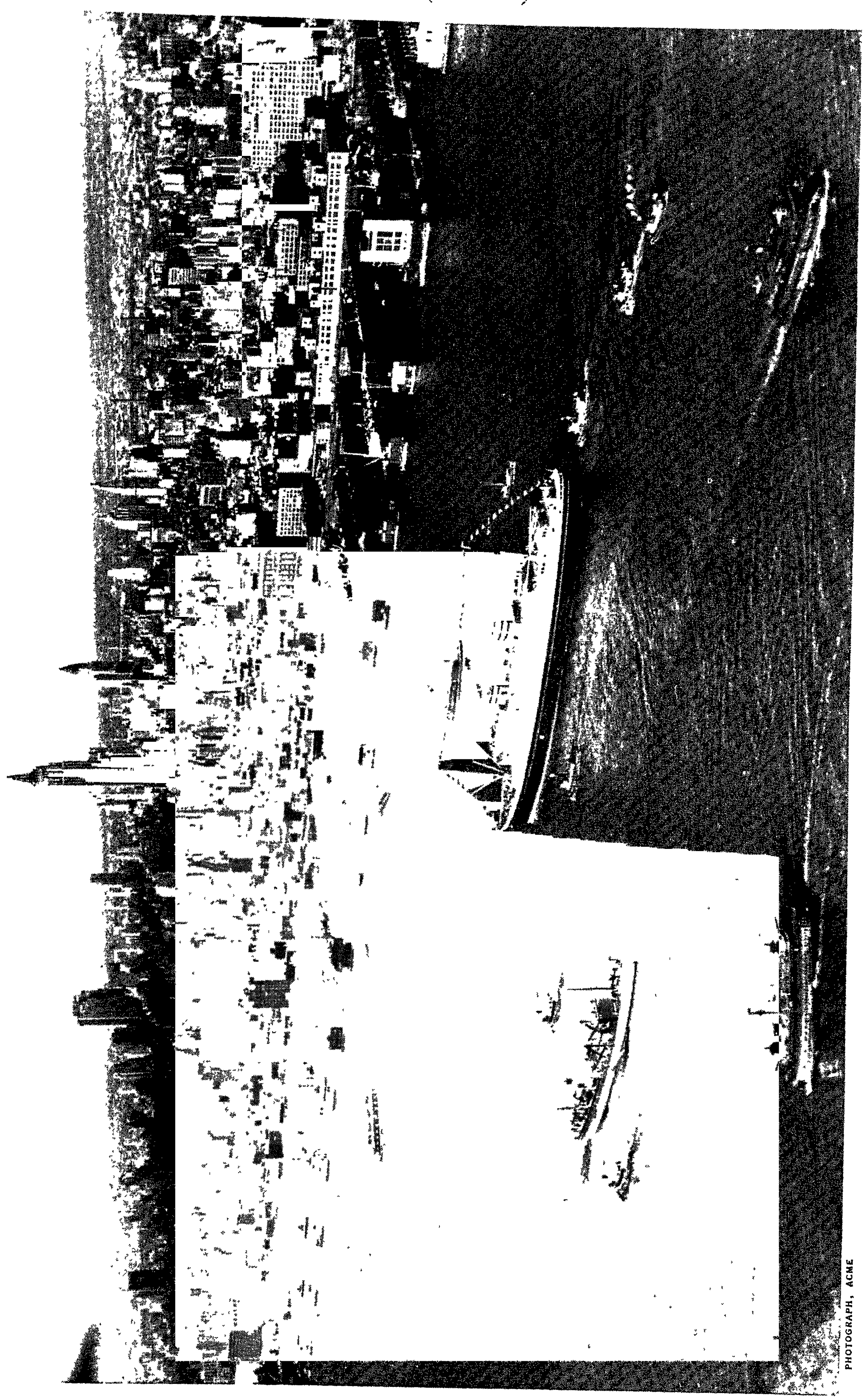
MANHATTAN ISLAND

An air view of Manhattan island, showing the Hudson (North river) at the left, and East river at the right. In the right foreground is Battery park, southernmost tip of the island; immediately behind is the downtown business district

PHOTOGRAPH, ACME

THE COMPLETED ROCKEFELLER CENTER

Left to right, RKO building, containing the Radio City Music Hall; RCA building with fronting NBC studios; and the U.S Rubber building rising above the Center theatre



SKYSCRAPERS OF NEW YORK CITY

Aerial view of midtown New York, with the Hudson river in the foreground. The two tallest spires in the centre are those of the Empire State building and the Chrysler building

NEW YORK (CITY)

PHOTOGRAPH, FAIRCHILD AERIAL SURVEYS, INC.

THE STATUE OF LIBERTY, BEDLOE'S ISLAND, NEW YORK HARBOUR

This statue was presented to the United States by France; the sculptor was Frederic Auguste Bartholdi. Every traveller entering or leaving New York harbour views this statue as a landmark and a symbol of the country. A new floodlight system was inaugurated in Oct. 1931. The inscription on the pedestal (1903) is from "The New Colossus" by Emma Lazarus and reads (in part):

Give me your tired, your poor,
Your huddled masses yearning to breathe free,
The wretched refuse of your teeming shore,
Send these, the homeless, tempest-tossed, to me:
I lift my lamp beside the golden door.

65 years of age and over; and assistance to the blind, cash, medical aid and institutional care.

Shelters, homes and a camp are maintained to aid the sick and indigent. Day care centres for children of working mothers and day care centres for aged persons are among the other services provided. In 1949–50 the average monthly public assistance case load of this department was 165,809.

The department of welfare is under a commissioner appointed by the mayor at a salary of $15,000. He has two deputies who receive $9,000 and $8,500 respectively. In 1941 the work of various independent city agencies like the board of child welfare which was interested in child care were made a part of the larger central welfare agency. Reorganization of the department in 1948 divided the work functionally among six bureaus.

In 1949–50 about $181,000,000 was spent by the department, of which the city contributed 23%, the state 55% and the federal government 22%.

The private relief agencies of the city offer a great variety of services for family welfare and institutional care. The more important ones are affiliated in the Welfare Council of New York City, which seeks to co-ordinate the efforts of the individual agencies and carry on special research and informational services in the interest of all agencies and the general public. Mention should be made also of the Jewish Board of Guardians, the many Catholic charities and of the Community Service Society of New York. The Association for Improving the Condition of the Poor (1848) and the Charity Organization society (1883) merged in April 1939 to form the Community Service society.

Correction.—The department of correction is under the direction of a commissioner appointed by the mayor at a salary of $15,000 and there are two deputy commissioners, with salaries of $7,500 and $8,000.

The department administers the city institutions for the care and custody of criminals and misdemeanants and for the detention of witnesses in criminal actions. Under it are five city prison units and two local detention pens; also, the house of detention for women, the New York city reformatory and the two city penitentiaries and workhouses and prison wards in Bellevue and King's County hospitals. The budget appropriation, 1950–51, was $6,995,864. The total number of admissions to these prisons and institutions was more than 170,000 annually.

Apart from the department of correction, the city magistrate's courts, the courts of domestic relations, the courts of special sessions and the county courts provide an extensive system of probational investigation and supervision. There is also a city parole commission comprising the commissioner of correction, the police commissioner (ex officio) and three members appointed by the mayor for ten years each. The mayor designates the chairman from the three appointees and the chairman receives $10,000 a year and the other two members $7,500 each. The budget of the parole commission, 1950–51, was $162,329. The commission employs a chief parole officer and other parole officers. The jurisdiction of the commission extends to prisoners given indeterminate sentences by the city courts, and the officer assigned to each offender retains supervision for three years.

A large number of private agencies, including the Protestant Big Brother movement, the Catholic Big Brother and Big Sister organizations, the Volunteers of America, Salvation Army and the Jewish Board of Guardians, also deal with correctional problems.

Public Water Supply.—In the early days, the water supply of New York was derived from wells and from streams and ponds. In 1799 the Manhattan company was incorporated ostensibly to supply the city with water but, under a clause in its charter, devoted itself primarily to the banking business. In 1834 the legislature authorized the city to begin the necessary works to bring water from the Croton watershed more than 30 mi. N., and the first Croton water was delivered to the city in 1842 through the Croton aqueduct. In 1883 the new Croton aqueduct was authorized, and thus additional water became available in 1890. In 1905 the board of water supply was created and work was begun immediately on a new system to bring water from the Catskill mountains, more than 100 mi. N. This commission developed an additional water supply from the Esopus and Schoharie watersheds with a total dependable yield of about 600,000,000 gal. daily flowing through the Catskill aqueduct.

The Catskill aqueduct delivers its water just north of the city line into Hill View reservoir, which has a storage capacity of 900,000,000 gal. From the Hill View reservoir, Catskill water is delivered into the five boroughs of the city by gravity flow, through two tunnels in solid rock at depths varying from 300 ft. to 700 ft. below the street level; the tunnels are at maximum respectively 15 and 17 ft. in diameter. The total cost of the Catskill water-supply system was about $193,000,000. The average daily consumption of water in New York city for 1949 was 1,160,000,000 gal. Since the Catskill supply was so large, the city decreased its use of Croton water, but later facilities to use the entire Croton supply were provided. The public water-supply systems provide a dependable yield of about 1,050,000,000 gal. per day. In view of the narrow margin between this and the mounting consumption, a new construction program to draw water from the Delaware river was begun in 1936. The first stage of the Delaware supply system, comprising Rondout and Neversink reservoirs, with a short tunnel connecting them, and the Delaware aqueduct from Rondout reservoir to the city, was scheduled for completion in 1952—a deep-pressure tunnel in rock, 13½ ft. to 19½ ft. in diameter and 85 mi. long. Like the Catskill aqueduct, the Delaware aqueduct would lead into Hill View reservoir at the northern boundary of the city, 295 ft. above sea level. From here through city tunnels no. 1 and no. 2 the water would reach all five boroughs. The water supply is aerated and chemically treated, so the city's water is clear and wholesome. This first stage would add 205,000,000 gal. per day to the supply The proposed second stage, scheduled for completion in 1956, comprised the East Delaware reservoir and a 26-mi. tunnel to Rondout reservoir. Together they would add 540,000,000 gal. per day, and New York city would have a dependable supply of 1,500,000,000 gal., or 6,250,000 tons of water per day. A drainage area of 1,700 sq.mi., greater than the entire land area of Rhode Island, is required for the city's water-supply system.

Sanitation.—A department of sanitation was created in 1929, consolidating the five separate borough departments of street cleaning into one division of street cleaning. In 1933 the three-member sanitation commission was replaced by a single commissioner. The 1950–51 appropriation for the department was $55,160,250.08.

The area covered daily by the department consists of 5,940 mi. of streets and servicing of 705,804 buildings and homes, containing more than 2,440,000 apartments, for removal of garbage, ashes and refuse. This work is ordinarily accomplished with a personnel of about 12,600 men and 3,600 pieces of motorized equipment. About 62,000,000 cu.yd. of garbage, ashes and rubbish are collected daily. In outlying districts refuse is used for land fills; an outstanding example of such a reclaimed area was the site of the World's fair of 1939–40, which was turned into a park and recreational area. In emergencies such as heavy snowstorms this manpower may be augmented by 20,000 extra labourers and 3,000 additional pieces of automotive equipment. In the winter of 1947–48, when there was a total snowfall of 61.5 in., its removal cost more than $11,780,000.

Public Works.—The department of public works is directed by a commissioner appointed by the mayor at a salary of $15,000 a year. The department has charge and control of all planning, construction and repair work of all structures, buildings and other public works, paid for wholly or in part by city funds, and it must maintain and operate them. It also has charge of sewers and sewage-disposal plants. The budget appropriation for 1950–51 was $11,879,424.96.

The total plant controlled by the department reached a value at mid-20th century of almost $1,000,000,000. In 1949 the estimated cost of projects under construction totalled more than $50,000,000.

The city in 1950 was engaged in a vast sewage-disposal project whereby pollution of harbour waters was to be eliminated. An engineering bureau was established in 1930 to tackle this problem and in 1938, under the new charter, it came under the department

of public works. The early bureau commenced work on the Ward's Island plant, and completed the Coney Island plant, giving the city its first modern sewage-disposal plant in 1935. Within five years three additional plants had been completed and put into operation: Ward's Island plant, Tallmans Island plant and a part of the Bowery bay plant.

In 1948 this program to end pollution of harbour waters was given additional impetus when the Interstate Sanitation commission stipulated that all sewage pollution of waters within its jurisdiction should end by Dec. 1959 and that a minimum construction program should be carried out by the end of 1953. At the completion of this program the city was to have six new sewage-treatment plants in addition to the seven modern and six old plants in operation at that time. The completion of the long-range program was to see a total of 17 modern plants in operation.

City Planning and Zoning.—The greater New York charter adopted in 1898 provided that the responsibility for laying out street systems should be primarily vested in the borough presidents, with specific approval resting on the board of estimate and apportionment and independent approval by the mayor for changes in plan. In 1903 the board of aldermen created an improvement commission which reported in 1907. In 1913 a heights of buildings commission was created. This led to the building zone resolution of July 25, 1916, which regulated the height and bulk of buildings thereafter erected and the boundaries for trades and industries. This resolution divided the city into "use," "height" and "area" districts. The "use" districts are: (1) "residence," where no building can be erected other than for specified uses, such as dwellings, clubs, hotels, etc.; (2) "business," where specified trades considered as either offensive or dangerous are prohibited; and (3) "unrestricted," where no zoning regulations or restrictions are provided. The "height" districts provide for setbacks in buildings erected in excess of certain heights, the height and extent of the setbacks depending on the width of the adjoining streets. There were six "area" districts designated as A, B, C, D, E and F, and the size of court and rear yard required bore a definite ratio with the height of the building. The new city planning commission designated a seventh, "G"—a residential zone restricted to one-family dwellings. Changes in the zoning regulations of 1916, and amendments thereto were vested in a standing committee of the board of estimate and apportionment, called the city plan and public improvements committee. Rapid growth of population and business activity and general changes in the city's structure rendered the old zoning resolution and its patchwork of amendments inadequate. A new zoning resolution based on a two-year study of the city's requirements by the city planning commission was being considered by the board of estimates for adoption in 1951.

New York was the first city to adopt a zoning resolution Efforts in 1939 and 1940 to establish a planning commission and a master plan for the city failed. However, the new charter provided for a city planning commission to consist of a full-time chairman, at a salary of $15,000 a year, five additional members appointed by the mayor, and the chief engineer of the board of estimate. The chairman is head of the city planning department. The commission is charged with preparing a master plan of the city for its future development. It is responsible for completing and maintaining the city map; for zoning changes; the preparation of a capital budget and a five-year capital program; the approval of assessable improvements; the platting of land and the acquisition of land for streets and other public purposes. Appeals from the actions and decisions of the different superintendents of buildings and officers of the fire department who are charged with the enforcement of zoning regulations are made to the board of standards and appeals.

Public Markets.—The prime responsibility of the department of markets lies in the supervision of the city's food industry, which in 1949 handled more than 13,000,000,000 lb. of foodstuffs that came through the markets located in the city. The commissioner of public markets, who is appointed by the mayor at a salary of $15,000 a year, has supervision and control over all public markets, market places and lands, and all auctioneers of food and permits and leases for business. The department's prime functions are to assure the consumer adequate distribution of food, purity of content and protection from profiteering and theft by short weights or measures. The manufacture and sale of ice is also supervised.

The chief markets, wholesale and retail, are the Brooklyn and Bronx terminal markets, Essex street retail market, First avenue retail market, Fulton fish market, Gansevoort, Park avenue, Washington, West Washington, 13th avenue retail market, Wallabout and numerous smaller street markets. A picturesque feature of the city's congested foreign districts is the open-air pushcart market. To protect the retailer and real estate values the city regulated the itinerant pedlar.

Parks and Recreation.—A consolidated department of parks was established in 1934, directed by a commissioner appointed by the mayor at a salary of $25,000 a year. Its 4,500 full-time personnel are under civil service; the 1950–51 budget figure was $17,325,635.03.

In 1950 the city had about 525 modern playgrounds ranging from a quarter acre to developments like the Macombs Dam park in the Bronx, occupying 30 ac. In all, the park system included about 26,526 ac. of land. The recreational facilities range from archery to swimming pools, from football fields to yacht basins. Among major additions and improvements were Flushing Meadows (site of the World's fair of 1939–40), Red Hook recreation area, Brookville and Juniper Valley parks, Riverside park, Fort Tryon park, the Municipal stadium on Randall's Island, Jacob Riis park, zoos in Central and Prospect parks and the entire reconstruction of Bryant, Highland and St. James' parks. The modern parkways for motor traffic are planned with regard to proper connections with state and county systems.

The largest of the parks are the Pelham bay (Bronx), 2,130 ac.; Van Cortlandt (Bronx), 1,146 ac.; Marine (Brooklyn), 1,792 ac.; Great Kills (Richmond), 1,256 ac.; Flushing Meadows (Queens), 1,257 ac.; Central (Manhattan), 840 ac., and Bronx, 721 ac.

Central park extends from 59th to 110th streets, between Fifth and Eighth avenues. It was purchased in 1856 for about $5,500,000, and laid out and developed by the architects Frederick Law Olmsted and Calvert Vaux under the direction of a board of 11 commissioners, the first committee of construction including William Cullen Bryant, Washington Irving and George Bancroft. Van Cortlandt, Pelham bay and Forest parks are the largest generally devoted to outdoor sports and recreation. In Van Cortlandt park is the Van Cortlandt mansion, built in 1748, and now maintained as a museum. The Bronx park is noted for its zoological and botanical exhibits, the African veldt, opened in 1941, being one of its major attractions, and Prospect park for its beauty Riverside park, in Manhattan, extends along the east bank of the Hudson river from 72nd to 129th streets, a distance of about three miles. City Hall park constitutes a part of what was called the "common lands" in the middle of the 17th century. Roger Morris park is the site of the Jumel mansion, the home of Mme. Jumel, wife of Aaron Burr, and here Gen. George Washington made his headquarters during the battle of Harlem heights. In Audubon park was the home of the naturalist John James Audubon. Poe park, in the Bronx, is the site of the Edgar Allan Poe cottage. In Fort Greene park, Brooklyn, is a vault containing the remains of a few of those who died in the British prison ships in 1776 and after.

Courts.—The judicial system of the city is composed of the following courts: magistrates', including felony, homicide, municipal term, night, probation, traffic, week-end, women's, arrest, summons and adolescent courts; municipal (civil actions involving not more than $1,000); city (civil actions involving $1,000 to $3,000); county (in New York county, the court of general sessions; major crimes); special sessions (chiefly misdemeanours); domestic relations, including family and children's courts (children under 16, except murder in the first degree); and surrogate's (estates of infants and deceased persons). The mayor appoints about 80 city marshals whose chief duties are to serve summonses and execute dispossess warrants.

EDUCATION

Public-School System.—The free public-school system is administered as the department of education by an unpaid board of

nine, appointed by the mayor, for terms of seven years. The school system in 1950 comprised 890 public day schools with an enrolment of 943,000. There were 135 high schools, 63 of which were vocational. For each district there is a local board of five appointed by the borough president for five years. Members receive no compensation and may be removed by the mayor after a hearing.

The chief executive officer of the board of education is the superintendent of schools who is elected by the board of education and sits with this body though without vote. He receives a salary of $25,000 a year and holds office for six years. There are eight associate superintendents of schools. The superintendent and associate superintendents of schools constitute the board of superintendents. Teachers are chosen by the board of education from lists of those who have qualified before a board of examiners of seven members appointed by the board of education. The total personnel of the department of education in 1950 was estimated at more than 45,700. Expenditures of the city for educational purposes in 1950–51 amounted to $270,511,174.37, of which $82,192,336 was appropriated by the state toward the payment of teachers' salaries. A teachers' retirement system is administered by the teachers' retirement board of seven unpaid members.

Higher Educational Facilities.—The city provides such facilities in the College of the City of New York including City college, Hunter college (women), Brooklyn college and Queens college. City college was established as the Free academy in 1847. The name was changed to the present one in 1929. The college occupies buildings of English Gothic style, constructed at a cost of more than $5,000,000, and a modern structure in lower Manhattan which houses its business school. Its enrolment in 1950 was in excess of 30,000, while its teaching staff was almost 1,000. Hunter college for women, originally intended as a teacher training school, was founded in 1870 as the "normal and high school." Free to women residents of the city, its enrolment in 1950 numbered 12,000, its staff more than 700. In addition, New York is the seat of Columbia university (*q.v.*) and New York university, which was founded in 1831. In 1835 it moved to Washington square, and in 1891 added a site of about 48 ac. on University heights in the Bronx. It enrols more than 36,000 students. Fordham university (7,000 men students) was founded in 1841 as St. John's college. In 1846 it was turned over to the Jesuits and incorporated. The name was changed to Fordham in 1907. It is situated in the Bronx. Long Island university in Brooklyn had in 1950 an enrolment of 4,500 students, chiefly in the schools of law and medicine. The year 1928 witnessed the opening of the present Yeshiva university (Jewish), which occupies new buildings of Ancient Semitic architecture situated in upper Manhattan. In 1950 it had almost 2,000 students. Among the more important of the professional schools are: the General Theological seminary (Protestant Episcopal); Union Theological seminary (Presbyterian); Jewish Theological Seminary of America; Cornell university medical college; Brooklyn Law school; the Institute of Public Administration; the New School for Social Research; and the professional schools of the various universities. The chief technical institutions are the Mechanics institute, founded in 1820; Cooper Union (*q.v.*); and Pratt and Polytechnic institutes, both in Brooklyn. The New York State Maritime college is at Fort Schuyler in the Bronx.

Libraries.—The first public library in New York was the Corporation library, established at the city hall (1697–1701). Up to 1795 it remained at the city hall and was the Library of Congress when New York was the nation's capital. It was later renamed the Society library. Other older libraries are: the Columbia university library (1754), that of the American Historical society (1804), and the Mercantile library, founded in 1820 by merchants' clerks. The municipal library system consists of the New York Public library, serving Manhattan, the Bronx and Richmond; the Brooklyn Public library and the Queens Public library. There are also numerous and important special libraries in the city.

Art.—Most of the principal American sculptors have at some time resided in New York and it is there, frequently in inconspicuous places, that one finds their masterpieces. Augustus Saint-Gaudens is represented by his "Peter Cooper," the equestrian statue of Sherman, the Admiral Farragut statue, the bronze relief of the Rev. Henry W. Bellows and other works; John Quincy Adams Ward, by the "Pilgrim," "Shakespeare," "Indian Hunter" and a monumental bronze Washington; Frederick W. MacMonnies by his "Nathan Hale," "Civic Virtue," "Horse Trainers and a Quadriga"; Daniel Chester French by the "Alma Mater"; George Gray Barnard by a fountain at Columbia; Karl Bitter by an "Abundance" and an equestrian statue of Franz Sigel; Anna Hyatt by a "Jeanne D'Arc"; Kirke Brown by an equestrian Washington; F. Auguste Bartholdi, the French artist, by a "Lafayette"; H. P. Proctor by a bronze group of panthers; and Edward Kemeys by a "Still Hunt." On the front of the Public library is Paul Bartlett's statue. A group by Albert Weinter depicting the purchase of Manhattan Island is in the city hall of records. The Statue of Liberty of Bartholdi, gift of France for the 100th anniversary of American independence, rises from Bedloe's Island 300 ft. above the harbour. (*See* LIBERTY, STATUE OF.) Modern U.S. sculpture is well represented by the works of such men as William Zorach, Jo Davidson and Isamu Noguchi.

The largest collection of art objects in America is in the Metropolitan Museum of Art. A vast number of paintings, statuary, metalcraft and other works of the masters are on display. Other museums of importance are the Whitney Museum of American Art, which exhibits works of U.S. artists of greater or lesser fame; the Museum of Modern Art, one of the world's most important sponsors of aesthetic experiment. Its retrospective exhibitions of almost all forms of modern graphic arts have attracted large audiences. The Guggenheim Museum of Non-Objective Art specializes in the collection of the form of art that gives it its title.

Aside from the public museums, the city has many famous art galleries where exhibitions of all forms of art may be viewed. Among the later important galleries is that of the Associated American Artists, an organization representing a large group of artists and sculptors. The Cloisters in Fort Tryon park, a branch of the Metropolitan Museum of Art, was a gift of John D. Rockefeller, Jr. It contains an outstanding set of Gothic tapestries, "The Hunt of the Unicorn."

Central and Prospect parks are adorned with many examples of fine statuary, and unfortunately, also, with many which are lacking in merit. Many sculptors are represented in the busts of great Americans in the Hall of Fame at New York university.

A few striking examples of 18th and early 19th century architecture remained at mid-century, notably St. Paul's chapel, designed by MacBean and built in 1764, the old church of St. Mark's-in-The-Bouwerie, completed in 1799, and city hall, the work of Joseph Mangen and John Macomb, completed in 1811. James Renwick designed the Gothic Grace church, completed in 1845, and St. Patrick's cathedral, which was built between 1858 and 1879. After the Civil War Richard M. Hunt, a graduate and teacher in the Paris School of Fine Arts, began his American career Among his first works were the Astor and Gerry houses and the *Tribune* building. George B. Post designed many beautiful residences, the *Times* and *World* buildings and the Produce and Cotton exchanges, Charles F. McKim, William R. Mead, and Stanford White were designers of the old Madison Square Garden, the Washington arch and the Metropolitan club. R. H. Robertson is known for his work on the American Tract Society and United Charities buildings. John Carrère and Thomas Hastings planned the National Academy of Design and the New York Public library; H. I. Hardenburg the Waldorf, Savoy and Manhattan hotels and the American Fine Arts building; and Ernest Flagg the Singer building, St. Luke's hospital and the Scribner building.

The art commission of the city of New York was established in 1898, being the first American municipal organization designed to protect a city against inferior structures and memorials.

Music.—In the first quarter of the 19th century, the Park theatre became a famous stage for dramatic and musical art. In the '40s and '50s the musical centre was Tripler hall on lower Broadway, which became Metropolitan hall in 1854 and then, following its destruction by fire shortly after, was rebuilt and rechristened the New York theatre and Metropolitan Opera house. Later its name was changed to the Winter Garden. The

present Metropolitan Opera house was built in 1883. In the latter half of the 19th century several other large halls for musical recitals were opened, notably, Steinway, Chickering, Hardman and Carnegie halls.

In the 20th century there was a growth of interest in all forms of musical activity, and many orchestras and musical societies were organized. There was a major shift in emphasis toward mass appreciation of fine music. Typical of the many new musical institutions were the Lewisohn Stadium concerts, played by the New York Philharmonic-Symphony orchestra and distinguished soloists before large crowds in the City college stadium.

Literature.—Cadwallader Colden, author of the *History of the Five Nations* (1730), was perhaps the first New York author of general reputation. The first authors' club, the Ancient Club of New York, was founded in the latter part of the 18th century and later included among its members Washington Irving, Fitz-Greene Halleck, James Kirk Paulding and Joseph Rodman Drake. A little later John James Audubon, Richard Henry Dana, James Fenimore Cooper, Edgar Allan Poe, William Cullen Bryant, John Bigelow, Julia Ward Howe and Robert Bonner were members of New York's literary life. In the 19th century the Bread and Cheese club brought together a most creditable group of writers. In the early 1920s Greenwich Village (*see* below) became the centre of American letters. During this period Edna St. Vincent Millay, Eugene O'Neill, Theodore Dreiser, among many made this part of New York their headquarters.

The influence of New York upon letters later declined somewhat although it remained the centre of American printing and publishing. The chief society of authors having headquarters in New York is the American Academy of Arts and Letters. Other notable literary organizations are the Society of Arts and Letters, Authors' guild, Catholic Writers' Guild of America, New York Drama league, American Dramatists, Grolier club, Century association and League of American Penwomen.

Scientific Collections and Learned Societies.—Chief of the scientific collections is that of the famed American Museum of Natural History. The zoological park in Bronx park is under the control of the New York Zoological society.

The botanical garden in Bronx park occupies about 400 ac. The museum contains a library, collections with about 1,800,000 specimens and research laboratories; its income comes from an endowment and from public funds. The Brooklyn Institute of Arts and Science (*q.v.*) maintains another large botanical garden.

The Hispanic Society of America, founded by Archer M. Huntington, maintains an excellent museum of Spanish and Portuguese paintings, manuscripts, maps, coins and antiquities. Other interesting collections are in the museum of the American Numismatic society, containing exhibits of medals and coins of all countries and of all periods, and the American Museum of Safety (industrial safety appliances).

The New York Historical society, founded in 1804, is the most important for material on New York state history. The Long Island Historical Society of Brooklyn and the New York Genealogical and Biographical association, founded in 1869, are notable in this field. The Quadrangle at Broadway and 156th street is the location of the American Numismatic society, the Geographical Society of New York, the Museum of the American Indian and Hispanic Society of America.

The New York Academy of Medicine, established in 1847, the Academy of Political Science at Columbia university, founded in 1880, and the New York metropolitan chapter of the American Society for Public Administration also deserve mention. (*See* SOCIETIES, LEARNED.)

(For New York city press data *see* NEWSPAPERS. For foundations *see* CARNEGIE TRUSTS; ROCKEFELLER BENEFACTIONS; etc. For museums *see* MUSEUMS AND ART GALLERIES.)

GREENWICH VILLAGE

Bounded on the north by 14th street, on the south by Spring street, running west from Broadway, Greenwich Village is a roughly triangularly shaped segment of New York city perhaps most commonly thought of as a home of American arts and letters. It is associated with Bohemianism, radicalism, struggling artists and exotic night clubs and restaurants maintained chiefly for visitors. This atmosphere was a carry-over from the period before and after World War I, when the "Village" was locally considered the centre of the American literary and artistic renaissance. Although at mid-20th century the annual sidewalk art show persisted, and many artists still lived in the Village, the great had mostly moved away, and the Village had become a replica of other city areas. Some parts retained their ancient quaintness. Southwest of Sheridan square at mid-century was the maze of winding streets forming Bedford, Barrow, Grove and Commerce. There could be found the age-worn dwellings erected by the burghers in the late 18th and early 19th centuries. The slate-covered, steep-roofed houses with their old chimney pots, imposing entrances and ironwork were among the best examples of early Village homes.

Elsewhere in the Village the houses and mews—converted stables with their interior gardens—that gave the village its old-world look were rapidly being torn down. Washington square, at the foot of Fifth avenue, dominated by Washington arch, erected in 1892, was the last remaining vestige of the dignity and good taste of the early wealthy settlers who built here when Washington square was the centre of high society. Even this was gradually succumbing to the advances of skyscraper apartments and New York university. In 1950 and 1951 Rhinelander mansion and other fine old buildings along the northern border of the park were torn down. On the southern side of the park, "genius row," the homes of some of the country's best-known artists and writers, had also disappeared.

THEATRES, CLUBS AND CHURCHES

Theatres, Arenas and Exhibitions.—The first dramatic performances in New York were probably those given in a building in Pearl street by a company of actors from London in 1732. Another company from London came to New York in 1749. The real beginning of the permanent theatre in New York was, however, in 1750, when a company under the management of Kean and Murray came from Philadelphia and established themselves in a house on Kip street (now Nassau), between John street and Maiden lane. Lewis Hallam arrived in 1753 from Virginia and erected a theatre in Nassau street, the first building constructed for theatre purposes, and opened it in 1753 with *The Conscious Lovers* and *Damon and Phelleda*. The first performance of *Romeo and Juliet* was given at this theatre in 1754 with Mrs. Hallam as Juliet. This theatre was abandoned the same year and was converted into a church by a society of Calvinists. The next theatre was at Crugers wharf on the East river and was opened by David Douglass in 1758 with *Jane Shore*. Douglass also opened another theatre at the corner of Nassau and what is now Beekman street in 1761 with *The Fair Penitent* and later gave the first performance of *Hamlet* in New York; he also established the John Street theatre, in 1767.

This theatre flourished until the Revolution and during the British occupancy of the city was used for amateur theatricals. After the British evacuation, Washington and his generals were frequent patrons of this theatre.

In 1798 a three-story stone theatre, the Park, was created between Ann and Beekman streets on Park row, for Hallam and Hodgkinson. This building was a very magnificent one for its time, costing about $180,000. The story of the theatre in New York for the next 50 years is largely the story of the Park theatre. In 1837 New York had five theatres, the Park, Bowery, Olympic, Chatham and Richmond Hill. Palmer's Opera house was built in the '40s as was also the Astor Place Opera house, where the Astor Place riot occurred as the result of a dispute between friends of the U.S. actor Edwin Forrest and his English rival William Macready. Twenty-two persons were killed and 36 were wounded by the militia called to quell the disturbance. In 1850, P. T. Barnum brought Jenny Lind to the U.S. for a series of concerts which began at Castle Garden at the Battery. Similar "pleasure gardens," as Niblo's, the New York, Cold Springs, East River, Vauxhall and Ranleagh, were utilized for concerts and other performances for which the capacity of theatres was inadequate. The

Crystal palace in Murray Hill was also a great amusement centre in the early '50s.

By the middle of the century the theatrical district was well established in the neighbourhood of Union square, which was also the shopping centre.

The Academy of Music, the Union Square, Irving Place and Wallack's were the chief theatres in this area. By 1870 23rd street had become the upper limit of the theatrical and shopping centre, with the Fifth Avenue theatre and Booth's. Ten years later the theatres had invaded the lower '30s with Daly's, the Standard, Wallack's and the Casino. In 1883 the erection of the Metropolitan Opera house at 39th street started an invasion of the '40s and by the end of the century, 42nd street had become the real centre of the theatrical district as it is today. The present theatre district comprises roughly a strip of Manhattan extending from 14th to 59th streets, and from Fifth to Eighth avenues. Broadway cuts diagonally across the strip and in the language of the district is the "main stem" to which the cross streets are tributary.

In this area there are about 200 theatres, including those in which moving pictures are a part of the program. According to the best available data, there are in all 4,445 theatres in greater New York, including those exhibiting moving pictures as part of their entertainments. Among the largest are: Radio City Music hall (6,200), Roxy (5,920), the Capitol (4,845), the Academy of Music (3,600), Paramount (3,664) and the Metropolitan Opera house (3,418).

Most of the theatres exhibiting the legitimate drama or musical comedies only are of less than 2,000 capacity (*see* STADIUM). The total seating capacity of places of amusement is about 1,500,000. (*See* THEATRE.)

Clubs.—Club life in New York is less significant now than in the earlier part of the present century before the development of the apartment house hotels, the change in social habits and customs coincident with the expansion of business and trade into former residential districts and the exodus from the city into suburban areas of so many of the leisured class who formerly sought city clubs for recreation and entertainment. The first social organizations of importance were the authors' Bread and Cheese club (1824), and the artists' Sketch club (1829). It was not until 1836, however, that club life in New York really began with the founding of the aristocratic Union and Hone clubs. The Knickerbocker (1871) was also the resort of the descendants of original New York settlers. The St. Nicholas was formed a little later for those whose ancestors were early residents of the colonies.

The Metropolitan (1891), with its costly house, was in fact a protest against the exclusiveness of many of the older clubs. The Union League (1863) was established for the purpose of aiding the union, and its first work was the organization of regiments of Negro troops. To offset this Republican influence, the Manhattan was organized in 1864 to advance Democratic ideals, although this is not now greatly emphasized.

The chief sport and athletic clubs are the New York Yacht (1844), the New York Athletic (1868) and the Racquet and Tennis. Other important clubs with more or less specialized interests are the Advertising Club of New York, Automobile Club of New York, the Camera, Century, City, Colony, Engineers, Explorers, Harvard, Lambs, Yale, Lawyers, Lotos, Players and Salmagundi clubs.

Many of the great office buildings in downtown New York contain luncheon clubs, such as the Downtown association, the Lawyers, Bankers and Whitehall.

Churches.—The Dutch Reformed Church (1628) was the first church in the city and is today known as the Collegiate Church of New York city. The Presbyterians organized here as early as 1638 and were tolerated by the Reformed Church, but it was not until the English occupancy that they made their influence felt. In 1719, the first Presbyterian church was built in Wall street; there are about 100 today. It was not until 1847 that a Congregational church attained great prominence in New York, when the Plymouth Church of Brooklyn was founded with Henry Ward Beecher as pastor. The Congregationalists number about 50 active churches. In 1664, the Lutherans obtained permission from the English Gov. Richard Nicolls to establish a church. The first Lutheran church was at Broadway and Rector street; it was destroyed in the fire of 1776. The Lutheran church grew rapidly and had at mid-century nearly 200 churches and chapels. The Protestant Episcopal Trinity church was built in 1697 at Broadway and Wall street where the present Trinity (1846) stands. St. Paul's chapel (1766) at Broadway and Vesey street is the oldest church edifice in the city; Grace, St. Thomas', the Church of the Transfiguration, familiarly known as "The Little Church Around the Corner," and the great Cathedral of St. John the Divine, at 110th street and Morningside avenue, are other notable Episcopal churches. The first Methodist church (1768) was erected in John street. African Methodist Episcopal churches for Negroes have a large membership. The first Baptists in New Amsterdam (1657) received little consideration at official hands and met in a private house in Broad street in 1715. In 1762 they built a church in Gold street. They have about 120 churches, some of the largest being for Negroes. St. Peter's (1785) was the first Roman Catholic church and in 1808 New York was made the seat of an Episcopal see. In the years prior to the Civil War the Catholic Church grew rapidly. In 1858, the present St. Patrick's cathedral at Fifth avenue and 51st street was begun, and in 1879 it was dedicated. It is the 14th in size among cathedrals and seats about 4,500 persons. There are about 430 Catholic churches. Besides other Christian groups there are numerous flourishing Jewish congregations, some of them of considerable age. There are also a number of undenominational churches and missions.

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NEW YORK FERN (*Dryopteris noveboracensis*), a beautiful North American fern of the shield-fern group. While named after New York, it is native to a much greater region, occurring in moist woods from Newfoundland to Minnesota and southward to Georgia and Arkansas.

The delicate fronds, 1 to 2 ft. high, rise on slender stalks (stipes) from widely creeping rootstocks.

(*See* SHIELD FERN.)

NEW YORK STATE BARGE CANAL SYSTEM consists of the Erie canal, the Champlain canal, the Oswego canal, the Cayuga-Seneca canal, Cayuga Lake inlet at Ithaca, the Glens Falls feeder and the lakes, reservoirs, feeders, harbour basins, and terminal docks facilities. The total length of the system is about 525 mi.

The total number of locks on the main channels of the improved canals, exclusive of the U.S. government lock at Troy, is 56. There are 34 locks on the Erie, 11 on the Champlain, 7 on the Oswego canal and 4 on the Cayuga and Seneca canal.

In addition, there are two junction locks and two guard locks.

Navigation is free and the usual navigation season is about seven months from early in April to Dec. 1. The canals are available for use 24 hours of the day. Boats about 300 ft. long, 42 ft. wide, with a draft of 10 ft. and a cargo capacity of 2,200 tons are generally used.

The Erie Barge canal is the main waterway, connecting the Hudson river at Troy with Lake Erie at Buffalo. It has a total length of 340 mi. and serves as the main route of transporting grain from the west to New York. It is 150 ft. wide and 12 ft. in depth. The cost of construction was $139,214,929.

The Cayuga and Seneca canal connects Montezuma, N.Y., with the Cayuga and Seneca lakes and affords communication between these lakes and the Erie canal. Including the lakes the length of the canal is 92 mi.; exclusive of the lakes, it is approximately 24 mi. It is 200 ft. wide and 12 ft. in depth. The cost of construction was about $8,154,000.

The Champlain canal connects Whitehall, N.Y., at the head of Lake Champlain with the Erie canal at Waterford, providing a waterway between the Atlantic seaboard and the navigable St. Lawrence. It is 60 mi. long, 125 ft. wide and 12 ft. in depth. The cost of construction was about $21,691,000.

The Oswego canal connects Lake Ontario at Oswego with the Erie canal at Syracuse and provides communication between Syracuse and Oswego and, by the use of the Welland canal, with the other Great Lakes. The cost of construction and improvement was about $12,000,000.

Through federal aid, the Erie canal from Waterford to Three River Point and the Oswego canal from its junction with the Erie canal at that point to its mouth at Oswego, the canal entrance at Lake Ontario, were being improved in order to provide for a channel depth of 14 ft. between locks.

This work includes the raising of fixed bridges to a minimum vertical clearance of 20 ft. above maximum navigable pool. The usual clearance provided under the fixed bridges spanning the canals is 15½ ft.

NEW ZEALAND, a member country or realm of the Commonwealth of Nations, consisting of a group of islands in the South Pacific. New Zealand proper, defined by letters patent of 1842 and an imperial act of 1863 as extending from 33° to 53° S. latitude and from 162° to 173° E. longitude, comprises: (1) the North and South Islands (44,281 and 58,093 sq.mi., respectively), cut asunder by Cook strait, a channel varying in width from 16 to 130 mi.; (2) Stewart (or Rakiura) Island (670 sq.mi.), separated from the southwest end of the South Island by Foveaux strait; (3) the Chatham Islands (372 sq.mi.), *c.* 420 mi. E.S.E. of Cook strait; and (4) a number of outlying minor islands included within the political boundaries of 1842. Of the minor islands (total area 307 sq.mi.), the Aucklands (234 sq.mi.), Campbell Island (44 sq.mi.) and the Antipodes (24 sq.mi.) are the principal; the Aucklands and Antipodes are uninhabited. About 925 mi. N.N.E. of Wellington (and thus just outside the 1842 boundary) are the volcanic Kermadecs (13 sq.mi.), annexed in 1887 and included in New Zealand proper. In Polynesia a number of inhabited islands were brought under New Zealand control in 1901. Rarotonga and Mangaia, in the Cook group (84 sq.mi.), and Niue or Savage (100 sq.mi.), of islands outside the Cook group, are the largest of these island territories. Rarotonga is hilly, well watered and very beautiful; Penrhyn and Suvarov (Suwarrow), small coral atolls outside the Cook group, contain excellent harbours. The Tokelau Islands (4 sq.mi.) were detached from the Gilbert and Ellice Islands colony and placed under New Zealand administration by an imperial order in council of 1925; by an act of 1948 they were finally made part of New Zealand's island territories. Total area of New Zealand (including island territories) 103,939 sq.mi.; of New Zealand proper (*i.e.,* excluding island territories) 103,736 sq.mi.

New Zealand also administers Western Samoa (main islands Upolu and Savai'i, 430 and 703 sq.mi. respectively), a United Nations trust territory, and the Ross dependency (about 175,000 sq.mi.), an antarctic region claimed by Great Britain in 1923. The island trust territory of Nauru (8 sq.mi.) is held jointly with the United Kingdom and Australia, although Australia undertakes the administration.

PHYSICAL FEATURES

The North Island is 515 mi. long from North cape to Cape Palliser in the south and varies in breadth from 6 to 200 mi. It is almost divided where the Hauraki gulf penetrates to within 6 mi. of Manukau harbour, south of Auckland. From the isthmus thus formed a narrow, very irregular peninsula reaches out northward for about 200 mi., moist and semitropical and beautiful rather than uniformly fertile. South of the Auckland isthmus the North Island rapidly broadens out. Its central physical feature is the series of unbroken mountain chains running northeastward from Cook strait to East cape, ranges seldom less than 3,000 ft. but never attaining 6,000 ft. in height. Hikurangi, their highest summit, though a fine mass, does not compare with the isolated volcanic cones which, rising west of the main mountain system and quite detached from it, are among the most striking sights in the island. Ruapehu (9,175 ft.) is intermittently active and Ngauruhoe (7,515 ft.) emits vapour and steam periodically. Egmont (8,260 ft.), in the west of the island, is quiescent; its symmetrical form and dense clothing of forest make it the most beautiful of the three. North of the two first-mentioned volcanoes Lake Taupo spreads over 238 sq.mi. in the centre of a pumice-covered plateau from 1,000 to 2,000 ft. above the sea; and round and beyond the great lake the region of the thermal springs covers 5,000 sq.mi. and stretches from Mt. Ruapehu to White Island, an ever-active volcanic cone in the Bay of Plenty. The most uncommon natural feature of the district, the Pink and White terraces, was blown up in the eruption of Mt. Tarawera in 1886, when for great distances the country was buried beneath mud and dust and a chasm 9 mi. long was opened. Fine lakes and waterfalls, innumerable pools, in temperature from boiling point to cold, geysers, solfataras, fumaroles and mud volcanoes attract tourists in large numbers. The healing virtue of many of the springs is widely known. The government maintains a sanatorium at Rotorua and Te Aroha, and there are private bathing establishments in other places, notably near Lake Taupo. (In the South Island there are hot pools and a state sanatorium at Hanmer Springs.) Though the overlying porous pumice reduces the fertility of the Taupo plateau, except under treatment, it has a good rainfall and is drained by unfailing rivers running through deep terraced ravines. The Waikato and Waihou (Thames) flow north, the Rangitaiki northeast, and Mokau, Wanganui, Rangitikei and Manawatu west or southwest. The first named, the longest river in the dominion, though obstructed by a bar like all western—and most eastern—New Zealand rivers, is navigable for about 70 mi. The Mokau and Wanganui run between ferny and forest-clad hills and precipices, often of great beauty.

East of the Taupo plateau and south of Opotiki on the Bay of Plenty are steep, thickly timbered ranges. On the southern frontier of this mountainous tract Waikaremoana extends its arms, the deepest and most beautiful of the larger lakes of the island.

From the mouth of the Waikato southward to about 25 mi. from Cape Terawhiti on Cook strait, and for a distance of from 20 to 40 mi. inland, the western coast skirts fertile grazing and dairy-farming country. On the east coast the same fertility is seen and, round Hawke bay, there is a hotter and drier summer. In the south centre, the upland plain of the Wairarapa has a climate ideal for grazing. The southern end of the island, rough though well grassed, is redeemed by the fine harbour of Wellington (formerly Port Nicholson), which is second only to the Waitemata (Auckland) as a commercial port. Everywhere the farmer may count on an adequate rainfall and—except on the plateau and the mountain highlands—mild winters and genial summers.

The dominating features of the South Island are not ferny plateaus or volcanic cones, but stern chains of mountains. The Southern Alps rise range upon range, almost touching the western shore and stretching from end to end of the island. In the southwest region, which has a heavy rainfall, there are many deep fjords which have been carved out by glacial action. One of these sounds, Milford, has become an important tourist centre,

but none of them, because of the difficult nature of the country, can be developed for settlement.

The South Island has two large and highly developed areas of flat country, the Canterbury plains and the Southland plains, which produce a large proportion of New Zealand's cereal crops. They are also important areas for the growing of root crops and the fattening of stock for export. The sunny valleys of the Nelson and Marlborough districts in the northern part of the South Island produce a large part of New Zealand's crops of apples and pears, hops and tobacco. Another important fruit-growing area is central Otago, which has the lowest rainfall in the country. The high country of the South Island has been developed for sheep rearing since the earliest days of settlement. The narrow coastal strip facing the Tasman sea, with its high rainfall, is particularly suited to dairy- and beef-cattle farming. Although the ports of the South Island handle a considerable overseas trade, good natural harbours are not as numerous as in the North Island.

There are many rivers even on the drier eastern coast; some are snow-fed and the rate of flow varies according to the season. The largest river, the Clutha, 154 mi. long (or 210 mi. from its true source at the head of the Makarora river), discharges a volume of water estimated at nearly 2,000,000 cu.ft. a minute. On the west the only two rivers of importance are the Buller and the Grey, the former justly famous for the grandeur of its gorges. Te Anau and Wakatipu (52 mi. long) are the chief lakes in the south though Manapouri is the most romantic. Mt. Cook is easily first among the mountain peaks. Its height, 12,349 ft., is especially impressive when it is seen from the sea off the west coast. On the northeast a double range, the Kaikouras, scarcely falls short of the Southern Alps in height and beauty. Apart from the fjords and lakes the chief beauties of the Alps are glaciers and waterfalls. The Tasman glacier is 18 mi. long and has an average width of $1\frac{1}{4}$ mi.; the Murchison glacier is 11 mi. in length. To the west of Mt. Cook the Franz Josef glacier crawls into the forest as low as 900 ft. above sea level. Among waterfalls the Sutherland is 1,904 ft. high, but has less volume than the Bowen and others. The finest mountain gorge, the Otira, is also the chief railway route from the east to the west coast. (A. T. CL.)

Geology.—New Zealand is part of the Australasian festoon on the Pacific edge of the Australasian arc. Because of its critical position it has had a particularly varied geological history, and includes, for its size, an unusually complete series of marine sedimentary rocks. It is still a matter of doubt whether Pre-Cambrian rocks constitute any portion of the islands. The oldest rocks, however, extend at intervals down the western side of the South Island. They include a complex of gneisses, schists and dioritic igneous rocks in Fiordland, and sillimanite gneisses on Stewart Island. The main mountain axis of the South Island is a one-sided structure, with a narrow belt of schists on the west and a broad zone of Palaeozoic and Mesozoic altered sediments on the east. This alpine axis is bounded to the west by the Alpine fault extending from Cook strait to south Westland and forming a complete structural division of the island.

Main Divisions.—The first evidence of life appears in rocks of Lower Ordovician age, forming a folded belt in the south at Preservation inlet and in the extreme northwest at Collingwood. They comprise graptolitic slates, quartzites and marbles, and are characterized by an Arenig fauna including *Tetragraptus, Bryograptus, Dichograptus* and *Didymograptus.* In Fiordland they pass north and east into metamorphic types and they appear to grade into the Fiordland gneisses.

In the Cobb-Takaka district, strata of Silurian age (Haupiri beds) extend north from the Cobb river in a wide belt to the Haupiri mountains. Lower Devonian rocks form an important series on the Baton river and at Reefton. The fauna consist of brachiopods, a few trilobites, lamellibranchs, corals and *Bryozoa,* the beds now being assigned to the Upper Siegenian or Lower Coblenzian.

Much of the highlands are built up of folded greywackes, slates and some limestone, with a volcanic horizon recognized near the base of this folded series. The whole is divided into a Permian (Te Anau and Maitai) series and a Mesozoic (Hokonui) series. The nature of the junction between the two is still little understood, various authorities claiming a complete conformity, much regression or marked diastrophism with plutonic (dioritic) intrusions.

In the type locality (Nelson district) the Maitai series (limestones, shales and slates) contain *Platyschisma, Strophalosia, Martiniopsis* and *Spirifer bisulcata,* a fauna characteristic of the Permian beds of eastern Australia. An extensive series of basic breccias (Te Anau series) forms the base of the Maitai series upon which the fossiliferous sediments rest. The top of the series is formed of greywackes, in places containing annelid tubes (*Terebellina*). These are referred to a Lower Triassic age. This Permian series has a wide distribution in the South Island. The succeeding events are not clear. Probably there followed a regression of the sea, succeeded in turn by a transgression when the Hokonui beds were laid down. The base of this series is of middle Triassic age, these beds being followed by Upper Trias. They include the Carnic, Noric and Rhaetic stages, the sediments being greywackes, limestones, a horizon of basic tuffs (Noric) and Rhaetic plant beds. The sequence or portions of it are recognized from both the South and North Islands.

The Noric beds, characterized by an abundance of *Pseudomonotis,* have a very wide distribution, extended throughout the Southern Alps in Canterbury, along the Hokonui hills, in the Nelson district and in the Mokau district of North Taranaki. The series extending from the middle Trias to the Rhaetic is of great thickness, of the order of 10,000 ft. The beds are followed conformably by Jurassic feldspathic sandstones, conglomerates, plant beds and some thin coal seams. Liassic, Bajocian and also Upper Jurassic marine faunas have been described. A widespread series of sediments containing *Inoceramus* occurs in the east of the North Island, probably, in part, of Upper Jurassic age, but extending into the Lower Cretaceous. The problematical schists of the South Island, well developed in the Otago region and referred to as the Otago schists, are perhaps of Mesozoic age, though they have been referred to horizons from the Archaean to the Jurassic. They appear to pass outward into sediments indistinguishable from Ordovician or Mesozoic strata.

At the close of this sedimentation, in Lower Cretaceous times, a strong orogenic movement supervened, in which the Hokonui system was folded along meridional lines, the earth movements being accompanied by widespread plutonic intrusions throughout the length of New Zealand. The dunite sills of the Dun mountain region and the gabbros and norites of North cape belong to this epoch, as perhaps do also some of the diorites of the southwestern district of the South Island. The most intense folding in the North Island is developed in the east; in the west the flexures become more open and undulating strata predominate. In the Otago region, the Otago schists have recently been interpreted as a flat lying series forming a packet of recumbent folds, the participating rocks being referred to members of the Maitai and Hokonui series.

Following the Hokonui diastrophism a series of sediments ranging from middle Cretaceous to Upper Pliocene was deposited, but the record has received diverse interpretations, particularly in regard to the structural relations of the beds and the correlation of formations in neighbouring regions. According to the view of P. Marshall, the whole series is conformable throughout, a difference in age of the basal strata in different districts being ascribed to overlap over an irregular surface of the older rocks. Summarily, the sequence of formations is as follows:

Middle Cretaceous (Albian)		Marine beds (in Kaikoura ranges)
Upper Cretaceous	Senonian	Greensands, basal coal measures
	Danian	Limestones (partly foraminiferal)
Eocene		Marine beds and coal measures
Oligocene, Miocene		Marine beds
Pliocene		Marine beds and gravels

The oldest rocks of this sequence are developed in the Kaikoura mountains of Marlborough, where a thickness of from 3,000 to 9,000 ft. of sandstones and mudstones, with conglomerates and some coal measures, were deposited. These Albian beds are followed by the Amuri limestones (2,500 ft.), but in Canterbury and

the coast of Marlborough Senonian strata underlie the limestone series. In the succeeding Eocene period the coal measures of the southwestern district of the South Island were formed and constitute the most valuable coal seams of New Zealand. The transgressions of Oligocene and Miocene times submerged much of both South and North Islands, but in the central region of Otago the land remained emergent. Fluviatile and lacustrine deposits, however, covered large parts of this area. They are frequently auriferous. A general retreat of the sea from the South Island took place in Pliocene times, but the North Island remained largely below sea level. In the Wanganui area a wonderful development of clays, 3,500 ft. thick, was deposited, apparently without break. The present topography of New Zealand developed as a result of important crust warpings and block faulting. The faults are not simple tensional movements, but involved strong lateral pressure, in which overthrusting and overfolding are developed. The isoclinally folded Tertiary rocks of the Lake Wakatipu region show particularly well the extreme effects of this movement. The earliest development of vulcanicity after the post-Hokonui orogeny is seen in the middle Cretaceous basalts of the Clarence region and the Upper Cretaceous rhyolites near Christchurch. Vulcanicity became more widespread in mid-Tertiary times. To this period belong the pillow lavas and tuffs of the Oamaru district and the rhyolites, andesites and dacites of the Coromandel peninsula. Propylitization of these andesitic rocks gave rise to the auriferous deposits of this latter area. Somewhat later came the alkaline eruptions of the Dunedin district and the basalts forming Banks peninsula. The alkaline rocks of the former area include a varied succession of alkaline trachytes, phonolites, trachydolerites and basalts.

Volcanic activity of Upper Tertiary time extending to the present day led to extensive eruptions of andesites and rhyolites in the North Island. Mt. Egmont consists largely of andesite. The main centres of activity lie on a northeast line of crustal weakness extending from Ruapehu to Mt. Edgecumbe, and the great rift of the Tarawera eruption extending to Lake Rotomahana has a similar trend. The great rhyolite plateau in the Taupo region is built largely of welded tuffs or "ignimbrites," representing white-hot volcanic ashes which became welded as they accumulated and developed jointing as they cooled.

Study of the fossil fauna and flora of the New Zealand region points from many lines of evidence to intimate connection, in Mesozoic times, between this land, Australia and Malaysia. In the later Cretaceous period the connection between Australia and New Zealand was severed, though the latter was directly associated with Antarctica. The complete isolation of the New Zealand region seems to have been accomplished by middle Tertiary time, by a gradual breakup of the circumpacific connections.

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(C. E. T.)

Climate.—The main islands of New Zealand extend through more than 12° of latitude, but contrasts of climate are modified by the influence of ocean currents and prevailing winds.

Table I gives some important data.

Table I.—*New Zealand Climate Data*

Station	Mean temp. (° F.)		Rainfall	
	Jan.	July	Total	Remarks
Auckland	66.3	51 2	45.3	Greater in winter
Rotorua	66.2	47.5	55.2	Greater in winter
Napier	64.8	47.3	35.2	Greater in winter
Wellington	60.9	47.2	47.5	Greater in winter
Nelson	61.5	45.0	38.0	Greater in winter
Hokitika	59.0	44.0	114.3	Spring often wettest
Lincoln (near Christchurch)	60.3	42.5	25.6	Generally distributed
Dunedin	58.6	39 5	37.0	Generally distributed
Ophir (central Otago)	62.3	36.9	17.6	Spring often wettest
Invercargill	57.0	41.4	45.3	Spring often wettest

The range of mean temperatures is small, the rainfall moderate save on the west slopes of the Southern Alps. The snow line reaches down to 3,000 ft. on the eastern side of the Southern Alps, which has rather lower temperatures than other parts, but on the western side it is at 3,700 ft. Nelson, sheltered from the west, is famed for its sunny climate with cool bracing nights.

The winter maximum of rainfall in the north is affected by prevailing winds and the all-year-round distribution of the light rainfall on the east side of the South Island contrasts with the tendency to a spring maximum on the western and southern fringes of the Southern Alps. Heavy rainfall on the west has allowed glaciers to exist and to reach down into the lowlands in some places in spite of the general mildness. The mountainous Stewart Island has about 65 in. of rainfall a year. (A. T. Cl.)

Vegetation.—There are about 1,000 species of flowering plants, of which about three-quarters are endemic. Most of those not peculiar to the country are Australian; others are South American, European and antarctic; and some have Melanesian affinities. Ferns and other cryptogamic plants are in great variety and abundance. The New Zealand flora, like the fauna, has been cited in support of the theory of the remote continental period.

The early colonists found at least half the surface of the archipelago covered with dense evergreen forest, a luxuriant growth of pines and beeches, tangled and intertwined with palms, ferns of all sizes, wild vines and other lianes and a rank, bushy, mossed undergrowth. Though much of the timber is of commercial value —notably the kauri pine (*Agathis australis*), totara (*Podocarpus totara*), puriri (*Vitex lucens*), rimu (*Dacrydium cupressinum*), matai (*Podocarpus spicatus*) and kahikatea (*P. dacrydioides*)—this has not saved the forests from wholesale, often reckless, destruction for settlement purposes. In late years active operations by the state, private companies and the settlers themselves, in reafforestation with European, Californian and Australian softwoods, have been doing much to restore the earlier ravages. These improvements are mainly in the naturally open and grassy regions of the eastern side of both main islands.

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Fauna.—In their natural state the islands had no land mammals except for two species of bat. The Polynesians brought a dog, now extinct, and a black rat, now very rarely seen. The wild dogs and pigs in outlying districts are descendants of domestic animals which have escaped into the bush. There are no land snakes. Of the two bats, one (*Mystacops tuberculatus*) belongs to a peculiar genus and one (*Chalinolobus morio*) is related to Australian and South African forms.

New Zealand is rich in birds, with 23 native species, some of which show Malayan affinity from before the isolation of the islands. The tui and the bellbird or makomako are famed as songsters, while the flightless and weak-winged birds are numerous: the kiwi (*Apteryx*), kakapo (*Strigops habroptilus*), takahe (*Notornis*) cannot fly. New Zealand formerly had 20 species of the gigantic running bird called the moa (*Dinornis*), a huge rail (*Aptornis*) and other bird types now extinct. The earlier destruction of the forests had disastrous effects on bird life. In the Alps a hawklike green parrot, the kea, which has been known to kill sheep, holds its ground. The pukeko, a handsome rail, abounds in swamps. The principal animal pests are deer, opossums and rabbits.

The most famous New Zealand animal, scientifically, is the tuatara (*Sphenodon punctatus*), the sole survivor of the reptilian order of the Rhynchocephalia, otherwise extinct since Mesozoic times so far as is known. This creature, lizardlike in appearance, grows to about two feet in length. The butterflies are few (only 16 species) and moths numerous (more than 1,200 species) and there is a poisonous native beach spider called katipo. An organism called *Peripatus* (*see* Onychophora) has a New Zealand species; it is intermediate in structure between the annelids and the arthropods and species occur in various isolated regions, mostly in southern lands.

Resolution, Kapiti and Little Barrier islets have been set aside as sanctuaries for the native fauna.

The minute young *Galaxias attenuatus* or native trout is fished as whitebait in tidal waters; and flounders are taken in salt or brackish lagoons and estuaries. Oysters, both mud and rock, are good and plentiful. Sharks are found everywhere and are common around the north; they rarely attack man. The albatross is the most conspicuous sea bird. Various penguins are found, the king penguin being confined to the Macquarie Islands.

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HISTORY

Even the approximate date of man's arrival in New Zealand is uncertain. All that can be safely asserted is that by the 14th century A.D. Polynesian canoemen had reached its northern shores in successive voyages. By 1642 they had spread to South Island, for there Abel Janszoon Tasman found them when, in the course of his circuitous voyage from Java in the "Heemskerk," he chanced upon the archipelago, coasted along much of its western side, though without venturing to land, and gave it the name it still bears. One hundred and twenty-seven years later, Capt. James Cook, in the barque "Endeavour," gained a much fuller knowledge of the coasts, which he circumnavigated, visited again and again and mapped out with fair accuracy. He annexed the country, but the British government disavowed the act. After him came other navigators, French, Spanish, Russian and American; and, as the 18th century neared its end came sealers, whalers and trading schooners in quest of flax and timber. English missionaries, headed by Samuel Marsden, landed in 1814, to make for many years but slow progress. They were hindered by murderous tribal wars in which muskets, brought in first by the chief Hongi, more than decimated the Maori. Still, cruel experience and the persevering preaching of the missionaries gradually checked the fighting, and by the year 1839 peace and Christianity were in the ascendant. So far the British government had resisted any pressure brought to bear in Downing street in favour of annexation. In vain Edward Gibbon Wakefield, organizer of colonizing associations, prayed and intrigued for permission to repeat in New Zealand the experiment tried by him in South Australia. Lord Glenelg, the colonial minister, had the support of the missionaries in withstanding Wakefield's New Zealand company, which at length resolved in desperation to send an agent to buy land wholesale in New Zealand and dispatch a shipload of settlers thither without official permission. Before, however, the "Tory" had thus sailed for Cook strait, it had become known to the English government that a French colonizing company—Le Compagnie Nanto-Bordelaise—was forming, under the auspices of Louis Philippe, to anticipate or oust Wakefield. With the assent of the Protestant missionaries the British authorities reluctantly instructed Capt. William Hobson, R.N., to make his way to northern New Zealand with a dormant commission of lieutenant governor in his pocket and authority to annex the country to Australia by peaceful arrangement with the natives. Hobson landed in the Bay of Islands on Jan. 22, 1840, hoisted the Union Jack and had little difficulty in inducing most of the native chiefs to accept the queen's sovereignty at the price of guaranteeing to the tribes by the treaty of Waitangi possession of their lands, forests and fisheries. Some French settlers, convoyed by a man-of-war, reached Akaroa in South Island in the following May. But Hobson had forestalled them, and those who remained in the country became British subjects. Meanwhile, a week after Hobson's arrival, Wakefield's colonists had sailed into Port Nicholson, and proposed to take possession of immense tracts which the New Zealand company claimed to have bought from the natives, and for which colonists had in good faith paid the company. Other bands of the company's settlers in like manner landed at Nelson, Wanganui and New Plymouth, to be met with the news that the British government would not recognize the company's purchases. Then followed weary years of ruinous delay and official inquiry, during which Hobson died after founding Auckland. His successor, Robert Fitzroy, drifted into an unsuccessful native war. A strong man, Capt. (later Sir) George Grey (*q.v.*), was at last sent over from Australia to restore peace and rescue the unhappy colony from bankruptcy and despair. Grey, much the best of the absolute governors, held the balance fairly between the white and brown races and bought large tracts of land for colonization, including the whole South Island, where the Presbyterian settlement of Otago and the Anglican settlement of Canterbury were established.

SELF-GOVERNMENT

In 1852 the mother country granted self-government and, after much wrangling and hesitation, a full parliamentary system and a responsible ministry were set going in 1856. For 20 years thereafter the political history of the colony consisted of two long, intermittent struggles—one constitutional between the central government (first seated at Auckland, but after 1865 in Wellington) and the powerful provincial councils, of which there were nine charged with important functions and endowed with the land revenues and certain rating powers; the other racial.

The Maori Wars.—The native tribes, brave, intelligent and fairly well armed, tried, by means of a league against land selling and the election of a king, to retain their hold over at least the central North Island. But their kings were incompetent, their chiefs jealous and their tribes divided. Their style of warfare, too, caused them to throw away the immense advantages which the broken bush-clad island offered to clever guerrilla partisans. They were poor marksmen, and had but little skill in laying ambuscades. During ten years of intermittent marching and fighting between 1861 and 1871 the Maori did no more than prove that they had in them the stuff to stand up against fearful odds and not always to be worsted. Round Mt. Egmont, at Orakau, at Tauranga and in the Wanganui jungles, they more than once held their own against British regiments and colonial riflemen. The storming of their favourite positions—stockades strengthened with rifle pits—was often costly; and a strange anti-Christian fanaticism, the Hau-Hau cult, encouraged them to face the white men's bullets and bayonets. But even their fiercest fighting leaders, Rewi and Te Kooti, scarcely deserved the name of general. Some of the best Maori fighters, such as the chiefs Ropata and Kemp, were enlisted on the white side, and with their tribesmen did much to make unequal odds still more unequal. Had Gen. Thomas Pratt or Gen. Duncan Cameron, who commanded the imperial forces from 1860 to 1865, had the rough vigour of their successor, Gen. Trevor Chute, or the cleverness of Sir George Grey, the war might have ended in 1864. Even as it was the resistance of the Maori was utterly worn out at last. After 1871 they fought no more. The colonists too, taught by the sickening delay and the ruinous cost of the war to revert to conciliatory methods, had by this time granted the natives special representation in parliament. A tactful native minister, Sir Donald McLean, did the rest. Disarmament, roads and land purchasing enabled settlement to make headway again in the North Island after 12 years of stagnation. Grey quarrelled with his masters in Downing street, and his career in the imperial service came to an end in 1868. His successors, Sir George Bowen, Sir James Ferguson, the marquess of Normanby and Sir Hercules Robinson, were content to be constitutional governors and to respect strictly the behests of the colonial office.

Sheep Farming and the Discovery of Gold.—Meanwhile the industrial story of New Zealand may be summed up in the words wool and gold. Extremely well suited for sheep farming, the natural pastures of the country were quickly parcelled out into huge pastoral crown leases, held by prosperous licensees, the squatters, who in many cases aspired to become a country gentry by turning their leases into freeholds. So profitable was sheep farming seen to be that energetic settlers began to burn off the bracken and cut and burn the forest in the North Island and sow English grasses on the cleared land. In the south artificial grassing went on for a time hand in hand with cereal growing, which by 1876 seemed

likely to develop on a considerable scale, thanks to the importation of American agricultural machinery, which the settlers were quick to utilize. Even more promising appeared the gold fields. Gold had been discovered in 1852. Not, however, until 1861 was a permanent field found—that lighted upon by Gabriel Read at Tuapeka in Otago. Thereafter large deposits were profitably exploited in the south and west of South Island and in the Thames and Coromandel districts of the Auckland province. Gold mining went through the usual stages of alluvial washing, deep sinking, river dredging and quartz-reef working. Perhaps its chief value was that it brought many thousand diggers to the colony, most of whom stayed there. Pastoral and mining enterprise, however, could not save the settlers from severe depression in the years 1867 to 1871. War had brought progress in the north to a standstill; in the south wool growing and gold mining showed their customary fluctuations. For a moment it seemed as though the manufacture of hemp from the native *Phormium tenax* would become a great industry. But that suddenly collapsed, to the ruin of many, and did not revive for a number of years.

In 1870 peace had not yet been quite won; industry was depressed; and the scattered and scanty colonists already owed £7,000,000 sterling. Yet it was at this moment that a political financier, Sir Julius Vogel, in that year colonial treasurer in the ministry of Sir William Fox, audaciously proposed that the central government should borrow £10,000,000, make roads and railways, buy land from the natives and import British immigrants. The house of representatives, at first aghast, presently voted £4,000,000 as a beginning. Coinciding, as the carrying out of Vogel's policy did, with a rising wool market, it for a time helped to bring great prosperity, an influx of people and much genuine settlement. A total of £14,000,000 of borrowed money, spent in ten years, was on the whole well laid out.

But prosperity brought on a feverish land speculation; prices of wool and wheat fell in 1879 and went on falling. Faulty banking ended in a crisis, and 1879 proved to be the first of 16 years of almost unbroken depression. Still, eight prosperous years had radically changed the colony. Peace, railways, telegraphs (including cable connection with Europe), agricultural machinery and a larger population had carried New Zealand beyond the primitive stage. The provincial councils had been swept away in 1876, and their functions divided between the central authority and small local bodies. Politics, cleared of the cross issues of provincialism and Maori warfare, took the usual shape of a struggle between landed wealth and radicalism. Sir George Grey, entering colonial politics as a Radical leader, had appealed eloquently to the workpeople as well as to the Radical "intellectuals," and though unable to retain office for very long he had compelled his opponents to pass manhood suffrage and a triennial parliaments act. A national education system, free, nonreligious and compulsory, was established in 1877. The socialistic bent of New Zealand was already discernible in a public trustee law and a state life insurance office. But the socialistic labour wave of later years had not yet gathered strength.

Sixteen years of depression, from 1879 to 1895, were followed by 26 years of great prosperity and in turn by 6 years of depression again, from 1921 to 1927. The slump conditions which prevailed in the 1880s (caused by a fall in the world price level) intensified the political atmosphere. In politics nearly 12 years of Conservative government were succeeded by 20 years of radicalism. The main aim of the legislation, which evoked world-wide interest, was social justice. Up to Jan. 1891 the Conservative forces controlled the country and for ten years progressive legislation was confined to a mild experiment in offering crown lands on perpetual lease, with a right of purchase (1882), a still milder instalment of local option (1881) and an ineffective Factories act (1886). In Sept. 1889, however, Sir George Grey succeeded in getting parliament to abolish the last remnant of plural voting. Finance otherwise absorbed attention; by 1890 the public debt had reached £38,000,000, against which the chief new asset was 1,300 mi. of railway, and though the population had increased to 650,000, the revenue was stagnant. (W. P. Re.; X.)

During the years 1879–90, the leading political personage was Sir Harry Atkinson. In Dec. 1890 he was overthrown by the progressives under John Ballance. Atkinson's party never rallied from this defeat, and a striking change came over public life, though Ballance, until his death in April 1893, continued the prudent financial policy of his predecessor. The change was emphasized by the active intervention in politics of the trade unions. These bodies decided in 1889 and 1890 to exert their influence in returning workmen to parliament, and where this was impossible, to secure pledges from middle-class candidates. The number of labour members elected to the general assembly was small, never more than six during more than 20 years, and no independent labour party of any size was formed. But the influence of labour in the progressive or, as it preferred to be called, Liberal party, was considerable and the legislative results noteworthy. Ballance directed his energies to constitutional reforms and social experiments. These in general did not interfere with the general lines of Atkinson's strong and cautious finance.

On Ballance's death in 1893, his place was taken by Richard Seddon, who put through the bill of that year granting woman suffrage; in 1919 women became eligible as parliamentary candidates. The Advances to Settlers act, 1894, inaugurated a series of schemes of state moneylending to farmers on mortgage of freehold or leasehold land; most classes of such advances were later administered by the State Advances corporation, created in 1936. Workers' wages were first safeguarded by the Truck act, 1891, and a series of acts between 1892 and 1899 aimed at making the payment of wages more certain and secure and at limiting creditors' rights to attach future earnings. Subsequently this code was consolidated into the Wages Protection and Contractors' Liens act, 1908, and that was superseded by a measure of like title in 1939.

The keystone of the regulative system was laid by the passing of the Industrial Conciliation and Arbitration act, 1894, under which disputes between employers and unions of workers were compulsorily settled by state tribunals; these, the arbitration courts, were empowered in 1898 to prescribe minimum rates of wages; and an amendment in 1903 prohibited any employer, worker, union of employers or union of workers from taking proceedings to defeat any of the provisions of an award during its currency. The Old-Age Pensions act, 1898, a pioneer measure in British countries, was the precursor of several in an outstanding program of social security. In 1898, also, the municipal franchise was greatly widened. Borrowing on a larger scale was begun in 1895, and in 12 years twice as many millions were added to the public debt. The general election of 1899 was the most languid held in 15 years, for politics ceased to be the chief topic of interest after New Zealand sent troops to serve in the South African War.

A marked commercial revival had taken place, mainly caused by the steady conversion of the colony's wastelands into pasture; the development of frozen meat and dairy exports, following the successful introduction of refrigeration to shipping in 1882; the continuous increase in the output of coal; the invention (in New Zealand) of gold dredging; the revival and improvement of hemp manufacture; the exploiting of the deposits of kauri gum; the reduction in the rates of interest on mortgage money; and a general rise in wages, obtained without strikes, which increased the spending power of the working classes. Commercial confidence was restored by the reconstruction of the Bank of New Zealand in 1895, and activity was stimulated by large public loans, while more cautious banking and the systems of taxation and rating on land values contributed to check land speculation.

The Liberal party headed by Ballance, Seddon and Sir Joseph Ward held office without a break for 21 years, mainly because of the general support given to its agrarian and labour policy by the smaller farmers and the working classes. In 1912 it fell, and the more conservative side, which by then had taken the title of Reform party, at last returned to office. The farmers, who had been organized into a powerful union, sought to destroy the liberal system of state tenancy in favour of freehold tenure with complete right of sale under a cheap and speedy land transfer law. The Reform party was prepared to give them this and numbers of them joined it. At the same time labour began to break away from the Liberals, under whose regime very few labour leaders had gained seats in parliament. After 1910 New Zealand labour followed the

example of Australia in creating its own party and, though serious strikes occurred in 1913, 1916 and 1921–22, the dominion remained on the whole industrially pacific.

Period of World War I.—In 1914 came World War I and a coalition ministry of Reformers and Liberals was formed in which William Ferguson Massey, the prime minister, had the help of Sir Joseph Ward as finance minister. New Zealand was not unprepared to be of service in wartime. A law passed in 1909 paved the way for compulsory training of the militia. Volunteers for service overseas came forward with enthusiasm and their fine physiques, initiative and self-reliance were qualities which distinguished the New Zealand contingents.

Heavy taxation and other severe war measures had to be endured in the dominion. Largely by forced loans from the banks and others direct from the taxpayers, £55,000,000 were borrowed internally. The output of gold and the chief products of food and raw materials were commandeered at war prices for the imperial government. The war debt, for the size of the population enormous, finally exceeded £81,500,000; but the interest on it was punctually paid. The £26,340,245 owing to the British government in 1922 because of war expenditure was funded, and funded-debt payments continued until 1931 when the British government, following the Hoover proposals, voluntarily suspended these obligations of New Zealand. At the peace New Zealand received a League of Nations mandate to administer Western Samoa.

Social legislation was more or less at a standstill in wartime but an important change was made in the liquor law. Local option was abandoned in favour of a triennial poll for and against national prohibition, which might be voted by a bare majority. Maintenance of the *status quo* was increasingly favoured in successive polls.

Between World Wars I and II.—Peace in 1918 was followed by three years of feverish activity and a wild speculation in rural land. When a very sudden fall of prices in 1921 stopped the orgy, the reaction was extremely severe. Thousands had mortgaged themselves in buying freeholds without adequate capital, nearly 1,000 farmers sought the bankruptcy court in the seven years 1921–27, and a large number had to part with their holdings. Because of rural embarrassment, a law of 1919 providing for a moratorium in the case of mortgages, other than trade mortgages, and of deposits, other than bank deposits, was continued until 1927.

The government had also to deal with many thousands of demobilized soldiers without employment. Pensions were bestowed on a liberal scale and more than 9,000 soldiers were settled on the land. There was a good deal of miscalculation, disappointment and failure in this scheme of military settlements. In 1936 soldiers' mortgages were transferred to the State Advances corporation. The Small Farms Amendment act, 1940, provided for settlement on the land of soldiers who had served in World War II, giving them absolute preference over all other applicants for land made available for selection under the legislation of 1932–33. With a view to protecting soldier settlers against the inflation of land values which ensued after the previous war, the Servicemen's Settlement and Land Sales act, 1943, controlled the price at which land could be sold or leased.

In 1919 the Liberal ministers withdrew from the coalition government, and the Reformers continuing in office had to meet industrial depression by economies in expenditure. The general elections of 1922 left Massey with a bare majority in the house of representatives, but the hopeless division of Labour from the Liberals enabled the Reformers just to hold their ground. Massey, the veteran premier who had led the Reformers to victory in 1912, died in 1925.

Following the 1925 general election the premiership went to Joseph Gordon Coates, newly elected leader of the Reform party, a comparatively young Auckland farmer. The elections proved to be the most complete triumph ever gained by a conservative party in the dominion. Labour won but 12 seats, but subsequently gained some by-elections and became the official opposition.

As a result of the encouragement given to farming, pastoral production constantly expanded, so that New Zealand had become one of the world's largest exporters of pastoral produce. As a consequence, its national income was extremely sensitive to price fluctuations of these products; so that, with the advent of the world-wide financial depression in 1930, its economic position became most vulnerable. Measures adopted during 1930–35 to help the farmers were numerous and often of a drastic character. The steps taken included the raising of the exchange rate, so that £N.Z.125 equalled £100 sterling; the adjustment of mortgages and farm indebtedness; the lowering of interest rates and farm costs; remission of certain rates and taxes; abolition of the graduated land tax; and the subsidization of farm labour.

Although New Zealand had obtained a unitary constitution in 1870, the country retained the status of a colony until Sept. 26, 1907, when it became a dominion. In common with the other dominions, representatives of the country shared in the direction of Great Britain's part in World War I, and in accordance with the independent status which it had attained, New Zealand was a signatory to the peace treaties and became a member of the League of Nations. As member of the British group of nations it signed the 1928 General Act for the Pacific Settlement of International Disputes (the "Kellogg pact") and the London naval treaty of 1930, and it was an individual signatory to the naval treaty signed in London in 1936. The New Zealand parliament approved in 1931 the draft Statute of Westminster (*q.v.*), which gave legal recognition to the autonomy of the dominions; New Zealand (in common with Australia and Newfoundland) requested that the operative parts of the statute should not become applicable until adopted by its own legislature. This step was not deemed necessary until 1947.

Sir Joseph Ward became prime minister in Dec. 1928, was succeeded in May 1930 by George William Forbes, and in 1931 the latter formed a coalition administration. At the Imperial Economic conference in Ottawa, Ont., in 1932 New Zealand agreed to more liberal tariff preferences for goods of British origin, and these were given legislative effect in 1934. Because of a worsening economic condition, there was a general reduction of 10% in wages and salaries in 1931, and the next year reductions were effected in pensions, salaries of state employees, rent, interest rates and other fixed charges. Such was the condition of the country at the time that between 1931 and 1935 there was a net exodus from New Zealand of 9,918 persons.

At the general election in 1935 the Labour party came into office under the premiership of Michael Joseph Savage, the party winning 53 seats against 20 for the National party (formed by the coalition of the Liberals and Reformers in 1931) and 7 held by Independents. Much legislation of the highest importance followed. The Reserve Bank of New Zealand, which had been established in 1934, was nationalized in 1936, the government subscribing the capital of £500,000 previously held privately. The government became the sole purchaser of dairy products for export, and their sole marketer, guaranteeing fair prices to the farmers for their butter and cheese. An amendment to the Arbitration act in 1936 restored the powers of the arbitration court, fixed basic wages and decreed a 40-hour week for industry, while a government bureau of industry was invested with wide powers for industrial planning. In 1936 free postprimary education was made available to every child. Most existing schemes of government advances for farming and industry were placed under the administration of the State Advances corporation, created in 1936, and the government embarked upon an ambitious scheme of building houses to be rented to workers.

In 1936 the prohibition against election of public servants to the house of representatives was removed (though, if elected, they ceased to be public servants), and with repeal of legislation of 1932 trade unions and like societies once more were permitted to use their funds for political purposes. The customary three-year life of parliament was extended to five years during World War I and, because of the acute economic crisis, to four years during 1934–37; in 1941, during World War II, the term of the 26th parliament was extended to four years. Parliament passed in 1936 the Mortgagors and Lessees Rehabilitation act, which made provision for the adjustment of excessive mortgage indebtedness; and sanctioned resumption and expansion of schemes of public works, which had been seriously curtailed during the previous period of financial stringency. The year 1938 saw passage of the Social Security act,

which consolidated pension measures and initiated extensive health and medical benefits. At the 1938 general election, at which Labour was returned to office, 92.85% of the electorate exercised their votes. The Labour party held 53 seats, the National party 25 and the Independents 2; as a result of by-elections and resignations from the party, immediately prior to the 1943 general election Labour representation had been reduced to 50, with 25 Nationals, 4 Independents and 1 Democratic Labour. Approximately 84.6% of the electorate voted at the general election in 1943, at which Labour seats fell to 45, the National party secured 34 and there was 1 Independent.

World War II.—Savage continued to head the Labour government until his death in March 1940; his successor as prime minister was Peter Fraser who, the following July, formed a special war cabinet. The country, no longer a belligerent automatically when the United Kingdom was at war, elected voluntarily and unanimously to support Britain's declaration of hostilities against Germany in 1939. The year 1940 marked the centenary of the proclamation of British sovereignty in New Zealand. A centennial exhibition was held in Wellington during Nov. 1939–May 1940, historical publications were produced and special stamps and coins issued.

Early in the conflict emergency war legislation was enacted, including the prohibition of strikes, a volunteer force was recruited for overseas service and service for home defense again became compulsory. After Dunkirk the dominion shipped half of its stock of rifle ammunition to Britain, where it was urgently needed, and in 1942, when the onrush of Japanese aggression was still unchecked, New Zealand dispatched half its trained troops, half of its limited bomber force and all of its anti-aircraft guns to defend the outpost of Fiji, key to strategy in the Pacific. The country became a base for U.S. forces.

Further reference to the part played in World War II is made in the section *Defense* below. (W. B. Pn.; X.)

After World War II.—The war placed a great strain on the basis of the welfare state and challenged much of the philosophy of the Labour party, which was still in power. In social security there was an increase of hardship, as well as of planning, for progress had to wait. A policy of stabilization was adopted, in accordance with three principles: (1) prewar control of prices and wages; (2) the maintenance of prices to the consumer of the necessities of life at as low a level as possible, and the distribution of those necessities as widely as possible; and (3) general agreement that economic stability rather than social progress was the best goal during wartime.

During the war this policy was remarkably successful: the cost of living did not increase at any great rate and the framework of social security was preserved. After the war ended, however, with the inevitable shortages of consumer goods, the policy of stabilization weakened and public irritation followed. More scope was urged for private enterprise. By and large, the war had little permanent effect on the economy, the pattern remaining as before with overseas markets and prospects dominant. In the election of 1949 the Labour government was defeated by the National party led by S. G. Holland, who then became prime minister. A campaign was immediately launched to establish more private enterprise; a reduction of subsidies on foodstuffs and a relaxation of controls was greatly hastened. The country remained prosperous since overseas prices for exports of butter, cheese, lamb and wool remained high. There was little unemployment and a vigorous policy of immigration continued to be encouraged.

In the legislative field important acts passed were the Westminster Adoption act of 1947, which ratified the Statute of Westminster passed by the U.K. Parliament in 1931. In 1949 the Military Training act introduced compulsory military training and the Gaming Amendment act instituted government-controlled off-course betting. In 1950 capital punishment, which had been abolished by the Labour government in 1941, was restored, and a major constitutional change was made by the introduction of an act abolishing the legislative council, the upper house of the New Zealand parliament. The peace treaty with Japan was ratified in 1952. An important change was made in the control of the state railways when in 1952 the administration was handed over to a commission; previously the railways were under the control of a government department. Probably the most important legislation in 1952 was the Land Settlement Promotion act which was designed to prevent undue aggregation of land and assist further settlement on farmlands.

In the conduct of external affairs there was little dissension. None questioned the primary loyalty to Great Britain and the commonwealth or the country's strong support of the United Nations and its specialized agencies. Recognition of the predominant power of the U.S. in the Pacific was implicit in the Australia-New Zealand-U.S. pact signed in 1951, but New Zealand spokesmen also insisted that all who fought against the axis and Japan should take part in the negotiation of the peace treaties, and they showed some apprehensiveness at the rearming of Japan. When war broke out in Korea, New Zealand troops were sent to support the U.N. command. New Zealand also enthusiastically supported the Colombo plan.

A notable event was the royal tour which brought Queen Elizabeth II and the duke of Edinburgh to New Zealand from Dec. 23, 1953, to Jan. 30, 1954; this was the first time that a reigning British monarch had visited the country.

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POPULATION

In Jan. 1840 New Zealand had a more or less fluctuating population of about 1,000 whalers, sealers, traders, missionaries and settlers. By 1861 the number was slightly less than 100,000. Gold discoveries in the 1860s and a vigorous development policy of public works and assisted immigration in the 1870s multiplied the number of colonists nearly five times, to 489,933 in April 1881. Subsequently the increase slackened because of economic depression, but with the development of the frozen-meat trade and rising world prices in the 1890s the population again increased steadily, and by March 1901 New Zealand's white population numbered 770,000. Natural increase rather than migration proved the principal factor for growth in population during the first 30 years of the 20th century. The rate of increase year by year declined substantially, however, and in the five depression years 1931–35 there was actually a net exodus from New Zealand of 9,918. Excluding Maori, at the census in 1921 the population numbered 1,218,913; in 1926 it was 1,344,469; in 1936, 1,491,484; and in 1945, 1,647,635. A census was taken in New Zealand proper on April 17, 1951, and in the island territories on Sept. 25, 1951. The following are the population totals: New Zealand proper (excluding Maori) 1,823,796, Maori 115,676, total 1,939,472; Cook Islands 15,079; Tokelau 1,571; Niue 4,588; trust territory of Western Samoa 83,096.

At June 30, 1953, the population of New Zealand was estimated at 2,047,405, including 124,089 Maori. The Maori are considered in a separate article (*see* Maori).

More than three-fifths of the population of New Zealand is urban and more than two-thirds of that is found in the North Island. There are four main cities. In the North Island are Auckland, the largest, with a population of 329,123 at the 1951 census; and Wellington, the capital, whose population of 133,414 shows an apparent fall from the figures of earlier years through the separation of Hutt (74,878) as a new urban area.

In the South Island are Christchurch (174,221) and Dunedin (95,457). Other towns (all of city status but with population

figures not confined to the city area) are, in the North Island, Hamilton (33,137), Gisborne (19,774), Napier (24,538), Hastings (23,797), New Plymouth (24,923), Wanganui (29,717), and Palmerston North (32,908); and in the South Island, Nelson (20,497), Timaru (22,851) and Invercargill (31,613). In recent years the greatest increase in population has been that of Auckland, but Hamilton and Hutt have also grown very rapidly. (Population figures given include suburbs.)

The birth rate declined steadily after 1921, reaching a figure of 16.17 per 1,000 of the population in 1935. Thereafter a steady improvement set in, and the rate for 1941 (22.81) was the highest attained after 1922; in 1952 the rate was 24.77 per 1,000. The Maori birth rate was about double that of the white population, the figure for 1952 being 45.41 per 1,000. The favourable climate of the country and the high efficiency of health services contributed toward a comparatively low death rate. In 1933 the death rate reached a new low point of 7.99 per 1,000; thereafter there was an increase, in 1952 the death rate being 9.47 per 1,000 mean population. New Zealand's population is predominantly of British stock. More than 90% of its people are of British Isles ancestry or were born in England, Ireland, Scotland or Wales.

Immigration.—People who are wholly of British birth and parentage and wholly of European race and colour are given verbal permission to enter New Zealand at the time of their arrival, provided they are in good health, of good character and in possession of a valid passport. Such people do not need written permits, visas, guarantees of work or to have any prescribed sum of money. Persons not wholly of British birth and parentage (that is aliens, naturalized British subjects and people both or either of whose parents were not born British subjects) and those not wholly of European race and colour must obtain written permits to enter the country from the immigration division of the department of labour and employment before they leave for New Zealand.

The New Zealand government introduced an assisted passage scheme in 1947 for migrants from the United Kingdom and from that time accepted single men and women under 46 for a wide variety of occupations. The scheme also included family groups nominated by a friend, relative or employer in New Zealand. The nominator in New Zealand had to guarantee accommodation for the family and the working members had to have occupational skill.

Between 1946 and March 31, 1953, 18,491 migrants were granted free passages to New Zealand from the U.K., and 45,994 settlers made their own way there from the U.K.; 30,703 migrated to New Zealand at their own expense from other commonwealth countries. During the same period 23,815 settlers from noncommonwealth countries arrived in New Zealand, of whom about 4,500 were displaced persons from Europe. (A. T. Cl.)

Religion.—Of those answering the "religion" question at the 1945 census 37.53% of Europeans and 32.99% of Maori were Anglicans; and 13.45% of Europeans and 15.38% of Maori were Roman Catholics. Of other Christian denominations the Presbyterian (23.38% of Europeans, 1.67% of Maori in 1945) and Methodist (Europeans 8.12%, Maori 7.63%) are the largest. The Latter-Day Saints (Mormons) have had considerable success among the Maori (*c.* 10% of Maori Christians). There are also a number of specifically Maori Christian sects of which Ratana (17.4% of Maori in 1945) and Ringatu (5.23%) are the strongest. The *Pai-marire* or Hau-Hau, the fanatical anti-Christian sect of the Maori wars, had only 662 adherents in 1945. (*See* also MAORI.)

Christianity was brought to the country in 1814 by an Anglican missionary priest, Samuel Marsden, "the apostle of New Zealand." New Zealand was constituted a mission archbishopric of the Church of England, with see at Auckland, in 1841, but in 1857 became an autonomous metropolitan see. In that year the Church of the Province of New Zealand was inaugurated, in full communion with Canterbury. Government is by a general synod, which elects the archbishop-metropolitan or primate from among the diocesan bishops. Thus the primate's see is not fixed in any one city. There are nine dioceses (including two with jurisdiction over Melanesia and Polynesia) and a separate bishopric (Aotearoa) for the Maori. The Roman Catholic Church is organized in three dioceses subject to the archepiscopal see of Wellington.

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Education.—The Education act of 1877 made state education in New Zealand free, secular and compulsory between the ages of 7 and 14. The school-leaving age was subsequently raised to 15. In 1914 the educational system was recast, the dominion department of education assuming many powers hitherto vested in local educational authorities.

Kindergartens.—Children between the ages of three and five may be enrolled at free kindergartens maintained by the New Zealand Free Kindergarten association. The government makes annual grants toward the support of the kindergartens, but the system is far from universal. In 1951 there were only 127 free kindergartens, with 4,906 children on the rolls.

Primary Schools.—Although every child has to be enrolled at the age of seven as a pupil of either a public or registered (private) school, entry to primary school is permissive from the age of five. All state primary schools are coeducational. The syllabus of instruction includes, besides the "three R's," elementary science, agriculture and, in some instances, dairy work. Older boys receive instruction in woodwork and metalwork at manual-training centres, and older girls are taught domestic subjects. In country districts where there are not enough children to warrant separate secondary schools, older pupils attend district high schools, which are under the same control as the primary schools. In addition, there are intermediate schools (formerly termed junior high schools) which provide varied and enriched courses for older children to help them decide on their lines of further education. There were, in 1951, 1,885 public schools within the primary-schools system, these including district high schools and intermediate schools or departments, and the number of pupils enrolled at the end of that year totalled 267,273.

Postprimary Schools.—In 1936 free postprimary education to the end of the year in which he is 19 was offered to every child completing a primary-school course or attaining the age of 14 years. A total of 90% of the children leaving public primary schools continue to full-time postprimary schooling. Postprimary (secondary) schools are termed grammar schools in Auckland, colleges in Wellington and high schools in the North Island and over most of the South Island. Where a secondary and a technical school are amalgamated under a single governing body the resulting institution is known as a combined school. Technical schools fall roughly into two types: those in the small centres distinguishable from secondary schools only by having a rather more strongly developed practical side; and large technical schools in the main centres—where city secondary schools provide an academic curriculum. In 1951 the state conducted 40 secondary schools, 7 combined schools, 110 secondary departments of district high schools and 30 technical high schools. The government assumed in 1938 full responsibility for the work of vocational guidance at postprimary schools.

Rural Education.—It is the policy of the government to provide for country children, as far as practicable, the same educational facilities as those available to town children. For this purpose small rural schools have been consolidated and school buses or free railway passes furnished. Where these do not suffice, a horseback allowance is made. Correspondence classes are conducted for those in very remote areas, and broadcasting is much used. Country teaching positions are relatively better paid, and every city teacher, to qualify for promotion, has to serve for three years at a country school. The curriculum is adapted to the social and economic background of each school. The teaching of agriculture is a special feature in rural schools, and projects are undertaken by boys' and girls' agricultural clubs.

Private Schools.—In 1922 registration of every private school was made compulsory and certain standards of efficiency and suit-

ability of staff, premises, equipment and curriculum required. In 1951 there were 308 private primary schools, of which 242 were conducted by the Roman Catholic Church. That denomination and the Anglican and Presbyterian churches maintain their own secondary schools (there were 74 in 1951), generally boarding establishments. In 1950, 35,922 pupils attended registered private primary schools and 9,341 registered private and endowed secondary schools. Some of the private secondary schools are run on English public-school lines and the headmasters of some of the boys' schools belong to the Headmasters' Conference of Great Britain. Of such schools Christ's college, Christchurch (1850), is the oldest. Others are King's college, Auckland (1896), and Wanganui Collegiate school (1854).

Maori Education.—While more than half the Maori children attend the public schools together with the white children, there are also a few village schools provided for their education, as well as some mission schools remaining from the pre-Maori wars system. The Maori frequently make better progress in their own schools, where they are taught Maori arts and crafts, song, legend and history. In 1951 there were 159 village schools and 10 mission schools, with a total roll number of 13,663 (of whom 1,142 were non-Maori) and 822 respectively; 19,154 attended the public schools. Maori are entitled to free secondary education provided in ten Maori high schools maintained by the government and, for those in remote districts, in private denominational schools by means of government scholarships. In all 863 pupils attended these schools and in 1951 there were nine district high schools offering courses of a practical nature specially suited to the needs of Maori pupils.

Higher Education.—The University of New Zealand (founded 1870 as an examining body; refounded 1926 as a federal university) comprises four university colleges—at Auckland (1882), Wellington (Victoria University college, 1897), Christchurch (Canterbury University college, 1873) and Dunedin (University of Otago, founded 1869 as a degree-granting institution; granting of degrees put in abeyance 1874). Although each provides the customary arts and science courses, Auckland specializes in architecture, commerce and engineering; Wellington in law; Christchurch in engineering and music; and Otago in medicine, dentistry, mining and metallurgical engineering. In practice an integral part of the University of New Zealand are the two "associated" agricultural colleges—Massey (1926), near Palmerston North, and Canterbury (1873), at Lincoln near Christchurch. The government provides liberal scholarships, bursaries and studentships. In 1951 of 11,691 enrolled students at the six colleges, 5,876 received free university education.

Adult Education.—The Workers' Educational association is one of the principal agencies for adult education. Working with the university colleges, it conducts tutorial classes in the cities and carries on work in the country by means of material specially prepared as a basis for discussion among groups of people. The organization receives government and university grants and donations from trade unions, local bodies and private individuals. The National Council of Adult Education co-ordinates the adult educational activities and recommends the amount and allocation of the annual grant for adult education paid by the University of New Zealand.

Educational Research.—With the financial assistance of the Carnegie Corporation of New York, the New Zealand Council for Educational Research was founded in 1933.

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CONSTITUTION AND GOVERNMENT

New Zealand was constituted a dominion in 1907. The Statute of Westminster (see *History* above), though not formally adopted till 1947, recognized its autonomy in 1931. In accordance with parliamentary legislation Queen Elizabeth II was proclaimed in Wellington on May 29, 1953, "by the Grace of God, of the United Kingdom, New Zealand and her other Realms and Territories Queen, Head of the Commonwealth, Defender of the Faith." This now declared the British monarch's specific and separate sovereignty over New Zealand, as also over other commonwealth realms. The sovereign is represented by the governor general, whom the former appoints after consultation with the New Zealand government. Representing a constitutional monarch, he must be guided in the execution of his powers and authority by the advice of the New Zealand cabinet; while he does not "govern" and his functions are "state" and formal, his signature affixed to an act of parliament or order in council expresses legislative or executive decision.

Although the Statute of Westminster was not formally adopted until 1947 by the New Zealand parliament, this had not diminished the dominion's freedom to conduct both its internal and external affairs as it saw fit, without the direction of the British government. New Zealand is represented overseas (1954) by high commissions in the United Kingdom, Australia and Canada; by an embassy in the U.S. (the first New Zealand mission to a foreign country, established as a legation in 1942); and by legations in France and Japan. The United Kingdom, Australia, Canada, India and Pakistan have high commissions in New Zealand; the U.S. maintains an embassy; and Belgium, France, Israel, Italy, the Netherlands, the Philippines, Sweden and the U.S.S.R. have legations.

Central Government.—There were in the early years of New Zealand six distinct settlements—Auckland, Wellington, Nelson, New Plymouth, Canterbury and Otago—between which communication was for several years irregular and infrequent. To meet their political needs the Constitution act of 1852 made them into provinces, with elective councils and superintendents subordinated to one colonial legislature. In 1876 the provincial system, which produced confusion because of lack of uniformity, was abolished and full control passed to the legislature, properly called the general assembly but usually known simply as parliament. This body consisted of the legislative council (the upper house) and the house of representatives (the lower house). The number of members of the legislative council was indeterminate and they were appointed for seven years by the crown; *i.e.,* by the governor general on the advice of the cabinet. Women became eligible for appointment in 1941. Provision was made in 1914 for an elected legislative council, but this change was not made. Members were paid and, subject to certain exemptions, could be fined for absence. As in the case of the United Kingdom house of lords, the legislative council could not initiate or amend taxation and revenue bills, and as a general rule most legislation was in fact first introduced in the lower house. In 1951, however, by an act passed in 1950, the legislative council was abolished and a constitutional reform commission was set up to decide on an alternative system.

The house of representatives has 80 members, four of whom are Maori. After each population census the 76 European electorates are readjusted according to population distribution. Until 1945 an addition was made to rural population so that the number of rural electorates, in proportion to their population, was higher than urban electorates. The "country quota," as this allowance was called, first appeared in 1881; it was computed on the basis that 28% is added to the rural population—for electoral purposes, population other than that contained in a city or borough of more

than 2,000 inhabitants or in any area within five miles of the chief post offices at Auckland, Wellington, Christchurch or Dunedin. From 1952 quotas for European electoral districts were obtained from the total population as disclosed by the census. Provision exists for an allowance or subtraction of 7½% of the total population where districts containing the exact quota could not be formed consistently with consideration to topography, community of interest, communications and existing electoral boundaries. In 1937 the normal life of parliament was fixed at three years. Women became eligible as parliamentary candidates in 1919 and public servants in 1936, the latter with the provision that if elected they immediately ceased to be public servants. Members of the legislative council were ineligible, as were individual contractors to the public service where payment of more than £50 was involved. An elector must be a British subject resident for one year in New Zealand and for three months in the electoral district in which he claims to vote.

Registration became compulsory in 1924. Maoris are qualified to vote only at elections of the four members representing their race, a secret ballot being introduced in 1937.

Executive administration is conducted on the principle of the British parliamentary system, that is, executive power is vested in a cabinet (the members of which, with the governor general, also constitute the executive council) responsible to the elected chamber of the legislature—the house of representatives. The cabinet, chosen from members of the majority party in the house, consists of the ministers or "political heads" of departments of the government. It is customary for the Maori race to be represented by one of its members in the cabinet. Members of the house of representatives are paid.

Cabinet portfolios are allocated by the prime minister, the leader of the majority party in the legislature. In the case of the National party, those who shall become members of the cabinet are selected by caucus (*i.e.*, by all the parliamentary National members), the prime minister only assigning those chosen to their respective posts; the prime ministers of other parties are free to decide who shall enter the cabinet.

Local Government.—With the abolition of provincial administration in 1876 (*see* above) the dominion was divided into 63 counties, with provision for elective councils to deal with such primary needs as road making and bridge building. For purposes of local administration of this type the 63 counties were later subdivided into 129 and, in addition, there were 127 borough councils (for areas not greater than 9 sq.mi. having a population of at least 1,000), 21 dependent town districts (where there were 50 householders in an area of not more than 2 sq.mi.) and 34 independent town districts (having a population of 500). Besides the 129 counties, and the boroughs and independent town districts within them regarded as separate administrative entities, there were numerous autonomous, overlapping districts formed from parts of counties (concerned with roads, drainage and rivers) and others made up of groups of adjacent districts of other types united for a common purpose. By 1952 there were altogether 909 local authorities. The compulsory amalgamation of many of these local bodies was sought repeatedly, but entrenched local interests frustrated all attempts at reform.

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Judiciary and Police.—The chief justice of New Zealand and a number of puisne judges constitute the supreme court and court of appeal. There are also three special courts—arbitration, compensation and land valuation. Magistrates' courts have both civil and criminal jurisdiction, but more serious criminal cases are not tried summarily but sent forward to the supreme court for trial or sentence. Maoris may use their own language in court.

The police force is a national organization maintained wholly by the central government. It replaced the New Zealand armed constabulary in 1866. (X.)

DEFENSE

Before 1939.—To assist the empire in the South African War of 1899–1902 New Zealand sent ten contingents of mounted rifles numbering 6,495 officers and men. In 1909 compulsory training in peacetime was introduced and in 1916, two years after New Zealand had joined with the rest of the empire in the war against Germany, recourse was had to conscription for service overseas; 98,950 men went overseas in that war, serving in many parts of the world, notably at Gallipoli (where the title Australian and New Zealand army corps was condensed to the famous "Anzac") and in France; 16,697 lost their lives on active service.

Compulsory military training in peacetime was suspended in 1930 and New Zealand faced the beginning of World War II with a small voluntary territorial force together with the New Zealand division of the royal navy (established 1920) and the Royal New Zealand air force (established as a separate service in 1937).

World War II.—The New Zealand government had, for several years before 1939, been very strong in its advocacy of collective action to check aggression and it showed no hesitation in joining the United Kingdom when Germany attacked Poland. In June 1940 both home and overseas service were put on a compulsory basis. After the "total" mobilization that followed Japan's entry into the war, industrial conscription was introduced. The New Zealand 2nd division, as the new expeditionary force was called, suffered severe casualties in 1941 in Greece and in Crete where the defense of the island was entrusted to its commander, Maj. Gen. B. C. (later Lord) Freyberg. Later in the year the division took part in the advance into Libya. In June 1942 it played a decisive part, at Minkar Kuaim, in stemming the axis advance into Egypt. It was one of the assaulting divisions at El Alamein and was prominent in the pursuit of the axis forces until their surrender in Tunisia. In Oct. 1943 the division crossed to Italy where it saw further hard fighting—particularly at Monte Cassino.

The 3rd division, formed for action in the Pacific, took part in relatively minor operations in the Solomons. The New Zealand naval forces (designated the Royal New Zealand navy in 1941) took an active part in hostilities from Dec. 1939 when the New Zealand cruiser "Achilles" took part in the battle of the Río de la Plata against the German pocket battleship "Admiral Graf Spee." Seven squadrons of the Royal New Zealand air force served in Europe with the R.A.F. and 26 with the U.S. forces in the Pacific. In all, 135,000 New Zealanders served overseas—10,130 were killed, 19,345 wounded and 8,086 taken prisoner. Conscription did not apply to the Maori population, 7,000 of whom served voluntarily in a Maori battalion which fought with great distinction as part of the 2nd division.

In 1939 New Zealand had no munitions industry but during the war its factories turned to the manufacture of many of the smaller types of munitions—small arms ammunition, shells, mortars, small vehicles such as carriers, etc. However, apart from its fighting men, its main contribution was in the maintenance of supplies of meat and dairy produce on which the United Kingdom was dependent. Five New Zealand merchant ships were lost through enemy action. To assist the large U.S. forces stationed in New Zealand and elsewhere in the Pacific from 1942 onward, substantial assistance was given by New Zealand under reciprocal aid both in defense construction and the supply of foodstuffs.

A Labour government was in office at the outbreak of war but from July 1940 the war effort was controlled by a war cabinet representing both sides of the house. A short-lived attempt at fuller co-operation between the parties in the form of a war administration failed in 1942, after which the opposition withdrew their support from the two of their members who continued to sit in the war cabinet. There was, however, complete agreement between the parties that the war effort should be prosecuted to the utmost of the country's resources.

Postwar.—Defense activities are supervised by a defense council of ministers and officials. In 1949 all male New Zealanders were made liable for a 14-week period of military training on becoming 18, to be followed by 60 days' service over the next three years. For the following six years they remain members of the reserve with no training liabilities. The introduction of compulsory training made possible the organization and training of a division in peacetime.

In fulfilment of its obligations under the United Nations charter New Zealand sent a voluntarily recruited field regiment of artillery with auxiliary units to join the United Nations forces in Korea. New Zealand frigates also served there from almost immediately after the outbreak of fighting. New Zealand also supplies some officers for the Fiji military forces.

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SOCIAL CONDITIONS

Labour Legislation.—As a result of the legislation of the Liberal government which came into power in 1891 New Zealand acquired world fame as a land of advanced social legislation while still in the pioneer stage of economic development. The labour code, established principally by the Industrial Conciliation and Arbitration act of 1894, provided for the settlement of industrial disputes by judicial means and not by strike action and enabled working conditions to be modified to meet changes in the country's economy without constant recourse to acts of parliament. The system of compulsory arbitration was modified to the point of abolition during the depression of the 1930s. It was restored by an amending act of 1936 which also empowered the court to fix basic wage rates for adult workers and, where practicable, to fix the maximum hours of work per week (exclusive of overtime) at 40. Union membership was made compulsory. During World War II strikes and lockouts were illegal. As a result of the serious waterfront strike of 1951 legislation was passed to ensure democratic control of unions. It provided for the election of officials by secret postal ballot and gave the state power to require a secret ballot to be taken at any stage during a strike. After 1944 all workers had a minimum paid holiday period of 14 days annually.

Social Security.—New Zealand's Old-Age Pensions act, 1898, was the first such measure in any British country. Widow's pensions were introduced in 1911; pensions were granted in 1915 to miners incapacitated through pthisis; in 1926 allowances were granted to families where the parents had more than two children and limited incomes; blind persons and chronic invalids also received pensions. The Social Security act of 1938 increased the rates of the various noncontributory civil pensions and placed them on a universal contributory basis. It also introduced a universal superannuation scheme under which benefits were to be paid irrespective of income received or property owned. Provision was also made for new health and medical benefits (*see* below). In 1945 family benefits were made payable for each child, irrespective of size of income or number of family. In 1948 many New Zealand social security benefits were put on a reciprocal basis with those in the United Kingdom and Australia. New Zealanders pay 1*s*. 6*d*. in each £1 of income to the Social Security fund which is also supplemented from general revenue.

Hospitals and Health.—Before 1938 the expenses of hospital boards were met by payments from local ratepayers, government subsidies and contributions from those patients who were able to pay. By the Social Security act the responsibility for the patient's share was transferred to the Social Security fund. The contribution of local ratepayers was being reduced in the mid-1950s and it was intended that by 1958 the entire cost should be borne by the state.

Under the social security scheme 7*s*. 6*d*. is paid from the fund toward the cost of a visit to or by a doctor. Medicines prescribed by a doctor are free. Maternity benefits include antenatal and postnatal advice and treatment, services of doctors and nurses at confinements and treatment and maintenance in hospital. In the case of private hospitals part of the fee for treatment and maintenance is covered by payments from the Social Security fund.

Housing.—Through the state advances department, created in 1894, the government lent money for the purchase of homes and the improvement of farms. In 1934–35 the department was reconstituted as the Mortgage corporation, a limited amount of private share capital being subscribed, but by another change in 1936 the State Advances corporation came into being, with the elimination of private share capital and the liberalizing of provisions governing advances. The government undertook direct home building in 1937. While actual erection was by private builders the purchase of land and the designing and letting of houses were carried out by the state. From 1950 tenants were given the opportunity of purchasing these state houses. The housing shortage became acute during World War II and continued into the 1950s. Rents were controlled from 1936.

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ECONOMY

Agriculture.—The total area of New Zealand, excluding the Cook and other Pacific islands annexed in 1901, but including the Kermadec Islands and the outlying islands within New Zealand proper, is 66,390,677 ac. Of this total 43,253,908 ac. were returned in 1950 as being in occupation, including reserves and native lands leased, but excluding areas within borough boundaries, holdings of less than 1 ac. in extent and native land held on the communal system; the total area grassed or cultivated was 20,228,434 ac. and 23,025,474 ac. were unimproved land.

The principal items cultivated are wheat, oats, grass seeds, potatoes, onions, tobacco and orchard produce and the produce of market gardens (truck farms), nurseries and hop gardens. Wheat is the most important grain crop grown in New Zealand—three-quarters of it in the Canterbury district and most of the remainder in north Otago. As not enough is grown for home consumption, large amounts have been imported for several years. The local growers' wheat prices are fixed yearly on a cost-of-production basis.

Grass is by far the most important crop to the farmer, and in many parts of the country tussock and other naturally established grasses have given way, after hard labour, to artificially sown pasture grasses. Aerial top-dressing was an important development. Large tracts of land in the Nelson district, formerly regarded as practically useless, were proved eminently suitable for growing fruit, particularly apples. Nearly one-third of the apple and pear crops are exported. The local market absorbs practically all the stone fruits (mostly cultivated in central Otago) and citrus fruits (produced in Auckland and Hawke's Bay). In 1950 the area under field crops was 1,165,405 ac.; under artificially grown pasture grasses, 17,946,229 ac.; under fruit trees 20,094 ac.; and in plantations, 907,741 ac.

Pastoral Production.—New Zealand is primarily a grazing country; it became the world's largest exporter of mutton, lamb, butter and cheese. Almost all kinds of sheep find a favourable habitat in the dominion; as of June 30, 1952, the total number of sheep was 35,384,000, the average size of the flocks being 1,008. Although ranking fifth among the principal sheep countries of the world, in 1952 New Zealand was fourth largest as a producer of wool and second as an exporter.

In 1952 the total number of cattle in the dominion was 5,450,000. Beef breeds increased after chilled shipments to overseas markets were proved to be satisfactory in 1933. Dairy cows in milk accounted for 36% of total cattle in 1952.

Dairy Produce.—Scientific management increased the season's yield of butterfat per cow from 152 lb. in 1920 to 260 lb. in 1951–52. There were 348 co-operative dairy factories in 1950, some exclusively concerned with turning out butter, a larger number cheese and a few producing dried milk powders and casein; in 1942 butter and cheese amounted to 2,345,000 cwt. and 2,688,000 cwt. respectively and in 1952 the figures were 3,670,000 cwt. and 1,825,000 cwt. The Primary Products Marketing commission, set up

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MOUNTAIN AND LAKE SCENES OF NEW ZEALAND

1. Milford Sound, one of the most magnificent fjords on the coast of South Island. In the background is Pembroke Peak and the Lion, so called because it resembles a lion couchant
2. Lake Waikaremoana and Panekeri Bluff, in the southeastern portion of the Auckland district. This is the scene of an extensive hydro-electric development
3. Mount Egmont, visible from nearly every part of Taranaki, is an extinct volcanic cone, on the western side of North Island
4. Lake Wakatipu, bordered on one side by the majestic Remarkables mountains, lies between Kingston and Queenstown, South Island
5. Arthur Valley and Diamond Gully lie at the head of Milford Sound on the west coast of Otago, on South Island
6. View of the agricultural country near Arrowtown, in the Wakatipu district, South Island

BY COURTESY OF THE NEW ZEALAND LEGATION, WASHINGTON, D C.

CITIES AND HARBOURS OF NEW ZEALAND

1. Wellington, capital of New Zealand, lies on the south end of North Island, on Port Nicholson
2. Queenstown, picturesquely located midway up Lake Wakatipu, is a favourite resort town in South Island
3. St. Kilda, a suburb just outside Dunedin, South Island, has a fine sandy beach on the ocean where there is good surf bathing
4. Picton, at the head of Queen Charlotte sound (Marlborough district, South Island), is 50 miles from Wellington, across Cook strait
5. Parliament buildings in Wellington, the seat of government and political centre of the dominion
6. Napier, capital of the Hawke's Bay district, showing the Cenotaph erected to the memory of soldiers of World War I. Napier has been rebuilt since it was destroyed in the earthquake of 1931
7. General view of Dunedin, capital of the Otago district, South Island
8. Christchurch, capital of the Canterbury district, South Island, showing Cathedral square in the heart of the city, which is on the plains 5 miles from the sea
9. Auckland, the largest city in New Zealand, on a beautiful deep-water harbour, North Island

in 1947, acquired ownership of butter and cheese, at f.o.b. rate or in store, marketing or disposing of it in the United Kingdom or regulating its distribution on the local market. The New Zealand Dairy board was concerned with the internal aspect of the dairy industry and herd testing.

Forestry.—State forests aggregated 9,481,000 ac. in 1951 and comprised 56% of the total forest area and 15% of the total area of New Zealand proper. The total forest area included 1,250,440 ac. of exotic forests, of which 796,440 ac. were administered by the New Zealand forest service (including 450,000 ac. planted) and 436,000 ac. were communal or belonged to afforestation companies.

To preserve young growth and encourage natural regeneration, logging is done in state forests by the government forest service. Fire hazard prediction instruments, radio and aircraft are used in forest fire prevention, while denudation of forests and soil erosion has also been checked. A development of the 1950s was two large pulp, paper and lumber projects—at Murupara and Tokoroa—based on nearly 500,000 ac. of exotic forest.

Fisheries.—The most important of the edible fishes are the snapper, the terakihi, flounders of various species, blue cod and the groper or hapuku. Except for groper and ling fishing by means of long lines, most fishing is carried on at depths of less than 40 fathoms. Fishery products marketed in 1951 were valued at £1,390,415. The principal oyster beds were those in Foveaux strait. With the enormous development of pelagic whaling, New Zealand's formerly important whaling industry greatly declined, and after 1940 the only shore station in commercial operation was that in Tory channel, Queen Charlotte sound. The taking of seals was prohibited. Swordfish (the common big-game fish), striped black marlin and broadbill (a rare visitor), mako shark and other big-game fish are found off the east coast of Auckland province.

Minerals and Mining.—Coal was mined in the 1930s to a greater value than gold, the mining of which had been New Zealand's chief industry in the 19th century. In 1951, 2,435,505 tons of coal, valued at almost £2 10*s.* a ton, were produced. Gold production declined considerably, and in 1951 only 75,115 oz. were produced, valued at £915,356. Production of kauri gum, the fossilized resin of former kauri forests, was considerable until its displacement by synthetic lacquers and resins. Silver is found alloyed with gold in the Hauraki region, and other minerals of commercial importance include tungsten ore, pumice, manganese ore, iron ore and silica sand and scheelite. Copper, mercury, tin, platinum, sulphur, asbestos, bentonite and phosphatic rock also occur. Petroleum of good quality but in limited quantity has been proved.

Factory Production.—While the farming industries were of major economic importance, the government made every effort to encourage establishment of local manufactures. During the early days of colonization bounties were offered in many instances to aid the introduction of new industries and to induce experienced factory workers to immigrate, and subsequently, in the development of New Zealand's tariff policy, locally manufactured products were afforded a measure of protection. Nevertheless, industrial expansion was necessarily limited by the size of the available market and by the competition of products of large-scale enterprises established in the more densely populated countries.

In 1930–31 there were 5,194 factories in operation in the dominion, the value of their output being £77,645,249. As a concomitant of the world-wide depression in trade and industry, factory production declined during the next two years, but a period of recovery then set in, reaching in 1941–42 a record high level with 6,367 manufacturing establishments having an output valued at £155,566,195.

World War II and shortages following it further stimulated industrial development and in 1950–51 the number of factories had increased to 8,318 with an output valued at £395,045,818. The principal industries are meat freezing and preserving, butter, cheese, condensed and dried milk manufacture, fellmongering and scouring, sawmilling and the manufacture of forestry products. Others of major importance include hydroelectric power production, woollen and clothing manufacture and fertilizer production.

Water Power.—New Zealand is topographically well suited to hydroelectric development, about 5,500 Mw. being available in the South Island and 1,250 Mw. in the North Island. In 1903 sole right to use the water power of the dominion, subject to any existing rights, was vested in the crown. This right might be delegated to local authorities and private concerns, and these were required, by regulations amended in 1934, to obtain permission to generate power from the minister of public works and to pay an annual rental. Hydroelectric power is put to a variety of uses on the farms and in industry, while many of the railway lines have been electrified. The government generating stations are: in the North Island, Maraetai (which began operations in 1953 with a capacity of 18,000 kw.), Karapiro (started 1947; 90,000 kw.), Arapuni (installed capacity, 1946, 157,800 kw.), Tuai (52,000 kw.), Piripaua (40,000 kw.), Kaitawa (32,000 kw.)—these three constituting the Waikaremoana scheme—and Mangahao (19,200 kw.); and in the South Island, Waitaki (105,000 kw.), Lake Coleridge (34,500 kw.), Highbank (25,200 kw.), Lake Tekapo (25,200 kw.), Lake Monowai (6,000 kw.), Cobb River (32,000 kw.) and Arnold (3,060 kw.). In 1943 the government adopted a ten-year plan for increasing the hydroelectric supply on the North Island. By 1953 three stations of ten planned—Arapuni, Karapiro, Maraetai—had been built on the Waikato river; long-distance power lines were to carry 220,000 v. instead of the existing 110,000 v. In 1953 about 93% of the population had access to electric supply, the cost of which to the consumers (83% of them domestic) was rather less than one penny per unit (kilowatt-hour). During 1953 a project for a 20,000 kw. geothermal steam station at Wairakei near Taupo in the central North Island was being studied: geothermal potential was estimated at 200 to 400 Mw.

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EXTERNAL TRADE

The total trade of New Zealand per head of population is one of the highest in the world. In 1952 the figure for exports and imports combined was just slightly more than £250 per head. This high volume of trade means that the New Zealand economy is very dependent on prices and conditions in world markets, especially in the United Kingdom and the United States, which are its largest customers.

Total merchandise trade (excluding specie) for the years 1949–52 is shown in Table II.

Table II.—*Merchandise Trade of New Zealand*

Calendar year	Exports £000	Imports £000	Total trade £000	Excess of exports £000
1949	147,290	119,713	267,003	27,577
1950	183,752	157,943	341,695	25,809
1951	248,127	206,534	454,661	41,594
1952	240,813	252,439	493,252	−11,626

Total overseas receipts and payments made by the New Zealand banking system during the same period are shown in Table III.

Table III.—*Overseas Receipts and Payments*

Item	1949 £000	1950 £000	1951 £000	1952 £000
Receipts for:				
Exports	139,203	194,786	254,135	215,909
Other items	19,531	18,790	21,999	29,452
Total	158,734	213,576	276,134	245,362
Payments for:				
Imports (excl. govt.)	109,657	140,816	201,293	199,973
Govt. debt and other services incl. payments for imports	28,426	28,444	29,994	38,503
Other items	27,140	29,861	28,790	30,327
Total	165,223	199,121	260,077	268,803
Balance	−6,489	+14,455	+16,058	−23,441

Exports.—In 1952 dairy products (butter, cheese, casein, dried and condensed milk), meat and wool accounted for 88% of total exports. Other exports are timber, sheep and cattle skins, apples, seeds and peas and canned vegetables. The quantity and value of the major exports from 1949 to 1952 are shown in Table IV. (The figures for 1951 and 1952 are affected by the long dock strike of 1951.)

TABLE IV.—*Quantity and Value of Major Exports*

Calendar year	Butter		Cheese		Frozen and chilled meat		Wool		Sheepskins and pelts	
	000 cwt.	Value £000	000 cwt.	Value £000	000 cwt.	Value £000	000 lb.	Value £000	Number 000	Value £000
1949	2,952	35,450	1,879	12,674	6,882	27,230	429,657	46,553	17,416	3,856
1950	2,750	35,567	1,998	14,536	6,761	28,629	393,974	74,653	17,461	6,736
1951	2,943	41,362	2,132	16,650	5,496	25,394	316,900	128,176	14,705	9,033
1952	3,670	55,929	1,825	15,769	7,710	40,475	438,107	81,998	20,092	6,417

After World War II, New Zealand became the world's greatest exporter of meat and dairy produce. In 1952, out of a total world trade in meat of 1,129,000 tons, New Zealand exported 32%, as compared with Denmark, 19%, and the Argentine, 13%; out of a world total for butter of 8,274,000 cwt., New Zealand's share was 44% (Denmark, 28%); and of cheese of 6,442,000 cwt., 29% (Netherlands, 23%). New Zealand was also the second largest exporter of wool, Australia in 1951 exporting 51% of a total of 1,796,000,000 lb. and New Zealand 17%. The United Kingdom takes about two-thirds of New Zealand's total exports, the United States being the next best customer with 11.7% of the total in 1951 and 11.4% in 1952. New Zealand supplied 57% of the butter imported by the United Kingdom in 1952, 63% of the cheese and 58% of the carcass meat. The importance of the trade link between the two countries can be further gauged by the fact that New Zealand's exports amounted to 54% of the total butter consumed in the U.K. in 1952, 44% of the cheese consumed and 21% of the carcass meat.

Since 1938 exports from New Zealand have been subject, as an exchange control measure, to licensing. The object of the export licensing system is not to restrict exports in any way but to ensure that the full value of the exports in terms of foreign currency becomes available to the banking system.

Imports.—More than 80% of New Zealand's total imports normally consist of articles wholly or mainly manufactured, a large proportion of them being goods (as, for instance, vehicles and tractors) which could not be produced economically in the country. In addition, many imports of manufactured or semimanufactured goods form the raw material of further factory processes in the country; *e.g.*, cotton piece goods. The principal groups of commodities imported are textile piece goods and drapery, metals and machinery, sugar, tea, alcoholic liquors, tobacco, paper and stationery, oils, motor vehicles and accessories, chemicals and drugs and manures. In 1952, 55% of New Zealand's imports came from the United Kingdom (60% in 1950, 43% in 1947). The increase between 1948 and 1950 can be attributed to the need to restrict expenditure in nonsterling areas and to the increased availability of British goods for export.

Over the years 1950–52 the proportion of imports coming from nonsterling sources increased as import licensing, with its preference for goods of United Kingdom origin, was relaxed. The proportion coming from the dollar area increased from 10% in 1950 to 13% in 1952 and from nonsterling Organization for European Economic Cooperation (O.E.E.C.) countries from 4.5% to 9.6%. This increase was mainly at the expense of the U.K. and Australia, the latter's proportion having fallen from 12% to 10.6%. Despite the strict control of imports from the dollar area, the United States with 9.3% and Canada with 3.5% were New Zealand's main suppliers after the U.K. and Australia. These four countries normally supply about 80% of New Zealand's imports. Table V shows overseas receipts and payments for 1952 by currency areas and countries.

TABLE V.—*Overseas Receipts and Payments, 1952*

Area	Trade transactions			Balance on all transactions £000
	Export receipts £000	Import payments £000	Balance £000	
United Kingdom . .	145,674	158,564	−12,890	−17,163
Australia . . .	2,925	26,324	−23,400	−25,520
Total, all sterling area countries	155,398	191,689	−36,291	−43,154
United States of America	23,318	19,407	3,911	2,338
Canada	4,495	7,318	− 2,823	− 2,752
Total, all dollar area countries	28,474	26,731	1,743	230
Total, all nonsterling E.P.U. countries	25,724	8,543	17,181	16,952
Total, all other countries	6,315	3,387	2,928	2,530
Total, all countries . .	215,909	230,263	−14,217*	−23,441

*Includes export transactions not assigned to currency areas.

In order to meet a serious decline in overseas funds, strict control of imports by a licensing system was introduced in 1938. This system was continued throughout World War II and early postwar years. After 1950, however, a wide range of goods was freed from licensing control when obtained from soft-currency areas. By 1952 about two-thirds of New Zealand's imports were not subject to licensing and many licences were retained solely to protect local industries. Imports from hard-currency areas were still strictly controlled in 1954, largely to assist in strengthening the sterling area reserves. However, in 1952 a large influx of imports and a fall in wool, hide and skin prices again caused a heavy drain on overseas funds and the Reserve bank, after consultation with the government, introduced in April 1952 a scheme for allocating exchange among importers. Importers are allowed a certain proportion of their 1950 remittances as a basic allocation (the proportion was 80% for 1952, 40% for 1953 and 75% for 1954). The importer can obtain this basic allocation from his trading bank and use it to buy any imports he wishes; any further foreign exchange he requires must be the subject of an application to the Reserve bank. Decisions are made on any application after consultation with government departments concerned, taking into account the essentiality of the goods, their supply position in New Zealand, import licences held by the importer and any other special circumstances. At the same time, import licences from hard-currency areas were reviewed, and motor vehicles were again placed under import licensing control. The granting of an import licence does not carry an automatic allocation of exchange, except in the case of motor vehicles. The scheme was considerably relaxed for 1954, 15 basic commodity groups (including cement, newsprint, tea, phosphate and basic slag) being released from the need for allocation. (D. L. Ws.)

Customs Duties.—New Zealand was party to the General Agreement on Tariffs and Trade (G.A.T.T.), initiated in Geneva, Switz., in 1947, and negotiated many agreements at the tariff conferences. In most cases, however, the imperial preference margin was not altered, and many of the negotiations aimed rather at binding existing rates of duty than at conceding any decrease other than the admission to most-favoured nation rates granted to all G.A.T.T. members.

TRANSPORT AND COMMUNICATIONS

Railways.—The railway system is state owned although there are a few minor private lines mainly serving colliery and saw-milling areas. In 1953 there were 3,535 mi. of state railways open for traffic. The gauge is 3 ft. 6 in. Many mountain chains and rivers make railway construction both difficult and expensive. By 1953 the capital cost had amounted to £93,329,718; *i.e.*, the cost per mile of open line was £26,402. Net earnings were only £83,272. In 1953 the government set up a commission to administer the system with the object of putting it on an economic basis. In 1952–53 more than 10,000,000 tons of goods were carried by rail.

Roads.—On March 31, 1950, there were 53,816 mi. of formed road in the country, 5,604 mi. of bridle track and 17,525 mi. of unformed legal roads, a total for all roads of 76,945 mi. The configuration of the country and the abundance of rivers made road

construction as difficult as the building of railways. Bridges of 25 ft. or more in the roads system in 1951 numbered 8,171. Of the 12,743 mi. of main highways, 5,224 mi. (the principal traffic routes) were classified as state highways and maintained at state expense. The cost of other main highways is shared between the state and local bodies and, with some exceptions, the cost of other roads is borne by local bodies.

Civil Aviation.—In 1945 complete control of air transport was given to the state-owned New Zealand National Airways corporation which took over the existing commercial operators. In 1948 provision was made for other concerns to operate new services and in 1951 the Air Services Licensing act provided for an authority to determine applications for licenses. The National Airways corporation remained by far the largest operator and of the 79,504,000 passenger-miles flown in the year ended March 1953, 79,499,000 passenger-miles were flown by its services. Private concerns were, however, beginning to be active in the mid-1950s in the transport of freight by air, a service which received a powerful impetus from its use during the longshoremen's strike of 1951. The most important international air service so far as New Zealand is concerned is that of Tasman Empire Airways, Ltd., a company formed to operate a service from Australia to New Zealand on capital subscribed by the United Kingdom, Australian, and New Zealand governments. It began operations in 1940 and now operates services from New Zealand to the Pacific islands as well as to Australia. Other services operating to New Zealand are Pan American World Airways (Auckland to San Francisco), British Commonwealth Pacific Airlines and Canadian Pacific Airlines (both Auckland to Vancouver). (A. T. Cl.)

FINANCE

The money composing the public debt of New Zealand was borrowed on the security of the country's public revenues, no part of the public estate being pledged for payment of either principal or interest. At March 31, 1953, the gross public debt stood at £667,600,000 (excluding £26,200,000 of funded debt owing to the British government, on which payments were suspended in 1931 as part of an international moratorium on inter-Allied debts incurred during World War I). Of this total £77,800,000 was domiciled in London. After 1933, when the nominal amount of the external debt was £138,100,000, new public borrowings overseas, other than for conversion and war purposes, ceased and a policy of repaying external debt was put into effect. Almost all the decrease occurred after 1945. In addition, £60,800,000 borrowed from the British government during World War II was repaid by 1946. With the exception of that portion incurred for war purposes (about £240,000,000), the greater amount of the borrowings was for productive and developmental purposes and resulted in revenue-producing assets such as railways, hydroelectric installations, telephones and houses. At March 31, 1953, £399,000,000 (60% of the total debt) was held by government departments and quasi-governmental organizations.

The ordinary revenue and expenditure of the government are shown in the consolidated fund. There are a number of other specialized accounts covering such activities as capital items, social security, commercial and other undertakings, etc. Successive changes in system have largely destroyed the comparability of the figures over any length of time.

Table VI.—*Consolidated Fund Transactions*

Year ended March 31	1950 £000	1951 £000	1952 £000	1953 £000
Receipts				
Income tax	48,483	59,442	78,102	78,701
Other taxation	55,370	62,739	78,835	75,561
Interest	5,886	6,566	7,338	6,893
Other receipts	15,257	15,010	16,514	16,666
Total receipts	124,997	143,757	180,788	177,822
Payments				
Debt charges	22,485	26,314	23,776	24,159
Defense	9,822	15,251	24,640	26,481
Education	11,614	13,346	15,904	18,124
Subsidies	14,856	9,372	15,320	14,720
Transfer to Social Security fund	12,000	14,000	14,000	14,000
Other expenditure	49,913	57,222	74,513	77,031
Total payments	120,689	135,504	168,153	174,515
Surplus	4,308	8,253	12,635	3,307

Most of the receipts of the consolidated fund come from taxation of various kinds but further small amounts are obtained from interest on public moneys, profits of state trading enterprises (such as post office, electricity supply and national airways) and from income earned by government departments for services rendered to the public. Payments from the fund are grouped under permanent or annual appropriations. The latter heading covers payments under departmental votes and the former covers interest on and amortization of the public debt and payments under numerous special acts. Details of the transactions of the fund for the years 1950–53 are shown in Table VI.

The Social Security fund derives most of its receipts from a uniform charge of 1*s.* 6*d.* in the pound on nearly all forms of income, including salaries, wages and the income of companies; the balance is mainly in the form of a transfer from the consolidated fund. Transactions from 1950 to 1953 are shown in Table VII.

Table VII.—*Social Security Fund Transactions*

Year ended March 31	1950 £000	1951 £000	1952 £000	1953 £000
Receipts				
Social security charge	31,703	35,766	43,613	45,508
Other	12,071	14,116	14,169	14,120
Total	43,773	49,882	57,782	59,628
Payments				
Medical and hospital benefits	8,461	8,723	9,368	10,4[illegible]9
Family allowances	14,851	15,289	16,110	16,854
Age and other monetary benefits	21,845	24,133	27,248	29,328
Other	1,203	1,274	1,453	2,216
Total	46,360	49,421	54,180	58,826

For the year ended March 31, 1953, taxation receipts per head of mean population amounted to £99 8*s.* 3*d.*, slightly less than the record figure of £102 7*s.* 9*d.* in 1951–52 but more than four times the figure of £23 9*s.* 2*d.* for 1938–39, the last financial year before World War II. Direct taxes on income (income tax and social security charge) amounted to £124,209,000 in 1952–53 and represented £61 16*s.* 3*d.* a head and 62.3% of total taxation. In 1938–39 the corresponding figure was £14,296,000, representing £8 17*s.* 5*d.* a head and 37.8% of total taxation. Other major taxes are customs and excise duties, sales taxes and death duties. The total tax revenue for 1952–53 was £199,771,000, which represented 30.9% of the national income. In the previous year the figure was £200,550,000 (32.5% of national income) and in 1938–39, £37,797,000 (19.5%). When assessing the high level of taxation in New Zealand, it is necessary to bear in mind the considerable proportion of government revenue which is returned to the taxpayers as monetary payments (without means test); *e.g.*, medical, hospital and family benefits.

In 1952–53 government capital expenditure amounted to £54,600,000, compared with £40,700,000 and £40,200,000 in the two previous years. The main sources of capital funds are loans, national savings and savings banks accounts, depreciation and renewal reserves and miscellaneous capital receipts. Among the major items of expenditure during 1952–53 were hydroelectric development (£12,700,000), housing (£9,800,000), railways (£7,600,000) and land conservation and development (£4,600,000). After World War II government expenditure on its various works programs, although greatly increased in amount, represented a smaller percentage of total capital expenditure than in prewar years. The proportion was 33% in 1952–53 as compared with an average of 42% in the years 1938–40.

Banking.—The banking institutions of New Zealand are the Reserve Bank of New Zealand, five trading banks, the Post Office Savings bank and five trustee savings banks. The Reserve bank, which began operations as the central bank of the country on Aug. 1, 1934, is now state owned, the original private shareholders having been bought out by the government in 1936. As the central bank, it is authorized to control credit, currency, the transfer of money to and from New Zealand and the disposal of export receipts for the time being held overseas. It also has the duty of maintaining a high and stable level of activity in New Zealand insofar as this can be effected by monetary means. Between 1939 and 1950 the minister of finance was empowered to issue directives to the bank on any aspects of central banking practice or policy. In 1950 the law was amended and the bank

must now give effect to any resolutions of parliament in respect of any of its functions or business. It remained a general function of the bank to give effect to the monetary policy of the government. The right of note issue was transferred from the trading banks to the Reserve bank on its establishment and it issued notes in denominations of 10*s*., £1, £5 and £10 and a few £50. Total notes in circulation amounted to £62,500,000 at the end of March 1953. The bank also issues and regulates the supply of coin and since 1936 has managed the public debt.

Two of the trading banks, the Bank of New Zealand and the National Bank of New Zealand, are incorporated by acts of the New Zealand parliament. All the share capital in the former, which had been partly state owned, was acquired by the government in 1945. It conducts more than 40% of banking business.

The other three banks are predominantly Australian institutions. All five banks maintain a large number of branches and agencies throughout the country. At the end of March 1953 demand deposits with the five banks amounted to £200,271,000, time deposits (on which interest ranging from ¾% to 2%, depending on the period of deposit, is paid) to £35,951,000 and advances and discounts to customers to £140,449,000.

In 1953 the number of open accounts in the Post Office Savings bank was 1,486,000, or 7 to every 10 of the population, and the total deposits amounted to £191,274,000, as compared with £84,700,000 credited to 1,087,000 accounts in 1943. Interest at the rate of 2½% is paid on deposits up to £500, 2% from £500 to £2,000 and 1½% from £2,000 to £5,000. The five trustee savings banks had at March 31, 1953, 371,000 depositors with an amount of £38,854,000 standing to their credit. In addition, all the savings banks carry national savings accounts which cannot be withdrawn, except in certain circumstances, for two to three years. They carry interest at 3% and were originally opened in 1940 to help meet war expenditure. At March 31, 1953, these deposits amounted to £62,930,000.

Coins and Currency.—Gold, silver and bronze coins of Great Britain and Australian gold coins were legal tender in New Zealand until 1935 with Australian silver and bronze in free, though not legal, circulation. Distinctive New Zealand silver coins were introduced in 1933 and bronze coins in 1939, the denominations and standards of fineness being the same as in the U.K. After 1947 cupronickel coins were issued in place of silver.

Following the assumption by the Reserve bank in 1934 of the sole right to issue notes, the trading bank notes were withdrawn from circulation and in 1936 the Reserve bank assumed liability for trading bank notes not yet presented. Until 1950 the Reserve bank was required to maintain a minimum reserve of 25% of the aggregate amount of the notes and other demand liabilities. This obligation was abolished in 1950 and the bank is now required to hold such reserves as, in the opinion of the board of directors, will provide a reasonable margin for contingencies. "Reserve" is defined as including gold coin and bullion, sterling exchange (deposits at the Bank of England, British treasury bills and bills of exchange), net gold exchange and net holdings of currencies freely convertible into sterling. From 1933 to 1948 exchange rates were based on a selling rate of £N.Z.125 = £100 sterling, but from Aug. 1948 the New Zealand pound was at parity with sterling.

In 1938, to meet a serious fall in overseas reserves, control over foreign exchange was introduced in conjunction with export and import licensing regulations. The exchange control system was extended in 1940 as a war measure and continued, with modifications. The system is administered by the Reserve bank with the trading banks acting as its agents. Broadly, the situation in 1953 was as follows: the foreign currency receipts on account of exports must be paid to a bank; payments for imports are made under an allocation scheme (*see* above); other payments within the sterling area are not restricted with the major exceptions of capital exports by New Zealand residents and travel allowances; remittances to countries outside the sterling area are treated on their merits; interest, dividends and profits may be remitted to any country but capital movements are strictly controlled; the export of money is subject to permission but the importation of money is not limited except in the case of silver coins and United Kingdom bank notes; dealings in nonsterling securities held by residents are subject to Reserve bank approval and the bank is empowered to acquire such securities if necessary.

In pursuance of its function of controlling credit in New Zealand, the Reserve bank introduced in 1942, with the co-operation of the trading banks and as a government policy measure, a selective control over bank advances aimed at preventing the expansion of credit for speculation and other purposes inconsistent with the war effort. This control was continued after the war to avoid the creation of new money for nonessential purposes or for the financing of capital expenditure when funds were available from other sources. The policy was subsequently modified to meet changing conditions and in 1952 was supplemented by raising the cash balances which the trading banks are required to hold at the Reserve bank. Each bank had to maintain a balance of not less than 7% of its demand liabilities and 3% of its time liabilities. In Aug. 1952 these ratios were raised to 10% and 5% respectively and in May 1953 to 20% and 10%. (D. L. Ws.)

NEW ZEALAND SPINACH: *see* SPINACH.

NEXT FRIEND, in law, the phrase used for a person who represents in an action another person who is under the disability of infancy to maintain a suit on his own behalf. Every application to the court on behalf of an infant must be made through a next friend. Previous to the Married Women's Property act, 1882, it was also usual for a married woman to sue by a next friend, but that act, allowing a married woman to sue in all respects as a *feme sole,* has rendered a next friend unnecessary in her case. In the case of an infant the father is prima facie the proper person to act as next friend; in the father's absence the testamentary guardian, if any; but any person not under disability may act as next friend so long as he has no interest in the action adverse to that of the infant. A married woman cannot, however, act as next friend, except in special cases. (*See* Rules of the Supreme Court, O. xvi, r. 16.) An infant defends a suit, not by a next friend, but by a guardian *ad litem.* A lunatic sues by his committee, but if he has no committee, or if the committee has some interest adverse to the lunatic, he sues by his next friend. A next friend has full power over the proceedings in the action as if he were an ordinary plaintiff, and he is therefore responsible for paying the costs, but he is not entitled to be heard in person. (*See* INSANITY IN LAW.)

NEXT-OF-KIN: *see* KIN.

NEY, MICHEL (1769–1815), duke of Elchingen, prince of the Moskowa, marshal of France, was born at Saarlouis on Jan. 10, 1769. His father was a cooper, and he received only a rudimentary education. In 1788 he went to Metz and enlisted in a regiment of hussars; in 1792 he was elected lieutenant; and in 1794 he became captain and was placed by Kléber at the head of a special corps of light troops. He was soon promoted *chef de brigade,* and in 1796 general of brigade. He commanded the right wing of Hoche's army up to the peace of Campo Formio. On the resumption of hostilities he again took the field, and for his surprise of Mannheim in 1799 received the grade of general of division. He fought in the Swiss campaign of Masséna, and when Masséna turned against the Russians, who were approaching from Italy, Ney was left in command holding his ground successfully against the Austrians, although his opponent was the famous Archduke Charles. In 1800 he was present at Hohenlinden. In May 1802 he married Mademoiselle Auguié, whom Josephine had chosen for him at Bonaparte's request. This event marks a change in Ney's political opinions, which can only be explained by Napoleon's power of captivating men. He was henceforward as ardent and sincere an admirer of Napoleon as hitherto he had been of revolutionary principles, and was one of the very few officers of the army of the Rhine who became a trusted lieutenant of the emperor. He carried out an important mission in Switzerland, and in 1803 he was placed in command of the camp of Montreuil. While there he begged Napoleon to declare himself emperor, and on the establishment of the empire he was made marshal of France, and received the grand eagle of the Legion of Honour. In 1805 he commanded the 6th corps of the Grand army, and his great victory at Elchingen (for which in 1808 he was made duke of Elchingen) practically secured the surrender of the Aus-

trians at Ulm. He was then ordered to the upper Adige, when he led the decisive attack at Friedland. After Friedland Napoleon gave him the title, "the bravest of the brave."

In 1808, after the first disaster to the French arms in Spain, Ney accompanied Napoleon there as commander of the VI. corps. He took part in the Peninsular War from 1808 to 1811. When acting under Masséna in the invasion of Portugal in 1810–11, he quarrelled bitterly with his former chief, and in spite of his distinguished service he was recalled to France by Napoleon and censured. He was re-employed with the *Grande Armée* in central Europe under Napoleon himself. In the 1812 expedition to Russia Ney commanded the centre at Borodino, and was created prince of the Moskowa on the evening of the victory. In the retreat he was a tower of strength, animating the rearguard with his own sublime courage, keeping the harassed and famished soldiers together under the colours and personally standing in the ranks with musket and bayonet. He was the last to recross the frontier, and threw the remaining muskets into the Niemen. In 1813 he commanded a corps in the German campaign, and in 1814 he shared in the campaign in France. At the fall of the Empire the fact that Ney acted in the negotiations in concert with Macdonald and Caulaincourt is sufficient proof of his desire to avert Napoleon's abdication. Less satisfactory was his loud protestation of devotion to the Bourbons, when the Restoration was a *fait accompli.* But he was mortified by the disdain of the returned *émigrés,* and retired to his country seat. While on his way to take up a command at Besançon, he heard of Napoleon's return. He hurried at once to assure Louis XVIII. of his fidelity. With the famous remark that the usurper ought to be brought to Paris in an iron cage, he proceeded to Lons-le-Saulnier to bar Napoleon's progress. But he deserted with his troops, and Napoleon's march became a triumphal progress. Ney's act was undeniably treason to his sovereign, but it was hardly the calculated treason that his *émigré* detractors saw fit to imagine. Napoleon received him kindly, but did not give him a command until just before the Waterloo campaign. The marshal took command of the left wing on the northern frontier on June 13. The next day the army moved into Belgium. Ney took part in the campaign successively in the roles of strategist, tactician and soldier. (*See* WATERLOO CAMPAIGN, 1815.) Much controversy has raged over his actions of June 15 and 16. At Waterloo he was subordinated to the personal command of Napoleon, but his advice was often offered and sometimes accepted, and he personally led several charges of the French up to the British squares. But when all was lost, his courage was extinguished. He made no attempt to second Davout and Grouchy in the last days of Napoleon's reign, and in despair advocated the restoration of the Bourbons. Soon a fresh order was issued denouncing him by name, and he was arrested on Aug. 5. When Louis heard of Ney's arrest he exclaimed, "By letting himself be caught he has done us more harm than he did on the 13th of March!" But neither king nor ministers were in a position to resist the clamour of the ultra-royalists for blood. Every fresh delay in the process of Ney's trial raised a new outcry at the court, in the salons and in the Chamber of Deputies; and fiercest of all in demanding immediate execution was the king's niece, the unhappy duchess of Angoulême, who lived to confess that had she known the record of Ney's services to France she would never have consented to his death. Ney was placed on trial before a court martial composed chiefly of his former brothers-in-arms, whose participation in the tragedy was probably never forgiven them by their countrymen. Others of the marshal's old comrades refused to serve, and were disgraced in consequence, until public opinion forced their reinstatement. The court took advantage of the plea of Ney's counsel that he was entitled to be tried by his equals in the Chamber of Peers. In spite of the courageous and eloquent appeal of the young duc de Broglie, the result of the trial before the latter body was a foregone conclusion; de Broglie was alone in voting for his acquittal. In the early morning of Dec. 7, 1815, Ney was shot in the Luxembourg gardens, near the Observatory. He met his death quietly and with a perfect soldierly dignity.

Ney left materials for memoirs, but in an incomplete state. The *Mémoires du maréchal Ney,* published in 1833, were collected from these papers by his brother-in-law Gamot and by General Foy. They cover only the earlier part of his career, and end with the battle of Elchingen (October 1805). An edition in English was published the same year.

See Rouval, *Vie du maréchal Ney* (1833); Dumoulin, *Histoire du procès du maréchal Ney* (1815, Eng. trans. 1816); Nollet-Fabert, *Éloge du maréchal Ney* (Nancy, 1852); Welschinger, *Le Maréchal Ney, 1815* (1893); A. Delmas, *Mémoire sur la révision du procès du maréchal Ney* (1832); *Military Studies by Marshal Ney* (Eng. trans., 1833); G. A. B. E. H. Bonnal, *La Vie Militaire du maréchal Ney* (1910, etc.); R. Androix, *Ney* (1914).

NEZ PERCÉ, a tribe of Sahaptin lineage on Snake river in Idaho and Oregon, now on Lapwai reservation, Idaho. The estimated population was 6,000 in 1805, 1,400 in 1885, 1,500 in 1921. In 1877, under Chief Joseph, they fought the United States, winning some engagements and engaging in a notable but finally unsuccessful retreat almost to Canada. They were the largest and easternmost Sahaptin tribe and most affected by influences from the Plains Indians.

NGAMI, a shallow lake of variable size forming the centre of an inland drainage system in the Bechuanaland (*q.v.*) Protectorate, South Africa. The lake once extended to a length of 20 m. and a width of 10 m., but is now little more than an expanse of reeds growing in a soft soil, below which brackish water is found. It is cut by 20½° S. and 23° E. Ngami is the lowest point of a large depression in the great plateau of South Africa. The area which drains to it is bounded south by the basin of the Orange, east by the Matabele hills, north by the western affluents of the Zambezi. The greater part of the Ngami water-system lies, however, north-west of the lake in the Angola highlands. On the high plateau of Bihe, in the hinterland of Benguella, rise two large rivers, the Okavango and the Kwito, which uniting discharge their waters into Ngami. From the north-east end of Ngami issues the Botletle or Zuga, a stream which runs south-east and drains towards the Makarikari marsh, from which there is no outlet.

Although Ngami has contracted in size in modern times the Okavango and its tributary the Kwito remain large rivers. The Okavango is known in its upper course as the Kubango. Its most remote source lies in about 12½° S. and 16½° E. and its length is over 900 m. It flows first south then south-east and east. In about 18° S. and 20½° E. it is joined on the north bank by the Kwito, a large navigable stream rising almost as far north as the Okavango. Its general course is south-east, but between 15° and 17° S. it flows south and even south-west. Below the Kwito confluence the Okavango, which is also joined by various streams from the south-west, is a rapid stream, generally navigable as far as the Popa falls, in 21° 50′ E. In the dry season, the water-level is from 4 to 20 ft. below the banks, but these are overflowed during the rains. At this period, April–June, some of the surplus water finds its way (in about 19° S.) by the Magwekwana to the Kwando or Linyanti (Zambezi system), to which, it is thought, the whole body of water may have once flowed. Below the Magwekwana outlet the Okavango, now called the Taukhe or Tioghe, turns almost due south, enters a swampy reed-covered plain and is broken into several branches. In this region the effects of desiccation are marked. Through the swamps the river formerly entered Ngami. Through the swamp some of the waters of the Okavango find their way eastward through a channel called Tamalakane to the Zuga or Botletle, the river which formerly flowed out of Ngami. The Botletle, whose bed is about 100 m. in length, loses itself in a system of salt-pans—round or oval basins of varying size sunk to a depth of 30 to 45 ft. in the sandstone, and often bounded by steep banks. The outer pans are dry for a large part of the year, the whole system being filled only at the height of the flood-season in August. The Botletle, which receives in addition the scanty waters of the northern Kalahari, at this season reaches the Makarikari marsh. In 1849 Livingstone found a large shallow lake. In 1896 Lugard and Passarge both found none. (*See* S. Passarge, *Die Kalahari,* 1904.)

NIAGARA, FORT, an American fortification, on the east side and at the mouth of Niagara river, opposite the Canadian village of Niagara-on-the-Lake. Ft. Niagara has a reservation of 288 ac., with fairly modern equipments, and several historic

buildings of the time of French and of British possession, in one of which, the old magazine (1757), William Morgan was imprisoned in 1826. Fort Niagara was long, especially during the French occupation of Canada, one of the most important forts in North America, being the key to the Great Lakes, beyond Lake Ontario. La Salle wintered here in 1678–9, built his ship the "Griffon," and established a trading post and Fort Conti, destroyed not long afterwards. Fort Denonville, built in 1687 by Jacques René de Brésay, marquis de Denonville, governor-general of Canada, in his cruel campaign against the Iroquois, was abandoned in 1688, after the garrison, commanded by Pierre de Troyes (d. 1687), had been wiped out by an epidemic. The first Fort Niagara, to be so named, was built in 1725–1727 at the instance of Charles le Moyne, 1st baron of Longueil (1656–1729), and became a very important military and trading post; the fort was rebuilt by François Pouchot (1712–1769) in 1756, but in July 1759, after a siege of about sixteen days, it was surrendered to Sir William Johnson by Pouchot. On the 14th of September 1763 a British force marching from Fort Schlosser (about 2 mi. above the Falls; built 1761) to Fort Niagara was ambushed by Indians, who threw most of their captives into Devil's Hole, along the Niagara river. In July 1764 a treaty with the Indians was signed here, which detached some of them from Pontiac's conspiracy. Joseph Brant, John Butler and, in general, the Indians of northwestern New York favouring the British during the Revolutionary War, made Fort Niagara their headquarters, whence they ravaged the frontier, and many loyalists and Indians took refuge here at the time of Gen. Sullivan's expedition into western New York in 1779. The fort was not surrendered to the United States until Aug. 1796. In the War of 1812 it was bombarded by the guns of Ft. George immediately across the river, and on Dec. 19, 1813 was surprised and taken by assault—most of the garrison being killed or taken prisoners—by British troops under John Murray. After the close of the war, on March 27, 1815, Ft. Niagara was restored to the United States, and a garrison was kept there until 1826. The fort was regarrisoned about 1836, and remained a post of the regular army until it was abandoned on Dec. 31, 1945.

See F. H. Severance, *An Old Frontier of France* (1917); L. L. Babcock, *War of 1812 on the Niagara Frontier* (1927); *Publications of the Buffalo Historical Society;* F. Parkman, *Conspiracy of Pontiac* (1851) and *Montcalm and Wolfe* (1884).

NIAGARA FALLS (formerly Clifton or Suspension Bridge), a city and port of entry of Welland county, Ont., 40 mi. S.S.E. of Toronto, on the west bank of the Niagara river and opposite the falls. Pop. (1951) 22,874. It is a station on the Canadian National, the New York Central and the Wabash railways and is served by the Niagara, St. Catharines and Toronto electric railway by motor coach from St. Catharines. Three steel bridges (including the renowned Rainbow bridge) connect with the U.S. town of Niagara Falls on the opposite bank. Its importance is largely due to the tourist traffic, but the unrivalled water power is being more and more employed. Factories turn out shredded wheat, batteries, candies, razors, fertilizers, automotive equipment and other light manufactures. Large electric plants transmit power to Toronto and other cities. Beautiful Victoria park extends along the bank of the river for 2½ mi. above the falls, and there is a unique garden theatre.

NIAGARA FALLS, a city and a port of entry of Niagara county, N.Y., U.S., at the great falls of the Niagara river (*q.v.*) 22 mi. N.N.W. of Buffalo. It is served by the Lehigh Valley, the New York Central, the Erie and the Niagara Junction railways, and by American Airlines. Pop. (1950) 90,872; in 1940 it was 78,029 by the federal census.

Beginning 7 mi. above the falls the city extends along the Niagara river to the falls. Goat Island separates the American fall (167 ft. high and 1,000 ft. wide) from the Horseshoe fall on the Canadian side (160 ft. high, with a crest of more than 2,000 ft. in a deep curve), and between them is the delicate Bridal Veil. Below the falls the river rushes between perpendicular walls 250 ft. high, in a series of rapids to the whirlpool. Goat Island, several smaller islands and Prospect park (10 ac. on the brink of the gorge) were made a state reservation in 1885. In the evening the falls are illuminated with changing colours by gigantic search lamps set in Queen Victoria park across the river. Niagara falls probably attract more visitors than any other single natural phenomenon of America. To protect their aesthetic value, the amount of water which may be diverted from either the Canadian or the American fall is limited by an international treaty. Practically all the permitted U.S. diversion is utilized in a hydroelectric development with an installed hydroelectric capacity in 1951 of 415,000 kw., serving approximately 3,300,000 people.

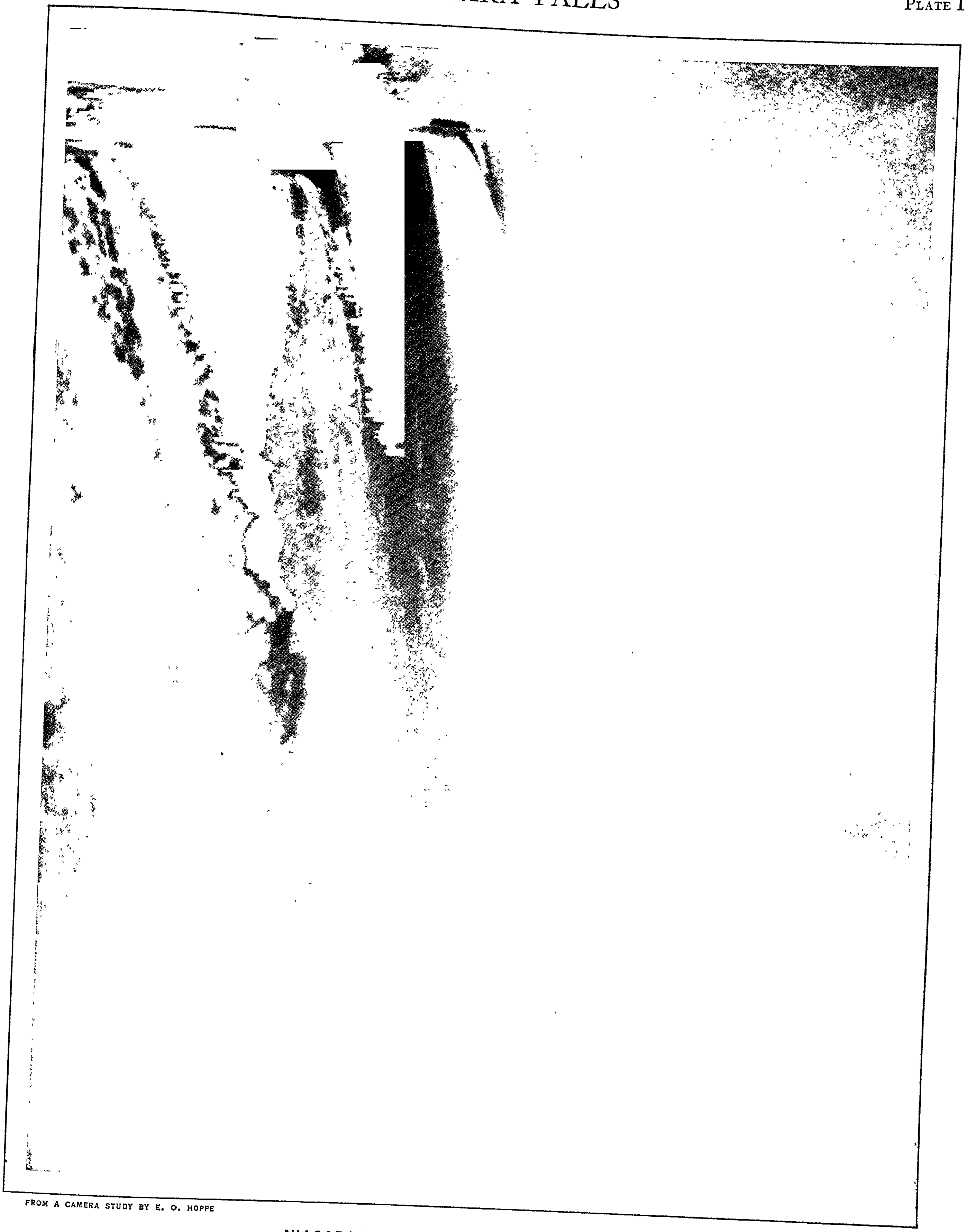
The city is an important manufacturing centre, especially of the electrochemical and electrometallurgical industries which are largely concentrated there. Of particular importance are the manufacture of abrasives, shredded wheat, caustic soda, paper, electrodes, ferroalloys and a great variety of chemical compounds. The aggregate factory output at mid-20th century was valued at approximately $200,000,000. The assessed valuation of property was $167,684,907 in 1950. In 1916 Niagara Falls adopted a city-manager form of government. The city is the seat of Niagara university (Roman Catholic; 1856). Old Fort Niagara (*q.v.*), 14 mi. N., was restored to its original condition.

A fort (Little Niagara) was built on the site of Niagara Falls in 1750, and after its destruction Ft. Schlosser was built in 1761. In 1806 Judge Porter founded the village of Manchester there, on the banks of the falls. It was burned by the British in 1813, and remained a straggling little settlement until the construction of the Hydraulic canal in 1852 and the subsequent development (especially after 1877) of power from the falls. The first bridge across the river was completed in 1835; the first railroad bridge (a suspension bridge by John A. Roebling) in 1855. In 1892 the villages of Manchester and Suspension Bridge were merged and chartered as the city of Niagara Falls, which in 1900 had a population of 19,457. Electric energy generated from the falls was first used for lighting Prospect park in 1879, and in 1881 power was sold for commercial use; but the great modern development dates from World War I, and the city's growth as a manufacturing centre has followed the development of the power resources. The falls have been the scene of many daring exploits, ever since Sam Patch in 1829 successfully leaped into the river twice, only to lose his life in a similar leap at the Genesee falls in Rochester. Several men and women have safely plunged over the Canadian fall or through the whirlpool in barrels, and in 1859, and again in 1860 (on the occasion of the visit of Edward VII, then Prince of Wales) Blondin performed amazing feats on a tightrope stretched across the gorge.

NIAGARA RIVER flows in a northerly direction from Lake Erie to Lake Ontario, a distance of about 34 miles. It constitutes part of the boundary between the United States and Canada, separating the State of New York from the Province of Ontario. It is the principal drainage outlet of the four upper Great Lakes, whose aggregate basin area is about 248,500 sq. miles. Its discharges at standard low water and standard high water of Lake Erie (570 and 575.11 ft. above mean tide at New York) are about 153,000 and 267,000 second-feet, respectively. The river is navigable from its source to the upper rapids, 20 mi., and from Lewiston to the mouth, 7 miles. The current is rapid for the upper navigable portion, where the average fall is about 0.5 ft. per mile. The total fall of the lower 7 mi. is 0.5 foot. The intermediate section of the river, consisting of 7 mi., includes a series of rapids and Niagara Falls, and has a total fall of 315 feet. The average width is about 3,500 feet.

Niagara Falls.—The falls of Niagara are justly celebrated for their grandeur and beauty, and are viewed every year by over 2,000,000 visitors. They are in two principal parts, separated by an island. The greater division, adjoining the left bank, is called the Horseshoe fall; its height is 158 ft., and the length of its curving crest line is 2,600 ft. The American fall, adjoining the right bank, is 167 ft. high and 1,000 ft. broad.

The water is free from sediment, and its clearness contributes to the beauty of the cataract. In recognition of the importance of the waterfall as a great natural spectacle, the Province of Ontario and the State of New York have retained or acquired title to the adjacent lands and converted them into parks, which are main-

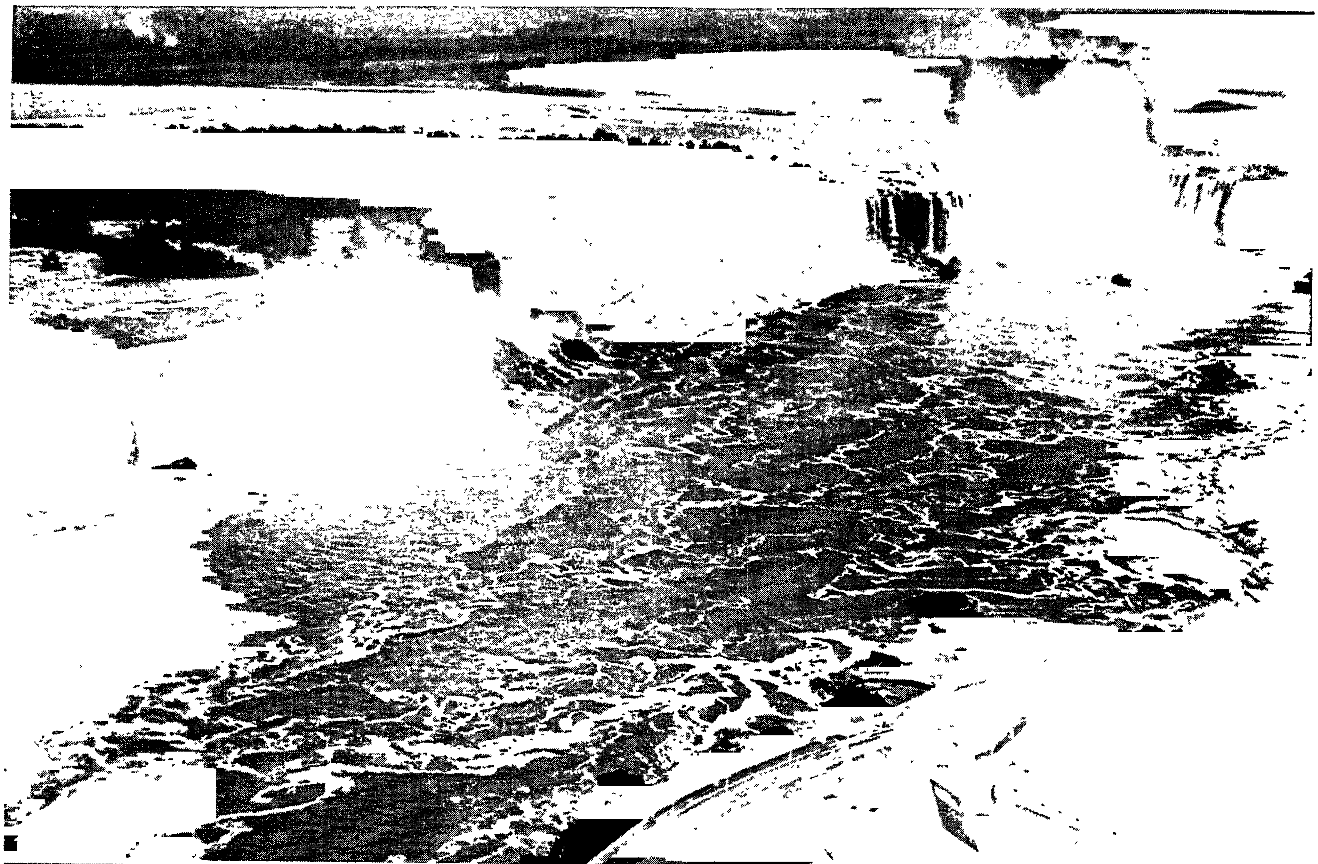


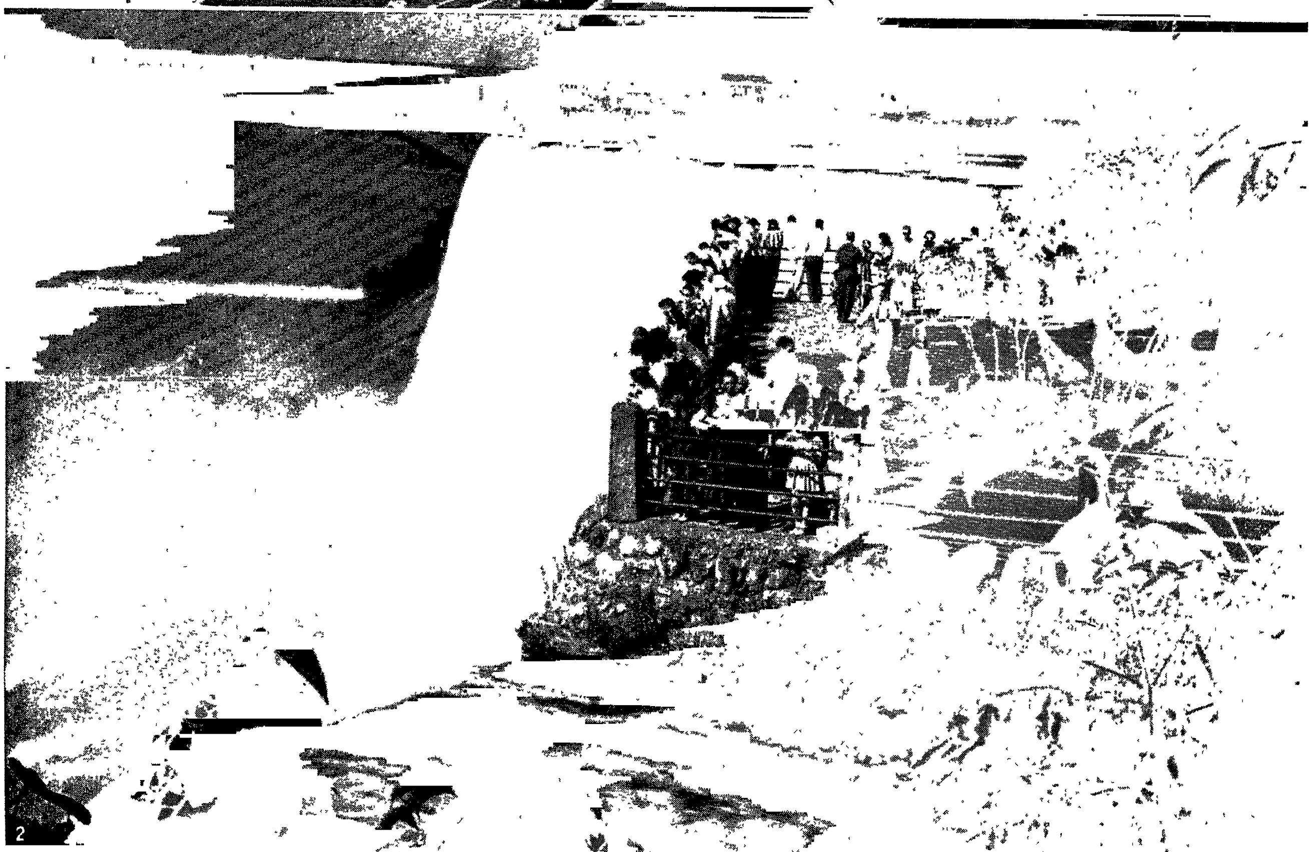
FROM A CAMERA STUDY BY E. O. HOPPE

NIAGARA FALLS ON THE AMERICAN SIDE

The brink of the American Fall at Niagara, showing a point of Goat Island. The precipice on the American side is 167 feet in height

NIAGARA FALLS





PHOTOGRAPHS, (1) EWING GALLOWAY, (2) NINA LEEN-PIX FROM PUBLIX

1. An airview of Niagara Falls from Ontario, Canada. The Horseshoe (Canadian) Fall at the right, 158 ft. high, is about 10 ft. lower than the American Fall, but is more than twice as long. The two falls are separated by Goat island

2. Top of the American Fall, with the observation platform for sightseers. The International bridge is at the left

tained at public expense for the convenience of visitors.

The scenic grandeur of Niagara falls depends upon the volume of water flowing over the falls, but also on its distribution as it approaches the crest. The statement that the Horseshoe fall is in danger of destroying itself as a spectacle by cutting a narrow "notch," destroying the symmetry of the horseshoe, possibly degenerating into a cascade and eventually draining the American falls, has unfortunately been widely circulated. The mean annual rate of recession of the crest at the central part of the Horseshoe has been determined as being about 5 ft. since 1764, 3.7 ft. since 1842 and 2.3 ft. per year since 1906.

The Horseshoe later cut back at a decreasing rate, the rate continuing to decrease. The recession of the American falls is negligible. By proper action, supervision and control by the two governments concerned, the scenic beauty of the falls can be preserved, the tendency toward erosion in the Horseshoe can be checked, water can be distributed over the at present bared flanks of the Canadian fall and a more dependable flow over the American fall ensured.

Geologic Age.—The problem of the river's age is of much interest to geologists, because its solution would aid in establishing a relation between the periods and ages of geologic time and the centuries of human chronology. The great Canadian glacier, which in the glacial period alternately crowded forward over the Great Lakes region and melted back again, so modified the face of the land by erosion and by the deposit of drift that the waters afterward had to find new courses. The Niagara river came into existence when the waning of the glacier laid bare the western part of the Ontario basin, and the making of the gorge was then begun.

If it were supposable that the lengthening of the gorge proceeded at a uniform rate, the computation of the time would be easy, but there are various modifying conditions. A weighing of the available evidence indicated 25,000 years as a lower limit for plausible estimates of the age of the river, but yields no suggestion of an upper limit.

Navigation.—Between Lake Erie and Lake Ontario, navigation passes through the Canadian Welland canal. The old canal had 25 lift locks, with a total lift of 326¾ ft. These locks were each 270 ft. long (usable length about 255 ft.) by 45 ft. wide, and were designed to have 14 ft. depth on the sills. A new canal, constructed by Canada and opened to navigation on April 20, 1931, was formally opened, August 6, 1932. Calculated to admit the largest existing lake freighters, its southern portion is for the most part an enlargement of the old canal. The northern portion follows a new course, entering Lake Ontario at Port Weller, about three miles east of the terminus of the old canal. The new canal is 27.6 mi. long and has a total lockage of 325½ ft. It has four single locks, one flight of three double locks and one guard lock. The locks have a usable length of 820 ft., a clear width of 80 ft., and 30 ft. depth of water on the sill at lowest lake stages. All locks have a lift of about 46 ft. The gates are of the mitering type. The prism is 200 ft. wide at the bottom, 310 ft. wide at the water line, and from 25 to 26½ ft. deep at low water. All masonry structures are so designed as to allow an ultimate deepening to 30 ft. at low water. The construction of this canal was commenced in 1913, it was largely suspended during World War I but was later resumed.

Water Diversion for Hydroelectric Power.—Under a treaty signed in 1950 between Canada and the U.S. the amount of water that might ultimately be diverted from the Niagara river for power purposes was estimated at 130,000 cu.ft. per second to be divided equally between Canada and the United States. Of the United States diversion about 32,500 cu.ft. per second was used during the early 1950s.

The hydroelectric capacity on the U.S. side was 415,000 kw., but this could be increased to approximately 1,695,000 kw. The net electric energy at the United States hydroelectric development at the Niagara river was approximately 3,880,000,000 kw.hr. in 1951. Much is used in nearby electrochemical industries for the manufacture of aluminum, ferrosilicon, carborundum, artificial graphite, liquid chlorine, calcium carbide, cyanamide and other products. The remainder is transmitted to various cities for miscellaneous uses. The maximum distance to which this power is transmitted is somewhat in excess of 200 miles. (E. JA.)

NIAM-NIAM: *see* AZANDE.

NIAS, largest of the chain of islands off the western coast of Sumatra, Indonesia. It is 80 mi. long and nearly 30 wide, hilly, with coasts rocky or sandy, and landing is often dangerous: it is partly volcanic and earthquakes occur. There are three small rivers. Pop. 170,000. The chief town and port is Gunungsitoli on the east coast.

The islets Nako, Bunga, etc., near the north and west coasts are inhabited by a race which appears to be Indonesian in character and to have some affinity with the Bataks of Sumatra. They squander their means on feasting and ornaments, but are hospitable and have a high code of sexual morality, any infringement of which is severely punished. Marriage is exogamic and wives are bought. At death, wife and property pass to a man's brother. Land belongs to the settler and is inherited in the direct line. A council of notables assists hereditary chiefs in administration. Slave trade was suppressed by the Dutch, who began trading there in 1669. Simple tattooing, teeth-filling and circumcision are practised. Weapons are carried and vendettas are common.

Houses are built on piles, and sometimes are fortified with double walls. They have windows, a common room in the centre, and separate rooms for the various families which occupy one house, the entrance being through the floor, from underneath, in the house centre. Houses of chiefs are costly and have carved statues, or seats of wood, or stone, outside.

The Niasese are pagans: human sacrifice on the death of a chief, also head-hunting, were prohibited by the Dutch. Statues of the household gods are hung up in the houses, the phallic symbol is known, and in South Nias menhirs and large dissoliths exist. The funeral rites of an important person are celebrated by the sacrifice of pigs.

There are good craftsmen in gold, silver and wood. The coconut is cultivated and the oil traded with Malay and Achinese settlers, or taken to the Sumatran coast. Pigs are kept and form an important article of trade. Coal of poor quality, iron and copper have been found; gold is said to exist.

Nias is administrated by the residency of Tapanuli, in Sumatra; it came under Japanese control during World War II. It has no telegraphic or steamer communication with the mainland.

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NIBELUNGENLIED, or DER NIBELUNGE NÔT, a mediaeval German heroic epic. The story on which it is based belongs to the general stock of Teutonic saga, and was very widespread under various forms, some of which are preserved. Thus it is touched upon in *Beowulf*, and fragments of it form the most important part of the northern *Eddas*, the poets of which evidently assumed that the tale as a whole was well known and that their hearers would be able to put each piece in its proper place. In the prose *Edda*, or *Volsungasaga*, which though largely primitive in spirit dates from the 13th century, it is set forth in full. The substance of this Norse version is as follows:—

"The three Anses—Odin, Loki and Hörnir—saw an otter devouring a salmon beside a waterfall. They killed and skinned the otter and, taking the skin with them, sought shelter for the night with Rodmar the giant. But Rodmar recognized the skin as that of his son, and demanded as *weregild* gold enough to cover it completely. Loki thereupon went back to the stream, where Andvari in the form of a pike was guarding a great treasure, caught him in a net, and forced him to surrender his hoard. But the piled-up gold left one hair exposed; in order to cover it Loki returned to Andvari and forced him to surrender a magic ring, which had the virtue of breeding gold. Thereupon Andvari, enraged, laid upon the hoard and all who should possess it a curse. This curse, the *Leitmotif* of the whole story, began to operate at once. Rodmar, for the sake of the treasure, was slain by his sons Fafnir and Regin; and Fafnir, seizing the whole, retired to a desolate heath and in the form of a snake or dragon brooded over the hoard. Regin, cheated of his share, plotted vengeance

and conquest of the treasure.

"To Regin, a notable smith, was sent Sigurd—son of the slain hero Sigmundr the Volsung and his wife Hiortis, now wife of the Danish king Alf—to be trained in his craft. To him Regin told of Fafnir and the hoard, and the young hero offered to go out against the dragon if Regin would weld him a sword. But every brand forged by the smith broke under Sigurd's stroke; till at last he fetched the fragments of the sword Gram, Odin's gift to his father, which Hiortis had carefully treasured. These Sigurd forged into a new sword, so hard that with it he could cleave the anvil, and so sharp that it would sever a flock of wool floating against it down stream; and, so armed, he sought and slew the dragon. But while roasting Fafnir's heart, which Regin had cut out, Sigurd burned his finger with the boiling fat and, placing it to his lips, found that he could understand the language of birds, and so learned from the chattering of the woodpeckers that Regin was planning treachery. Thereupon he slew the smith, and loading the treasure on the magic steed Grani, given to him by Odin, set out on his travels.

"On a fire-girt hill Sigurd found the Valkyrie Brunhild in an enchanted sleep, and ravished by her beauty awakened her; they plighted their troth to each other and, next morning, Sigurd left her to set out once more on his journey. Coming to the court of Giuki, a king in the Rhine country, Sigurd formed a friendship with his three sons, Gunnar, Hogni and Guthorm; and, in order to retain so valuable an ally, it was determined to arrange a match between him and their sister Gudrun. Queen Grimhild, skilled in magic, therefore gave him an enchanted drink, which caused him to forget Brunhild. Gunnar, on the other hand, wished to make Brunhild his wife, and asked Sigurd to ride with him on this quest, which he consented to do on condition of receiving Gudrun to wife. They set out; but Gunnar was unable to pass the circle of fire round Brunhild's abode, the achievement that was the condition of winning her hand. So Sigurd, assuming Gunnar's shape, rode through the flames on his magic horse, and in sign of troth exchanged rings with the Valkyrie, giving her the ring of Andvari. So Gunnar and Brunhild were wedded, and Sigurd, resuming his own form, rode back with them to Giuki's court, where the double marriage was celebrated. But Brunhild was moody and suspicious, remembering her troth with Sigurd and believing that he alone could have accomplished the quest.

"One day the two queens, while bathing in the river, fell to quarrelling as to which of their husbands was the greater. Brunhild taunted Gudrun with the fact that Sigurd was Gunnar's vassal, whereupon Gudrun retorted by telling her that it was not Gunnar but Sigurd who rode through the flames, and in proof of this held up Brunhild's ring which Sigurd had given to her. Brunhild, maddened by jealousy and wounded pride, now incited the three kings to murder Sigurd by exciting their jealousy of his power. The two elder, as bound to him by blood-brotherhood, refused; but the youngest, Guthorm, who had sworn no oaths, consented to do the deed. Twice he crept into Sigurd's chamber, but fled when he found the hero awake and gazing at him with flashing eyes. The third time, finding him asleep, he stabbed him; but Sigurd, before he died, had just strength enough to hurl his sword at the murderer, whom it cut in two. Brunhild, when she heard Gudrun wailing, laughed aloud. But her love for Sigurd was great as ever, and she determined not to survive him; distributing her wealth to her hand-maidens she mounted Sigurd's funeral pyre, slew herself with his sword, and was burnt with him.

"In course of time Gudrun married Atli (Attila), king of the Huns, Brunhild's brother. Atli, intent on getting hold of the hoard which Gudrun's brothers had seized, invited them to come to his court. In spite of their sister's warnings they came, after sinking the treasure in the Rhine. On their refusal to surrender the hoard or to say where it was concealed, a fierce fight broke out in which all the followers of Gunnar and Hogni fell. Atli then once more offered to spare Gunnar's life if he would reveal his secret; but Gunnar refused to do so until he should see the heart of Hogni. So Hogni's heart was cut out, the victim laughing the while; but when Gunnar saw it he cried out that now he alone knew where the hoard was and that he would never reveal the secret. His hands were then bound, and he was cast into a den of venomous serpents; but he played so sweetly on the harp with his toes that he charmed the reptiles, except one adder, by which he was stung to death. Gudrun, however, avenged the death of her brothers by slaying the sons she had borne to Atli and causing him unwittingly to drink their blood and eat their hearts. Finally, in the night, she killed Atli himself and burned his hall; then, leaping into the sea, she was carried by the waves to new scenes, where she had adventures not connected with those recorded in the *Nibelungenlied.*"

This story, in spite of the late date of the *Volsungasaga,* represents a very primitive version. The setting of the *Nibelungen* story, on the other hand, is mediaeval rather than primitive, though its extant versions are of much earlier date, and it contains primitive elements not found in the other. Everywhere the supernatural elements are eliminated or subordinated. The gods have vanished from the scene; there is nothing of Loki and his theft of Andvar's hoard, nothing of Odin and his gifts of the sword Gram, and the magic horse Grani; and not till the third *Aventiure,* when Siegfried comes to Worms, are we given even a hint that such things as the sword and treasure exist.

In the legend of Sigurd the Volsung, the plot had turned upon the love and vengeance of Brunhild, so in the song of the Nibelungs it is the love and vengeance of Kriemhild, the Gudrun of the northern saga, that forms the backbone of the story and gives it from first to last an artistic unity which the *Volsungasaga* lacks. The tragedy of the close of the story is emphasized by the pomp and circumstance that surround the ill-fated hero. The primitive setting of the northern version has vanished utterly. Sigmund is king of the Netherlands; the boy Siegfried is brought up by "wise men that are his tutors" (*Avent.* ii.); and when, attracted by the fame of Kriemhild's beauty, he rides to Worms to woo her, it is as the typical handsome, accomplished and chivalrous king's son of mediaeval romance.

It is at this point (*Avent.* iv.) that some primitive elements are suddenly and awkwardly introduced. As Siegfried approaches Worms, Kriemhild's brothers, the Burgundian kings Gunther, Giselhêr and Gêrnot watch his coming, and to them their faithful retainer, "the grim Hagen," explains who he is. This can be no other than the hero who slew the two kings of the Nibelungs, Schilbunc and Nibelunc, and seized their treasure, together with the sword Balmunc and the *tarnkappe,* or cape of darkness, which has the virtue of making him who wears it invisible. Another adventure, too, he can tell of him, namely, how he slew a dragon and how by bathing in its blood his skin became horny, so that no weapon could wound him save in one place, where a linden leaf had fallen upon him as he stooped, so that the blood did not touch this spot. In spite of Hagen's distrust and misgivings, Siegfried now fights as the ally of the Burgundians against the Saxons (*Avent.* iv.), and undertakes, on condition of receiving Kriemhild to wife, to help Gunther to woo Queen Brunhild, who can only be won by the man who can overcome her in three trials of strength (*Avent.* vi.). Siegfried and Gunther accordingly go together to Brunhild's castle of Isenstein in Iceland, and there the hero, invisible in his *tarnkappe,* stands beside Gunther, hurling the spear and putting the weight for him, and even leaping, with Gunther in his arms, far beyond the utmost limit that Brunhild can reach (*Avent.* vii.). Brunhild confesses herself beaten and returns with the others to Worms, where the double marriage is celebrated with great pomp (*Avent.* x.). But Brunhild is ill content; though she saw Siegfried do homage to Gunther at Isenstein she is not convinced, and believes that Siegfried should have been her husband; and on the bridal night she vents her ill humour on the hapless Gunther by tying him up in a knot and hanging him on the wall. "I have brought the evil devil to my house!" he complains to Siegfried next morning; and once more the hero has to intervene; invisible in his *tarnkappe* he wrestles with Brunhild and, after a desperate struggle, takes from her her girdle and ring before yielding place to Gunther. The girdle and ring he gives to his wife Kriemhild (*Avent.* x.).

One day, while Siegfried and his wife were on a visit to the Burgundian court, the two queens fell to quarrelling on the ques-

tion of precedence, not in a river but on the steps of the cathedral (*Avent.* xiv.). Kriemhild was taunted with being the wife of Gunther's vassal; whereupon, in wrath, she showed Brunhild the ring and the golden girdle taken by Siegfried, proof that Siegfried, not Gunther, had won Brunhild. So far the story is essentially the same as that in the *Volsungasaga;* but now the plot changes. Brunhild drops out, becoming a figure altogether subordinate and shadowy. The death of Siegfried is compassed, not by her, but by the "grim" Hagen, Gunther's faithful henchman, who thinks the glory of his master unduly overshadowed by that of his vassal. Hagen easily pursuades the weak Gunther that the supposed insult to his honour can only be wiped out in Siegfried's blood; he worms the secret of the hero's vulnerable spot out of Kriemhild on pretence of shielding him from harm (*Avent.* xv.) and then arranges a great hunt in the forest, so that he may slay him when off his guard. The 16th *Aventiure* describing this hunt and the murder of Siegfried is perhaps the most powerful scene in all mediaeval epic. When the hunters sat down to feast, it was found that the wine had been forgotten. Hagen thereupon proposed that they should race to a spring some way off in the forest. Siegfried readily agreed, and though handicapped by carrying shield, sword and spear, easily reached the goal first, but waited, with his customary courtesy, until the king had arrived and drunk before slaking his own thirst. Then, laying aside his arms, he stooped and drank. Hagen, seizing the spear, thrust it through the spot marked by Kriemhild on Siegfried's surcoat. The hero sprang up and, finding that his sword had been removed, attacked Hagen with his shield.

Then reproaching them for their cowardice and treachery, Siegfried fell dying "amid the flowers" while the knights gathered round lamenting. The whole spirit of this scene is primitive Teutonic rather than mediaeval. The same is true, indeed, of the whole of the rest of the poem. Siegfried, to be sure, is buried with Catholic rites; but Kriemhild, while praying for his soul like a good Christian, plots horrible vengeance like her pagan prototype. Mistress now of the Nibelungen hoard, she sought to win a following by lavish largesses; but this Hagen frustrated by seizing the treasure, with the consent of the kings, and sinking it in the Rhine, all taking an oath never to reveal its hiding-place (*Avent.* xix.). At last, however, after 13 years, Kriemhild's chance came, with a proposal of marriage from Etzel (Attila) king of the Huns, which she accepted on condition that he would help her to vengeance (*Avent.* xx.). Then more years passed; old feuds seemed to be forgotten; and the Burgundian kings, in spite of Hagen's warnings, accepted their sister's invitation to visit her court (*Avent.* xxiii.–xxiv.).

The journey of the Burgundians into Hunland is described by the poet at great length (*Avent.* xxv.–xxvii.). From this point onward the story is dominated by the figure of the grim Hagen, who, twitted with cowardice and his advice spurned, is determined that there shall be no turning back and that they shall go through with it to the bitter end. With his own hands he ferries the host over the Danube and then destroys the boat, so that there may be no return. At Attila's court (*Avent.* xxviii.) it is again Hagen who provokes the catastrophe by taunting Kriemhild when she asks him if he has brought with him the hoard of the Nibelungs:

"The devil's what I bring you!" Hagen then replied,
"What with this heavy harness and my shield beside,
I had enough to carry; this helmet bright I brought;
My sword is in my right hand, and that, be sure, I bring you not!"

The sword was Siegfried's. It is Hagen, too, who after the first onslaught of the Huns, strikes off the head of Ortlieb, the son of Etzel and Kriemhild, and who, amid the smoke and carnage of the burning hall, bids the Burgundians drink blood if they are thirsty.

But for all their prowess, after a prolonged struggle (*Avent.* xxix.–xxxvii.) the Burgundians were at last overwhelmed. Most of the chief figures of heroic saga had come up against them; Attila, Hildebrand, the Ostrogoth Theodoric (Dietrich von Bern). To the last named even Hagen armed with Siegfried's sword had to yield (*Avent.* xxxviii.). Kriemhild came to him as he lay in bonds and demanded the Nibelung treasure. He refused to reveal its hiding place so long as Gunther, also a prisoner, should live. Gunther was accordingly slain by the queen's orders and his head was brought to Hagen, who cried out when he saw it that all had been accomplished as he had foretold:

"Now none knows where the hoard is save God and I alone:
That to thee, devil-woman, shall nevermore be known!"

Whereupon Kriemhild slew him with Siegfried's sword. But Kriemhild was not destined, like Gudrun, to set out on further adventures. Hildebrand, horrified at her deed, sprang forward and cut her to pieces with his sword.

In sorrow now was ended the king's high holiday,
As ever joy in sorrow ends and must end alway.

To some mss. of the *Nibelungenlied* is added a supplementary poem called the *Klage* or *Lament,* a sequel of 2,160 short-line couplets, describing the lament of the survivors—notably Etzel—over the slain, the burying of the dead, and the carrying of the news to the countries of the Burgundians and others. At the end it is stated that the story was written down, at the command of Bishop Pilgrim of Passau, by a writer named Konrad (Kuonrât) in Latin and that it had since been sung (*getichtet*) often in the German tongue.

Sources of the Story.—The origin and nature of the various elements that go to make up the story of the *Nibelungenlied* have been, and continue to be, the subject of debate. The view at one time most generally accepted was that first propounded by Karl Lachmann in his "Kritik der Sage von den Nibelungen" (*Rheinisches Museum für Philologie,* num. 249, 250, 1829, republished in his *Zu den Nibelungen . . . Anmerkungen* in 1836), namely that the story was originally a myth of the northern gods modified into a heroic saga after the introduction of Christianity, and intermingled with historical elements. This view was also maintained by Richard von Muth in his *Einleitung in das Nibelungenlied* (Paderborn, 1877). On the other hand, so early as 1783 Johannes von Müller of Göttingen had called attention to the historical figures appearing in the Nibelungenlied, identifying Etzel as Attila, Dietrich of Bern as Theodoric of Verona, and the Burgundian kings Gunther, Giselhêr and Gêrnot as the Gundaharius, Gislaharius and Godomar of the *Lex Burgundiorum;* in 1820, Julius Liechtlen (*Neuaufgefundenes Bruchstück des Nibelungenliedes,* Freiburg-im-Breisgau) roundly declared that "the *Nibelungenlied* rests entirely on a historical foundation, and that any other attempt to explain it must fail." This view was, however, overborne by the great authority of Lachmann, whose theory, in complete harmony with the principles popularized by the brothers Grimm, was accepted by a long series of critics. In later years criticism tended to revert to the standpoint of Müller and Leichtlen and to recognize in the story of the Nibelungen a misty and confused tradition of real events and people. Mythical elements it certainly contains; and to those figures which—like Siegfried, Brunhild, or Hagen—cannot be traced to historical originals, a mythical origin is still provisionally ascribed, though Theodor Abeling (*Das Nibelungenlied,* 1907) made out a plausible case for identifying Siegfried with Segerio, son of the Burgundian king Sigimund and Brunhild with the historical Brunichildis.

The basis of the story is then, according to this view, historical, not mythical; a medley of Franco-Burgundian historical traditions, overlaid with mythical fancies. The historical nucleus is the overthrow of the Burgundian kingdom of Gundahar by the Huns in 436; and round this there gathered an accretion of other episodes, equally historical in their origin, however distorted, with a naïve disregard of chronological possibility. In the *Eddas* the identity of the original Franco-Burgundian sagas is fairly preserved. In the *Nibelungenlied,* on the other hand, the influence of other wholly unconnected stories is felt: thus Hildebrand appears during the final fight at Etzel's court, and Theodoric the Great (Dietrich von Bern; *see* Theodoric).

Origin of the Poem.—The controversy as to the underlying elements of the Nibelung legend extends to the question of the authorship and construction of the poem itself. Was it from the first—whatever additions and interpolations may have followed—conceived as a single, coherent story, or is it based on a number

of separate stories, popular ballads akin to the *Eddas,* which the original author of the *Nibelungenlied* merely collected and strung together? The answer to these questions has been sought by a succession of scholars in a critical comparison of the mediaeval mss. of the poem still surviving. Of these 33 are now known, of which 10 are complete, the rest being more or less fragmentary. The most important are those first discovered, viz., the mss. lettered C (Hohenems 1755), B (Schloss Werdenberg, 1769), A (Hohenems 1779); and round these the others more or less group themselves. They exhibit many differences: put briefly C is the most perfectly finished in language and rhythm; A is rough, in places barbarous; B stands halfway between the two. Which is nearest to the original? Karl Lachmann (*Zu den Nibelungen und zur Klage, Anmerkungen,* 1836) decided in favour of A. He applied to the *Nibelungenlied* the method which Friedrich August Wolf had used to resolve the *Iliad* and *Odyssey* into their elements. The poem, according to Lachmann, was based on about 20 popular ballads, originally handed down orally, but written down about 1190 or 1200. This original is lost, and A—as its roughness of form shows—is nearest to it; all other mss. including B and C are expansions of A. Lachmann's view was first seriously assailed by Adolf Holtzmann (*Untersuchungen über das Nib.*, Stuttgart, 1854), who argued that the original could not have been strophic in form—the fourth lines of the strophes are certainly often of the nature of padding—that it was written by Konrad (Kuonrât of the *Klage*) writer to Bishop Pilgrim of Passau about 970–984, and that of existing mss. C is nearest to this original, B the copy of a ms. closely akin to C, and A an abbreviated corrupt copy of B. This view was adopted by Friedrich Zarncke, who made C the basis of his edition of the *Nibelungenlied* (Leipzig, 1856). A new hypothesis was developed by Karl Bartsch in his *Untersuchungen über das Nibelunglied* (Leipzig, 1865). According to this the original was an assonance poem of the 12th century, which was changed between 1190 and 1200 by two separate poets into two versions, in which pure rhymes were substituted for the earlier assonances; the originals of the *Nibelungenlied* and *Der Nibelunge Nôt* respectively. Bartsch's subsequent edition of the *Nibelunge Nôt* (1st ed., Leipzig, 1870) was founded on B, as the nearest to the original. To this view Zarncke was so far converted that in the 1887 edition of his *Nibelungenlied* he admitted that C shows signs of recension and that the B group is purer in certain details.

It is impossible here to follow the further developments of the question. Theodor Abeling's *Das Nibelungenlied und seine Literatur* gives a full bibliography from 1756 to 1905. Other important contributions are: Andreas Heusler, in the *Sitzungsberichte der Königl. Preuss. Akad. der Wissenschaften,* xlvii (1914), in which he investigates anew the genesis of the saga; Hermann Fischer, *Über die Entstehung des Nibelungenliedes, in Sitzungsber der Königl. Bayer. Akad. der Wiss., Philos. und hist. Klasse,* 1914, who traces the influences at work on the poem and concludes that it was written under that of Bishop Wolfger of Passau. With this Friedrich Wilhelm (in *Müncher Archiv,* part 7, 1916) is in agreement. There have also been during latter years advocates of a Latin original of the poem; *e.g.,* R. Pestalozzi, *Die Nibelungias* (*Neue Jahrbücher,* 39, 1916–17), but this idea is generally discredited. There are English translations of the poem by A. G. Foster-Barham (1887) and Margaret Armour (prose, 1897); and Alice Horton (1898). (W. A. P.)

See M. Thorp, *The Study of the Nibelungenlied* (1940).

NICAEA or Nice (mod. *Isnik, i.e., εἰς Νικαίαν*), an ancient town of Asia Minor, in Bithynia, on the Lake Ascania. Antigonus built the city (316 B.C.?) on an old deserted site, and soon afterward Lysimachus changed its name from Antigonia to Nicaea, calling it after his wife. Under the Roman empire Nicaea and Nicomedia disputed the title of metropolis of Bithynia. Strabo describes the ancient Nicaea as built regularly, in the form of a square, with a gate in the middle of each side. From a monument in the centre of the city all the four gates were visible at the extremities of great cross streets. After Constantinople became the capital of the empire Nicaea grew in importance, and after the conquest of Constantinople by the crusaders became the temporary seat of the Byzantine emperor; the double line of walls with the Roman gates is still well preserved. The possession of the city was long disputed between the Greeks and the Turks. It remained an important city for some time after its final incorporation in the Ottoman empire; but became subsequently an insignificant village.

NICAEA, COUNCIL OF. The Council of Nicaea (A.D. 325) is an event of the highest importance in the history of Christianity. Its convocation by Constantine and its course illustrate the radical revolution which the position of this religion, within the confines of the Roman empire, had undergone in consequence of the Edict of Milan. From his accession Constantine had shown himself the friend of the Christians; and, when his victory over Licinius (A.D. 323) gave him undisputed possession of the crown, he adhered to this religious policy, distinguishing and fortifying the Christian cause by gratuities and grants of privilege. This propitiatory attitude originated in the fact that he recognized Christianity—which had successfully braved so many persecutions—as the most vital and vigorous of religions, and as the power of the future. Consequently he directed his energies toward the establishment of a positive relationship between it and the Roman state. But the church could only maintain its great value for the politician by remaining the same compact organism which it had proved itself to be under the stormy reign of Diocletian. Scarcely, however, did it find itself in the enjoyment of peaceful relations with the state, when violent feuds broke out in its midst, whose extent, and the virulence with which they were waged, threatened to dismember the whole religious body. Donatism in the west was followed by the Arian struggle in the east. The former movement had been successfully arrested, though it survived in North Africa till the 5th century. The conflict kindled by the Alexandrian presbyter Arius with regard to the relation of Christ to God assumed a more formidable character (*see* Arius). Constantine therefore had recourse to an institution previously evolved by the Christian Church—the convocation of a synod to pronounce on burning questions—enlarging it, however, to correspond with the altered circumstances. He convened a council, designed to represent the whole church of the empire, at Nicaea in Bithynia, a town situated no great way from the imperial summer residence of Nicomedia and within easy reach by sea of the oriental bishops. In consequence of the vast distances, the west was not largely represented, but the able theologian Hosius, bishop of Cordova, was present. The three most important bishoprics of the east were represented (Alexandria, Antioch and Jerusalem); a prominent part was also taken by Eusebius, bishop of Nicomedia, and his namesake of Caesarea (the historian), along with a very large number of others from the east. Among the attendant clergy, the still youthful deacon Athanasius, destined to succeed Alexander in the see of Alexandria, was prominent as the most powerful antagonist of Arianism (*see* Athanasius "The Great"). The synod sat from May 20 to July 25.

The deliberations on the Arian question passed through several distinct stages before the final condemnation of Arius and his doctrines was reached. A clearly defined standpoint with regard to this problem—the relationship of Christ to God—was held only by the comparatively small group of Arians and a not much larger group who adhered with unshaken conviction to the Alexandrian view. The bulk of the members occupied a position between these two extremes. They rejected the formulas of Arius, and declined to accept those of his opponent; that is to say, they were merely competent to establish negations, but lacked the capacity, as yet, to give their attitude of compromise a positive expression. That the majority of the council should have adopted this neutral tendency is easily intelligible when we consider the state of theology at that period. True, at Nicaea this majority eventually acquiesced in the ruling of the Alexandrians; yet this result was due, not to internal conviction, but partly to indifference, partly to the pressure of the imperial will—a fact which is mainly demonstrated by the subsequent history of the Arian conflicts. For if the Nicaean synod had arrived at its final decision by the conscientious agreement of all non-Arians, then the confession of faith there formulated might indeed have evoked the continued antagonism of the Arians, but must necessarily have

been championed by all else. This, however, was not the case; in fact, the creed was assailed by those very bodies which had composed the *laissez-faire* centre at Nicaea; and we are compelled to the conclusion that, in this point, the voting was no criterion of the inward convictions of the council.

In the synod, an Arian confession of faith was first brought forward and read; but it aroused such a storm of indignation that obviously, in the interests of a restoration of ecclesiastical peace, there could be no question of its acceptance. On this, Eusebius of Caesarea submitted the baptismal creed of his community. Since the creed dated from a period anterior to the outbreak of the Arian struggle, its reception would have been equivalent to a declaration on the part of the council that it declined to define its position with reference to the controversy of the hour. That the greater number of delegates were not disinclined to adopt this subterfuge, and to shelve the actual solution of the whole problem by recognition of this or some similar neutral formula, is extremely probable. But the emperor saw that, if the difficulties were eluded in any such way, it was inevitable from the very nature of the case, that they should rise again in an accentuated form, and that consequently no pacification could be expected from this policy.

Accordingly Constantine proposed that the Caesarean creed should be modified by the insertion of the Alexandrian passwords (including the decisive term ὁμοούσιος, "identical in nature"), as if for the purpose of more accurate definition, and by the deletion of certain portions. That he appreciated the import of these alterations, or realized that this revision was virtually the proclamation of a new doctrine, is scarcely probable. The creed thus evolved by an artificial unity was no ratification of peace: in fact, it paved the way for a struggle which convulsed the whole empire. For it was the proclamation of the Nicene Creed that first opened the eyes of many bishops to the significance of the problem there treated; and its explanation led the Church to force herself, by an arduous path of theological work, into compliance with those principles, enunciated at Nicaea, to which, in the year 325, she had pledged herself without genuine assent.

BIBLIOGRAPHY.—*See* the Histories of Dogma by Harnack, Loofs and Seeberg; articles in Hastings, *Encyclopaedia of Religion and Ethics* and Herzog-Hauck, *Realencyklopädie,* 3rd ed.; Bethune-Baker, *Introduction to the early History of Christian Doctrine;* Gore, *Dissertations on Subjects connected with the Incarnation;* and (from another point of view) Mellone, "Athanasius the Modernist" in *The Price of Progress* (1924). In addition to the Arian problem, the council dealt with the question of the "lapsed" in the recent persecution, the question of "heretical baptism" and other matters (*see* Hefele, *History of Councils,* vol. i.).

NICANDER (2nd cent. B.C.), Greek poet, physician and grammarian, was born at Claros, near Colophon, where his family held the hereditary priesthood of Apollo. He flourished under Attalus III of Pergamum. He wrote a number of works both in prose and verse, of which two are preserved. The longest, *Theriaca,* is a hexameter poem (958 lines) on the nature of venomous animals and the wounds which they inflict. The other, *Alexipharmaca,* consists of 630 hexameters treating of poisons and their antidotes. In his facts Nicander followed the physician Apollodorus. Among his lost works may be mentioned: *Aetolica,* a prose history of Aetolia; *Heteroeumena,* a mythological epic, used by Ovid in the *Metamorphoses* and epitomized by Antoninus Liberalis; *Georgica* and *Melissourgica,* of which considerable fragments are preserved, said to have been imitated by Virgil (Quintilian x. 1. 56).

The works of Nicander were praised by Cicero (*De oratore,* i, 16), imitated by Ovid, and frequently quoted by Pliny and other writers. His reputation does not seem justified; his works, as Plutarch says (*De audiendis poetis,* 16), have nothing poetical about them except the metre, and the style is bombastic and obscure; but they contain some interesting information as to ancient belief on the subjects treated.

Editions by J. G. Schneider (1792, 1816); O. Schneider (1856) (with the Scholia); H. Klauser, "De Dicendi Genere . . . Nicandri" (*Dissertationes Philologicae Vindobonenses,* vi. 1898). The Scholia (from the Göttingen ms.) have been edited by G. Wentzel in *Abhandlungen der k. Gesellschaft der Wiss. zu Göttingen,* xxxviii. (1892). *See* also W. Vollgraff, *Nikander und Ovid* (Groningen, 1909 *seq.*).

NICANOR, Greek grammarian, son of Hermeias of Alexandria (or Hierapolis), lived during the reign of the Roman emperor Hadrian (A.D. 117–138).

He devoted himself chiefly to the study of punctuation and the difference of meaning caused by it. Hence he was nicknamed the Punctuator. He is known to have written on the punctuation of Homer and Callimachus. He was possibly the author of a work *On the Change of Names of Places,* of which some fragments were preserved in C. W. Müller's *Fragmenta Historicorum Graecorum,* iii, 632.

See edition of the *Iliad* and *Odyssey* fragments by L. Friedlander (1850) and O. Carnuth (1875) respectively.

NICARAGUA, the largest country of Central America, lying between Honduras and Costa Rica, which form its north and south boundaries, respectively, and reaching from the Caribbean sea on the east to the Pacific ocean on the west. Its area, which is still undetermined owing to boundary disputes with Honduras and incomplete surveys, is generally put at from 49,200 to 51,660 sq.mi., the former being the most generally accepted.

The coast line is about 300 mi. on the Caribbean and 200 mi. on the Pacific.

The Honduran boundary as generally accepted starts at Cape Gracias a Dios, follows the Segovia river inland and then at 86° W. takes an imaginary line to the upper waters of the Río Negro, which it follows to the Gulf of Fonseca. The Costa Rican boundary is now agreed upon, under treaties of 1858, confirmed in 1888 and settled in 1896, to be a line 2 mi. S. of the San Juan river and Lake Nicaragua.

Physical Features.—Nicaragua is crossed by the two mountain chains that traverse the western hemisphere, and which provide some fine highland valleys. Its most striking natural features, however, are the two great lakes, Lake Nicaragua, about 100 mi. long and 45 mi. wide, and Lake Managua, to the north of it, and connected with it by the Tipitapa river. Lake Managua's length is 38 mi. and its width varies from 10 mi. to 16 mi.

The surface of the country is naturally divided into five clearly

SCENE IN A JUNGLE SWAMP OF THE LOW COAST-LAND OF NICARAGUA

distinct zones: (1) the series of volcanic peaks which extend parallel to the Pacific at a little distance inland; (2) the plains and lakes of the great depression which lies to the east of these mountains and stretches from sea to sea, between the Bay of Fonseca and the mouths of the San Juan; (3) the main cordillera, which skirts the depression on the east, and trends northwest from Monkey Point or Punta Mico on the Caribbean sea, until it is merged in the ramifications of the Honduran and Salvadoran highlands; (4) the plateaus which slope gradually away from the main cordillera towards the Caribbean; (5) the east or Mosquito coast (*see* MISKITO COAST), with its low-lying hinterland. The chain of volcanic cones, which constitutes a watershed quite equal in importance to the cordillera itself, consists for the most part of isolated igneous peaks, sometimes connected by low intervening ridges.

The main Nicaraguan cordillera, which flanks the depression on

the east, has often been called the Cordillera de los Andes, from its supposed continuity with the mountain chains of Panamá and the west coast of South America. There is in fact no such continuity, for the San Juan valley completely separates the mountains of Panamá from the main Nicaraguan system. The main cordillera bears different names in different parts of Nicaragua. Thus the important section which terminates at Monkey Point is commonly called the Cordillera de Yolaina. The summits of the main cordillera seem nowhere to exceed 7,000 ft. in altitude; the mean elevation is probably less than 2,000 ft.; the declivity is sheer toward the lakes, and gradual toward the Caribbean. On the east, the cordillera abuts upon the region of plateaus and savannas, which occupies nearly half of the area of Nicaragua.

Climate.—The climate along the coasts, where most of the population lives, is hot and often sultry; in the highland sections there is the usual relatively cool and even climate of the tropical upland. There are two seasons, wet and dry, the former extending from May or June to November or December and dry in the remaining period, although on the east coast, the rainy season often extends well into the so-called dry period. Rainfall varies in different sections, as much as 297 in. a year having been recorded at Bluefields, on the Caribbean coast; the mean at Rivas, on the Pacific side, is 102 in. a year.

History.—The history of Nicaragua in connection with the other Central American countries and down to the dissolution of the union is discussed in the article on CENTRAL AMERICA. The first white man to see Nicaragua was Gil González de Avila, who landed on the coast of Chiriquí in 1522. The leading Indian tribe of the country was then led by a great chief called Nicaragua, from whom the country derived its name. Nicaragua was baptized, and his tribe converted to the Roman Catholic faith and moved with the Spaniards to the conquest of the other tribes.

Hernán de Córdoba, who succeeded Gil González in command of the province for Spain, founded Granada in 1524, the city then being situated between the two great lakes. Nicaragua was incorporated, for administrative purposes, in the captaincy general of Guatemala.

Nicaragua, with independent existence dating from the dissolution of the Central American union in 1838, early developed into a battleground for the two rival cities of León and Granada, the former the capital of the Liberals, the latter of the Conservatives. In 1856 the American filibusterer, William Walker (*q.v.*), arrived with his 66 followers, espousing the cause of León and waging a bitter war against the Granadinos which ended in his execution in 1860. Both the United States and Great Britain, through their agents, took active but undercover parts in the Walker episode.

Nicaragua had open difficulties with various foreign powers, chiefly the United States and Great Britain, almost throughout the 19th century. The Mosquito Indians on the Caribbean coast, under the protection of Great Britain, gave that power a claim to Nicaraguan territory until 1850 when the Clayton-Bulwer treaty between Great Britain and the United States stipulated that neither party could occupy, fortify, colonize or exercise dominion over any portion of Central American territory. Actual transfer of the Mosquito territory did not take place, however, until 1893, when Nicaragua occupied it by force. The Clayton-Bulwer treaty also neutralized any canal which should be constructed across Nicaragua by either Great Britain or the United States. Other European powers became involved with Nicaragua during the ensuing years. In 1875, Germany and, in 1895, Great Britain, blockaded Nicaraguan ports to force redress of injuries.

In 1909, two Americans, Cannon and Groce, were executed, after torture, and this led to a U.S. naval demonstration and demands, and was one of the direct elements leading to U.S. intervention. A period of comparative quiet existed in Nicaragua under a series of Conservative presidents until 1893, when José Santos Zelaya, a Liberal, seized the power as a result of a revolution and ruled Nicaragua until 1909. There were various attempts at revolution, but none succeeded until that of 1909. The United States broke off diplomatic relations with Zelaya as a result of the Cannon-Groce executions, describing the Zelaya regime as a "blot on the history" of Nicaragua. The U.S. cruiser "Des Moines" prevented fighting at Bluefields on Dec. 18, 1909, thus making defeat of the Conservative revolutionists impossible, and inaugurating what is now known as the intervention of the United States against Zelaya and the Liberals who backed him. On Dec. 23, the Conservatives defeated the Zelaya troops at Rama, capturing most of the army, and on the following day Zelaya took refuge aboard a Mexican gunboat at Corinto and left the country. José Madriz, a Liberal, took the reins of government, but the United States refused recognition; he was succeeded by Juan J. Estrada, an artisan, who had some Conservative and some Liberal backing and was regarded as a neutral. The United States accorded his government recognition, but it was short-lived.

Adolfo Díaz was elected provisional president in 1910. He was elected a second time in 1913, retiring in 1916; he was again chosen provisional president by vote of the senate in 1927. Under President Díaz, in 1912, the U.S. marines were invited into Nicaragua on the plea of their need to protect foreign lives and property during the so-called Mena revolution, and the legation guard which succeeded the 1912 expeditionary force remained until 1925, and unquestionably preserved peace and gave Nicaragua the period of rest and recuperation which was marked by its prosperity.

(*See* CENTRAL AMERICA.)

President Díaz was succeeded by Emiliano Chamorro in 1916, and he in turn by his nephew, Diego M. Chamorro (1920–23), who died in office and was succeeded by Bartolo Martínez, vice-president. The election of 1924, under laws framed by a U.S. expert but without the U.S. supervision that had been planned, resulted in the election of a coalition ticket, Pres. Carlos Solórzano being an anti-Chamorro Conservative, and Juan B. Sacasa, vice-president, being the leader of the Liberals. Gen. Emiliano Chamorro, who stood again for the presidency as a Conservative, was defeated, and on Oct. 24, 1925, he led a coup d'état which captured the Loma, the fortified hill overlooking Managua, and forced the resignation and departure first of Vice-President Sacasa and next of President Solórzano. Gen. Chamorro was named designate for the presidency by the senate, which had been changed in political complexion through the support of the Chamorro charges of fraud in the previous election (although previously these claims had been disallowed).

Sacasa was declared to have given up his rights by his departure from the country and General Chamorro assumed the presidency. The United States refused recognition, as did other Central American and European governments. Sacasa, meanwhile, had pressed Washington for his own recognition as the legitimate president, but this was refused on the ground that he was not in his country or in possession of the power. He left Washington and went to Mexico, where he had been recognized and where Pres. Plutarco Elias Calles furnished him with arms, ammunition and men.

The appearance of the Mexican element in the situation greatly disturbed Washington, and while before the attitude had been one of neutrality, the United States immediately moved to outwit the Mexican smuggling of arms, to isolate the fighting (the Sacasa forces had formed their bases on both the Caribbean and Pacific coasts) and to bring the revolution to an end with the elimination of Sacasa.

This policy of isolating the fighting and of landing marines to protect foreign interests in the country resulted in weakening the Liberal offensive and also in the resignation of General Chamorro. The Nicaraguan senate, reorganized with alternates or with original members in their seats, thereupon elected Adolfo Díaz designate and thus automatically president. An outcry arose throughout Latin America that the appointment had been forced by the United States. To allay such feelings Col. Henry L. Stimson was sent as a personal representative of Pres. Calvin Coolidge to Nicaragua where he soon arranged an armistice between the warring elements pending an early election, which should be held under U.S. supervision. The Liberals, with the exception of a band of *insurrectos* under Gen. Augusto Sandino, laid down their arms peaceably. The vote was taken on Nov. 4, 1928, and resulted in an overwhelming victory for Gen. José M. Moncada, who had been leader of the Liberal army at the time of Stimson's visit.

The United States soon afterward began the gradual withdrawal of its troops as rapidly as their place could be taken by a local national guard. Guerrilla warfare continued between government forces and General Sandino's rebels.

The presidential election of 1932 was likewise held under United States supervision, and Sacasa was elected. On Feb. 3, 1933, the new government signed a peace pact with Sandino, who agreed that his followers, except 100, should be disarmed, receiving in return amnesty and land. A year later, Sandino visited the president at Managua, and shortly after leaving the presidential palace was shot down in cold blood by members of the national guard. Charges that the assassination was by direct order of the minister of war, Gen. Anastasio Somoza, were vigorously denied.

Unsatisfactory economic conditions and personal friction between President Sacasa and members of the government brought his forced resignation in June 1936, and Carlos Jarquín became provisional president. The regular presidential elections in November of that year resulted in the choice of General Somoza as the republic's chief executive. Somoza, who had been left in command of the national guard when the U.S. marines were withdrawn in 1933, remained to dominate Nicaraguan politics and government for more than a decade, and his administrations became increasingly authoritarian in nature. He first took office in Jan. 1937 and began a vigorous policy, placing special emphasis on public works. The already unsatisfactory condition of the world market for coffee, Nicaragua's most important product, was made acute by Brazilian abandonment of its control of coffee exports and prices. Nicaraguan finances suffered seriously, but under the firm hand of President Somoza, order and stability were maintained. The long-standing boundary dispute with Honduras flared up earlier in the same year, but efforts of several American republics succeeded in easing the tension.

Under President Somoza's leadership, Nicaraguan foreign policy followed closely the lead of the United States. At the outbreak of World War II in 1939, Nicaragua proclaimed neutrality and co-operated with the United States in policies designed to defend the western hemisphere. After the attack on Pearl Harbor in Dec. 1941, Nicaragua declared war against Japan, Germany and Italy; and in 1945 the republic became one of the original members of the United Nations organization. In that body, especially after 1947, Nicaraguan delegations generally supported the United States in measures affecting its "cold war" with the Soviet Union.

With respect to domestic politics, Somoza retained firm control of the government of Nicaragua. He relied upon *continuismo*, a political technique common to a number of the Central American states, to retain power despite constitutional limitations on the presidential term of office. Thus Somoza, inaugurated in Jan. 1937, acquired a new eight-year term with the adoption of the constitution of 1939. That document prohibited the immediate re-election of the president, but an amendment adopted in 1943 permitted exception in Somoza's case.

A presidential election held in Feb. 1947 resulted in the choice of Leonardo Argüello as president. Argüello, thought to be faithful to Somoza, exhibited signs of political independence almost immediately after taking office on May 1. He was deposed on May 25 in a coup d'état led by former President Somoza.

Benjamín Lacayo Sacasa, more acceptable to Somoza, thereupon became acting president on an interim basis, and was replaced on Aug. 15 by Pres. Víctor M. Román y Reyes. The latter, faithful to Somoza, died in office in May 1950. At that time Somoza resumed the presidency on a theoretically provisional basis, and on May 1, 1951, he was inaugurated for a new six-year term.

Population.—The 1950 census of the Americas assigned to Nicaragua a population of 1,053,189. The principal cities and their 1950 populations are: Managua, 107,444; León, 31,008; Matagalpa, 10,362; and Granada, 21,743. An overwhelming majority of the population of the country is *mestizo*. Some Negroes live on the Caribbean coast.

Political Organization.—The constitution of 1950 superseded those of 1939, 1911, 1905 and 1894. It vested the executive authority in the president of the republic, theoretically elected by a popular vote for a six-year term and ineligible for immediate re-election. The president must be a native Nicaraguan at least 30 years of age. The constitution provided for a cabinet (heads of the various national government departments) appointed by the president.

Legislative power is vested in a bicameral congress. The senate is composed of one member for each of the 15 departments into which the republic is divided, plus all of the country's living former presidents. The former are elected for six-year terms while the latter have life tenure in the senate. The lower chamber, called the house of deputies, is made up of 40 members. This figure is arrived at through arbitrary assignment of a given number of deputies for each of the 15 departments, after which one deputy is added for every 30,000 inhabitants. The deputies are elected for six-year terms. Congress convenes annually on April 15 for a 60-day regular session; additional special sessions can be called by the president of the republic when he deems them necessary.

Nicaragua is a unitary, or centralized, republic. The 15 primary political divisions are called departments. Each is governed through a political chief and a police chief, both appointed by the president of the nation.

The judiciary consists of the supreme court of justice and a superior judge of labour at Managua; 5 courts of appeal, located respectively at León, Granada, Matagalpa, Bluefields (also known as El Bluff) and Masaya; and about 150 lower courts. Elected by congress, the members of the supreme court of justice and the superior judge of labour have six-year terms, and the judges of the courts of appeal 4-year periods in office.

Education and Religion.—The educational system is highly centralized under the minister of public instruction, and primary education is free and theoretically compulsory. In 1949 there were 1,302 primary schools with 2,918 teachers and 89,991 pupils; 78 secondary schools with 556 teachers and 10,891 students; and two universities—at Granada and León—with 620 students. The two universities were merged in 1951. In the 1949 budget, the equivalent of $1,552,878 was set aside for education.

Roman Catholicism is the principal religion, but all are tolerated. Managua is the seat of an archdiocese which embraces the dioceses of Granada, León, and Matagalpa. Pres. Anastasio Somoza re-established religious instruction in the schools, reversing a quarter-century policy.

Finance.—In 1925, the córdoba was made the monetary unit. It was initially on a parity with the U.S. dollar, but declined until, on June 8, 1938, it was officially pegged at the rate of five córdobas per dollar and thereafter was controlled at that rate. A gold reserve of 9,413.2057 fine ounces was set up at New York city. In 1948, Nicaragua's internal public debt came to 28,873,741.22 córdobas, while the recognized external debt was figured at 17,276,355.60 córdobas.

Defense.—Nicaragua was virtually without an army from 1912, when U.S. marines were first landed, until 1933, when they departed. During this period, the marines furnished ample defense to the government. A small guard was maintained at the capital, largely for parade purposes. When the U.S. troops were withdrawn in 1933, they left Nicaragua with a national guard, which had been organized and trained by the marines.

Economics and Trade.—Nicaraguan prosperity depends primarily upon the country's coffee crop and the world price of coffee. This commodity constitutes from 25% to 30% of the republic's exports and provides a livelihood for more than half the population. In 1951 the country exported 262,578 60-kg. bags of coffee, of which 94.5% was shipped to the United States. Other major Nicaraguan exports include bananas, gold, cotton, lumber, hides and skins, sugar, ipecacuanha root and cacao. The United States

Value of Nicaraguan Foreign Trade
(In U.S. dollars)

	1939	1944	1948	1951
Imports	6,365,000	10,151,000	24,134,000	30,000,000
Exports.	8,301,000	15,412,000	26,683,000	41,000,000

purchases the bulk of the exports of Nicaragua and is the principal supplier of her imports. The latter include textiles, especially cotton, machinery and apparatus and miscellaneous manufactured goods and foodstuffs.

Communications.—Nicaragua's principal ports are Corinto (*q.v.*), San Juan del Sur, on the Pacific coast, Bluefields (*q.v.*) or El Bluff, and Puerto Cabezas, on the Caribbean, with San Juan del Norte of lesser importance. Communications within the country are limited. River transportation is significant, especially on the San Juan river. The National railroad from Corinto on the Pacific coast runs through León, Managua, Masaya and Granada to Diriamba.

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(L. W. BE.; G. I. B.)

NICASTRO, a town and episcopal see of Calabria, Italy, in the province of Catanzaro, 17 mi. W.N.W. of it by rail, and 5½ mi. E. of S. Eufemia, a station on the line along the west coast from Naples to Reggio di Calabria. Pop. (1936) 16,273 (town), 24,998 (commune). It is on the isthmus between the gulfs of S. Eufemia and of Squillace, the narrowest part of Calabria, 970 ft. above sea-level, and commands a fine view. Frederick II's son Henry was imprisoned in the castle. The place suffered greatly from the earthquake of 1638, which also destroyed the Benedictine abbey of S. Eufemia, founded by Robert Guiscard.

NICCOLI, NICCOLO DE' (1363–1437), Italian humanist, was born and died at Florence. He was one of the chief figures in the company of learned men which gathered round Cosimo de' Medici. Niccoli's chief services to classical literature consisted in his work as a copyist and collator of ancient mss. Many of the most valuable mss. in the Laurentian library are by his hand, amongst them those of Lucretius and of 12 comedies of Plautus. Niccoli's private library was the largest and best in Florence; he also possessed a small but valuable collection of ancient works of art, coins and medals. He regarded himself as an infallible critic, and could not bear the slightest contradiction.

See the *Life* in *Traversarii Epistolae* (ed. L. Mehus, 1759); G. Voigt, *Die Wiederbelebung des klassischen Altertums* (1893); G. Zippel, *Nicolò Niccoli* (Florence, 1890).

NICCOLITE, a mineral consisting of nickel arsenide, NiAs, containing 43.9% nickel. Crystals are hexagonal, but are rare and indistinct. It usually occurs as compact masses of a pale copper-red colour, with metallic lustre on the uneven fractured surfaces. It is opaque and brittle, and the streak is brownish-black. The specific gravity is 7.5 and the hardness 5½. Niccolite occurs with ores of cobalt, silver and copper at Annaberg and Schneeberg in Saxony, at Sangerhausen and Mansfeld in Prussian Saxony and other localities.

NICE, a city of France, the chief town of the department of the Alpes Maritimes, and previous to 1860 the capital of the county of Nice (Nizza) in the kingdom of Sardinia, 739 mi. by rail from Paris. Pop. (1946) 211,165. The population fluctuates with the seasons, owing to the influx of winter visitors.

The town is situated at the mouth of the Paillon (Paglione), at the northern end of the Baie des Anges. The historical nucleus of the town is an isolated limestone hill, running back for some distance from the shore and formerly crowned by a castle. Towards its south-west corner stands a tower (Tour Bellanda or Clérissy) dating, it is said, from the 5th century. The old town stretches along the western base of the hill; the "town of the 18th century" on ground farther west slopes gently towards the Paillon; and to the north-east and north and west beyond the stream lies the modern city. To the east of the hill the commercial quarter surrounds the port. The whole frontage of Nice is composed of fine embankments, notably the Promenade des Anglais begun 1822–24 at the cost of the English colony, and the course of the Paillon also is embanked on both sides. Nice has a Roman Catholic cathedral—Ste. Réparate, dating from 1650—two Russian churches, two synagogues and an Anglican chapel. Architecturally the most remarkable church is Notre Dame du Voeu, a modern Gothic building. The lycée was founded by the Jesuits in the 17th century. There is an astronomical and meteorological observatory on Mont Gros (1,220 ft.). The city is famous for its carnival festivities, especially the "battle of flowers."

Industry and Trade.—The industrial establishments are perfumery factories, distilleries, oil-works, furniture and woodwork factories, confectionery works, soap-works, factories for silk goods, straw hats, rubber goods, pianolas, metal goods and a national tobacco factory. Besides the vine, the trees principally cultivated in the neighbourhood are the olive, the orange, the mulberry and the carob; and the staple exports are oil, agricultural produce, fruits and flowers. Nice now joins on the north-east the ancient episcopal town of Cimiez, where are the most luxurious hotels. Reckoning from east to west the town is surrounded by a girdle of beautiful towns—Carabacel, St. Etienne, St. Philippe and Les Beaumettes. On the east of the port lie Montboron, Riquier and St. Roch, the last partly occupied by barracks. The entrances to the port of Nice and the outer pier have been improved; that of the outer port is 300 ft. wide, and that of the inner 220 ft. The area of the harbour is about 8 ac.; vessels drawing more than 23 ft. cannot enter; its trade is mostly coastal, principally in French and Italian vessels. Nice is an episcopal see (first mentioned at the end of the 4th century) under the archbishop of Aix. It belongs to the XV military division (Marseilles). It is the seat of a prefect, of tribunals of first instance and of commerce and of a board of trade arbitrators. The coastal railway is the main line of communication; an extension of the branch line up the Paillon valley to l'Ecarène joining the Ventimiglio-Coni (Cuneo) line at Breil was opened on Oct. 30, 1928.

Climate.—Protected towards the north by hills which rise stage behind stage to the main ridge of the Alps, Nice is celebrated for the mildness of its climate. The mean temperature is 60°, that of winter being 49°, of spring 56°, of summer 72° and of autumn 63°. For a few nights in winter there is frost, but snow is practically unknown. The highest reading of the thermometer is rarely above 90°. There are 67 days with rain in the course of a year; but it usually falls in heavy showers which soon leave the sky clear again; the whole annual amount exceeds 32 in. Fine

THE GARDEN OF KING ALBERT I IN NICE

days and rainy days are almost equally distributed throughout the different seasons. The winds are very variable, sometimes changing several times a day, but the most frequent is the east wind. April and May are the most windy months. The south-west wind (called *Libeccio,* or wind of Libya) is moist and warm; the north-east (or *Gregaou,* Greek), which is rare, brings storms of hail and even snow in winter. The mistral (from the north-west) and the tramontane (from the north) are generally stopped by the mountains. The climate of Nice, combining sea and sun, is suitable for convalescents, especially after acute affections of the lungs or surgical operations. Sufferers from the effects of paralysis or in the chronic stages of the rheumatic disorders are said to find its moderately warm character particularly soothing. Autumn is the best season. Patients with heart disease may find the summer heat trying.

History.—Nice (*Nicaea*) was founded about two thousand years ago by the Phocaeans of Marseilles, and was named in honour of a victory (*νίκη*) over the neighbouring Ligurians. It soon became a busy trading station, but had a rival in the town of Cemenelum, in existence till the time of the Lombard invasions, which has left its ruins at Cimiez. In the 7th century Nice joined the Genoese league formed by the towns of Liguria. In 729 it repulsed the Saracens; but in 859 and 880 they pillaged and burned it, and for the most of the 10th century remained masters of the surrounding country. As an ally of Pisa, Nice was the enemy of Genoa, and both the king of France and the emperor endeavoured to subjugate it; but it maintained its liberties. In the course of the 13th and 14th centuries it fell more than once into the hands of the counts of Provence; and at length in 1388 it placed itself under the protection of the counts of Savoy. The maritime strength of Nice rapidly increased till it was able to cope with the Barbary pirates; the fortifications were largely extended and the roads to the city improved. During the struggle between Francis I and Charles V great damage was caused by the passage of the armies invading Provence; pestilence and famine raged in the city for several years. In 1543 Nice was attacked by the united forces of Francis I and Barbarossa; and the inhabitants were ultimately compelled to surrender, and Barbarossa was allowed to pillage the city and to carry off 2,500 captives. Pestilence appeared again in 1550 and 1580. In 1600 Nice was taken by the duke of Guise.

By opening the ports of the countship to all nations, and proclaiming full freedom of trade, Charles Emmanuel in 1626 gave a great stimulus to the city. Captured by Catinat in 1691, Nice was restored to Savoy in 1696, but it was again besieged by the French in 1705, and in 1706 its citadel and ramparts were demolished. The treaty of Utrecht in 1713 gave the city back to Savoy; and in the peaceful years which followed the "new town" was built. From 1744 till the peace of Aix-la-Chapelle (1748) the French and Spaniards were again in possession. In 1775 the king of Sardinia destroyed all that remained of the ancient liberties of the commune. Conquered in 1792 by the armies of the French Republic, the county of Nice continued to be part of France till 1814; but after that date it reverted to Sardinia. By a treaty concluded in 1860 between the Sardinian king and Napoleon III it was again transferred to France.

NICEPHORUS, the name of three emperors of the East.

Nicephorus I., emperor 802–811, was a native of Seleucia in Pisidia, who was raised by the empress Irene to the office of *logothetes.* With the help of the patricians and eunuchs he contrived to dethrone Irene, and to be elected emperor. His sovereignty was endangered by the revolt of his general Bardanes. But Nicephorus achieved the submission of Bardanes, who was relegated to a monastery. A conspiracy headed by the patrician Arsaber had a similar issue. Nicephorus set himself with great energy to increase the empire's revenue. By his rigorous imposts he alienated the favour of his subjects, and especially of the clergy. In 803 and 810 he made a treaty with Charlemagne, by which the limits of the two empires were amicably fixed. Venice, Istria, the Dalmatian coast and South Italy were assigned to the East, while Rome, Ravenna and the Pentapolis were included in the Western realm. By withholding the tribute which Irene had agreed to pay to Harun al-Rashid, Nicephorus committed himself to a war with the Saracens. Compelled by Bardanes's disloyalty to take the field himself, he sustained a severe defeat at Crasus in Phrygia (805), and only obtained peace on condition of paying a yearly contribution of 30,000 gold pieces. By the death of Harun in 809, Nicephorus was left free to deal with the Bulgarian king, Krum, who was harassing his northern frontiers. In 811 Nicephorus invaded Bulgaria and drove Krum to ask for terms, but in a night attack he allowed himself to be surprised and was slain along with a large portion of his army.

See Gibbon, ed. Bury (1911) vol. v., p. 204–205, Bury's *Eastern Roman Empire.*

Nicephorus II. (Phocas), emperor 963–969, belonged to a Cappadocian family which had produced several distinguished generals. He was born about 912, joined the army at an early age, and, under Constantine VII., became commander on the eastern frontier. In the war with the Saracens he began with a severe defeat (956), which he retrieved in the years following by victories in Syria. In 960 he led an expedition to Crete, and wrested the whole island from the Saracens. He then returned to the east with a large and well-equipped army. In the campaigns of 962–963 he forced his way through Cilicia to Syria and captured Aleppo, but made no permanent conquests. Upon the death of Romanus II., Nicephorus was proclaimed emperor by the eastern troops, and was eventually acknowledged at Constantinople as colleague of the infant sons of Romanus. In 964–966 he definitely conquered Cilicia and again overran Mesopotamia and Syria, while the patrician Nicetas recovered Cyprus. In 968 he reduced most of the fortresses in Syria, and after the fall of Antioch and Aleppo (969), which were recaptured by his lieutenants, secured his conquests by a peace. On his northern frontier he began a war against the Bulgarians, to whom the Byzantines had of late been paying tribute (967), and by instigating an attack from the Russians distracted their attention effectively. Nicephorus was less successful in his western wars. After renouncing his tribute to the Fatimite caliphs, he sent an expedition to Sicily under Nicetas (964–965), but was forced by defeats on land and sea to evacuate that island completely. In 967 he made peace with the Saracens of Kairawan and turned to defend himself against their common enemy, Otto I. of Germany, who had attacked the Byzantine possessions in Italy; but after some initial successes his generals were defeated and driven back upon the southern coast. Owing to the care which he lavished upon the proper maintenance of the army, Nicephorus was compelled to exercise rigid economy in other departments. By his heavy imposts and the debasement of the coinage he forfeited his popularity with the rest of the community, and gave rise to riots. He was finally assassinated in his sleeping apartment by his nephew and successor John Zimisces. Nicephorus was the author of an extant treatise on military tactics.

Nicephorus III. (Botaniates), emperor 1078–1081, rose to be commander of the troops in Asia. He revolted in 1078 from Michael VII., and with the connivance of the Turks assumed the purple. In face of another rebellious general, Nicephorus Bryennius, his election was ratified by the aristocracy and clergy. With the help of Alexius Comnenus he drove out of the field Bryennius and other rivals, but failed to clear the invading Turks out of Asia Minor. Nicephorus ultimately quarrelled with Alexius, and was banished to a monastery.

See Gibbon, *Decline and Fall* (ed. Bury, 1911); Finlay, *Hist. of Greece;* G. Schlumberger, *Nicéphore Phocas* (Paris, 1890); K. Leonardt, *Kaiser Nicephorus II.* (Halle, 1887).

NICEPHORUS PATRIARCHA (*c.* 758–829), Byzantine historian and patriarch of Constantinople (806–815). He was like his father Theodorus, a zealous opponent of Iconoclasm. He was secretary to the imperial commissaries at the council of Nicaea in 787, which witnessed the triumph of his opinions; but, feeling dissatisfied with court life, he retired into a convent. In 806 he suddenly succeeded Tarasius as patriarch of Constantinople, but was deposed by the Iconoclast Leo V. in 815 and died in exile 829. After his death he was included among the saints of the Orthodox Church.

Nicephorus is the author of two important works on the iconoclastic questions: the *Apologeticus Maior* (817) and the *Apologeticus Minor;* his historical works are two: the *Chronologia Compendiaria,* a table of dates from Adam to the year of his own death; the *Breviarium Historicum,* a history of the years 602–799—a very poor composition, only valuable owing to the paucity of other materials. Editions: Complete, J. P. Migne, *Patrologia Graeca,* vol. c. Theological: A Mai, *Nova Patrum Bibliotheca* i., ii. and iii. Historical: de Boor Teubner, 1880. *See* also Krumbacher, *Geschichte der byzantinischen Litteratur* (1897) and A. Burckhardt in *Byzantinische Zeitschrift* 5. p. 465.

NICHOLAS, ST., bishop of Myra, in Lycia, a saint honoured by the Greeks and the Latins on the 6th of December. His cult is as celebrated as his history is obscure. He was bishop of Myra in the time of the emperor Diocletian, was persecuted, tortured for the faith, and kept in prison until the more tolerant reign of Constantine, and is said to have been present at the council of Nicaea, though Athanasius, who knew all the notable bishops of the period, never mentions Nicholas, bishop of Myra. The oldest known monument of the cult of St. Nicholas seems to be the church of SS. Priscus and Nicholas built at Constantinople by the emperor Justinian. (*See* Procopius, *De aedif.* i. 6.) In the West, the name of St. Nicholas appears in the 9th century martyrologies, and churches dedicated to him are to be found at the beginning of the 11th century. It is more especially, however, from the time of the removal of his body to Bari, in Apulia, that his cult became popular. The inhabitants of Bari organized an expedition, seized his remains by means of a ruse, and transported them to Bari, where they were received in triumph on May 9, 1087, and where the foundations were laid of a new basilica in his honour. This was the origin of a famous and still popular pilgrimage. There are nearly 400 churches in England dedicated to St. Nicholas. He is the patron saint of Russia; the special protector of children, scholars, merchants and sailors; and is invoked by travellers against robbers. In art St. Nicholas is represented with various attributes, being most commonly depicted with three children standing in a tub by his side.

A legend of his surreptitious bestowal of dowries upon the three daughters of an impoverished citizen, who, unable to procure fit marriages for them, was on the point of giving them up to a life of shame, is said to have originated the old custom of giving presents in secret on the Eve of St. Nicholas, subsequently transferred to Christmas Day. Hence the association of Christmas with "Santa Claus," an American corruption of the Dutch form "San Nicolaas," the custom being brought to America by the early Dutch colonists. (For the ceremony of the boy-bishop elected on St. Nicholas's Day *see* BOY-BISHOP.)

See N. C. Falconius, *Sancti Nicolai acta primigenia* (Naples, 1751); *Bibliotheca hagiographica Graeca* (Brussels, 1895), p. 96; *Bibl. hagiogr. Latina* (Brussels, 1899), n. 6104–6221; F. Nitti di Vito, *Le Pergamene di S. Nicola di Bari* (Bari, 1901); Charles Cahier, *Caractéristiques des saints* (Paris, 1867), p. 354; Frances Arnold-Forster, *Studies in Church Dedications* (London, 1899), i. 495–501 and iii. 21; L'abbé Marin, *Saint Nicholas, évêque de Myre* (1917).

NICHOLAS I., sometimes called The Great, and certainly the most commanding figure in the series of popes between Gregory I. and Gregory VII., succeeded Benedict III. in April 858. According to the annalist Prudentius of Troyes, "he owed his election less to the choice of the clergy than to the presence and favour of the emperor Louis II. and his nobles"—who can hardly have foreseen with what ability and persistency the rights of the Holy See as supreme arbiter of Christendom were to be asserted even against themselves by the man of their choice. Of the previous history of Nicholas nothing is recorded. His pontificate of nine years and a half was marked by at least three memorable contests which have left their mark in history. The first was that in which he supported the claims of the unjustly degraded patriarch of Constantinople, Ignatius (*q.v.*); but two of its incidents, the excommunication of Photius (*q.v.*), the rival of Ignatius, by the pope in 863, and the counter-deposition of Nicholas by Photius in 867, were steps of serious moment towards the permanent separation between the Eastern and the Western Church.

The second great struggle was that with Lothair (*q.v.*) the king of Lorraine (second son of the emperor Lothair I., and brother of the emperor Louis II.), about the divorce of his wife Theutberga or Thietberga. The pope not only quashed the whole proceedings against Theutberga, but excommunicated and deposed bishops Gunther and Thietgaud, who had been audacious enough to bring to Rome in person the "libellus" of the synod which had given judgment. The archbishops appealed to Louis II., then at Benevento, to obtain the withdrawal of their sentence by force; but, although he actually occupied the Leonine city (864), he was unsuccessful in obtaining any concession, and had to withdraw to Ravenna.

The third great ecclesiastical cause which marks this pontificate was that in which the right of bishops to appeal to Rome against their metropolitans was maintained in the case of Rothad of Soissons, deposed by Hincmar of Reims. In the course of the controversy with the great and powerful Neustrian archbishop papal recognition was first given (in 865) to the False Decretals, which had probably been brought by Rothad to Rome in the preceding year. (*See* DECRETALS.) Nicholas was the pope to whom Boris, the newly converted king of Bulgaria, addressed himself for practical advice in some of the difficult moral and social problems arising out of the transition from heathenism to Christianity. The pope's letter in reply to the hundred and six questions and petitions of the barbarian king is perhaps the most interesting literary relic of Nicholas I. now extant. He died on Nov. 13, 867, and was succeeded by Adrian II.

The *epistolae* of Nicholas I. are printed in Migne, *Patrologia Lat.* vol. 119, p. 769 *seq. See* F. Gregorovius, *Rome in the Middle Ages,* vol. iii. (Eng. trans., London, 1900–1902); H. Lämmer, *Nikolaus I. und die byzantinische Staatskirche seiner Zeit* (Berlin, 1857); J. Roy, *Saint-Nicolas I.* (Paris, 1900); J. Richterich, *Papst Nikolaus I.* (Bern, 1903); A. Greinacher, *Die Anschauungen des Papstes Nikolaus I. über das Verhältnis von Staat und Kirche* (1909).

NICHOLAS II., pope from December 1058 to July 1061, was a Burgundian named Gerard, who at the time of his election was bishop of Florence. He was set up by Hildebrand, with the support of the empress-regent Agnes and of the powerful Duke Godfrey of Lorraine, against Benedict X., the nominee of the Roman nobles, and was crowned at Rome, after the expulsion of Benedict, on Jan. 24, 1059. He continued the policy of ecclesiastical reform associated with the name of Hildebrand (afterwards Gregory VII.). He entered into relation with the Normans, now firmly established in southern Italy, and the new alliance was cemented at Melfi, where Nicholas II., invested (1059) Robert Guiscard with the duchies of Apulia, Calabria and Sicily, and Richard of Aversa with the principality of Capua, in return for fealty and the promise of assistance. The first fruits of this arrangement, based on no firmer foundation than the forged "Donation of Constantine" (*q.v.*), but destined to make the papacy more independent in both the Eastern and Western Empires, was the reduction in the autumn, with Norman aid, of Galera, where the anti-pope had taken refuge, and the end of the subordination of the papacy to the Roman nobles.

Meanwhile Nicholas had sent legates to Milan to adjust the difference between the Patarenes and the archbishop and clergy. Archbishop Wido, in face of the ruinous conflict in the Church of Milan, was forced to submit to the terms proposed by the legates, involving the subordination of Milan to Rome; the new relation was advertised by the unwilling attendance of Wido and the other Milanese bishops at the council summoned to the Lateran palace in April 1059. This council continued the Hildebrandine reforms by sharpening the discipline of the clergy, and regulated future elections to the Holy See. (*See* LATERAN COUNCILS, and CONCLAVE.) The emperor's traditional rights in the matter of papal elections were completely ignored. Stephen, cardinal priest of S. Chrysogonus, was sent to the German court to attempt to allay the consequent ill-feeling, but was not received. Pope Nicholas, moreover, had offended the German bishops by what they regarded as arbitrary interference with their rights; they retaliated, in a synod held early in 1061, by declaring the new electoral law annulled, and the pope himself deposed. But party strife in Germany enabled the pope to ignore these proceedings. Nicholas II. died at Florence in July 1061.

His *Diplomata, epistolae, decreta* are in Migne, *Patrolog.* Lat. 143, pp. 1301–1366. *See* the article "Nikolaus II." by C. Mirbt in Herzog-

Hauck, *Realencyklopädie* (3rd ed., Leipzig, 1904), with bibliography. Other lists of authorities are in Potthast, *Biblioth. Hist. Med. Aev.* (2nd ed., Berlin, 1896), p. 854; and Ulysse Chevalier, *Répertoire des sources hist. biobibliogr.* (Paris, 1905), vol. 3347, *s.v.* "Nicolas II."

NICHOLAS III. (Giovanni Gaetano Orsini), pope from Nov. 25, 1277 to the 22nd of August 1280, was a Roman nobleman who had served under eight popes. He succeeded John XXI., largely through family influence, after a six-months' vacancy in the Holy See. A born politician, he concluded a concordat with Rudolph of Habsburg in May 1278, by which the Romagna and the exarchate of Ravenna were guaranteed to the pope; and in July he issued an epoch-making constitution for the government of Rome, which forbade foreigners taking civil office. Nicholas issued the bull *Exiit* on Aug. 14, 1279, to settle the strife within the Franciscan order between the parties of strict and loose observance. He repaired the Lateran and the Vatican at enormous cost. Nicholas brought just reproach on himself by his nepotism. *See* also the *Catholic Encyclopaedia* (*s.v.*).

See "Les Registres de Nicolas III.," published by Jules Gay in *Bibliothèque des écoles françaises d'Athènes et de Rome* (Paris, 1898–1916); A. Potthast, *Regesta pontif. Roman.* vol. 2 (Berlin, 1875); A. Demski, "Papst Nikolaus III.," in *Kirchengeschichtliche Studien* (Münster, 1903); F. Gregorovius, *Rome in the Middle Ages*, vol. 5, trans. by Mrs. G. W. Hamilton (London, 1900–1902); Fr. Wertsch. *Die Beziehungen Rudolfs von Habsburg zur röm. Kurie bis zum Tode Nikolaus III.* (Bochum, 1880); G. Palmieri, *Introiti ed esiti di Papa Niccolò III.* (Rome, 1889).

NICHOLAS IV. (Girolamo Masci), pope from Feb. 22, 1288, to April 4, 1292, a native of Ascoli and a Franciscan monk, succeeded St. Bonaventura as general of his order in 1274, was made cardinal-priest of Sta. Prassede and Latin patriarch of Constantinople by Nicholas III., cardinal-bishop of Palestrina by Martin IV., and succeeded Honorius IV. after a ten-months' vacancy in the papacy. He was a pious, peace-loving monk with no ambition save for the church, the crusades and the extirpation of heresy. He steered a middle course between the factions at Rome, and sought a settlement of the Sicilian question. In May 1289 he crowned Charles II. king of Naples and Sicily after the latter had expressly recognized papal suzerainty, and in February 1291 concluded a treaty with Alphonso III. of Aragon and Philip IV. of France looking toward the expulsion of James of Aragon from Sicily. The loss of Ptolemais in 1291 stirred the pope to renewed enthusiasm for a crusade. He sent the celebrated Franciscan missionary, John of Monte Corvino (*see* MONTE CORVINO, GIOVANNI DI), with some companions to labour among the Tatars and Chinese. He issued an important constitution on July 18, 1289, which granted to the cardinals one-half of all income accruing to the Roman see and a share in the financial management, and thereby paved the way for that independence of the college of cardinals which, in the following century, was to be of detriment to the papacy. Nicholas was succeeded by Celestine V.

See "Les Registres de Nicolas IV.," ed. by Ernest Langlois in *Bibliothèque des écoles françaises d'Athènes et de Rome* (Paris, 1886–1893); A. Potthast, *Regesta pontif. Roman.* vol. 2 (Berlin, 1875); F. Gregorovius, *Rome in the Middle Ages*, vol. 5, trans. by Mrs. G. W. Hamilton (London, 1900–1902); O. Schiff, "Studien zur Geschichte Papst Nikolaus IV." in *Historische Studien* (1897); W. Norden, *Das Papsttum u. Byzanz* (Berlin, 1903); R. Röhricht, *Geschichte des Königreichs Jerusalem* (Innsbruck, 1898); J. B. Sägmüller, *Die Thätigkeit u. Stellung der Kardinäle bis Papst Bonifaz VIII.* (Freiburg-i.-B., 1896); J. P. Kirsch, "Die Finanzverwaltung des Kardinalkollegiums im 13. u. 14. Jahrhunderte" in *Kirchengeschichtliche Studien* (1895). *See* also the *Catholic Encyclopaedia* (*s.v.*).

NICHOLAS V. (Tomaso Parentucelli or Tomaso da Sarzana), pope from March 6, 1447, to March 24, 1455, was born at Sarzana, where his father was a physician, in 1398. In 1444 he was made bishop of Bologna by Pope Eugenius IV., who sent him to Frankfort to negotiate an understanding between the Holy See and the empire with regard to the reforming decrees of the council of Basel. On his return to Rome, he was made cardinal priest of Sta. Susanna (December 1446). He was elected pope in succession to Eugenius IV. on March 6, 1447.

With the German king, Frederick III., he made the Concordat of Vienna, or Aschaffenburg (Feb. 17, 1448), by which the decrees of the council of Basel against papal annates and reservations were abrogated so far as Germany was concerned; and in the following year he secured a still greater triumph when the resignation of the anti-pope Felix V. (April 7), and his own recognition by the rump of the council of Basel, assembled at Lausanne, put an end to the papal schism. The next year, 1450, Nicholas held a jubilee at Rome. In March 1452 he crowned Frederick III. as emperor in St. Peter's, the last occasion of the coronation of an emperor at Rome. Under the generous patronage of Nicholas humanism made rapid strides. He employed hundreds of copyists and scholars, giving as much as ten thousand *gulden* for a metrical translation of Homer, and founded a library of nine thousand volumes. He restored the walls and numerous churches of Rome and began the rebuilding of the Vatican and St. Peter's.

In 1452 a formidable conspiracy for the overthrow of the papal government, under the leadership of Stefano Porcaro, was discovered and crushed. This revelation of disaffection, together with the fall of Constantinople, darkened the last years of Nicholas; "As Thomas of Sarzana," he said, "I had more happiness in a day than now in a whole year." He died on March 24, 1455.

See Herzog-Hauck, *Realencyklopädie für protestantische Theologie und Kirche*, vol. xiv. (1904), with full references; *Cambridge Modern History*, i. 76–78; and M. Creighton, *History of the Papacy* (London, 1882), vol. ii.

NICHOLAS V. (Pietro Rainalducci), antipope in Italy from 1328 to 1330 during the pontificate of John XXII. at Avignon, a native of Corbara in the Abruzzi, joined the Franciscan order in 1310. He was elected through the influence of the excommunicated emperor, Louis the Bavarian, by an assembly of priests and laymen, and consecrated at St. Peter's on May 12, 1328, by the bishop of Venice. After spending four months in Rome, he withdrew with Louis to Viterbo and thence to Pisa, where he was guarded by the imperial vicar. He was excommunicated by John XXII. in April 1329, and sought refuge with Count Boniface of Donoratico near Piombino. Having obtained assurance of pardon, he presented a confession of his sins first to the archbishop of Pisa, and then (Aug. 25, 1330) to the pope at Avignon. He remained in honourable imprisonment in the papal palace until his death in October 1333.

See F. Gregorovius, *Rome in the Middle Ages*, vol. 6, trans. by Mrs. G. W. Hamilton (London, 1900–1902); Baluzius, *Vitae paparum Avenionensium*, vol. 1 (Paris, 1693); J. B. Christophe, *Histoire de la papauté pendant le XIVième siècle*, vol. 1 (Paris, 1853); E. Marcour, *Anteil der Minoriten am Kampfe zwischen König Ludwig IV. von Bayern und Papst Johann XXII.* (Emmerich, 1874); Eubel, "Der Gegenpapst Nicolaus V. u. seine Hierarchie," in *Hist. Jahrbuch*, vol. 12 (1891).

NICHOLAS I. [NIKOLAI PAVLOVICH], emperor of Russia (1796–1855), eighth child of the emperor Paul I. and his wife Maria Feodorovna, was born at Tsarskoe-Selo on June 25 (July 6, N.S.), 1796. He was only five years old when his father's murder brought his brother Alexander I. to the throne (1801). His education was supervised by M. von Lambsdorff, director of the 1st cadet corps and ex-governor of Courland. But Nicholas and his brother Constantine had little taste for learning. They were interested mainly in military matters.

The grand-duke Nicholas joined the Russian headquarters in France in 1814, but not to take part in any fighting. In 1815 he was with the Allies in Paris, and in the following year set out on the *grand tour*, visiting Moscow and the western provinces of Russia, Berlin (where he was betrothed to Princess Charlotte Louise, daughter of Frederick William III.), and England. His marriage marked the beginning of intimate relations between the courts of Berlin and St. Petersburg. On the 17/29th of April 1818 their first child, the future emperor Alexander II., was born. In the autumn Nicholas was placed in command of the 2nd brigade of the 1st division of the Guard.

Alexander I. died at Taganrog on Dec. 1, 1825. Constantine was at Warsaw; Nicholas was too conscious of his unpopularity in the army—the fruit of his drastic discipline—to dare to assume the crown without a public abdication on the part of the legitimate heir. The result (*see* CONSTANTINE PAVLOVICH) was a three weeks' interregnum, of which the discontented spirits in the army took advantage to bring to a head a plot that had long been

hatching in favour of constitutional reform. When on Dec. 14 the troops who had already taken the oath to Constantine were ordered to take another to Nicholas, it was easy to persuade them that this was a treasonable plot against the true emperor. The Moscow regiment refused to take the oath, and part of it marched, shouting for Constantine and "Constitution," to the square before the Senate House, where they were joined by a company of the Guard and the sailors from the warships. In this crisis Nicholas showed high personal courage, if little decision and initiative. For hours he stood, or sat on horseback, amid the surging crowd, facing the mutinous soldiers—who had loaded their muskets and formed square—while effort after effort was made to bring them to reason, sometimes at the cost of life—as in the case of Count Miloradovich, military governor of St. Petersburg, who was mortally wounded by a pistol shot while arguing with the mutineers. When at last the emperor consented to use force, a few rounds of grapeshot sufficed to quell the mutiny. The chief conspirators—Prince Shchepin-Rostovski, Suthoff, Ryleyev, Prince Sergius Trubetskoi, Prince Obolenski and others—were arrested the same night and interrogated by the emperor in person. A special commission, consisting entirely of officers, was then set up; and before this, for five months, the prisoners were subjected to a rigorous inquisition. The prisoners were kept in solitary confinement in the casemates of the inner fortress of St. Peter and St. Paul. They were brought blindfolded before the commission, and then suddenly confronted with their interrogators. Many went mad under the ordeal, one died, and one starved himself to death (Schiemann, ii. 73). It was soon clear that the Dekabrist (December) rising was but one manifestation of a vast conspiracy permeating the whole army. A military rising on a large scale in the south was only averted by the news of the failure of the mutiny at St. Petersburg; and at Moscow there were many arrests, including that of Colonel Paul Pestel, the chief of the revolutionary southern league. The 121 prisoners were finally brought to trial before a supreme criminal court, established by imperial *ukaz* (June 1–12, 1826). Some were condemned to death, others to solitary confinement in fortresses, others to the Siberian mines and colonies. Of the latter many were accompanied by their wives, though the Russian law allows divorce in the case of such sentences; the emperor unwillingly allowed the devoted women to go, but decreed that any children born to them in Siberia would be illegitimate.

In spite of his reverence for his brother's memory, Nicholas made a clean sweep of "the angel's" Bible Society; as for Alexander's projects of reform, the pitiful legacy of a life of unfulfilled purposes, these were reported upon by committees, and shelved. Nicholas too saw the need for reform; the Dekabrist conspiracy had burnt that into his soul; but he had his own views as to the reform needed. The state was corrupt, disorganized; what was wanted was not more liberty but more discipline. So he put civil servants, professors and students into uniform, and for little offences had them marched to the guard-house; thought was disciplined by the censorship, the army by an unceasing round of parades and inspections. The one great gift of Nicholas I. to Russia, a gift which he really believed would be welcome because it would bring every subject into immediate contact with the throne, was—the secret police, the dreaded Third Section of the Private Chancery of the emperor.

The crowning fault of Nicholas was, however, that he would not delegate his authority; whom could he trust but himself? In this he resembled his contemporary the emperor Francis I. But Francis would "sleep upon" a difficult problem; Nicholas never slept. His constitution was of iron, his capacity for work prodigious; reviews and parades, receptions of deputations, visits to public institutions, then eight or nine hours in his cabinet reading and deciding on reports and despatches—such was his ordinary day's work. Under the "Iron Tsar" the outward semblance of authority was perfectly maintained; but behind this imposing façade the whole structure of the Russian administrative system continued to rot and crumble.

Revelations of the rottenness of the under-structure had, indeed, begun before the outbreak of the war with Turkey in 1828. The newly organized squadron which in 1827 set out on the cruise which ended at Navarino only reached Plymouth with difficulty, and there had to be completely refitted. The disastrous Balkan campaign of 1828 was an even more astounding revelation of corruption, disorganization and folly in high places. The weary and starving soldiers were forced to turn out amid the marshes of the Dobrudscha before the emperor as spick and span as on the parade grounds of St. Petersburg; but he could do nothing to set order in the confusion of the commissariat, which caused the troops to die like flies of dysentery and scurvy; or to remedy the scandals of the hospitals. His presence hampered the initiative of Prince Wittgenstein, the nominal commander-in-chief; for Nicholas was incapable of leaving him a free hand.

These then were the leading principles which underlay Nicholas's domestic and foreign policy from first to last: to discipline Russia, and by means of a disciplined Russia to discipline the world. The mission of Russia in the West was, in accordance with the principles of the Holy Alliance as Nicholas interpreted them, to uphold the cause of legitimacy and autocracy against the Revolution; her mission in the East was, with or without the co-operation of "Europe," to advance the cause of Orthodox Christianity, of which she was the natural protector, at the expense of the decaying Ottoman empire. The sympathy of Europe with the insurgent Greeks gave the tsar his opportunity. The duke of Wellington was sent to St. Petersburg in 1826 to congratulate the new tsar on his accession and arrange a concert in the Eastern Question. The upshot proved the diplomatic value of Nicholas's apparent sincerity of purpose and charm of manner; the "Iron Duke" was to the "Iron Tsar" as soft iron to steel; Great Britain, without efficient guarantees for the future, stood committed to the policy which ended in the destruction of the Ottoman sea-power at Navarino and the march of the Russians on Constantinople. By the treaty of Adrianople in 1829 Turkey seemed to become little better than a vassal state of the tsar, a relation intensified, after the first revolt of Mehemet Ali, by the treaty of Unkiar-Skelessi in 1833. In the West, Nicholas himself proposed an armed intervention of the Alliance "to restore order" in Belgium and France; and when his allies held back even proposed to intervene alone, a project rendered impossible by the outbreak of the great insurrection in Poland, which tied the hands of all three powers.

Then, the insurrection in Poland once crushed, and Poland itself scarce surviving even as a geographical expression, he drew the three eastern autocratic powers together in a new "Holy Alliance" by the secret convention of Berlin (Oct. 3, 1833) reaffirming the right and duty of intervention at the request of a legitimate sovereign. The cordial understanding with Austria, cemented at Münchengrätz and Berlin, was renewed, after the accession of the emperor Ferdinand, at Prague and Töplitz (1835); on the latter occasion it was decided "without difficulty" to suppress the republic of Cracow, as a centre of revolutionary agitation. He allowed himself to be persuaded by Metternich to support the cause of Don Carlos in Spain, and so early as May 1837, in view of the agitation in Hungary, he announced that "in every case" Austria might count on Russia.

These cordial ties were loosened, however, by the fresh crisis in the Eastern Question after 1838. Metternich was anxious to summon a European conference to Vienna, with a view to placing Turkey under a collective guarantee. Nicholas refused to be a party to it. Moreover, as Austria showed an inclination to approach the maritime powers, he determined to come to an agreement with Great Britain, in order to settle the Eastern Question according to his own views; this is the explanation of those concessions in the Eastern Question which ended in the Quadruple Alliance of 1840 and the humiliation of Louis Philippe's government. The new Anglo-Russian *entente* led in 1844 to a visit of the tsar to the English court. (*See* EASTERN QUESTION.)

When the storm of revolution burst over Europe in 1848, Nicholas remained entrenched behind the barriers of his own disciplined empire. But in 1849 he intervened in Hungary, at the entreaty of Francis Joseph, crushed the insurgent Hungarians and handed back their country as a free gift to the Habsburg king. Scarcely less valuable to Austria was the tsar's intervention in the quarrel between Austria and Prussia arising out of the Hesse inci-

dent and the general question of the hegemony of Germany. In October 1850 he had a meeting with Francis Joseph at Warsaw, at which Count Brandenburg and Prince Schwarzenberg were present. Prussia, he declared, must in the German question return to the basis of the treaties of 1815 and renew her *entente* with Austria; this was the only way of preserving the old friendship of Prussia and Russia. In face of the threat conveyed in this, the Prussian government decided to maintain peace (Nov. 2), Radowitz resigning as a protest. Thus Nicholas, who refused to believe in the perfidy ascribed by Frederick William to Austria, was the immediate cause of Prussia's humiliation at Olmütz.

Nicholas was soon to have personal experience of the perfidy of Austria in the troubles that led up to the Crimean War. Gratitude, in the tsar's opinon, should have made her neutral if not friendly. When the dispute arose with Napoleon III. over the guardianship of the Holy Places Nicholas could not believe that Christian powers would resent his claim to protect the Christian subjects of the sultan; he believed he could count on the friendship of Austria and Prussia; as for Great Britain, he would try to come to a frank understanding with her. The disillusionment that followed was profound. In October 1853 Nicholas met his brother monarchs of the triple alliance at Warsaw for the last time. In December, at the conference of Vienna, Austria had already passed over to the enemy. Prussia was wavering, neutral indeed, but joining the other powers in a guarantee of the integrity of Turkey (April 9, 1854), urging the tsar to accept the decisions of the Vienna conference, and on his refusal signing a defensive alliance with Austria (April 20, 1854), which included among the *casus belli* the incorporation in Russia of the banks of the Danube and a Russian march on Constantinople. Thus Nicholas, the pillar of the European alliance, found himself isolated and at war, or potentially at war, with all Europe. The invasion of the Crimea followed, and with it a fresh revelation of the corruption and demoralization of the Russian system. At the outset Nicholas had grimly remarked that "Generals January and February" would prove his best allies. These acted, however, impartially; and if thousands of British and French soldiers perished of cold and disease in the trenches before Sevastopol, the tracks leading from the centre of Russia into the Crimea were marked by the bones of Russian dead. The revelation of his failure broke the spirit of the Iron Tsar, and on March 2, 1855, he threw away the life which a little ordinary care would have saved.

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NICHOLAS II. (1868–1918), tsar of Russia, eldest son of Alexander III., was born at St. Petersburg (Leningrad), on May 18, 1868. An English tutor, Mr. Charles Heath, taught him excellent English, and inspired a love of sports and healthy exercise, while a Russian general, Danilovich, supervised his military training, but there was no attempt to provide him with the comprehensive knowledge required from one whom fate had destined to rule an immense empire. The only occasion which was offered to the young tsarevich to acquaint himself with the problems of the world was his journey to the Far East, so abruptly cut short in Kyoto by the sabre cut of a Japanese fanatic.

He wedded Princess Alix of Hesse at the deathbed of his father; at the festival of his coronation more than 3,000 people were crushed to death through the negligence of the officials who had to arrange a distribution of bounties; and during the coronation itself the imperial chain on his breast fell to the ground. Such impressions contributed strongly to inspire him with a mystic resignation, especially unsuitable for a monarch who had to lead the nation through times of great crisis at home and in foreign affairs. Nicholas II. followed in the footsteps of his father, seeking to preserve peace in foreign relations, and continuing in home affairs, though in a much milder form, the policy of centralization and Russification which had characterized the previous reign. His pacific tendencies were shown by his systematic opposition to all bellicose excitement, by his maintaining M. de Giers in the post of minister of foreign affairs, by his offering the post, on the death of that statesman, to M. de Staal, by his restraining France from dangerous adventures, and by initiating the Peace Conference at The Hague. To these ought perhaps to be added the transformation of the Franco-Russian *entente cordiale* into a formal alliance, since the alliance in question might be regarded as favourable to the preservation of the *status quo* in Europe. In the internal administration during the first years of his reign he introduced by his personal influence, and without any great change in the laws, a more humane spirit towards those of his subjects who did not belong by language and tradition to the dominant nationality, and who were not members of the Eastern Orthodox Church; but he disappointed the men of liberal views by giving it to be clearly understood soon after his accession that he had no intention of circumscribing and weakening the autocratic power by constitutional guarantees or parliamentary institutions. In spite, however, of his desire for peace he let his country drift into the disastrous war with Japan; and notwithstanding his sincere attachment to the principles of bureaucratic autocracy, it was he who granted the constitutional reforms which altered the whole political outlook in Russia. (*See* RUSSIA.)

Nicholas II.'s political outlook was dominated by a kind of theocratic or hieratic spirit; he was looking back for inspirations to the ideas and customs of the Muscovite period; he was induced to impersonate the figure of Alexis Mikhailovich, the father of the western reformer Peter the Great; in 1913 the tercentenary of Michail Feodorovich's accession to the throne after the "Great Troubles" was celebrated with much splendour and emphasis. Pilgrimages were performed with great devotion and circumstance.

The courtiers and bureaucrats in the immediate surroundings of the tsar, men like Sipiaguin, Nicolas Maklakov and Sabler, took advantage of these prepossessions in order to keep up a constant hostility against progressive reformers and western adaptations. But the most dangerous representative of mystic reaction was the tsar's consort, the Empress Alexandra Feodorovna. Of German descent on her father's side and of English descent on the side of her mother (Princess Alice, the daughter of Queen Victoria), she had received her education in England, but, on coming to Russia, she surrendered completely to the most extreme form of theocratic exaltation.

While her sister, the widow of the Grand Duke Sergius, killed by a terrorist, had devoted herself to a simple life at the head of a community of hospital nurses, Alexandra Feodorovna, highly strung and hysterical, sought providential guidance in the midst of unbalanced women and false prophets like the French medium Philippe and the famous Rasputin. The latter obtained a hold on her through the hypnotising influence he exercised over her son, the tsarevich Alexis, a boy affected by the rare disease of hereditary haemophilia. But the crafty peasant had contrived to obtain gradually a psychical domination over the empress and her friends which made it possible for him to distribute political favours and to have his say in the most important affairs of state. The empress considered him as the God-sent representative of the Russian nation, of that mass of peasants which, as she was convinced, was the firm mainstay of autocracy in Russia. And in the later years of Nicholas II.'s reign, the years of great trial and danger, Alexandra Feodorovna stepped in more and more often to direct the tsar's choice of his ministers and to prevent him from making concessions to the spirit of the time. For the circumstances which brought Russia into the World War *see* RUSSIA: *History*.

The suspicion that Alexandra Feodorovna was secretly favour-

ing the cause of Germany and revealing military secrets to the Kaiser—a suspicion often expressed abroad and popularly accepted in Russia—is, according to most competent witnesses, devoid of any basis in fact. The empress was intensely patriotic in her own way, opposed to the aggressive policy of the Hohenzollerns, and never advocated a treacherous compromise with the Central Powers. A former lady-in-waiting, Princess Vassiltchikov, who towards the close of 1916 brought the project of such a compromise from Germany, was promptly ordered out of St. Petersburg (Leningrad). Nevertheless, Alexandra Feodorovna proved to be the evil genius of the Russian dynasty, by her blind and obstinate support of reactionary tendencies and of worthless adventurers, at a time when a wise and firm policy of reform was more needed than ever. All the better representatives of the dynasty—the Dowager Empress, the Grand Duke Nicholas Mikhailovich, the Grand Duchess Victoria—warned her of the imminent danger of that régime of fleeting ministerial shadows which set in after the catastrophe of the War Office in 1915.

The emperor remained passive as commander-in-chief at headquarters while the Empress Alexandra spurned all advice with contempt and continued to pull the strings by dismissing men like Sazonov and Palivanov, and appointing timeservers like Sturmer, Protopopov or Galitzin. The assassination of Rasputin did not frighten but enraged her; she erected a kind of shrine over the body of the prophet and sent the Grand Duke Dmitry Pavlovich, who had taken part in the murder, into exile. Her power was broken only by the revolution.

The thread of the Romanov dynasty was cut without much resistance. When in March 1917 the emperor received at headquarters a telegram from the president of the Duma informing him of the events of St. Petersburg and demanding his abdication, and Gutchkov and Shulgin arrived with the act of abdication itself, he submitted with fatalistic composure. He refused to give up his crown to his son with Grand Duke Michael as regent, because he did not wish to trust the boy to the danger of a political storm; and his abdication was made in favour of the Grand Duke Michael, who in his turn refused to accept the crown unless it was tendered to him by the will of the people. The last chance of a régime of constitutional monarchy was cut short. Proposals were made on behalf of the British Government to allow Nicholas II. and his family to take up their abode in England; but the Provisional Government in St. Petersburg did not accede to that plan. Kerensky and Milyukov declared that the imperial family were in safety in Russia. Later on the emperor submitted meekly to be transferred from Pskov to Tsarskoe Selo and thence to Tobolsk, where he was interned with his family—his wife, his son and his four daughters—for months.

The end came with the rumour of a Czechoslovak advance on the Ural in 1918. The Soviet Commissaries in Moscow urged the greatest vigilance on the Ekaterinburg commissar, Yourkovsky, and the commander of the guard, Medvediev, without indicating any means for removing the prisoners from the threatened zone. The communists of Ekaterinburg held a secret meeting in which they decided to put the tsar and his family to death, and sent an order to Yourkovsky. The latter demanded that it should be duly signed, and 16 signatures were affixed to it. On the night of July 16 Yourkovsky roused the prisoners and conducted them into a cellar of the house. Medvediev, with the Lettish guards, entered the room while some Russian soldiers were looking in. Yourkovsky placed the doomed persons at one end of the room and read the sentence hurriedly by torchlight. The tsar stepped forward and said something indistinctly, when Yourkovsky drew his revolver and shot him in the head. A general fusillade followed. Later the corpses were removed and destroyed by fire. Although the belief is general that all members of the family perished, a claim arose in 1928 by Mrs. Anastasia Tschaikovsky that she was the Grand Duchess Anastasia, the tsar's youngest daughter, who had been rescued from the massacre by two soviet soldiers. (*See* RUSSIA.)

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NICHOLAS I. (1841–1921), king of Montenegro, was born at Njeguš, the ancient home of the Njeguš-Petrović dynasty, on Sept. 1, 1841. His father, Mirko Petrović, was brother of the Vladika Danilo II. who had declined episcopal office, married and declared the succession hereditary in the direct male line. As, however, Danilo II. left no male issue, and Mirko declined the succession, Nicholas became heir to the throne of Montenegro. He was educated in Trieste and at the Academy of Louis le Grand in Paris, returning to Montenegro on the assassination of his uncle (Aug. 13, 1860). He took part in the campaign against Turkey of 1862, which, after Austria's intervention, was followed by a prolonged peace. In 1868 he travelled to St. Petersburg (Leningrad) to meet the tsar Alexander II., who received him with favour, and afterwards regularly supplied him with subventions of arms and money, referring to him on a memorable occasion as his "only friend." During the Near Eastern crisis of 1876 (*see* EASTERN QUESTION), Nicholas declared war on the Porte, and winning brilliant successes in this and the following wars at Vučidd, Podgorica and Nikčić, captured Antivari and Dulcigno. The Congress of Berlin (*q.v.*) brought Montenegro formal recognition as a sovereign State and doubled her area, besides giving her an outlet on the sea at Antivari. Nicholas now entered on a long period of peace largely filled with intrigues with and against his son-in-law, Peter, later King Peter I. of Serbia (*q.v.*) regarding a possible later Yugoslav state to comprise both Serbia and Montenegro. On Dec. 19, 1900, Nicholas assumed the title of Royal Highness.

In 1905 he was forced by public opinion, which was revolting against his despotic methods, to grant a constitution. He was at once involved in quarrels with his political opponents, culminating in the scandalous but obscure "Cetinje bomb plot" of 1905. On Aug. 28, 1910, encouraged by Austria, who helped to estrange him further from Serbia, Nicholas assumed the title of king. In the Balkan Wars (*q.v.*) he was the first to declare war on Turkey, but although these wars gave Montenegro an accession of territory, the dynasty lost prestige, its unpopularity and with it the movement for the union of Serbia with Montenegro, increased. In the World War Montenegro threw in her lot with Serbia; Nicholas, however, maintained touch with Austria, from whom he begged a separate peace (Jan. 13, 1916). On Jan. 19, Nicholas fled to Italy and France. The breach widened between him and his people, and the "Great National Assembly" on Nov. 26, 1918, proclaimed his deposition and that of his dynasty. The old ex-king passed the remainder of his days in Italy. He died at Antibes on March 1, 1921.

A rude but often benevolent despot of the fighting type, Nicholas was also a poet of talent. His works include *Balkanska Tsaritsa* and *Knyaz Arvaniti* (dramas); *Haïdana, Potini Abenserage* and *Pesnik i Vila* (poems), *Skuplijene Pesme* and *Nova Kola* (songs). In Nov. 1860, Nicholas married Milena (1847–1923) daughter of the *voivode* Petar Vukotić. On the death of Nicholas, his eldest son Danilo was proclaimed by the small monarchist party king of Montenegro (Mar. 1, 1921), but abdicated on Mar. 7, 1921, in favour of his nephew Michael, eldest son of Prince Mirko (b. Sept. 1, 1908).

NICHOLAS (1856–1929), Russian Grand Duke and soldier. Nikolai Nikolaievich was born on Nov. 6, 1856 the grandson of the emperor Nicholas I. and first cousin of the emperor Alexander III. Educated at the school of military engineers, he received his commission in 1872, and in the following year, at the early age of 16, entered the military academy. In the war of 1877–78, as a general staff officer for special service, he joined the staff of his father, the very popular Grand Duke Nikolai Nikolaievich (Senr.), who had been appointed commander-in-chief of the Russian forces. He distinguished himself at the crossing of the Danube at Zimnicea on April 15, 1877, and in the attack on the Shipka.

After the war the Grand Duke joined the Guard Hussar Regiment, in which the emperor Nicholas afterwards served, and passed through every stage as officer till appointed commander in 1884—a position he occupied for 6½ years. He then commanded in succession a brigade and a division, and in 1895 was appointed

inspector-general of cavalry. He held this post for ten years, a period which is regarded as a bright epoch in the history of the Russian cavalry, for he carried through fundamental reforms in training and in the organization of the cavalry schools, of the cavalry reserves and of the remount service.

In 1905 Nicholas was appointed commander-in-chief of the St. Petersburg military district, a post he held till the outbreak of the World War in Aug. 1914. Here, as elsewhere, he gave proof of his zeal for efficiency. Setting himself the task of instilling the lessons of the Japanese war, he encouraged musketry and work in extended order, but at the same time allowed no slackness in ceremonial. To help him in his work he called from the Far East men like Generals Ivanov, Lesh and Lechitski, who were of comparatively humble origin but had made their reputation in the field. The appointment of such men to high command in the Imperial Guard was characterized in his diary at the time by another grand duke as "revolutionary," but the men selected justified their choice in the World War.

In the same year (1905) as he was appointed commander-in-chief of the St. Petersburg military district, Nikolai Nikolaievich became the first president of the newly created council of national defence, and he held this position till 1908, when the council was abolished. During this time the emperor seems to have hesitated between the final adoption of a military system analogous to that of Germany, under which the chief of the general staff, as well as the minister of war, should have the right of access and of direct report to the sovereign, and of the system in vogue in countries with a constitutional Government, under which that right was confined to the minister of war. On the council the Grand Duke worked in close co-operation with General Palitsin, who, in 1908, on the emperor's decision in favour of the latter system, gave way to General Sukhomlinov as chief of the general staff, the latter, in the following year, replacing General Rediger as minister of war.

From 1908 to 1914 Nicholas took no part in the strategical preparation for the war, the work being delegated by the emperor to General Sukhomlinov and his nominees on the general staff. At the outbreak of war the emperor first intended to take command himself, and actually appointed the grand duke Commander-in-chief of the VI. (Reserve) Army at St. Petersburg (Leningrad). It was only on the evening of Aug. 1, the day of Germany's declaration of war, that he yielded to the entreaties of his ministers and decided to hand over the supreme command to the grand duke.

Services During the War.—The commander-in-chief was responsible for carrying out a plan which he had no hand in drawing up, a plan which was dependent on promises previously made, without his cognisance, to the French general staff. He had to work in accordance with the "Regulations for the Direction of the Army in the Field," a new edition of which had been issued on the very eve of the war, handing over much power to the two group commanders.

The plan of the Russian general staff consisted of the invasion of East Prussia by a right group (I. and II. Armies), while a left group (IV., V., III. and VIII. Armies) operated against the Austrians in Galicia, and a centre group (IX. and X. Armies) assembled at Warsaw to advance on Posen. It was owing to the decision of the grand duke that this centre group was broken up, the X. Army being sent north to fill the gap left by the failure in East Prussia, and the IX. Army sent south to overwhelm the Austrians in southern Poland.

When the Germans came to the rescue of their discomfited ally by advancing in Oct. 1914 to the outskirts of Warsaw, the transfer of the Russian armies from left to right in rear of the Vistula, and the concentration of superior forces on the enemy's left or northern flank which compelled his retreat, were masterly movements. If the next German advance, culminating in the operation of Lódz owing to mistakes by Russian army commanders, definitely removed all possibility of an invasion of Posen, the Russians held on through the winter of 1914–15 to the line of the Narev-Vistula-San-Carpathians, and were only compelled by lack of munitions in the spring and summer of 1915 to retreat to a line that they held substantially through 1916–17.

There was no demand from the fighting men at the front for the change at G.H.Q. which occurred on Aug. 21, 1915, when the emperor announced that he would assume the supreme command. It is said that Rasputin had prophesied that the Russian armies would continue to be defeated till the emperor placed himself at their head. Certainly the impostor had no reason to love the Grand Duke Nicholas. A story repeated among the soldiers relates that he had applied to the commander-in-chief for permission to come to the front "to bless the troops," and the latter had telegraphed in reply two Russian words which being translated run—"Come, I shall hang you."

The grand duke was appointed viceroy and commander-in-chief in the Caucasus. Up to that time the brunt of the fighting against Turkey had been borne by the British in Gallipoli, the Sinai Peninsula and Mesopotamia. The advent of the new commander put new life into the Russian forces. He pushed forward an expeditionary force under General Baratov through Enzeli and Hamadan to screen Persia from further German penetration, and to establish touch with the British troops in Mesopotamia. He collected guns and stores, and raised and trained efficient troops, and, in spite of immense difficulties in supply, ably assisted by Generals Yudenich and Prjvalski, occupied in three successful offensives all Armenia, including the fortress of Erzerum, the port of Trebizond and the town of Erzinjan.

The revolution of March 12, 1917, found the grand duke still in the Caucasus. The emperor's last official act was to nominate him to be once more supreme commander-in-chief. His journey from the Caucasian headquarters at Tiflis to the headquarters at Mogilev was in the nature of a triumphal procession, patriotic demonstrations and crowds of people greeting him at every station on the way. Twenty-four hours after his arrival at Mogilev he received a telegram from Prince Lvov, the chief of the provisional Government, cancelling his appointment. The next two years the grand duke spent in the Crimea, taking no part in politics. At last, in March 1919, he left Russian soil on the British cruiser "Marlborough," and lived quietly near Paris. He died in Jan. 1929. (A. W. F. K.)

NICHOLAS, SIR EDWARD (1593–1669), English statesman, was born on April 4, 1593, of a Wiltshire family. He was educated at Salisbury grammar school, Winchester college and Queen's college, Oxford. After studying law at the Middle Temple, Nicholas became secretary to Lord Zouch, warden and admiral of the Cinque ports, in 1618, and continued in a similar employment under the duke of Buckingham. In 1625 he became secretary to the Admiralty; then extra clerk of the privy council with duties relating to Admiralty business, and from 1635 to 1641 he was one of the clerks in ordinary to the council. In this situation Nicholas was concerned with the levy of ship-money. He had Charles's confidence, became a privy councillor and a secretary of State, and attended the king at Oxford, and carried out the business of the treaty of Uxbridge. Nicholas arranged the details of the king's surrender to the Scots, though he does not appear to have approved of the step; and he arranged the capitulation of Oxford. He went to France, and after the king's death he remained on the Continent concerting measures on behalf of the exiled royal family, but he never had any real influence with Charles II. After the Restoration he lived in retirement.

See *The Nicholas Papers*, ed. by G. F. Warner (Camden Society, 1886–97), containing Nicholas's correspondence and some autobiographical memoranda. Private correspondence between Nicholas and Charles I. will be found in the *Memoirs of John Evelyn*, ed. by W. Bray (1827); *The Egerton Mss.* and the *Ormonde Papers* contain many references to Nicholas.

NICHOLAS, NORTHERN or **LENIN LAND** lies in the Arctic sea, about 30 m. N. of Cape Chelyuskin, extending in a north-easterly direction from 77° 50′ N., 99° E. to beyond 81° N. The small Alexis (Little Taimir) and Starokadomski islands lie at the eastern end of Alexis strait, which separates Nicholas Land from the mainland. This land was discovered in 1913 by the Russian hydrographical expedition in the "Taimir" and "Vaigach" under B. A. Vilkitski. He took possession for Russia and charted the eastern side. In the following year he returned and

charted the southern coast. The northern and western sides are unknown. The east coast is much indented and a deep gulf or strait occurs in about 79° N. In the south there is a low plain covered with tundra, but on the east the land is lofty (1,500 ft.) and flat-topped with large valley glaciers. Both sedimentary and volcanic rocks occur, but details are lacking. Water of over 100 fathoms depth lies close to the eastern side.

See papers in *Petermann's Mitteilungen,* 60 (1914); *Geographical Journal* (Dec. 1919), and *Geographical Review* (July 1925). (R. N. R.-B.)

NICHOLS, JOHN (1745–1826), English printer and author, was born at Islington on Feb. 2, 1745. He edited the *Gentleman's Magazine* from 1778 till his death, and in that periodical, and in his numerous volumes of *Anecdotes and Illustrations,* he made invaluable contributions to the personal history of English men of letters in the 18th century. He was apprenticed in 1757 to "the learned printer," William Bowyer, who took him into partnership in 1766. On the death of his friend and master in 1777 Nichols published a brief memoir, which afterwards grew into the *Anecdotes of William Bowyer and his Literary Friends* (1782). *The Literary Anecdotes of the 18th Century* (1812–1815), into which the original work was expanded, forms only a small part of Nichols's production. It was followed by the *Illustrations of the Literary History of the 18th Century, consisting of Authentic Memoirs and Original Letters of Eminent Persons,* which was begun in 1817 and completed by his son John Bowyer Nichols (1779–1863) in 1858. He died on Nov. 26, 1826.

Nichols's other works include: A *Collection of Royal and Noble Wills* (1780); *Select Collection of Miscellaneous Poems* (1782), with subsequent additions, in which he was helped by Joseph Warton and by Bishops Percy and Lowth; *Bibliotheca Topographica Britannica* (1780–1790); with Richard Gough, *The Progresses and Public Processions of Queen Elizabeth* (1788); and the *History and Antiquities of the Town and County of Leicester* (8 vols., 1795–1815).

A full memoir of John Nichols by Alexander Chalmers is contained in the *Illustrations,* and a bibliography in the *Anecdotes* (vol. vi.) is supplemented in the later work. *See* also R. C. Nichols, *Memoirs of J. G. Nichols* (1874).

NICHOLS, ROBERT MALISE BOWYER (1893-1944), English poet and writer, the son of J. B. B. Nichols, also a poet, was born on Sept. 6, 1893, and educated at Winchester and at Trinity college, Oxford. In 1914 he obtained a commission in the Royal Field Artillery, and served in France until 1916. From 1918 to 1919 he was engaged on propaganda work in the United States for the Ministry of Information. From 1921 to 1924 he was professor of English literature at the Imperial college, Tokyo. In addition to his published work, he contributed to *The London Mercury* and other periodicals. Nichols died Dec. 17, 1944.

His published work includes *Invocation,* poems (1916); *Ardours and Endurances* (1917); *The Budded Branch* (1918); *Aurelia* (1920); *The Smile of the Sphinx* (1920); *Guilty Souls,* drama (1922); *Wings over Europe,* drama, with M. Browne (1929); *Fisbo,* a satirical poem (1934); *Such Was my Singing,* poems (1942).

NICHOLSON, JOHN (1822–1857), British soldier and administrator of India, son of Alexander Nicholson, a north of Ireland physician, was born Dec. 11, 1822, and educated at Dungannon College. He was presented with a cadetship in the Bengal infantry in 1839 by his uncle Sir James Hogg, and served in the first Afghan War of 1839–42; he distinguished himself in the defence of Ghazni, and was one of the prisoners who were carried to Bamian and escaped by bribing the guard upon General Pollock's successful advance. In Afghanistan Nicholson first met Sir Henry Lawrence, who got him the appointment of political officer in Kashmir and subsequently on the Punjab frontier. In 1847 he was given charge of the Sind Sagar district, and did much to pacify the country after the first Sikh War. On the seizure of Multan by Mulraj, he rendered great service in securing the country from Attock, and was wounded in an attack upon a tower in the Margalla Pass, where a monument was subsequently erected to his memory. On the outbreak of the second Sikh War he was appointed political officer to Lord Gough's force, when he rendered great service in the collection of intelligence and in furnishing supplies and boats.

On the annexation of the Punjab he was appointed deputy commissioner of Bannu. There he became a kind of legendary hero, and many tales are told of his stern justice, his tireless activity and his commanding personality. In the course of five years he reduced the most turbulent district on the frontier to such a state of quietude that no crime was committed or even attempted during his last year of office, a condition of things never known before or since. He would go personally to the scene of a crime or a legal dispute and decide the question on the spot. Every man in his district, whether mountain tribesman or policeman, felt that he was controlled by a master hand, and the natives said of him that "the tramp of his war-horse could be heard from Attock to the Khyber." It is little wonder that the natives worshipped him as a god under the title of Nikalsain.

When the Mutiny broke out in May 1857 Nicholson did more than any other single man to keep the Punjab loyal and to bring about the fall of Delhi. When the news of the rising at Meerut arrived, Nicholson was with Edwardes at Peshawar, and they took immediate steps to disarm the doubtful regiments in that cantonment. Together they opposed John Lawrence's proposal to abandon Peshawar, in order to concentrate all their strength on the siege of Delhi. In June Nicholson was appointed to the command of a movable column, with which he again disarmed two doubtful regiments at Phillaur. In July he made a forced march of 41 m. in a single day in the terrific heat of the Punjab summer, in order to intercept the mutineers from Sialkot, who were marching upon Delhi. He caught them on the banks of the Ravi near Gurdaspur, and utterly destroyed them, thus successfully achieving what hardly any other man would have attempted. In August he had pacified the Punjab and was free to reinforce Gen. Archdale Wilson on the ridge before Delhi.

Before Nicholson's arrival the counsels of the commanders before Delhi, like those at Meerut, suffered from irresolution and timidity. As General Wilson's health declined, his caution became excessive, and Nicholson was especially sent by Sir John Lawrence to put more spirit into the attack. His first exploit after his arrival was the victory of Najafgarh, which he won over the rebels who were attempting to intercept the British siege-train from Ferozepur. After marching through a flooded country scarcely practicable for his guns, Nicholson, with a force of 2,500 troops, defeated 6,000 disciplined sepoys after an hour's fighting and thenceforth put an end to all attempts of the enemy to get in the rear of the British position on the ridge. Nicholson grew fiercely impatient of General Wilson's procrastination and at one time was thinking of appealing to the army to set Wilson aside and elect a successor; but at last, on Sept. 13, he forced Wilson to make up his mind to the assault, and he himself was chosen to lead the attacking column. On the morning of Sept. 14 he led his column, 1,000 strong, in the attack on the Kashmir gate and successfully entered the streets of Delhi. But in trying to clear the ramparts as far as the Lahore gate, he undertook a task beyond the powers of his wearied troops. In encouraging them as they hesitated, he turned his back on the enemy and was shot in the back. The wound was mortal; he died on Sept. 23.

His best epitaph is in Sir John Lawrence's Mutiny report:

> Brigadier-General John Nicholson is now beyond human praise and human reward. But so long as British rule shall endure in India, his fame can never perish. He seems especially to have been raised up for this juncture. He crowned a bright, though brief, career by dying of the wound he received in the moment of victory at Delhi. The Chief Commissioner does not hesitate to affirm that without John Nicholson Delhi could not have fallen.

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NICHOLSON, JOSEPH SHIELD (1850–1927), British economist, son of an Independent minister, was born on Nov. 9, 1850 at Wrawby in Lincolnshire, and educated at Edinburgh university and Trinity college, Cambridge, where he won the Cobden Prize in 1877 (the first award), and again in 1880. After studying at Heidelberg and at London university, he became a private tutor at Cambridge.

In 1880 he went to Edinburgh university as professor of political economy. He wrote more than 20 volumes on economics, of which the chief are: *The Silver Question* (1886), *Money and Monetary Problems* (1888), *Bankers' Money* (1903), *The Tariff Question* (1903), *The History of the English Corn Laws* (1903), *Project of Empire* (1909) and *Principles of Political Economy* (3 vols., 1893, 1897, 1901). In all his economic writings he advocated the principles of Adam Smith. He resigned his chair in 1925 and died in Edinburgh on May 12, 1927.

NICHOLSON, MEREDITH (1866–1947), U.S. writer, was born at Crawfordsville, Ind., Dec. 9, 1866, and educated in the public schools of Indianapolis. He was a reporter and later editor on the *Indianapolis News* and was U.S. minister to Paraguay (1933–34), Venezuela (1935–38) and Nicaragua (1938–1941). He died on Dec. 21, 1947, in Indianapolis.

He published the following novels: *The Main Chance* (1903), *The House of a Thousand Candles* (1905), *The Port of Missing Men* (1907), *The Little Brown Jug at Kildare* (1908), *The Lords of High Decision* (1909), *A Hoosier Chronicle* (1912), *The Poet* (1914), *And They Lived Happily Ever After* (1925), *The Cavalier of Tennessee* (1928), *Poems* (1906) and several historical and critical volumes, including *The Hoosiers* (1900) and *The Valley of Democracy* (1918).

NICHOLSON, WILLIAM (1753–1815), English writer on natural philosophy, was born in London in 1753. Nicholson occupied himself with writing and lecturing on natural philosophy, including chemistry, and with the construction of various machines and the first voltaic pile in England. In 1797 the *Journal of Natural Philosophy, Chemistry and the Arts,* generally known as *Nicholson's Journal,* the earliest work of the kind in Great Britain, was begun; it was carried on till 1814. He died in London on May 21, 1815.

Besides contributions to the *Philosophical Transactions,* Nicholson wrote translations of Fourcroy's *Chemistry* (1787) and Chaptal's *Chemistry* (1788), *First Principles of Chemistry* (1788) and a *Chemical Dictionary* (1795); he also edited the *British Encyclopaedia, or Dictionary of Arts and Sciences* (6 vols., London, 1809).

NICHOLSON, SIR WILLIAM (1872–1949), English painter, engraver and illustrator, was born in Newark-on-Trent in 1872. He first became known to the wider public by his illustrative work in *An Alphabet, An Almanack of Sports* (with Rudyard Kipling) and *London Types* (with W. E. Henley) in 1898; by the "Portrait of Queen Victoria," a delightful coloured wood engraving; the *Velveteen Rabbit* with its clever end papers and by the whole series of quaint and witty books and posters which he produced in collaboration with his brother-in-law, James Pryde (as "the Beggarstaff Brothers").

His more serious work is found in his painting, whether dealing with a portrait, a landscape or still life. Among his paintings in oil are "The Black Pansy," "The Landlord" (Manchester City Art gallery), "The Girl with the Tattered Gloves," "Fish" and the portraits of "Marie Tempest," "Ursula Lutyens" and "The Master of Jesus." Other works are the "Square Book of Animals" and the "Buildings of Oxford." Nicholson was knighted in 1936. He died at Blewbury, Berkshire, Eng., May 16, 1949.

See monograph in *Contemporary British Artists* (1923).

NICIAS (d. 414 B.C.), a soldier and statesman in ancient Athens, inherited from his father Niceratus a considerable fortune invested mainly in the silver mines of Laurium. Evidence of his wealth is found in the fact that he had no less than 1,000 slaves whom he hired out. He was several times colleague with Pericles in the strategia, and on Pericles' death became the leading advocate of the Periclean policy of pinpricks (ἐπιτειχισμοί) and concentration on the Thraceward region against the offensive policy of the democrats under Cleon. At the amphibious tactics of the ἐπιτειχισμός he was unsurpassed. Having been largely responsible for the "peace of Nicias" (421), he appears in the rather obscure history of the following years as the leader of the peace party, in opposition to Alcibiades. In 415, much against his will, he was appointed leader of the Sicilian expedition with Alcibiades and Lamachus; and the recall of Alcibiades, followed by the death of Lamachus, left him in sole command. Demosthenes came out with reinforcements early in 413 and took charge for a brief space, but at the end the main responsibility for the delay, and so perhaps for the disaster, rests with Nicias. He was put to death during that year by the Syracusans.

Besides Thucydides *see* Plutarch's *Nicias* and Diod, xii, 83; also GREECE and PELOPONNESIAN WAR, THE.

NICKEL (symbol Ni), a grayish-white metallic element, hard, tough and markedly resistant to oxidation and corrosion. It is widely familiar because of its use in coinage, but has become more important for its many domestic, industrial and military applications, which during the period 1939–49 consumed more than 250,000,000 lb. of the element each year. The metal itself is well suited for direct use in many kinds of mechanical equipment, but it is more commonly employed in the form of alloys. Use in this form dates from prehistoric times, for early man fashioned some of his implements from meteoric iron, which normally contains 5% to 15% nickel. It was also used in alloy form by the Chinese in ancient days, but nickel itself was not isolated until 1751, when A. F. Cronstedt prepared an impure sample from an ore containing niccolite (NiAs). An ore of this same type had earlier caused copper and silver miners in Saxony considerable trouble because it yielded a brittle unfamiliar product. They came to refer to it as "kupfernickel," after "Old Nick" and his mischievous gnomes, and Cronstedt applied their name to his new element. His results were confirmed in 1775 by T. O. Bergman, and the name nickel soon became generally accepted. About a century elapsed, however, before nickel was mined in quantity for a growing world market.

Occurrence and Production.—Nickel is the 24th element in order of abundance, and constitutes about 0.016% of the earth's crust. It is a fairly common minor constituent of igneous rocks but there are singularly few deposits which qualify with respect to concentration, size and accessibility for commercial interest. The most important sources of the metal are the mixed sulphide ores containing pentlandite, $(Fe,Ni)S$; nickeliferous pyrrhotite, Fe_5S_6 to $Fe_{16}S_{17}$; and nickeliferous chalcopyrite, $CuFeS_2$. Ores of this type are mined on a large scale in the Sudbury district of Ontario, Can., and to a lesser extent in the Petsamo district of Finland, ceded to the U.S.S.R. during World War II. Minor deposits of nickeliferous sulphide ores occur in Norway, China, India, Alaska and the United States (Missouri), but the production from these sources is not appreciable. Complex silicate ores containing garnierite, $H_2(Ni,Mg)SiO_4$, and other mixed silicates constitute an important secondary source of the metal. They are mined notably in New Caledonia and occur in some quantity in Venezuela, Brazil, the U.S.S.R. and to a lesser extent in Greece, Egypt and the United States (North Carolina and Oregon). The nickeliferous iron oxide ores of Cuba served as a source of the metal during World War II. Ores of this same type occur in Greece, Borneo and the Republic of the Philippines. Selected production figures in millions of pounds of nickel are summarized in the following table:

Year	1935	1940	1945	1948
Canada	138.5	245 5	245.1	262.1
New Caledonia	13 9	23.2	9.5	10.7
Cuba	0.0	0.0	24.0	0 0
All others	14.0	39.9	40.8	57.9
World total	166.4	308.6	319.4	330.7

Metallurgy.—The metallurgy of nickel is fairly complex and costly. The nickeliferous sulphide ores of Canada, which are embedded in a matrix of basic rock, are first ground and carried through a series of flotation processes which yield nickel and copper concentrates. The nickel concentrate is roasted to reduce the sulphur content and then smelted to a matte which, after controlled cooling followed by grinding and flotation, yields a material which is essentially nickel sulphide. This concentrate is sinter roasted and the resulting product goes in part to the market as nickel oxide sinter for use in the alloy steel industry, and the balance is reduced and either melted into anodes for electrolytic refining, or converted into the volatile carbonyl (Mond process) for recovery as highly purified nickel pellets. The silicate ores are fused with calcium carbonate, calcium sulphate and coke to yield a double sulphide of nickel and iron and a siliceous slag which is discarded. This crude matte is smelted under conditions which eliminate the iron as a silicate and yield a fairly

pure nickel sulphide which can readily be converted to the metal. The nickeliferous iron ores are selectively reduced and the nickel extracted as the soluble nickel ammonia complex by treatment with a mixture of ammonium hydroxide and ammonium carbonate solution in the presence of oxygen. This solution is handled by countercurrent techniques and on being stripped of ammonia for re-use, yields a precipitate of basic nickel carbonate which can be calcined to nickel oxide for direct sale. The metal may be obtained on a laboratory scale by the reduction of nickel hydroxide, nitrate or formate and by the electrolysis of soluble nickel salts, such as nickel sulphate, in the process of nickel plating.

Physical Properties.—Nickel has an atomic number of 28 and occurs in Group VIII of the periodic arrangement of the elements, after iron and cobalt and above palladium and platinum. It resembles iron in strength and toughness but is more like copper, which follows it with atomic number 29, in resistance to oxidation and corrosion. This combination of useful properties accounts for many of its applications. Nickel has an atomic weight of 58.69 and consists of the following stable isotopes:

Mass number	58	60	61	62	64
Per cent abundance	67.76	26.16	1.25	3.66	1.16

Radioactive isotopes with half lives ranging up to about 60 hours have been prepared. Nickel has the following physical constants:

Density, g./cm.^{3}	8.90 (20° C.)
Melting point, °C.	1455
Boiling point, ° C.	2900
Specific heat, cal./g./° C.	0.1095 (18° C.) .1340 (1360° C.)
Latent heat of fusion, cal./g.	73
Coefficient of expansion, cm./cm./° C.	0.0000129 (25–100° C.) .0000135 (375–1000° C.)
Thermal conductivity, cal./cm.^{2}/sec./° C./cm.	0.142 (18° C.)
Hardness, Brinell number	85 (99.99% Ni, annealed) 210 (99.4% Ni, cold-rolled)
Atomic radius, Å (Ångstrom unit=10^{-8} cm.)	1.24
Ionization potential, volts	7.61 (I), 18.2 (II)
Electrode potential, molal, volts	+0.231 (25° C.)
Electrical conductivity, basis copper=100%	16%
Resistivity, ohm-cm.	7.8 (20° C.)
Magnetic permeability, μ,	110 (initial) 600 (maximum)
Curie temperature, ° C.	360
Tensile strength, lb./in.^{2}	46,000 (99.99% Ni, annealed) 105,000 (99.4% Ni, cold-rolled hard temper)

Uses of Nickel in Alloys and As the Metal.—More than 65% of the nickel produced is normally incorporated in alloys with iron. Nickel steels (0.5%–10% nickel) possess special properties of strength and toughness and are used in great quantities in the manufacture of automobiles, trucks, buses, ships, aeroplanes, railway locomotives and cars and special parts for most types of transportation equipment. They are also used in agricultural equipment, machine tools, mining and excavating machinery, oil well and refinery equipment, steel mill machinery, power-generating equipment and many types of steel construction. Stainless steels (2%–26% nickel) are resistant to corrosion, tarnish and stain and are used extensively wherever these properties in association with strength and toughness are required, as, for example, in transportation equipment such as streamlined trains, aeroplanes and truck tanks; kitchen equipment, tableware and cooking utensils; and in equipment for the chemical and process industries, textile and paper mills and oil refineries. Heat-resistant steels (2%–26% nickel) are used to meet the high-temperature requirements of furnace and other equipment parts for the glass, ceramic, metal and chemical manufacturing industries. Many other alloys with iron such as the nickel cast irons (1%–5% nickel) meet special needs in the manufacture of metal equipment.

About 15% of the nickel produced is used in high nickel alloys with copper (65%–70% nickel). These alloys have many desirable physical properties and are highly resistant to corrosion. They are extensively used in building, chemical and food-processing equipment and in marine and power-generating equipment. Considerable quantities are also incorporated in cupronickel alloys (2.5%–45% nickel), which are used notably for condenser tubes and salt-water lines. Increasing quantities of nickel are being used in heat-resisting alloys (commonly 78% nickel, 14% chromium, the balance iron and minor elements) which retain their properties of strength, toughness and resistance to oxidation and corrosion at high temperatures, and in electrical resistance alloys (80%–85% nickel) which are used in heating elements, pyrometers, rheostats and other electrical controls. Magnetic alloys (29%–90% nickel), nonmagnetic alloys (8%–27% nickel), permanent magnet alloys (14%–32% nickel), high permeability alloys (45%–80% nickel) and controlled expansion alloys (30%–60% nickel) have been developed for many diverse applications. Nickel coinage (25%–100% nickel) has been adopted in many countries and the so-called nickel silvers (10%–30% nickel, the balance primarily copper and zinc) are used in many familiar articles such as plated silverware stock, slide fasteners, decorative hardware and jewellery. Many other alloys are in current usage and new nickel alloys are constantly being developed for changing industrial needs. (*See* ALLOYS; STEELS, ALLOY.)

About 15% of the nickel produced is normally used directly as the virtually pure metal. It is employed in equipment for the food-processing, chemical and radio industries. Nickel, as well as stainless steel and other nickel alloys, is used to clad steel and provides, in an economical way, a protective coating which is markedly effective against the corrosive action of chemicals. It is similarly used in electroplating, where it is particularly useful to secure protection from atmospheric corrosion and is kept free from tarnish by a thin layer of chromium.

Chemical Properties and Compounds.—The 28 orbital electrons of nickel are distributed as follows: $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $3d^8$ and $4s^2$. The two electrons in the highest energy level ($4s$) are readily yielded to form a stable, doubly charged cation. The electrode potential for this reaction is +0.231 v., placing nickel above hydrogen in the electromotive series in the following position: Co, *Ni*, Sn, Pb, H. The metal reacts slowly with strong acids under ordinary conditions to liberate hydrogen and form Ni^{++}. The salts formed are slightly acid and yield a precipitate of hydrous nickel oxide when the pH of dilute solutions is raised above about 6.7. The metal is uniquely resistant to the action of alkalies and is frequently used for containers to handle concentrated solutions of sodium hydroxide. The element exhibits only a minor tendency to assume the univalent or tervalent states and such ions are not stable in aqueous solution. The third shell contains only 16 electrons, lacking 2 of the stable inert gas arrangement, and many of the compounds involving special valence forces can be attributed to this electronic structure.

Nickelous oxide, NiO, is by far the most common oxide of the metal. It occurs in nature in small quantities as the mineral bunsenite and can be prepared by heating nickel sulphide in air, nickel hydroxide and basic carbonates, nickel nitrate and many other nickel derivatives. In fact, it is usually the end product of the ignition of nickel compounds in air. It can be reduced to nickel by heating with carbon, hydrogen and other reducing gases. It is soluble in strong acids unless it contains impurities or has been sintered, in which case fusion with $KHSO_4$ may be necessary. Nickel oxide is used in ground-coat enamels for its beneficial effects on adherence and in colouring ceramics and glass. Nickelous hydroxide, $Ni(OH)_2$, is obtained as a light-green precipitate when nickel salts are treated with alkalies. It is readily soluble in acids and ammonium hydroxide, yielding in the latter case the complex ion $Ni(NH_3)_4^{++}$. It may be reduced with hydrogen at sufficiently low temperatures to yield active nickel catalysts and is incorporated in the Edison nickel-iron alkaline storage battery, where it yields higher valent hydrous oxides when the battery is charged. Basic nickel carbonates result from the reaction between nickel salts and alkali carbonates. If a mixture of alkali and hypohalite is used, higher hydrous oxides of variable composition are yielded as black precipitates. These products are all converted to nickelous oxide, NiO, on complete dehydration and yield exclusively the double-charged nickel cation on solution in acids. Nickel forms a related series of compounds with sulphur. In addition to the commercially important mixed sulphide ores already mentioned, such minerals as millerite (NiS) and polydymite (Ni_3S_4) belong to this group of compounds. Nickelous sulphide, NiS, is highly insoluble and is readily precipitated when nickel salts are mixed with alkaline sulphides in aqueous solution. Other sulphides, such as Ni_3S_2, can be obtained by direct reaction of sulphur and sulphur compounds with the metal and its derivatives.

Nickel sulphate is the most familiar salt. It can readily be prepared by dissolving nickel metal or nickelous hydroxide in sulphuric acid. It is quite soluble in water (140 g. Ni per 1,000 ml. water at 0° C., 761 g. at 100° C.) and can be purified by recrystallization, to yield the heptahydrate, $NiSO_4 \cdot 7H_2O$, in the form of emerald-green rhombic prisms. This salt yields a yellow anhydrous nickel sulphate when heated above 300° C., and when strongly heated above 840° C. loses SO_3 and leaves a residue of NiO. The hydrated salt is widely employed in plating baths and in dips for steel vessels which are to be coated with vitreous enamel and commonly serves as a reagent for the preparation of nickel catalysts. The nickel halides and nickel nitrate can be similarly prepared and purified. Nickel chloride crystallizes as the hexahydrate, $NiCl_2 \cdot 6H_2O$, and becomes anhydrous when heated above 140° C. Nickel nitrate hexahydrate, $Ni(NO_3)_2 \cdot 6H_2O$, dissolves in its own water of crystallization at about 57° C., readily dehydrates at higher temperatures and decomposes at about 300° C. to yield NiO in air, or pyrophoric nickel when heated in a reducing atmosphere. It is used in the preparation of special nickel catalysts and powders and, along with the chloride, is also used to some extent in nickel plating. Most nickel salts form double compounds with other salts, and co-ordination complexes with ammonia. Nickel also forms co-ordination complexes with alkali cyanides and in this behaviour exhibits properties similar to those of palladium and platinum.

Nickel readily forms salts with organic acids, either by direct reaction between nickelous hydroxide and the acid or by double decomposition between suitable salts. Nickel formate, $Ni(HCOO)_2$, which is one of

the most familiar of these, is unique in that it decomposes at about 240° C. to give off hydrogen and carbon dioxide, leaving a residue of finely divided nickel which is particularly useful as a hydrogenation catalyst. The higher fatty acid salts, such as the stearate and oleate, are water insoluble and exhibit colloidal properties typical of the metal soaps when dispersed in organic liquids.

Nickel forms a series of compounds in which co-ordination or secondary valence forces are involved in addition to those of the usual salt structure. The highly insoluble, striking red derivative with dimethylglyoxime, commonly precipitated in nickel analyses, is a characteristic inner-complex compound involving a chelate ring. This derivative is nonpolar in character, highly insoluble in water, but somewhat soluble in chloroform and other organic solvents. It sublimes without decomposition when heated *in vacuo,* but is readily converted quantitatively to NiO on strong heating in air. No true alkyl derivatives had been reported in the literature at mid-20th century, and it is possible that they are unstable under ordinary conditions.

Nickel carbonyl, $Ni(CO)_4$, is an unusual compound in that it contains a neutral nickel atom surrounded by four co-ordinately bound carbonyl groups. It can be prepared by treating at 25° C. finely divided metallic nickel, such as is obtained by decomposing the formate at minimum temperatures, with carbon monoxide; sulphur acts as a catalyst for this reaction. The product is a colourless mobile liquid with a high vapour pressure and is very poisonous if inhaled. It boils at 43° C. and begins to decompose at 60° C. or less, depending on the conditions, to metallic nickel and carbon monoxide. A very fine nickel powder may be prepared in this manner, or pellets may be built up on nuclei of nickel as in the Mond process. A bright nickel mirror or nickel plate may also be obtained and nickel carbonyl can serve as a source of reactive carbon monoxide in certain organic syntheses. (*See* CARBONYLS, METAL.)

Analytical.—Nickel is precipitated in the ammonium sulphide group along with cobalt, manganese, zinc and iron in systematic analyses. The nickel and cobalt sulphides remain as undissolved residue after the precipitate is extracted with 1N hydrochloric acid. The two elements may be differentiated by the fact that nickel gives a red precipitate in the dimethylglyoxime tests, or a brown borax bead. In quantitative analysis nickel may be isolated and weighed directly as the dimethylglyoxime complex, or this compound may be ignited to NiO. It may also be determined by a volumetric procedure, such as with potassium cyanide solution (the complex nickel cyanide ion, $Ni(CN)_4^{=}$, is formed) using silver iodide as an indicator, or by electrolysis of a strongly ammoniacal solution.

Uses of Nickel Compounds.—Nickel compounds have been used mainly in electroplating, in the production of nickel catalysts, in ground-coat enamels, in storage batteries of the Edison type, and in the production of special nickel powders. Many nickel compounds exhibit insecticidal, fungicidal and bactericidal action, but have not received wide practical use because of the availability of effective cheaper materials. Ingested nickel is relatively nontoxic and any quantities that might be picked up incidentally through the use of nickel or nickel-alloy cooking utensils or in fats hydrogenated over nickel catalysts are considered to be without physiological action.

Nickel Catalysts.—Nickel catalysts are among the most familiar in catalytic chemistry and have been the subject of intensive investigations of both theoretical and applied nature. Probably more than 1,000,000 lb. of the metal was used in this field each year over the decade from 1939 to 1949. Catalytic nickel can be prepared by many different methods. Nickelous hydroxide and basic carbonates, nickel nitrate, formate and various other organic compounds yield, on thermal decomposition at moderate temperatures in a reducing atmosphere, finely divided nickel in a highly active form. Nickel sulphate and other soluble salts are frequently the starting reagent. The precipitates obtained when they are mixed with alkalies in aqueous solution, frequently in admixture with carrier materials such as diatomaceous earth, are washed, dried and reduced. Nickel formate yields active nickel directly when it is decomposed without access to air, such as under oils which are to be treated. Nickel alloys containing a metal which can be selectively dissolved away, such as the nickel-aluminum preparations of M. Raney which yield on treatment with sodium hydroxide soluble sodium aluminate and an active nickel residue, are commonly employed. Nickel catalysts are most frequently utilized in hydrogenating unsaturated organic compounds. The element, in common with palladium and platinum, exhibits unusual capacity to occlude hydrogen, and its effectiveness as a catalyst in reactions involving hydrogen is frequently explained in terms of this phenomenon. The most familiar application is the hydrogenation of fats and oils, in the process known as fat hardening. A fraction of 1% of active, finely divided nickel suffices to catalyze the addition of hydrogen to unsaturated compounds in vegetable, animal and fish oils, converting them from liquids to solids with more desirable physical properties and greatly improved chemical stability. The nickel is recovered by filtration and may be re-used or may be employed in continuous processes. Many millions of pounds of natural oils are treated annually in this manner for use in edible products such as shortenings and oleomargarine, in soaps and numerous industrial preparations. Nickel catalysts are also extensively used in many operations in industrial chemistry, especially in the synthesis of organic chemicals and pharmaceuticals, and in desulphurization operations in petroleum chemistry and in the production of gaseous fuels. Although the quantity of nickel used in chemical operations is dwarfed by the great tonnages which go into structural applications, it has become a reagent of great importance in the expanding chemical industries.

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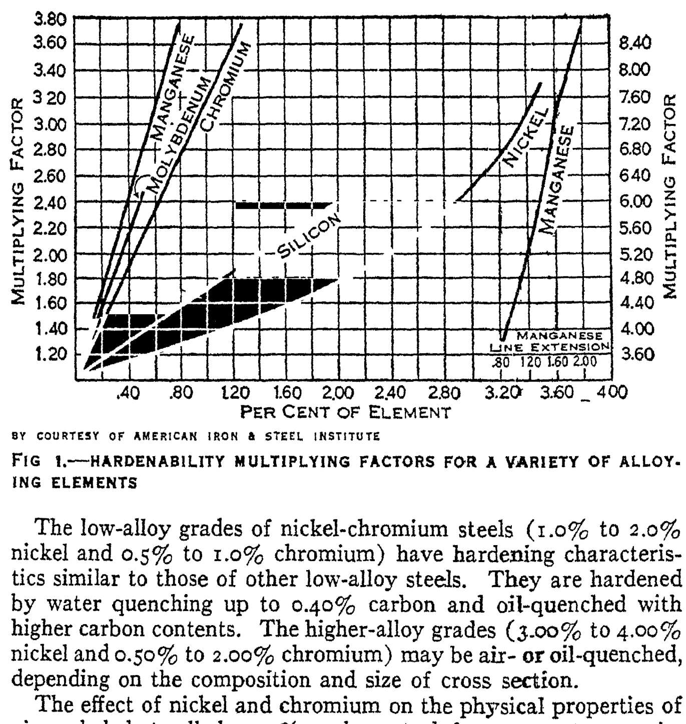
NICKEL-CHROMIUM STEELS. Nickel-chromium steel, an alloy of iron, nickel (1–4%), chromium (0.40–1.75%), and carbon (0.05–0.60%), constitutes one of the oldest and most widely used classes of low-alloy steels. Nickel, which forms austenite, a noncarbide constituent of steel, is added to steel to increase strength and toughness, with a moderate effect on hardenability. Chromium unites with carbon to form complex carbides and increase hardenability greatly if carbon (above 0.10%) is present. The effect of nickel, chromium and other elements on the hardenability of steel is illustrated in fig. 1.



BY COURTESY OF AMERICAN IRON & STEEL INSTITUTE

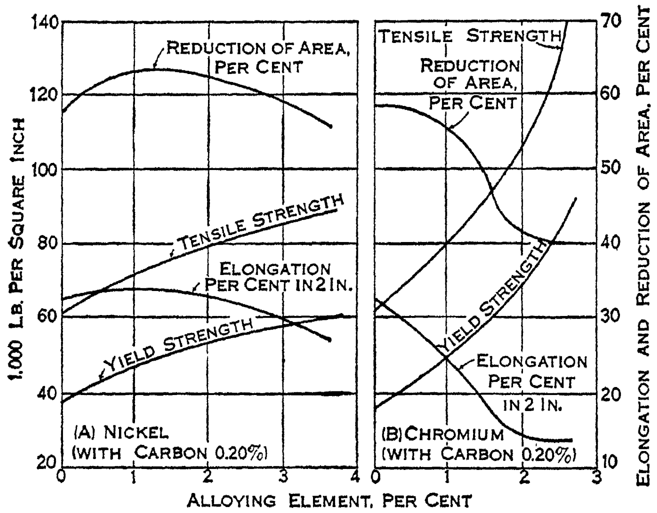
FIG 1.—HARDENABILITY MULTIPLYING FACTORS FOR A VARIETY OF ALLOYING ELEMENTS

The low-alloy grades of nickel-chromium steels (1.0% to 2.0% nickel and 0.5% to 1.0% chromium) have hardening characteristics similar to those of other low-alloy steels. They are hardened by water quenching up to 0.40% carbon and oil-quenched with higher carbon contents. The higher-alloy grades (3.00% to 4.00% nickel and 0.50% to 2.00% chromium) may be air- or oil-quenched, depending on the composition and size of cross section.

The effect of nickel and chromium on the physical properties of air-cooled, hot-rolled 0.20% carbon steel for a 0.05 to 0.75 in. section is illustrated in fig. 2.

Nickel-chromium steel may be produced in an electric or open-hearth furnace. Nickel is not oxidized in the molten bath and therefore yields 100% recovery (*see* NICKEL STEEL). Chromium presents a different problem because it is oxidized and enters the slag under normal basic open-hearth operations. It is, therefore, not recovered from scrap in this operation, and additions must be made in the bath after it is thoroughly deoxidized or to the ladle during the tap. Recovery of chromium is possible, however, in the electric furnace with proper slag manipulation (*see* STAINLESS STEEL); that is, using a reducing slag or the addition of silicon or chrome silicide (reducing agents) to the furnace bath following an oxidizing condition to reduce the Cr_2O_3 in the slag to chromium and return it to the metal portion. Nickel-chromium steel may also be made in an acid open-hearth or acid electric furnace, using raw materials free from undesirable elements that cannot be removed by these processes. Nickel-chromium steels may be poured into

ingots or castings; and the usual deoxidizer, as in nickel steel, is silicon, which is added in the ladle to about 0.25% of the final chemical analysis of the heat. Ingots are stripped and placed in soaking pits as soon as they are solidified to prevent cooling cracks.



BY COURTESY OF PITMAN PUBLISHING CORP

FIG. 2.—EFFECT OF (A) NICKEL AND (B) CHROMIUM ON THE TENSILE PROPERTIES OF ROLLED CARBON STEELS

Semifinished products, such as blooms, slabs, and shapes, are stacked close together to prevent cooling cracks. Nickel-chromium steels are subject to flakes or hair cracks, as are many other air-hardening steels. No specific cure has been found; but thorough deoxidation, slow pouring at correct temperatures, and slow heating and cooling assist in avoiding flakes.

Nickel-chromium steels hold first place in use in the United States for important parts that are to be case-hardened or for highly stressed forgings. They are also widely used for heavy castings, such as those for bridges, locomotives and rolling-mill machinery, and for abrasion-resisting castings, such as power-shovel teeth and impact hammers.

The table shows a wide range of about 60 A.I.S.I. and S.A.E. nickel-chromium steels used in the United States.

Range of A.I.S.I. and S.A.E.† Standard Nickel-Chromium Open-Hearth and Electric Furnace Steels*

No. (Series)	C	Ni	Cr	Mo
A.I.S.I. 3100	0.13/0.53	1.10/1.40	0.55/0.90	—
S.A.E. 3200	.10/ .55	1.50/2.00	.90/1.25	—
A.I.S.I. 3300	.08/ .19	3.25/3.75	1.40/1.75	—
S.A.E. 3400	.10/ .55	2.75/3 25	.60/ .95	—
A.I.S.I. 4300	.15/ .43	1.65/2.00	.40/ .90	0.20/0.30
A.I S.I. 8600	.13/ .65	.40/ .70	.40/ .60	.15/ .25
A.I.S.I. 8700	.18/ .53	.40/ .70	.40/ .60	.20/ .30
A.I.S.I. 9300	.08/ .20	3.00/3.50	1.00/1.40	.08/ .15
A.I.S.I. 9400	.35/ .48	.30/ .60	.30/ .50	.08/ .15
A.I.S.I. 9700	.45/ 67	.40/ .70	.10/ .25	.15/ .25
A.I.S.I. 9800	.38/ .43	.85/1.15	.70/ .90	.20/ .30

*American Iron and Steel Institute.
†Society of Automotive Engineers.

Steels of the 3100 series, such as 3115 and 3120, are low-cost carburizing grades used for piston rings, automotive power train gears, oil-well-bit reamer cutters, and many other small, case-hardened parts. The S.A.E. 3200 steels containing 2% nickel and 1% chromium are most often used in the high carbon ranges. These steels are superior to the 3100 series in tensile properties and are used for automobile drive and axle shafts, master connecting rods of radial aircraft engines and many highly stressed keys and pins. Steel of the A.I.S.I. 3300 series, containing around 0.30% or 0.40% carbon, develop mechanical properties superior to those of the lower alloy content nickel-chromium steels, particularly in sections over $3\frac{1}{2}$ inches. They are therefore used extensively for forgings and bars that require rigid mechanical properties, such as large rocker arms and connecting rods. The S.A.E. 3400 series steels exhibit excellent resistance to fatigue, combined with good strength and ductility, which is especially valuable in parts likely to be subject to occasional overstressing from vibration or other causes. A.I.S.I. 3450 is used for heavy-duty gears of medium section in machine-tool construction.

Many nickel-chromium steels have been developed containing small additions of molybdenum, which are more complex steels (*see* table) with outstanding properties. The addition of molybdenum increases depth-hardening properties which makes it possible to develop strength and hardness in large sections equal to those secured in small sizes of other steels. Another characteristic of the nickel-chromium-molybdenum steels that contributes to their usefulness is high-hardness-machinability properties. Some compositions may be machined with Brinell hardnesses exceeding 400. These steels also show high resistance to creep up to about 1,000° F., and find application in valves and fittings in steam power plants. Steels with about 0.55% carbon, 0.65% manganese, 2.00% nickel, 0.90% chromium and 0.20% molybdenum are used for roller bearings where ductility is required along with high hardness and fatigue resistance.

The consumption of contained nickel metal (exclusive of scrap) and chromium metal, consumed in manufacture of steel in the United States in 1952 was 45,000 and 150,000 net tons, respectively. Of this quantity, 60% of the nickel and 67% of the chromium was consumed in stainless steels, leaving 40% and 33%, respectively, for other alloy steels, including nickel-chromium steels.

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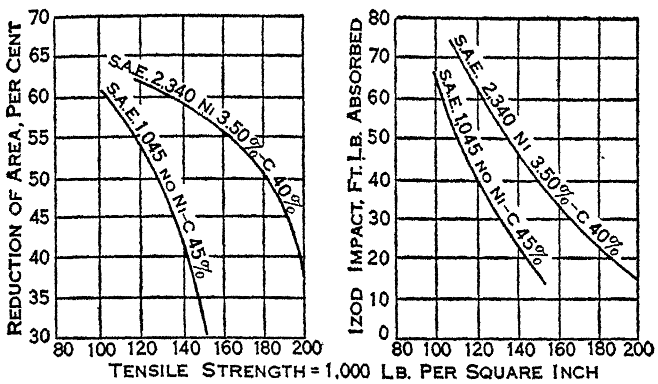
NICKEL SILVER, comprises a range of alloys of copper, nickel and zinc which are silvery in appearance but contain no silver. Its composition varies from 7% to 30% nickel, the alloy most widely used being "18% nickel silver" (18% nickel, 62% copper, 20% zinc). In general the zinc content is lowered as nickel is increased, the copper content varying between 53% and 63%. The importance of these alloys lies in their colour, ductility, good mechanical properties and suitability for working in a wide variety of cast, rolled and extruded or drawn shapes. The addition of 1%–2% lead improves machining properties. Such alloys resist corrosion better than does brass but tarnish slowly through the action of sulphur in the air. Their colour ranges from nearly white in the 30% alloy to pale brassy yellow in the alloys with low nickel content.

A natural alloy known as paktong (white copper), smelted by the Chinese from copper-nickel ores, was one of the first alloys used by man. It was later improved by the addition of zinc ores and was imported into Europe by the East India company. Not until the 1840s was the alloy made in Europe by mixing the three metals and it was known as German silver until 1914. After an electroplating plant was set up in Birmingham in 1844 German silver was found very suitable as a basis for silver plating.

Nickel silver is used extensively for electroplated table and ornamental silverware (being the base of E.P.N.S.), for jewellery and fancy goods, for architectural and ornamental metalwork, for some food and chemical equipment and for marine and plumbers' fittings. In hard rolled strip form it is used for spring elements, especially in electrical and telephone relays. (P. E. G.)

NICKEL STEEL. Nickel steel was first produced by J. F. Hall of England and M. Marbeau of France about 1885, each working independently. The grades commercially used are an alloy of nickel (0.20%–5.00%), carbon (0.10%–0.60%) and the remainder iron. The primary reason for adding nickel to steel is to increase its strength, toughness, depth hardness, and resistance to fatigue. These properties may be gained with small percentages of nickel (often referred to as an austenite former), which lower the eutectoid ratio (1% of nickel = 0.042% carbon) and tend to suppress transformation of austenite during cooling. In effect this results in

a full-hardened steel with great strength and toughness, even after slow cooling (*see* fig.), which is not possible with ordinary carbon steel. Higher percentages of nickel than those specified above are not used commercially in nickel steel (*see* STAINLESS STEEL) because a martensitic structure, such as 0.40% carbon and 7% nickel, will result which has low elongation and shock-resistant values and is difficult to work and machine.



BY COURTESY OF THE INTERNATIONAL NICKEL CO., INC.

LEFT: NICKEL STEELS OIL-QUENCHED. RIGHT: CARBON STEELS WATER-QUENCHED

Nickel steel may be produced in the electric or open-hearth furnace in the same manner as carbon steel, except that cleaner scrap is generally used and greater control exercised because of the economic risks. Nickel is not oxidized in the molten bath. It is, therefore, completely recovered from nickel-bearing scrap, and nickel may be added to meet specification early or late during the making of the heat. Nickel steel may be teemed into ingots or castings; and the usual deoxidizer is silicon, which is added in the ladle to about 0.25% of the final chemical analysis of the heat. Ingots are stripped as soon as solidified and placed immediately in soaking pits to prevent cooling cracks. The hot-working temperatures vary slightly from 2,200° F., depending on the chemical composition. Blooms, slabs, plates and shapes are stacked close together and protected from drafts while cooling. Surface imperfections are removed from nickel steel in the semifinished state and in the finished state if permitted by the user.

Industrial Uses.—By using high-strength steel, structures can generally be lightened in weight; for this reason, nickel steels and other alloy steels are widely used in the automotive and railroad industries. It is estimated that the U.S. automotive industry alone consumes 60% of all alloy-steel bar stock used in the country for the production of gears, shafts, roller bearings, nuts, bolts and various forgings. The weight saving over carbon steel by the use of nickel-alloy steel may be as much as 50%. For example, the weight of the entire rear-end assembly of an automobile may be reduced one-half by using smaller axles, housings, and bearings of nickel steel and at the same time be as strong as twice its weight of carbon steel.

In a steam locomotive, nickel steel is used for axles, boiler and

TABLE I.—*Effects of Nickel on Hardness and Low Temperature Strength Using a 0.20% Carbon Normalized Steel*

Nickel (%)	Brinell hardness	Charpy impact resistance in ft.-lb. at	
		Room temperature	-50° F.
0.0	127	80	7
1.0	146	94	30
2.0	155	88	35
3.0	168	88	40
4.0	187	75	50

firebox plate, and frame casting. In the diesel it is used for gears, generator roof and side sheets, and frame. In marine propulsion, such steels are used for shafts and in reduction-gear assemblies. In aircraft it is used for landing-gear parts and power-transmitting parts of reciprocating engines. Nickel steel was chosen for the forging of the world's largest supersonic wind tunnel at the air force research centre at Tullahoma, Tenn., with the following composition 0.28% carbon, 0.65% manganese, 2.85% nickel, 0.35% molybdenum and 0.07% vanadium. Nickel steel has also been used in long-span bridges to reduce dead weight and increase the pay load (for example, the George Washington bridge across the Hudson river at New York city and the San Francisco-Oakland bridge). Although the greater portion of nickel steel is employed for rolled or forged products, a generous quantity is used for castings. Cast-nickel alloys also respond to heat treatment and give high values for strength and hardness. A few uses are railroad passenger-car truck frames, rolling-mill rolls, heavy-cast machinery gears, crusher-jaw castings, impact hammers, and power shovels.

One of the outstanding characteristics of nickel steels is resistance to embrittlement at low temperatures, for which reason it is utilized in chemical equipment for subzero operations. This fact, plus the effect of nickel on hardness, is shown in Table I.

Table II illustrates the wide range of these steels used in the United States.

Steel A is an inexpensive water or oil hardening steel for parts of moderate importance, steel B can be oil-quenched direct from the carburizing heat for a tough core and file-hard case; it has good machining properties and is widely used for roller bearings, gears, piston pins, and drive shafts. Steel C usually is given a more elaborate heat treatment for a strong, tough core; it is used for gears, shafts, and machine parts requiring extra toughness as well as surface hardness and constancy of dimension. Steel D is hard to work but after proper case hardening gives parts having extreme hardness and resistance to shock; examples are aircraft en-

TABLE II.—*Range of Analyses of Nickel-Bearing Steels*

	Low-nickel		Medium-nickel	High-nickel
	A (%)	B (%)	C (%)	D (%)
Carbon	0.10–0.40	0.06–0.43	0.10–0.50	0.09–0.20
Manganese	.30–1.20	.25– .90	.40– .90	.40– .60
Nickel	.20–1.00	1.40–2.00	3.25–3.75	4.50–5.25
Molybdenum	—	.15– .30	None or .20– .30	—

gines, crankshafts, truck, bus and tractor transmission, and differential gears.

Great strides had been made by the 1950s in finding substitutes for nickel in steel. Manganese, boron and nitrogen had been proved possible substitutes. Many high-nickel alloys had been developed containing up to 95% nickel that are widely used today. Some of these are lead in wire for light globes and radio tubes, thermocouples, low-coefficient-of-expansion material, alloys that resist chemicals and other corrosive mediums, and magnets.

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NICOBAR ISLANDS, a group of 12 inhabited and 7 uninhabited islands in the Bay of Bengal, between Sumatra and the Andaman Islands (*q.v.*). The Andaman and Nicobar Islands together constitute a chief commissioner's territory of the republic of India. The aggregate area of the Nicobars is 635 sq.mi., Great Nicobar (*Loöng*), the largest and southernmost of any size, covering 333 sq.mi. Principal of the central group of islands are Camorta and Nankauri (Nancoury), between them being a landlocked shelter called Nankauri harbour. Chief island of the northern group is Car Nicobar (*Pu*), area 49 sq.mi., on which is the headquarters of the administration. Some of the islands have mere flat coral-covered surfaces; others, again, are hilly, the Great Nicobar rising to 2,105 ft. On that island there are considerable and beautiful streams, but the others generally are badly off for

fresh surface water. The marine surveys of these islands are still meagre and unsatisfactory. In 1951 the inhabitants of the Nicobar Islands numbered 12,009, Car Nicobar being by far the most densely populated island.

Geology and Climate.—The Nicobars form part of a great submarine chain, of which the Andamans are a continuation. Elaborate geological reports were issued by a Danish scientific expedition in 1846 and an Austrian expedition in 1858. H. Rink of the Danish expedition considered that the islands belong to the Tertiary age. The Baron von Hochstetter of the Austrian expedition classified the most important formations thus: eruptive, serpentine and gabbro; marine deposits, probably late Tertiary, consisting of sandstones, slates, clay, marls, and plastic clay; recent corals. He considered the whole group connected geologically with the great islands of the Malay archipelago farther south. Earthquakes of great violence were recorded in 1847 and 1881 (with tidal wave), and mild shocks were experienced in Dec. 1899.

The climate is unhealthy. The islands are exposed to both monsoons, and smooth weather is only experienced from February to April, and in October. Rain falls throughout the year, generally in sharp, heavy showers. The rainfall varies from 90 to 135 in., and the shade temperature from 64° to 92° F.

Flora and Fauna.—The vegetation of the Nicobars has not been subjected to a systematic examination by the Indian forest department like that of the Andamans, and indeed the forests are inferior in economic value to those of the more northerly group. There are fruit trees, such as the coconut (*Cocos nucifera*), the betel nut (*Areca catechu*), and the Nicobar breadfruit (*Pandanus leram*), a thatching palm (*Nipa fruticans*) and various timber trees of some commercial value, but only one timber tree (*Myristica irya*) would be considered first class in the Andamans. The palms of the Nicobars are exceedingly graceful.

The mammals are not numerous: in the southernmost islands are a small monkey, the crab-eating macaque (*Macaca irus*), a tree shrew (*Tupaia nicobarica*), rats and mice, bats and the Nicobar flying fox. It is doubtful if the wild boar is indigenous; cattle, when introduced and left, have speedily become "wild." The birds, of which there are many kinds, show strong Indian affinities. Notable among those found in the islands are the megapode (*Megapodius nicobaricus*) characteristic of the Australian region, the edible-nest-building swift, the hackled and pied pigeons, a parakeet (*Palaeornis caniceps*) and an oriole. Snakes, lizards and chameleons, crocodiles, turtles and an enormous variant of the edible Indian crab are numerous; butterflies and other insects have not yet been systematically collected. The fresh-water fish are reported to be of the types found in Sumatra.

History.—The situation of the Nicobars along the line of a very ancient trade route has caused them to be reported by traders and seafarers through all historical times. In the 17th century the islands began to attract the attention of missionaries. At various times France, Denmark, Austria and Great Britain all had more or less obscure rights to the islands, the Danes being the most persistent in their efforts to occupy the group, until in 1869 they relinquished their claims in favour of the British, who at once began to put down the piracies of the islanders, and established a penal settlement, which was withdrawn in 1888. Car Nicobar in the north and Camorta in the centre are the principal ports of the group.

In 1942, during World War II, the Nicobar Islands were occupied by Japanese forces, who developed Car Nicobar as a big supply base. In 1945 the islands were reoccupied by the Allies.

(X.)

Ethnology.—The Nicobarese are probably a mixture of Malay and Burmese (Talaing) strains, with a more primitive element now represented by the Shom Pen of the interior of Great Nicobar. They are of relatively short stature (average height of adult male, 5 ft. 3¾ in.) and sturdy build; hair may be slightly wavy or curly, scanty on face and body; brachycephaly is usual. The language, which has several dialects, belongs to the Mon-Khmer group.

The political unit is the village. There are hereditary headmen who govern with a council of elders; the power of the headman depends on his personality, and public opinion is the final arbiter. Land is held by the community, but there is private ownership of fruit and coconut trees. The status of women is high; they inherit and own property, and girls have considerable freedom in the choice of a husband. The marriage tie is loose, and separation (which ends the marriage) is frequent. Polygamy is rare and is confined to the rich.

Clothing is scanty. Men wear a belt and a cloth perineal band with a tail behind, perhaps connected with one of their stories of origin—that they are descended from a man who mated with a bitch. Articles of European clothing are now often worn. Houses vary in shape; they are built on piles, with thatched roofs and are reached by a notched pole. Much cooking is done in them on clay hearths, but there are also separate cookhouses. Special houses are built by communal labour for feasts and meetings. The coconut is the main crop and yams and other vegetables are grown; fish, turtles, pigs and fowl are also important in the diet. Crossbows are used for shooting birds, spears for hunting pigs, spears, nets, traps and poison for fish, harpoons for turtles. The dao (half sword, half chopper) is the universal tool. Canoes are single outriggers with dugout hulls.

The concept of a beneficent creator is known, probably due to missionary influence. The indigenous religion consists in belief in a multiplicity of spirits, many of them those of ancestors, who may be friendly (locally) or more frequently malevolent. The latter bring disease and misfortune. There is a class of mediums who can communicate with, and control, the spirits; those causing sickness may be caught and towed out to sea in model boats. Grotesque carvings of aggressive mien are kept in houses to scare away evil spirits. Men can acquire reputations as sorcerers by eccentric behaviour, such as sitting in pig wallows and collecting bristles; they are much feared, and are sometimes killed.

The natives of Chowra act as middlemen for the group. They alone make pottery, with clay obtained from Teressa, and exchange it for canoes made in the southern and central islands, which they trade to the north. Chowra men go to Nankauri to burn shells for lime (used in betel chewing), paying in pots for the privilege.

(B. A. L. C.)

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NICOLAI, CHRISTOPH FRIEDRICH (1733–1811), German author and bookseller, was born on March 18, 1733, at Berlin, son of the well-known bookseller, Christoph Gottlieb Nicolai (d. 1752).

In 1749 he went to Frankfurt-on-Oder to learn his father's business, finding time also to become acquainted with English literature. In 1752 he returned to Berlin, and began to take part in literary controversy by defending Milton against the attacks of J. C. Gottsched.

Nicolai's *Briefe über den jetzigen Zustand der schönen Wissenschaften in Deutschland,* published anonymously in 1755 and reprinted by G. Ellinger in 1894, were directed against both Gottsched and Gottsched's Swiss opponents, Johann Jakob Bodmer and Johann Jakob Breitinger; his enthusiasm for English literature won for him the friendship of Gotthold Lessing and Moses Mendelssohn. In association with Mendelssohn he established in 1757 the *Bibliothek der schönen Wissenschaften;* and with Lessing and Mendelssohn *Briefe, die neueste Literatur betreffend* (1759); from 1765 to 1792 he edited the *Allgemeine deutsche Bibliothek.* The *Bibliothek* served as the organ of the so-called "popular philosophers," who warred against authority in religion, and against what they conceived to be extravagance in literature, and Nicolai showed a complete incomprehension of the new movement of ideas represented by Johann von Herder, Goethe, Schiller, Kant and Fichte.

Of Nicolai's independent works, perhaps the only one with some historical value was his *Anekdoten von Friedrich II* (1788–92). His romances were forgotten, although *Das Leben und die Meinungen des Herrn Magister Sebaldus Nothanker* (1773–76) and his satire on Goethe's Werther, *Freuden des jungen Werthers*

(1775), had a certain reputation in their day. Between 1788 and 1796 Nicolai published in 12 volumes a *Beschreibung einer Reise durch Deutschland und die Schweiz,* which bore witness to the narrow conservatism of his views in later life. He died in Berlin on Jan. 11, 1811.

See his *Bildniss und Selbstbiographie* ed. M. S. Löwe in the *Bildnisse jetzt lebender Berliner Gelehrter,* in 1806. *See* also L. F. G. von Göckingk, *F. Nicolai's Leben und literarischer Nachlass* (1820); J. Minor, *Lessings Jugendfreunde,* in J. Kürschner's *Deutsche Nationallitteratur,* vol. lxxii. (1883); M. Sommerfeld, *F. Nicolai und der Sturm und Drang* (Halle, 1921).

NICOLAÏ, OTTO (1810–1849), German composer, was born on the 9th of June in Königsberg. He studied music in Berlin and in 1833 became organist to the German embassy in Rome. There his operas *Enrico II.* (1839) and *Il Templario* (1840) were produced, besides some church music, a series of songs, and a number of compositions for the pianoforte. He was Kapellmeister of the court opera in Vienna from 1841 to 1847, when he was appointed Hof Kapellmeister at the Berlin Opera House. There, only two days before he died (on the 11th of March, 1849), was performed his famous opera, *The Merry Wives of Windsor.*

NICOLAS, SIR NICHOLAS HARRIS, G.C.M.G., 1840 (1799–1848), English antiquary, fourth son of John Harris Nicolas (d. 1844), was born at Dartmouth on the 10th of March 1799. Having served in the navy from 1812 to 1816, he studied law and was called to the bar at the Inner Temple in 1825. His work as a barrister, however, was confined principally to peerage cases before the House of Lords, and his time was mainly devoted to genealogical and historical studies. He died near Boulogne on Aug. 3, 1848.

The most important of the works of Nicolas is his *History of the Orders of Knighthood of the British Empire; of the Order of the Guelphs; and of Medals, Clasps, etc., for Naval and Military Services* (1841–42).

See E. S. P. Haynes, *Personalia* (1918).

NICOLAUS DAMASCENUS, Greek historian and philosopher of Damascus, flourished in the time of Augustus and Herod the Great, with both of whom he was on terms of friendship. He instructed Herod in rhetoric and philosophy, and had attracted the notice of Augustus when he accompanied his patron on a visit to Rome. Later, when Herod's conduct aroused the suspicions of Augustus, Nicolaus was sent on a mission to bring about a reconciliation. He survived Herod, and it was through his influence that the succession was secured for Archelaus; but the date of his death, like that of his birth, is unknown. Fragments of his universal history (Ἱστορία καθολική), from the time of the Assyrian empire to his own days, his autobiography, and his life of Augustus (Βίος Καίσαρος) have been preserved, chiefly in the extracts of Constantine Porphyrogenitus.

Fragments in C. Müller, *Fragmenta historicorum Graecorum,* iii.; *see* also F. Navet, *Nikolaus von Damascus* (1853), containing an account of his life and writings, and translation of the fragments.

NICOLAUS OF LYRA (*c.* 1265–1349), French commentator, was born in Lire, now Vieille-Lyre (Eure). He entered the Franciscan order at Verneuil about 1300, and studied at Paris, where, becoming a doctor some time before 1309, he taught for many years. From 1319 he was provincial of his order in France, and was present in that capacity at the general chapter at Pérouse (1321). In 1325 he was provincial of Burgundy, and as executor of the estate of Jeanne of Burgundy, widow of King Philip VI., he founded the college of Burgundy at Paris, where he died in the autumn of 1349, being buried in the chapter hall of the convent of the Cordeliers.

Among the authentic works of Nicolaus of Lyra are: (1) two commentaries on the whole Bible, one (*Postilla litteralis,* 1322–31) following the literal sense, the other (*Postilla mystica seu moralis,* 1339) following the mystic sense. There are numerous editions (Rome, 1471–72; Douai, 1617; Antwerp, 1634). (2) *Tractatus de differentia nostrae translationis* (*i.e.,* Vulgate) *ab Hebraica veritate,* 1333. (3) Two treatises against the Jews. (4) A theological treatise on the Beatific Vision, directed against pope John XXII. (1334), unpublished. (5) *Contemplatis de vita S. Francisci,* a book of devotions.

In addition to the notices in Wadding, du Moustier, Sbaraglia and Fabricius, *see* C. Siegfried, in *Archiv. f. wissenschaftliche Erforschung des A.T.,* vols. i., ii.; A. Merx, *Die Prophetie des Joel und ihre Ausleger* (1879, pp. 305–366); M. Fischer in *Jahrbücher f. protestantische Theologie,* xv.; F. Maschkowski, in *Zeitschrift f. alttestamentliche Wissenschaft,* xv.; Neumann in *Revue des études juives,* vols. 26 and 27; H Labrosse in *Positions des thèses de l'École des Chartes* (1906).

NICOLE, PIERRE (1625–1695), one of the most distinguished of the French Jansenists, was the son of a provincial barrister, and was born at Chartres. Sent to Paris in 1642 to study theology, he soon entered into relations with the Jansenist community at Port Royal (*q.v.*) through his aunt, Marie des Anges Suireau, who was for a short time abbess of the convent. For some years he was a master in the "little school" for boys established at Port Royal, and taught Greek to young Jean Racine, the future poet. With Antoine Arnauld, he acted as general editor of the controversial literature put forth by the Jansenists. He had a large share in collecting the materials for Pascal's *Provincial Letters* (1656); in 1658 he translated the *Letters* into Latin, under the pseudonym of Nicholas Wendrock. In 1664 he himself began a series of letters, *Les Imaginaires,* intended to show that the heretical opinions commonly ascribed to the Jansenists really existed only in the imagination of the Jesuits. His letters being violently attacked by Desmaretz de Saint-Sorlin, an erratic minor poet who professed great devotion to the Jesuits, Nicole replied to him in another series of letters, *Les Visionnaires* (1666). In the course of these he observed that poets and dramatists were no better than "public poisoners."

About the same time Nicole became involved in a controversy about transubstantiation with the Huguenot Claude; out of this grew a massive work *La Perpétuité de la foi de l'église catholique touchant l'eucharistie* (1669), the joint effort of Nicole and Antoine Arnauld. But Nicole's most popular production was his *Essais de morale* (14 vols., 1671 *seq.*), a series of short discussions on practical Christianity. In 1679, on the renewal of the persecution of the Jansenists, Nicole was forced to fly to Belgium in company with Arnauld. But the two soon parted. Nicole was elderly and in poor health; the life of a fugitive was not to his taste, and he complained that he wanted rest. "Rest," answered Arnauld, "when you have eternity to rest in!" In 1683 Nicole made a rather ambiguous peace with the authorities, and was allowed to come back to Paris. There he continued his literary labours; he was writing a refutation of the new heresy of the Quietists when death overtook him on Nov. 16, 1695. (*See* PORT ROYAL.)

Several abridgments of the *Essais* exist, notably a *Choix des essais de morale de Nicole,* ed. Silvestre de Saci (1857).

Nicole's life is told at length in the 4th volume of Sainte Beuve's *Port-Royal.*

NICOLL, ROBERT (1814–1837), Scottish poet, was born on Jan. 7, 1814, at the farm of Little Tullybeltane, in the parish of Auchtergaven, Perthshire. At sixteen the boy was apprenticed to a grocer and wine-merchant at Perth. In 1833 he began to contribute to *Johnstone's Magazine* (afterwards *Tait's Magazine*), and in the next year his apprenticeship was cancelled. In 1836 he became editor of the *Leeds Times.* He died at the house of his friend William Tait, at Trinity, near Edinburgh, on Dec. 7, 1837, in his twenty-fourth year. He had published a volume of *Poems* in 1835; and in 1844 appeared a further volume, *Poems and Lyrics,* with an anonymous memoir of the author by Mrs. C. I. Johnstone. The best of his lyrics are those written in the Scottish dialect.

See P. R. Drummond, *Life of Robert Nicoll, Poet* (1884).

NICOLL, SIR WILLIAM ROBERTSON (1851–1923), Scottish Nonconformist divine and man of letters, was born at Auchindoir, Aberdeenshire, on Oct. 10, 1851, the son of a Free Church minister. He graduated M.A. at Aberdeen in 1870, and studied for the ministry at the Free Church college there until 1874, when he was ordained minister of the Free church at Dufftown. Three years later he moved to Kelso, and in 1884 became editor of the *Expositor.* In 1886 he founded the *British Weekly,* a Nonconformist organ which obtained great influence over opinion in the free churches. Robertson Nicoll helped to make the fortunes of the paper by the papers which he contributed over the signature of "Claudius Clear." He also founded and edited the *Bookman* (1891, etc.), and acted as chief literary adviser to the publishing firm of Hodder and Stoughton. He edited *The*

Expositor's Greek Testament (1897, etc.), and a series of *Literary Lives* (1904, etc.). He was knighted in 1909 and died on May 4, 1923. *See* T. H. Darlow, *William R. Nicoll* (1925).

NICOLLS, RICHARD (1624–1672), American colonial governor, was born probably at Ampthill, Eng., in 1624. He commanded a royalist troop of horse during the Civil War and on the defeat of the king went into exile. Soon after the Restoration he entered the service of the duke of York, through whose influence he was appointed in 1664 on a commission to conquer New Netherland from the Dutch and to regulate the affairs of the New England colonies and settle disputes among them. The expedition set sail from Portsmouth on May 25, 1664, and New Amsterdam was surrendered to Nicolls on Sept. 8. Under authority of a commission from the duke of York, Nicolls assumed the position of deputy governor of New Netherland (New York). His policy was vigorous but tactful, and the transition to the new regime was made smoothly and with due regard to the interests of the conquered people. The English system of law and administration was at once introduced into Long Island, Staten Island and Westchester, where the English element already predominated, but the change was made much more slowly in the Dutch sections. A code of laws known as the "duke's laws," drafted by the governor with the help of his secretary, Matthias Nicolls (*c.* 1630–87), was proclaimed in 1665 and continued in force until 1683. Nicolls returned to England in the summer of 1668 and continued in the service of the duke of York. He was killed in the naval battle of Southwold bay May 28, 1672.

See J. R. Brodhead, *History of the State of New York,* rev. ed. (1872); Woodrow Wilson, *A History of the American People,* vol. i (1902); M. Schuyler, *Richard Nicolls, First Governor of New York, 1664–1668* (New York, 1933); For the "duke's laws" see *Laws of Colonial New York,* i, 6–100.

NICOMACHUS, a Neo-Pythagorean philosopher and mathematician, born at Gerasa in Arabia Petraea, flourished about A.D. 100. Two treatises by him are extant: (1) The *Introductio arithmetica* sets out the elementary theory and properties of numbers. Numbers are no longer denoted by lines as in Euclid, but are written in the ordinary notation; hence general principles can be stated only with reference to particular numbers taken as illustrations. Nicomachus states a rule about cubes which enables us to sum any number of forms of the series of natural cubes beginning from 1; otherwise the book is mathematically unimportant. It had, however, great vogue ("You count like Nicomachus," says a character in Lucian). A Latin translation by Apuleius of Madaura (born about A.D. 125) is lost; but we have Boëtius' version. The commentators include Iamblichus, Heronas, Asclepius of Tralles, Joannes Philoponus and Proclus. The Greek text was edited by R. Hoche (Teubner, 1866) and the commentaries of Iamblichus and Philoponus by Pistelli (Teubner, 1894) and Hoche (Leipzig, 1864, and Berlin, 1867), respectively. There is an English edition by F. E. Robbins and L. C. Karpinski (New York, 1926). (2) The *Enchiridion Harmonices* (edited by Jan in *Musici Scriptores Graeci,* 1895) is on the Pythagorean theory of music. Nicomachus is said to have written *Theologumena arithmetices* (in two books) on the properties of numbers, of which the *Theologumena arithmeticae* edited by Ast (1817) contains no more than fragments, at most. (T. L. H.)

NICOMACHUS, of Thebes, Greek painter, active *c.* 390–340 B.C., was a contemporary of the greatest painters of Greece; Vitruvius observes that if his fame was less than theirs, it was the fault of fortune rather than of demerit. Pliny (xxxv, 108) gives a list of his works, among them a "Rape of Persephone," "Victory in a Quadriga," a group of Apollo and Artemis and the "Mother of the Gods Seated on a Lion." Pliny tells us that he was a very rapid worker and used but four colours.

NICOMEDES I, king of Bithynia (*c.* 278–248 B.C.). He made himself master of the whole country and put to death his brother, who had set himself up as an independent ruler. He enlarged and consolidated the kingdom, founded the city of Nicomedia as the capital and fought successfully for some time with Antiochus of Syria. Nicomedes II, king of Bithynia (149–91 B.C.), was fourth in descent from Nicomedes I. A popular ruler, he adhered steadily to the Roman alliance. His son, Nicomedes III, ruled until 74 B.C.

NICOMEDIA: *see* ISMID.

NICOPOLIS (VICTORY CITY), **ACTIA,** an ancient city of Epirus, founded 31 B.C. by Octavian (Augustus) in memory of his victory over Antony and Cleopatra at Actium. The colony, composed of settlers from many neighbouring towns, succeeded and became the capital of southern Epirus and Acarnania, with the right of sending five representatives to the amphictyonic council. On the spot where Octavian's tent had stood he built a sanctuary to Neptune adorned with beaks of captured galleys, and instituted the Actian games in honour of Apollo. The city was restored by the emperor Julian and again (after the Gothic invasion) by Justinian, but in the middle ages it was supplanted by Prevesa. The ruins, now known as Palaeoprevesa (Old Prevesa), lie about 3 mi. N., on a small bay at the narrowest part of the peninsula which separates the Gulf of Arta (Sinus Ambracius) from the Ionian sea. The most conspicuous objects are the acropolis, two theatres and an aqueduct.

NICOSIA, the capital of Cyprus, situated in the north central part of the island. Pop. (1946) 34,485; (1951 est.) 39,000. Its earliest name was Ledra, but Leucos, son of Ptolemy Soter (280 B.C.), is said to have changed its name to Leucotheon, corrupted into mediaeval Greek Leucosia and Frankish Nicosia. A mile southwest of the town lies the very large Bronze Age necropolis known as Hagia Paraskevi. The principal monuments of the Lusignan period are the fine Gothic cathedral of St. Sophia, now a mosque, and the church of St. Catherine, now the Haidar Pasha mosque. Adjoining St. Sophia is an early church, later used as a grain store, mistakenly identified in modern times as the church of St. Nicolas of the English. The Famagusta gate was originally known as Porta Giuliana, named for its builder, the Venetian engineer Giulio Savorgnano. In 1567 he reduced the circuit of the city from 9 mi. to 3, constructing a circular earthwork fortification with 11 heart-shaped bastions. Nicosia was captured by the Turks in 1570 after a famous siege of seven weeks. The weaving of silk and other textiles by hand is of importance. Most of the government offices and English residences are located without the walls. There is a narrow-gauge railway connecting Nicosia with the seaport of Famagusta, 37 mi. distant.

See R. Gunnis, *Historic Cyprus* (Philadelphia and London, 1936).

NICOSIA, city and episcopal see (since 1816), Sicily, It., province of Enna, 21 mi. N. of the railway station of Leonforte (which is 49 mi. W. of Catania), 2,840 ft. above sea level. Pop. (1951) 19,428 (commune). The town retains a mediaeval appearance, with a Norman cathedral and other interesting churches, among them S. Maria Maggiore, with a reredos by Antonio Gagini. A Lombard dialect is still spoken there.

NICOTERA, GIOVANNI (1828–1894), Italian patriot and politician, was born at San Biagio on Sept. 9, 1828. Joining the party of Young Italy he was among the combatants at Naples in May 1848 and was at San Pancrazio with Garibaldi during the defense of Rome. After the fall of Rome he fled to Piedmont, where he organized the expedition to Sapri in 1857, but shortly after his arrival there he was defeated and severely wounded by the Bourbon troops. Condemned to death, but reprieved through the intervention of the British minister, he remained a prisoner at Naples and at Favignana until 1860, when he joined Garibaldi at Palermo. Sent by Garibaldi to Tuscany, he attempted to invade the papal states with a volunteer brigade, but his followers were disarmed and disbanded by Ricasoli and Cavour. In 1862 he was with Garibaldi at Aspromonte; in 1866 he commanded a volunteer brigade against Austria; in 1867 he invaded the papal states from the south, but the defeat of Garibaldi at Mentana put an end to his enterprise. His parliamentary career dates from 1860. During the first ten years he engaged in violent opposition, but from 1870 onward he joined in supporting the military reforms of Ricotti. Upon the advent of the left in 1876, Nicotera became minister of the interior, and governed with remarkable firmness. He was obliged to resign in Dec. 1877, when he joined Crispi, Cairoli, Zanardelli and Baccarini in forming the "pentarchy" in opposition to Depretis, but he only returned to power 13 years later as minister of the interior in the Rudini cabinet of

1891. On this occasion he restored the system of uninominal constituencies and resisted the socialist agitation. He fell with the Rudini cabinet in May 1892, and died at Vico Equense, near Naples, on June 13, 1894.

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NICOTIANA, a genus of plants of the nightshade family (Solanaceae), comprising about 45 species of herbs and shrubs, native chiefly to tropical America. They are strongly scented, annuals or perennials, possessing narcotic poisonous properties. They have alternate, simple, usually entire but sometimes wavy-margined, large leaves, and white, yellow, greenish or purple, fragrant flowers, with a long, tubular, five-lobed corolla, usually opening at night. Besides *N. Tabacum*, important as the source of commercial tobacco (*q.v.*), several other species are cultivated as ornamental plants. Some ten species are found in the southern and western parts of the U.S., *N. glauca* (tree tobacco) a slender evergreen shrub native to Brazil, has become widely naturalized on the Pacific coast. *N. rustica,* one of the plants known as wild tobacco, formerly cultivated by the Indians of the eastern states, is of uncertain origin, but is thought to be the source of the first tobacco taken from tropical America to Europe, and popularized by John Nicot, for whom the genus was named.

NICOTINE, a volatile liquid, is the principal alkaloid (*see* Alkaloids) of tobacco, in which it occurs to the extent of 4% to 5% along with minute amounts of closely related alkaloids. Nicotine is still used in medicine to a small extent, but the principal demand for it is as a horticultural insecticide. It is prepared by adding lime or caustic soda to a filtered, concentrated, aqueous extract of tobacco (stalk and other tobacco refuse is generally used) and recovering the alkaloid so set free, by extraction with a suitable solvent or by steam distillation. This crude alkaloid is freed from water by a chemical drying agent, such as solid potash, and then fractionally distilled. Pure nicotine, $C_{10}H_{14}N_2$, is a highly poisonous colourless liquid, with an unpleasant odour; it boils at 246°–247° C., $[\alpha]_D$–168.5°, and is soluble in most solvents including water. The dipicrate crystallizes in short, yellow prisms, melts at 218° C. and is characteristic of the alkaloid. Nicotine was synthesized in the year 1904 by Pictet, Crepieux and Rotschy.

NICTHEROY, officially Niterói, a city of Brazil and capital of the state of Rio de Janeiro, on the east shore of the Bay of Rio de Janeiro, opposite the city of that name. Population (1950) 174,535; (*municipio,* 190,147). A railway connects the city with the interior, with Macae, on the coast, and with the lines of Minas Gerais. Niterói is practically a residential suburb of Rio de Janeiro. It occupies, in great part, the low alluvial plain that skirts the shores of the bay and fills the valleys between numerous low wooded hills. The site is shut off from the seacoast by a range of high rugged mountains. The shore line of the bay is broken by large, deeply indented bays.

The city consists of a number of these partially separated districts—Praia Grande, São Domingos, Icaraí, Jurujuba, Santa Rosa, São Lourenço, Ponta d'Areia and Barreto—all together covering 8 or 9 mi. of the shore. An electric street railway connects all the outlying districts with the ferry stations of Praia Grande and São Domingos. The city is characteristically Portuguese in the construction and style of its buildings—low, heavy walls of broken stone and mortar, plastered and coloured outside, with an occasional facing of glazed Lisbon tiles, and covered with red tiles. Among the public buildings are several churches and hospitals (including the Jurujuba yellow-fever hospital and the Barreto isolation hospital), the government palace, a municipal theatre and a large Salesian college situated in the suburbs of Santa Rosa on an eminence overlooking the lower bay. Several large islands fill the upper bay near the eastern shore; some are used as coal deposits for the great steamship companies, and one (Flores) is used as an immigrants' depot. Manufactures include cotton and woollen fabrics, tobacco, spirits, soap and tiles.

The first settlement on the east side of the Bay of Rio de Janeiro dates from 1671, when a chapel was erected at Praia Grande, in the vicinity of an Indian village. The settlement did not become a village until 1819, when it was named Villa Real da Praia Grande. In 1834 the city and municipal district of Rio de Janeiro were separated from the province, and Praia Grande became the capital of the latter in the following year. In 1836 it was raised to the dignity of a city and received the appropriate name of Niterói, from the Indian name *Nyterõi,* "hidden water." In the naval revolt of 1893–94 the older districts of the city suffered much damage from desultory bombardments, but the insurgents were too few to take possession. Soon afterward the seat of government was removed to Petrópolis, but restored in 1903.

NIDAROS: *see* Trondhjem.

NIEBUHR, BARTHOLD GEORG (1776–1831), German statesman and historian, son of Karsten Niebuhr (*q.v.*), was born at Copenhagen on Aug. 27, 1776. After studying at the university of Kiel, he became private secretary to Count Schimmelmann, Danish minister of finance, but in 1799 entered the state service. He was chief director of the national bank from 1804 to 1806 when he took a similar appointment in Prussia. He accompanied the Prussian government to Königsberg, where he rendered considerable service in the commissariat, and was afterward still more useful as commissioner of the national debt and by his opposition to ill-considered schemes of taxation. In 1810 he was made royal historiographer and professor at Berlin university, and two years later published two volumes of his *Römische Geschichte* (Eng. trans., 1847–51). In 1816, while on his way to Rome to take up the post of ambassador, he discovered in the cathedral of Verona the long-lost *Institutes* of Gaius, afterward edited by Savigny, to whom he communicated the discovery under the impression that he had found a portion of Ulpian. During his residence in Rome Niebuhr discovered and published fragments of Cicero and Livy, aided Cardinal Mai in his edition of Cicero *De Republica,* and shared in planning the great work on the topography of ancient Rome by von Bunsen and Platner (1773–1855), to which he contributed several chapters. In 1823 he resigned the embassy and established himself at Bonn, where he died on Jan. 2, 1831.

Niebuhr's *Roman History,* to which he added a third volume (1832), counts among epoch-making histories both as marking an era in the study of its special subject and for its momentous influence on the general conception of history. "The main results," says Leonhard Schmitz, "arrived at by the inquiries of Niebuhr, such as his views of the ancient population of Rome, the origin of the plebs, the relation between the patricians and plebeians, the real nature of the ager publicus, and many other points of interest, have been acknowledged by all his successors." He was the first to deal with the ancient history of Rome in a scientific spirit and introduced new principles into historical research. He suggested the theory of the myth; he brought in inference to supply the place of discredited tradition and showed the possibility of writing history in the absence of original records; he drew attention to the importance of ethnological distinctions, and laid stress on institutions, and social traits to the neglect of individuals.

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NIEBUHR, KARSTEN (1733–1815), German traveller, was born at Lüdingworth, Lauenburg, Holstein, on March 17, 1733, the son of a farmer. He worked as a peasant in his early years, but managed to learn surveying. In 1760 he was invited to join the expedition which was being sent out by Frederick V of Denmark for the scientific exploration of Egypt, Arabia and Syria. He studied mathematics and Arabic for a year and a half before the expedition set out. The expedition sailed in January 1761, and, landing at Alexandria, ascended the Nile. Proceeding to Suez, Niebuhr visited Mount Sinai, and in October 1762 the expedition sailed from Suez to Jeddah, journeying thence overland to Mocha. Here in May 1763 the philologist of the expedition, van Haven, and the naturalist Forskål, died. Sana, the capital

of Yemen, was visited, but the remaining members of the expedition were obliged to return to Mocha. Niebuhr saved his life and restored his health by adopting native dress and food. From Mocha the ship sailed to Bombay; the artist of the expedition and the surgeon died. Niebuhr was now the only surviving member of the expedition. He stayed fourteen months at Bombay, and then returned home by Muscat, Bushire, Shiraz and Persepolis, visited the ruins of Babylon, and thence went to Baghdad, Mosul and Aleppo. After a visit to Cyprus he toured Palestine, crossing Mount Taurus to Brussa, reaching Constantinople in February 1767 and Copenhagen in the following November. He married in 1773, and held a post in the Danish military service and lived at Copenhagen. In 1778 he accepted a position in the civil service of Holstein, and went to reside at Meldorf, where he died on April 26, 1815.

He published *Beschreibung von Arabien* (1772); *Reisebeschreibung von Arabien und anderen umliegenden Ländern* (2 vols., 1774–78) besides papers in *Deutsches Museum.* He also edited Forskål's *Descriptiones animalium, Flora Aegyptiaco-Arabica,* and *Icones rerum naturalium* (1775–76).

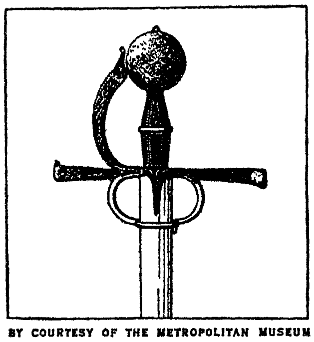
French and Dutch translations of his narratives were published during his lifetime, and a condensed English translation, by Robert Heron, of the first three volumes in Edinburgh (1792). His son Barthold (*see* above) published a short *Life* at Kiel in 1817; an English version was issued in 1838 in the *Lives of Eminent Men,* published by the Society for the Diffusion of Useful Knowledge. *See* D. G. Hogarth, *The Penetration of Arabia* ("Story of Exploration" series) (1904).

NIEDERWALD, a broad hill in Germany, in the province of Hesse-Nassau, opposite Bingen, forming the south-western apex of the Taunus range (*q.v.*). Its summit is clothed with dense forests of oak and beech, while its southern and western sides, which descend sharply to the Rhine, are covered with vineyards. On the hill above Rüdesheim, stands the national monument of the war of 1870–71. Cog railways run up the hill.

NIEHAUS, CHARLES HENRY (1855–1935), American sculptor, was born at Cincinnati, O., on Jan. 24, 1855. He was a pupil of the McMichen school of design, Cincinnati, and also studied at the Royal Academy, Munich, returning to America in 1881. In 1885, after several years in Rome, he established his studio in New York city. In 1906 he became a National Academician. His principal works are a statue of President Garfield, for Cincinnati; the Hahnemann memorial, in Washington; "Moses" and "Gibbons," for the congressional library, and "James A. Garfield," "John J. Ingalls," "William Allen" and "Oliver P. Morton," for Statuary hall, the Capitol, Washington; "Hooker" and "Davenport," State House, Hartford, Conn.; the Astor memorial doors, Trinity church, New York; "General Forrest," Memphis, Tenn.; Generals Sherman and Lee, and William the Silent; "The Scraper, or Greek Athlete using a Strigil"; statues of Lincoln, Farragut and McKinley, at Muskegon, Mich.; a statue of McKinley and a lunette for McKinley's tomb, at Canton, O.; "The Driller," at Titusville, Pa., in memory of Col. E. L. Drake, who, in 1859, originated the petroleum industry of America; "Francis Scott Key," at Baltimore; and the war memorials at Newark and Hackensack, N.J.

NIEL, ADOLPHE (1802–1869), marshal of France, was born at Muret on Oct. 4, 1802, and entered the École Polytechnique in 1821, whence he passed to the engineer school at Metz, becoming lieutenant in the Engineers in 1827 and captain in 1833. He served with distinction in Algeria and in the Crimean War. Niel commanded the IV. corps in the war against the Austrians. (*See* ITALIAN WARS.) On the field of battle of Solferino he was made a marshal of France. After service in a home command, he became minister of war (1867). He drafted and began to carry out a far-reaching scheme of army reform, based on universal service and the automatic creation of large reserves. He also rearmed the whole of the army with the chassepôt rifle. He died on Aug. 13, 1869, in Paris.

NIELLO (the Italian form of Lat. *nigellum,* diminutive of *niger,* "black"), a method of producing delicate and minute decoration on a polished metal surface by incised lines filled in with a black metallic amalgam. In some cases it is very difficult to distinguish niello from black enamel; but the black substance differs from true enamel in being metallic, not vitreous. Our knowledge of the process and materials employed in niello-work is derived mainly from four writers, Eraclius the Roman (a writer probably of the 11th century), Theophilus the monk, who wrote in the 12th or 13th century, and, in the 16th century, Benvenuto Cellini and Giorgio Vasari. The design was cut with a sharp graving tool on the smooth surface of the metal, which was usually silver, but occasionally gold or even bronze. An alloy was formed of two parts silver, one-third copper and one-sixth lead; to this mixture, while fluid in the crucible, powdered sulphur in excess was added; and the brittle amalgam, when cold, was finely pounded, and sealed up in large quills for future use. A solution of borax to act as a flux was brushed over the metal plate and thoroughly worked into its incised lines. The powdered amalgam was then shaken out of the quills on to the plate, so as to cover completely all the engraved pattern. The plate was now carefully heated over a charcoal fire, fresh amalgam being added, as the powder fused, upon any defective places. When the powder had become thoroughly liquid, so as to fill all the lines, the plate was allowed to cool, and the whole surface was scraped, so as to remove the superfluous niello, leaving only what had sunk into and filled up the engraved pattern. Last of all the nielloed plate was very highly polished, till it presented the appearance of a smooth metal surface enriched with a delicate design in fine grey-black lines. This process was chiefly used for silver work on account of the vivid contrast between the whiteness of the silver and the darkness of the niello. As the slightest scratch upon the metal received the niello, and became a distinct black line, ornament of the most minute and refined description could easily be produced.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

VENETIAN SWORD HILT OF THE EARLY 16TH CENTURY

The earliest specimens of niello belong to the Roman period. Two fine examples are in the British Museum. One is a bronze statuette of a Roman general, nearly 2 ft. high, found at Barking hall in Suffolk. The dress and armour have patterns partly inlaid in silver and partly in niello. The dark tint of the bronze rather prevents the niello from showing out distinctly. This statuette is apparently a work of the 1st century. The other example is not earlier than the 4th century. It is a silver casket or lady's toilet box, in which were found an ampulla and other small objects, enriched with niello-work.

From Roman times till the end of the 16th century the art of working in niello seems to have been constantly practised in some part at least of Europe, while in Russia and India it has survived to the present day. From the 6th to the 12th century a large number of massive and splendid works in the precious metals were produced at Byzantium or under Byzantine influence, many of which were largely decorated with niello; the silver dome of the baldacchino over the high altar of S. Sophia was probably one of the most important of these. Niello is frequently mentioned in the inventories of the treasures belonging to the great basilicas of Rome and Byzantium. The Scala d'Oro in S. Mark's, Venice, 10th century, owes much of its refined beauty to niello patterns in the borders. This art was also practised by Bernward, artist-bishop of Hildesheim (11th century). In France, too, judging both from existing specimens of ecclesiastical plate and many records preserved in church inventories, this mode of decoration must have been frequently applied all through the middle ages: especially fine examples once existed at Notre Dame, Paris, and at Cluny, where the columns of the sanctuary were covered with plates of silver in the 11th century, each plate being richly ornamented with designs in niello. Among the early Teutonic and Celtic races, especially from the 8th to the 11th centuries, both in Britain and other countries, niello was frequently used to decorate the very beautiful personal ornaments of which so many specimens enrich the museums of Europe. The British Museum

possesses a fine fibula of silver decorated with a simple pattern in niello and thin plates of repoussé gold. This, though very similar in design to many fibulae from Scandinavia and Britain, was found in a tomb at Kerch (Panticapaeum). Several interesting gold rings of Saxon workmanship have been found at different times, on which the owner's name and ornamental patterns are formed in gold with a background of niello. One with the name of Ethelwulf, king of Wessex (836–858), is now in the British Museum. Another in the Victoria and Albert Museum has the name of Alhstan, who was bishop of Sherborne from 823 to 867. The metal-workers of Ireland, whose skill was quite unrivalled, practised largely the art of niello from the 10th to the 12th century, and possibly even earlier. Fine croziers, shrines, fibulae and other objects of Irish workmanship, most skilfully enriched with elaborate niello-work, exist in considerable numbers. From the 13th to the 16th century but little niello-work appears to have been produced in England. It is, however, in Italy that the art of niello-work was brought to greatest perfection. During the whole mediaeval period it was much used to decorate church plate, silver altar-frontals and the like. The magnificent frontals of Pistoia cathedral and the Florence baptistery are notable instances of this. During the 15th century, especially at Florence, the art of niello-work was practised by almost all the great artist-goldsmiths of that period. The British Museum possesses the finest existing example of 15th-century German niello. It is a silver beaker, covered with graceful scroll-work, forming medallions, in which are figures of cupids employed in various occupations.

Bibliography.—*The Archaeological Journal* of 1862 (vol. xix., p. 323) has an excellent monograph on the subject, *see* also vol. xii., p. 79 and vol. iv., p. 247; Labarte, *Arts of the Middle Ages* (1855); Texier, *Dictionnaire de l'orfèvrerie*, p. 1822 (Paris, 1857); Lessing, *Collectaneen zur Literatur* (vol. xii., art. "Niellum"); C. Davenport in *Journal of Soc. of Arts*, vol. xlviii. (1901).

NIEM [Nyem, or Nieheim], **DIETRICH OF** (*c.* 1345–1418), mediaeval historian, was born at Nieheim, a small town subject to the see of Paderborn. He became a notary of the papal court of the rota at Avignon, and in 1376 went with the Curia to Rome. Urban VI. made him an abbreviator to the papal chancery. His chief importance lies in the part he took in the controversies arising out of the Great Schism. He accompanied Gregory XII. to Lucca in May 1408, and, having in vain tried to make the pope listen to counsels of moderation, he joined the Roman and Avignonese cardinals at Pisa. He adhered to the pope elected by the council of Pisa (Alexander V.) and to his successor John XXIII., resuming his place at the Curia. In view of the increasing confusion in the Church, however, he became one of the most ardent advocates of the appeal to a general council. He was present at the council of Constance as adviser to the German "nation." He died at Maastricht on March 22, 1418.

Niem's most important works are the *Nemus unionis*, a valuable collection of papal documents; and the *De schismate*, giving the history of events from 1376 to 1410, when he completed the work. It was continued in the *Historia de vita Johannis XXIII.*

For bibliography *see* Potthast, *Bibl. hist. medii aevi* (2nd ed., Berlin, 1896), p. 1,051, *s.v.* "Theodoricus de Niem"; and generally *see* the article on Niem by Theodor Lindner in *Allgemeine deutsche Biographie* (Leipzig, 1886); and Erler, *Dietrich von Nieheim* (Leipzig, 1887).

NIEMCEWICZ (nyĕm-tsä'vĭch), **JULIAN URSIN** (1757–1841), Polish scholar, poet and statesman, was born in 1757. In the earlier part of his life he acted as adjutant to Kosciusko, was taken prisoner with him at the fatal battle of Maciejowice (1794), and shared his captivity at St. Petersburg. On his release he travelled for some time in America, where he married. After the Congress of Vienna he was secretary of state and president of the constitutional committee in Poland, but in 1830–31 he was again driven into exile. He died in Paris on the 21st of April 1841. Niemcewicz wrote comedies, novels and historical works, but he is best remembered by his *Historical Songs of the Poles* (Warsaw, 1816), a series of lyrical compositions in which the chief heroes are of the golden age in Polish history.

His collected works were published in 12 vols. at Leipzig (1838–40).

NIEPCE (nē-eps'), **JOSEPH NICEPHORE** (1765–1833), French physicist, and one of the inventors of photography, was born at Châlon-sur-Saône on March 7, 1765. He served in the army and was *administrateur* of the district of Nice from 1795 to 1801. Returning in that year to his birthplace, he devoted himself along with his elder brother Claude (1763–1828) to mechanical and chemical researches. In 1813 the idea of obtaining photographs first suggested itself to him, and in 1827 he succeeded in producing a photograph on a metal plate. Niepce learned that L. J. M. Daguerre was working in the same direction, and in 1829 the two united their forces "pour coopérer au perfectionnement de la découverte inventée par M. Niepce et perfectionnée par M Daguerre" (*see* also Photography). Niepce died at Gras, his property near Châlon, on July 3, 1833.

NIERSTEIN, a village of Germany, in the *Land* of Hesse. on the left bank of the Rhine, 8 m. S. from Mainz by the railway to Worms. Pop. (1933) 4,807. Nierstein was originally a Roman settlement, and was a royal residence under the Carolingian rulers. Later it passed from the emperor to the elector palatine of the Rhine. It contains an old Roman bath—Sironabad—and sulphur springs. It is famous for its wines.

NIETZSCHE, FRIEDRICH WILHELM (1844–1900), German philosopher, born Oct. 15, 1844 at Röcken near Lützen, in the Prussian province of Saxony, came of a family of clergymen. Both his father and his grandfather were Protestant pastors, while his paternal grandmother and his mother, née Oehler, were also pastors' daughters. They were honourable, pious people, cheerful and happy, with a social life embellished by poetry and music; while their official standing secured them from the petty cares of existence. Nietzsche's forbears also enjoyed singular bodily vigour, which they retained in all its freshness to old age. Nietzsche's father, who died prematurely from a fall down a flight of steps, was an exception. In his joy over the birth of a son, this father inserted in the Church register of Röcken at Friedrich's christening the question from Luke i., 66, "what manner of child shall this be?"

Wagner and Schopenhauer.—The boy was educated at Naumburg and at the famous old Fürstenschule of Pforta, which he left with an excellent leaving certificate (with only one "unsatisfactory," in mathematics). In the autumn (1864) he was entered at the University of Bonn, as a student of theology and classical philology. As, however, he found at Bonn an exceptionally gifted teacher of classical philology in Ritschl, he soon, to the great grief of his family, abandoned theology and devoted himself exclusively to philological studies. In fact, the undergraduate Nietzsche severed himself not only from theology but from Christianity; the determining influence in this change was his reading of Schopenhauer, whose great work, *The World as Will and Idea*, had fallen into his hands by accident.

His enthusiasm for Schopenhauer and for music—an art which Nietzsche loved and practised throughout his life—brought him into touch with Richard Wagner, who was then living at Triebschen on the Lake of Lucerne. Nietzsche, as a young student of 25, had, on Ritschl's recommendation, been appointed professor at Basel; and close personal intercourse with Wagner followed. The two men agreed in their judgment of their own time, and in their appreciation of antiquity; Nietzsche combined Wagner's views and his own researches on Greek artistic achievement in *Die Geburt der Tragödie* (1870–71). But the book was severely condemned by the official German school, under the leadership of Ulrich v. Wilamowitz, and Nietzsche as a classical scholar was outlawed.

He clung all the more closely to Wagner, at whose side he waged war against German lack of culture. The four *Unzeitgemässen Betrachtungen*, devoted to this struggle, were intended to restore Germany, whose development Nietzsche felt had been jeopardized by the victories of 1864, '66 and '70, to intellectual pursuits. These four polemical works (1873–76) are entitled *David Strauss, der Bekenner und Schriftsteller; Vom Nutzen und Nachteil der Historie für das Leben; Schopenhauer als Erzieher;* and *Richard Wagner in Bayreuth.*

In working on the last of these, Nietzsche began to be conscious of reservations both on the cultural value of Wagner's creations, and on his personality; during the Bayreuth Festival, these reser-

vations led to estrangement and ultimately to passionate renunciation. (See *Der Fall Wagner, Nietzsche contra Wagner,* 1888.) Nietzsche held that Wagner's art was nothing more than the dope required by a decadent generation, and the whitewashing of Schopenhauer's pessimism. In both his models, Schopenhauer and Wagner, he began to discern tendencies towards Christian and Buddhistic negation, and therefore, though with much pain, broke loose from them. The first expression of this emancipation is found in *Menschliches all-zu Menschliches* (2 vols. 1878), in which Nietzsche enters on his essentially negative critical period. In 1879, probably owing to the pain caused by his violent separation from his friends and masters, Nietzsche's health became so bad that he had to resign his professorship at Basle. Thenceforward, he lived chiefly in northern Italy, the Engadine, or the French Riviera, on the small pension granted him by the university of Basle.

Maturity.—From this time onwards, he devoted himself wholly to philosophy, and with the gradual improvement in his health, entered the third and mature period of his creative life, during which his best works were given to the world. In *Morgenröte* (1880–81) and *Die fröhliche Wissenschaft* (1881–82), he fought romanticism in all its manifestations, and revealed art, religion and philosophy as illusions invented by man as weapons in his struggle for development, for prevailing over himself and his fellows.

In the years 1883–85, he produced work which he himself regarded as his highest achievement. Written in the style of an Old Testament prophet, this work which was his own New Testament, the gospel of the superman and the eternal recurrence, was entitled *Also Sprach Zarathustra. Ein Buch für Alle und Keinen.* Nietzsche provided a valuable interpretation of this work, parts of which even to-day are difficult to understand, in the two volumes of *Jenseits von Gut und Böse* (1885–86) and *Genealogie der Moral* (1887). He then planned a greater work, *Der Wille zur Macht: Versuch zur Umwertung aller Werte.* It was never finished, but contains no less than 1,052 valuable aphorisms: its two volumes (Vols. xiv. and xv. in the English works) are divided into the following sections:—(1) European Nihilism, (2) A Criticism of the Highest Values that have prevailed hitherto, (3) The Principles of a New Valuation, (4) Discipline and Breeding. The three fine and stimulating books, *Götzendämmerung, oder wie man mit dem Hammer philosophiert, Der Antichrist,* and the autobiography *Ecce Homo,* date from his last and exceptionally productive period, the year 1888.

At the turn of the year (1888–89) Nietzsche broke down, probably from overwork; for, outwardly calm as his life had been, the philosopher had suffered most violent moral upheavals, and had moreover recorded his innermost experience in a brief space of time in a number of carefully thought out works. Another cause of his breakdown was probably his extreme loneliness; only in the last year of his conscious life was he "discovered" by the Danish-European critic and author, Georg Brandes; he himself had neither followers nor disciples. We may take him at his word when, on July 8, 1886, he writes to his sister:—"My health is really quite normal—only my soul is so sensitive and so full of longing for good friends of my own kind. Get me a small circle of men who will listen to me and understand me—and I shall be cured." Nietzsche lived on for another 12 years, first with his mother at Naumburg and, after the latter's death, with his widowed sister, Elizabeth Förster-Nietzsche at Weimar, where he died on Aug. 25, 1900. He was buried in the churchyard of Röcken.

The Message.—In order to understand Nietzsche's philosophy, which departs conspicuously from the orthodox and academic, it is necessary once more to make a profound study of his development. Nietzsche, it must be remembered, did not spin his view of life out of his inner consciousness, but lived and suffered it—a fact which explains both his language, free from learned jargon, and his half pathetic, half ironical style, which is yet always so full of poetry and metaphor.

Nietzsche, as we have seen, started his philosophical career with Schopenhauer—the philosopher who took such a gloomy and despondent view of life that, at last, in wrath over his own aversions, he denied the will to life altogether. In the end Nietzsche came to regard Schopenhauer's principal work as the outpourings of a melancholy young man. Its author never fought his way through to cheerful maturity, but remained fettered to the doctrines he had laid down early in life. Nietzsche, whose motto was, "Only he who altereth remains unalterably mine," condemned this lack of capacity for development.

The changes in Nietzsche's own nature took place under the influence of Pre-Socratic antiquity; by this standard he weighed both Schopenhauer's and every other philosophy which either denied or was hostile to life. He saw that pagan antiquity had said "yea" to life; but that there had been, and now existed, other and different judgments and valuations of existence and "things." The attitude of civilization towards existence and "things," depended upon that civilization's values; and values may be either life-promoting or life-arresting.

The Good, The True and The Beautiful.—What are the ruling values of our civilization? Nietzsche replies, the ruling values of our civilization are those of the good, the true and the beautiful; which have ruled for thousands of years. All thinkers, including Plato, have acknowledged them as the highest. Nietzsche condemns these values as life-arresting; they are moreover quite illusory, for there is no instinct for goodness, truth and beauty. What does exist is another instinct—the will to power, the will to a stronger and higher existence. This will to power designates as good, true and beautiful, whatever is useful to the individual, whatever serves his advancement and enables him to establish his type by victory over others and using those others for his ends. Not goodness, truth or beauty *per se* determines what is good, true and beautiful, but something which lies behind goodness, truth and beauty, something which is higher, deeper, more important and more mighty than any of them, and uses "good," "true" and "beautiful," merely as means, as weapons to affirm and promote its own life and the lives of those that are like it—to wit, the will to power.

Good, true and beautiful are therefore not fixed values; they are relative, and there always stands behind them some human type, which by means of them is furthering its own ends. How came they to prevail as absolute values? How came they to prevail to such an extent that ultimately they were imposed upon all? "*Cui bono* were these values proclaimed?" Nietzsche asks. And he replies, "Even these, our present values, are the expression of a will to power—but of the will of the impotent, the humble, the feeble, the subjected, the peaceloving, who by means of these values wished to predominate and—have succeeded."

Our values "good," "true" and "beautiful," which led to Schopenhauer's philosophy and to the gloomy and disintegrated state of the world, came, according to Nietzsche, from the Jews. Among the Jews, the slave people of antiquity, arose the values which, with the help of religion and its moral content, still rule our present-day world. It is true that the Jews themselves once maintained a yea-saying attitude to the world. In the days of their prosperity, when they were still a triumphant and warlike people, ruled by capable kings, they too called "good" everything that was "bold," "vigorous," "joyful," "cruel" and "self-reliant." But ultimately these Jews fell under the heel of various foreign invaders, and their faith in the old natural values declined —but not their will to live, which now they fostered under a table of values and judgments the reverse of those they had formerly held.

Thenceforward they gradually and systematically demonetized "good." They called good all that was "cautious," "clever," "humble," "pacific," "mendacious" and "adaptable"; while their "evil" became everything that was "strong," "hard," "upright," "energetic," "exuberant" and "self-respecting." Thus, in the end, the Jews transvalued all values; thus they corrupted the master morality into the slave morality. "The Jews," says Nietzsche, "performed the miracle of the inversion of valuations; they led the slave-insurrection in morals. Jesus of Nazareth, this 'Redeemer,' bringing salvation and victory to the poor, the sick, the sinful—was he not really temptation in its most irresistible form, tempta-

tion to seize hold of those very Jewish values and new ideals? '*Sub hoc signo*' Israel, with its slave morality, triumphed over the noble ideals of master morality. Under Israel's flag the people have triumphed, or the slaves, or the populace, or the herd, or whatever name you care to give them. The 'masters' have been done away with; the morality of the common man has triumphed."

Levelling.—The Jews thus bequeathed the values of their decadence to Christianity, and the latter, for its part, accentuated them, and spread them all over the world through many centuries of preaching and propaganda. Since the Crucifixion of Christ the noble have only been able to assert themselves for brief periods in Europe; *i.e.*, at the Renaissance, under Louis XIV., and under Napoleon I. They were immediately suppressed by the Reformation, the French Revolution and the so-called Wars of Liberation against the "Corsican invader." All this occurred gradually, without mankind becoming aware of what had happened, so that the world never obtained a clear conception of how thoroughly it had been Semitized.

The 19th, Nietzsche's own century, which he assailed most wrathfully, had, according to him, finally let loose all these Christian instincts. These instincts, in their political disguise, dominate all modern movements—the labour, pacifist and feminist movements. "All distinctions must be removed," is the order of the day, even the natural distinction between man and woman. Yet, according to Nietzsche, the emancipation of woman can lead only to her enfeeblement and the destruction of her charm; and, therefore, only to defective offspring. If healthy children are to be produced, the differences between the sexes should be maintained, even deepened. But modern democracy will have nothing to do with differences, and in this demand is it not the legatee of Christianity? Christianity claims the equality of men before God, democracy, the equality of all men before the law. And as democracy derives from Christianity, so does socialism, which is little more than the Gospel in modern dress. For the Gospel was originally "the announcement that the road to happiness lies open to the poor and lowly—that all that is necessary is emancipation from institutions, tradition, and the tutelage of the ruling classes.

"This Christianity is no more than the typical teaching of the Socialists. Property, acquisition, fatherland, rank and position, courts of law, the police, State, Church, education, art, militarism: all these are so many obstacles in the way of happiness, so many mistakes, snares, and devil's artifices, on which the Gospel passes sentence—all this is typical of socialistic doctrine." (*Der Wille zur Macht,* Aphorism 209.)

The Will to Power.—Is there then no escape from this topsy-turvy world? Is there no hope that other than Semitic values will once again prevail, and that other than "herd" men will be born? Are the "meek and the poor in spirit" always to be allowed to "have their say," and thus continue to "torture" the ears of him who "remembers with a shudder that mankind's fate depends upon the success of its highest types?"

To the anxious enquirer who puts this question, Nietzsche replies:—"Yes, there is a way, but new Gods, or resuscitated old Gods can no longer be of any avail. Our only hope lies in new men." And, according to him, these new men are already in process of formation. "The aspect of the European of to-day," says our philosopher, "makes me very hopeful. A daring and ruler race is building itself up, upon the foundation of an extremely intelligent gregarious mass. . . . The same conditions which go to develop the gregarious animal also force the development of the leaders." (*Der Wille zur Macht,* Aph. 955–56.) "While, therefore, the democratization of Europe will tend to the production of a type prepared for slavery in the most subtle sense of the term, the strong man will necessarily, in individual and exceptional cases become stronger and richer than he has perhaps ever been before. . . . The democratization of Europe is at the same time an involuntary preparation for the rearing of tyrants—taking the word in all its meanings, even in its most spiritual sense.". . .

For Nietzsche saw great dangers threatening both the 20th century and its successor. With them would come the classical era of great wars and revolutions, says this poet-philosopher, who, incidentally, was also a true prophet. In these wars and revolutions (which by-the-bye he only foresaw and did not bring about as Allied War propaganda alleged), he welcomed a means for the masculinization of the world, the rearing of a higher type of man, and the creation of a new ruler caste.

For these, and these alone, he demanded emancipation from the Judaeo-Christian morality. Only to these higher and stronger men, from whom ultimately Superman was to spring, did he grant and recommend his famous formula of the transvaluation of all values:—"The aim should be to prepare a transvaluation of values for a particularly strong kind of man, most highly gifted in intellect and will, and, to this end, slowly and cautiously to liberate in him a whole host of slandered instincts, hitherto held in check: whoever meditates about this problem belongs to us, the free spirits—though not to that kind of 'free spirit' which has existed hitherto: for these desired practically the reverse." (*Der Wille zur Macht,* Aph. 957.) And in the very next aphorism he adds: "I am writing for a race of men which does not yet exist: for the lords of the earth.". . . "Live dangerously!"—this motto, which he himself lived up to, Nietzsche addresses to these future lords of the earth, while gladly conceding to others the right to strive for happiness and safety, and to cultivate domestic virtues. For, in all his writings, the philosopher emphasized that he had set up no moral code for the generality of men, and that he had no wish to lead lesser men away from their virtues and their duties. "I am a law only for mine own; I am not a law for all. He, however, who belongs to me must be strong of bone and light of foot,"—(*Also Sprach Zarathustra*).

The Rejection of Nietzsche.—An aristocratic doctrine like this, addressed to a self-confident democracy, inevitably met in the first place with misunderstanding, or, rather, with silence, then contempt, and finally with rejection. It was rejected all the more firmly, when, despite Nietzsche's warning, many uninvited guests pressed into his garden, and indulged their chaotic and rebellious instincts "beyond good and evil." Nietzsche himself had forseen these unwanted disciples, and had warned the world as follows:—"The first followers of a Creed prove nothing against it." To these false followers, Nietzsche preferred his adversaries, among whom the true believers were by no means the worst.

But those he esteemed least were his former colleagues; for the ears of scholars and university professors were least attuned to his message. To these men, as has been well said, the new teaching was a "bolt from the blue": although even this was not entirely true; for, like every other thinker, Nietzsche of course had his predecessors, whom he expressly mentioned by name—Heraclitus, Empedocles, Spinoza and Goethe.

His doctrine fared just as badly with the politicians whom he offended, without exception, the conservatives by his revolutionary views, and the socialists by his conservatism. He arraigned no less all the religious sects and classes. Jew and gentile, man and woman, patriot and pacifist, were all criticized; for the roller of equality had levelled everything and everybody, and property constituted the only distinction—not, however, in Nietzsche's eyes; for he saw and asked: "Mob above, mob below! what to-day means poor or rich?" Thus, for the first 50 years after it was expounded, the teaching, despite the recognition of individuals, fell, as it were, between all stools; while its messenger by his countless opponents in every country, including Germany, was branded as misanthropist, madman, promotor of wars, infidel, dysangelist and corruptor of morals.

Nietzsche's Contribution.—A further and more dispassionate study of his philosophy must, however, lead to a different conclusion, particularly on the charge of irreligion, although it must be admitted that the firm rejection of Nietzsche's teaching by those who clung to the old beliefs is quite comprehensible. Nietzsche was a destructive genius of the first order, and his revolutionary movement could not but arouse suspicion and misunderstanding at the time. Men felt, if only unconsciously, the unprecedented acuteness and the novelty of his attack; for Nietzsche's vigilant eye descried all his opponents' weak points, and his psychological ruthlessness tore veil after veil from ideals cherished for centuries. Where his predecessors had seen vices, he saw virtues, or the possibility of virtues; and where they had

seen virtues, he saw vices, or the possibility of vices. His attack on Christianity was much more thorough than that of Voltaire, whose *"écrasez l'infâme!"* had really done no more than assail the outworks of the Christian stronghold, its dogmas and ceremonies, without however aiming at the inner core of the faith, the Christian ideal itself.

Thus Nietzsche's rejection of all the values which had been held most sacred for centuries inevitably made him the great solitary that he was. Such daring and scornful condemnation, such glacial negation, could not be understood at once or greeted with applause, especially as at first his very motives remained obscure. Nobody understood in the early days that his teaching against pity sprang from his love of healthy life; against morality, from his love of a higher ethic; and against patriotism from his desire for a united Europe.

Late and slowly the world began to change its mind about "the anti-antichrist" and to perceive that he was not merely "anti" but that the destroyer of the old tables of values was also a creator of new values. For in Nietzsche, destruction was accompanied by creation, wrath by blessing and his vehement "nay" by an equally emphatic "yea." His "nay" was directed at sickness, weakness and decadence, while his "yea" was for all those healthy instincts slandered and suppressed by the religion and morality up to his day. Nietzsche became the redeemer of these honest and virile instincts and endeavoured to make their corresponding lordly virtues contribute to a great vision which he had had of the future. This vision, conceived in ecstasy, he depicted with the versatile talent of a scholar, a musician and a poet and left to posterity a series of works which bear witness to his profound morality and are to be regarded in the highest sense of the word as religious.

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(O. L.)

NIEUPORT (Flem. NIEUWPOORT), a town of Belgium in the province of West Flanders. Pop. (1947) 5,062. It was the port of Ypres, and is situated on the Yser about 10 mi. S. of Ostend. At one time Lombartzyde was the port of the Yser, but in the course of the 12th century mud was silted up, and ships went further south to Sandeshove, where it was more navigable. This place became the *novus portus,* or Nieuport. It was strongly fortified in the middle ages and its siege by the French in 1488–89 is an episode of its heroic period. Under its walls in 1600 Maurice of Nassau defeated the archduke Albert and the Spaniards. It contains an ancient cloth market, a fine town hall and an old church, and outside is a lighthouse dating from 1289. More than once in the course of its history, the town has been completely rebuilt, hence its draftsboard plan, preserved even after the wholesale destruction of 1914–18.

Nieuport has one of the main artificial drainage outlets of the low country, the locks of Palingbrug. After World War I they were rebuilt in the form of six locks debouching on the canal of the Yser. They played an important part in the war, being the instrument of the famous flooding of the front on the Yser on Oct. 29, 1914; all that was necessary to submerge a large part of the district, under the enemy's fire, was to reverse the normal process; *i.e.,* to close the locks to the lower and open them to the higher water, so as to allow the tide to flow inland.

Nieuwpoort Bad, 2 mi. from the town, is a fashionable seaside resort dating from 1869.

NIÈVRE, a department of France, formed from the old province of Nivernais with a small part of the Orléanais. It is bounded northwest by Loiret, north by Yonne, east by Côte d'Or, east and southeast by Saône-et-Loire, south by Allier and west by Cher. Pop. (1946) 248,559. Area 2,660 sq.mi. Nièvre falls into three regions. In the east are the granitic mountains of the Morvan, one of the most picturesque parts of France, containing Mont Prénelay (2,789 ft.) and several lesser heights. The north and centre are occupied by plateaus of Jurassic limestone with a maximum elevation of 1,400 ft. The west and southwestern part of the department is a district of plains, composed mainly of Tertiary formations with alluvial deposits, and comprising the valleys of the Loire and the Allier. The lowest level of the department is 446 ft., at the exit of the Loire. Eastern Nièvre belongs to the upper basin of the Yonne, a tributary of the Seine, followed by the southern part of the Nivernais canal; western Nièvre drains toward the Loire, which crosses its southwestern corner and then forms its western boundary.

The principal cereals are oats and wheat; potatoes and various kinds of forage are also largely grown. On the extensive pastures much cattle is fattened. The Nivernais and Charolais are the chief breeds. The rearing of sheep and draught horses is also important. Vines are grown in the Loire valley and near Clamecy. The white wines of Pouilly are widely known. Nièvre abounds in forests, the chief trees being the oak, beech, hornbeam, elm and chestnut. Coal is mined at Decize, and gypsum, building stone and kaolin are quarried. The best-known mineral springs are those of Pougues and St. Honoré. Nièvre is famous for ironworks, the most important being those of Fourchambault. At Imphy there are large steelworks. The government works of La Chaussade at Guérigny make chain cables, anchors, armour plates, etc. There are also manufactories of agricultural implements and hardware, potteries, manufactories of porcelain and faïence (at Nevers) and glassworks, tileworks, chemical works, paper mills and sawmills, as well as tanneries, boot and shoe factories, cask manufactories and oil works (colza, poppy and hemp). In the Morvan district the timber industry is important.

Much of the traffic is by water; the canal along the Loire runs through the department for 38 mi., and the Nivernais canal for 78 mi. The chief railway is that of the P.L.M. company, whose main line to Nîmes follows the valley of the Loire and Allier. Nièvre is divided into 4 *arrondissements* (Nevers, Cosne, Château-Chinon and Clamecy being their capitals), 25 cantons and 313 communes. It forms the diocese of Nevers under the archbishop of Sens and part of the *académie* (educational district) of Dijon and of the region of the 8th army corps. The chief towns are Nevers, the capital, Clamecy, Fourchambault, Cosne, La Charité and Decize. The appeal court is at Bourges.

NIFO, AGOSTINO (AUGUSTINUS NIPHUS) (1473?–1538 or 1545), Italian philosopher and commentator, was born at Japoli, Calabria. He lectured at Padua, Naples, Rome and Pisa, and was deputed by Leo X to defend the Catholic doctrine of immortality against the attack of Pomponazzi and the Alexandrists. In return for this he was made count palatine, with the right to call himself by the name Medici. He edited (1495) the works of Averroes, with a commentary compatible with his lately acquired orthodoxy. In the great controversy with the Alexandrists he opposed Pomponazzi's theory that the death of the body means the death of the soul. He insisted that the individual soul, as part of absolute intellect, is indestructible, and on the death of the body is merged in the eternal unity.

His principal philosophical works are *De immortalitate animi* (1518 and 1524); *De intellectu et daemonibus; De infinitate primi motoris quaestio* and *Opuscula moralia et politica.* His numerous commentaries on Aristotle were frequently reprinted, the best-known edition being printed at Paris in 1654 in 14 vol.

NIĞDE (Arab. *Nakidah*), the chief town of a vilayet in Turkey, situated on the Kaisarieh-Cilician Gates road. It is remarkable for the beauty of its buildings, dating from almost all ages of the Seljuk period. After the fall of the sultanate of Rum (of which it had been one of the principal cities), Niğde became independent, and, according to Ibu Batuta, ruinous, and did not pass into Ottoman hands till the time of Mohammed II. It represents no classical town, but, with Bor, has inherited the importance of Tyana, whose site lies about 10 mi. S.W. A Hittite-inscribed monument, brought perhaps from Tyana, has been found at Niğde. Pop. (1950) 12,423; of the vilayet, 331,061.

NIGEL (d. 1169), bishop of Ely, head of the exchequer in the reigns of Henry I. and Henry II., was brought into the exchequer in early life (1130). Soon after his uncle Roger of Salisbury secured him the bishopric of Ely, much to the disgust of the monks. Nigel incurred the suspicion of leaning towards the Angevin interest, when Roger of Salisbury and Alexander of Lincoln were arrested by Stephen (Jan. 1139). He attempted to maintain himself in his see by force of arms, but he was forced to fly to the empress at Gloucester. He was reconciled to Stephen in 1142 and restored to his see; but he now quarrelled with Henry of Winchester and was forced to go to Rome. Fortunately, he secured the strong and uniform support of the Roman Curia. At the accession of Henry II. (1154) Nigel was summoned to reorganize the exchequer. He was the only surviving minister of Henry I., and his knowledge of the exchequer business was unrivalled. This was the great work of his life. To the work of his son Richard, the *Dialogus de Scaccario*, we owe our knowledge of exchequer procedure as it was left by Nigel. The bishop took little part in politics, except as an administrator. In 1166 his health was broken by a paralytic seizure.

See F. Liebermann, *Einleitung in den Dialogus de Scaccario* (1875); J. H. Round, *Geoffrey de Mandeville* (1892).

NIGER, a great river of West Africa, inferior only to the Congo and Nile among the rivers of the continent. Rising within 150 m. of the sea in the mountainous zone which marks the north-east frontiers of Sierra Leone and French Guinea, it traverses the interior plateaux in a vast curve, flowing north-east, east and south-east, until it finally enters the Gulf of Guinea through an immense delta. Its total length is about 2,600 miles. About 250 m. from its mouth it is joined by the Benue, coming from the east from the mountainous region of Adamawa. From its mouth to the limit of navigability from the sea the Niger is in British territory; above that point it flows through French territory. The area of the Niger basin is calculated at 580,000 sq.m. at least.

The source of the Niger lies in 9° 5′ N. and 10° 47′ W.; the most northerly point of the great bend is about 17° N. and the mouth is in 4° 30′ N. 6° E. The river is known locally under various names, the most common being Joliba (a Mandigo word meaning great river) and Kworra or Quorra. By the last name the Niger was known in its lower reaches before its identity with the upper river was established. The Tembi, the stream considered the chief source of the Niger, issues from a deep ravine 2,800 ft. above sea-level where, from a moss-covered rock a spring issues and has made a pool below. The overflow forms the Tembi, which within a short distance is joined by two other rivulets, the Tamincono and Falico, which have their origin in the same mountainous district. After flowing north for about 100 m., the river turns eastward and at its confluence with the Tankisso (a northern tributary), 210 m. from its source, has attained dimensions sufficient to earn for itself the title Joliba. Taking at this point a decided trend northward, the Niger, 100 m. lower down, at Bamako has a depth of 6 ft. with a breadth of 1,300 feet. Seven or eight miles below Bamako the Sotuba rocks mark the end of what may be considered the upper river. Thirty miles below Sotuba are the rapids of Tulimandio; a little lower down is Kulikoro, from which point the bed of the stream for over 1,000 m. is fairly free from impediments.

Middle Niger and Lake Region.—The Niger here turns more directly to the east and increases in volume and depth. Below Sansandig the banks of the river become low, and the Niger is split up into a number of channels. Mopti is at the junction of the main stream with a large right-hand backwater or tributary, the Bani or Mahel Balevel, on which is situated the important town of Jenné. Below Mopti is a swampy and treeless region and the first of a series of lakes (Debo) is reached. These lakes are chiefly on the left of the main stream, with which they are connected by channels conveying the water in one direction or the other according to the season. At high water most of these are united into one general inundation. The largest lake, Faguibini, is nearly 70 m. long by 12 m. broad, has high shores and reaches a depth exceeding, in parts, 160 feet. It is not until Kabara, the port of Timbuktu, is reached, a distance of 450 m. from Sansandig, that the labyrinth of lakes, creeks and backwaters ceases. Below Kabara the river reaches its most northerly point. Here, and for some 500 m. down stream the river is bordered on the north by the Sahara; in places it is desert on both sides, with long lines of sand dunes. At Bamba it is shut in by steep banks, and narrows to from 600 to 700 yd., again spreading out some distance down. At Tosaye (about 250 m. from Timbuktu) the stream turns distinctly south-east and preserves that direction throughout the remainder of its course. Here, just before the bend becomes pronounced, the Baror and Chabar rocks reduce the width of the river to less than 500 ft., and at low water the strength of the current is a serious danger to navigation.

At Ansongo, 430 m. below Timbuktu, the navigable reach of the middle Niger, in all 1,057 m., ends. Four huge flint rocks bar the river at Ansongo and effectually prevent further navigation except in very shallow draught vessels. From Ansongo to Say, some 250 m., the river presents a labyrinth of rocks, islands, reefs and rapids. From Say, where the stream is about 700 yd. in breadth, to Bussa, there is another navigable stretch extending 300 miles. After the desert region is past the Niger receives the waters of the river Sokoto, a considerable stream flowing from the north-east. Some distance below this confluence are the Bussa rapids. These rapids are of a more dangerous character than any encountered between Ansongo and Say. "In one pass, some 54 yd. wide, shut in between two large reefs, a good half of the waters of the Niger flings itself over with a tremendous roar" (Hourst). The rapids extend for 50 m. or more; in a less obstructive form they continue to Rabba.

Lower River and Delta.—A little above Rabba the river makes a loop south-west, at the head of the loop being (right bank) Jebba. Here there is an island in midstream, taken advantage of in the bridging of the river by the railway from Lagos. Sixty miles lower down is the mouth of the (left hand) tributary the Kaduna, a river of some magnitude whose head waters are not far from Kano. In 7° 50′ N. 6° 45′ E. the Niger is joined by its great tributary the Benue. At their confluence the Niger is about ¾ m. broad and the Benue rather more than a mile. The united stream forms a lake-like expansion about 2 m. in width, dotted with islands and sandbanks; the peninsula at the junction is low, swampy and intersected by numerous channels. The stream, as far south as Iddah (Ida), a town on the east bank, rushes through a valley cut between the hills, the sandstone cliffs at some places rising 150 ft. high. Between Iddah and Onitsha, 80 m., the banks are lower and the country flatter, and to the south of Onitsha the whole land is laid under water during the annual floods. Here may be said to begin the great delta of the Niger, which, extending along the coast for about 120 m., and 140 or 150 m. inland, forms one of the most remarkable of all the swampy regions of Africa. The river breaks up into an intricate network of channels, dividing and subdividing, and intercrossing not only with each other but with the branches of other streams, so that it is exceedingly difficult to say where the Niger delta ends and another river system begins. The Rio Nun is a direct continuation of the line of the undivided river, and is thus the main mouth of the Niger. From the sea the only indication of a river mouth is a break in the dark green mangroves which here universally fringe the coast. The crossing of the bar—where the depth of water is but 12 or 13 ft.—requires considerable care, and as other branches of the Niger afford better access the Nun mouth is now little used. East of the

Nun the estuaries known as the Brass, Sombrero, New Calabar, Bonny, Opobo (or Imo), etc. (with the exception, perhaps, of the first-named), seem to derive most of their water from independent streams. West of the Nun all the estuaries up to the Forcados seem to be true mouths of the great river. The Forcados has supplanted the Nun river as the chief channel of communication by water with the interior. The mouth of the Forcados is 2 m. wide, the bar, formerly but ¾ m. across, had by 1927 grown to 2¼ m. across, but the depth of water allowed vessels of 18 ft. draught to enter the river; within the bar is a deep water natural harbour of 3 to 4 square miles. Five miles up stream is the port of Burutu. From the mouth of the Forcados to the main stream is 105 m., with a minimum depth in the dry season of seven feet. The other western mouths of the Niger have as a rule shallow and difficult bars. The delta is the largest in Africa and covers 14,000 square miles, a larger area than the more famous Nile delta.

The Benue.—The Benue is by far the most important of the affluents of the Niger. The name signifies in the Batta tongue "Mother of Waters." The river rises in Adamawa in about 7° 40′ N. and 13° 15′ E., at a height of over 3,000 ft., being separated by a narrow water parting from one of the head-streams of the Logone, whose waters flow to Lake Chad. In its upper course the Benue is a mountain torrent falling over 2,000 ft. in some 150 miles. With the Chad system it is connected by the Kebbi or Mayo Kebbi, a river which issues from the south-west end of the Tuburi marshes, and eventually joins the Benue. The Tuburi marshes occupy an extensive depression in the plateau east of the Mandara hills, and are cut by 10° N., 15° E. The central part of the marshes forms a deep lake, whence there is a channel going northward to the Logone.

Below the Kebbi confluence the Benue, now a considerable river, turns from a northerly to a westerly direction and is navigable all the year round by boats drawing not more than 2½ feet. At Yola, a town some 850 m. by river from the sea and at an altitude of 600 ft., the width of the stream at flood time reaches to 1,000 or 1,500 yd., and though it narrows at the somewhat dangerous rapids of Runde Gilla to 150 or 180 yd., it soon expands again. About 50 m. above Yola the Benue is joined by the Faro, a river rising in the Adamawa hills, and some 50 m. below Yola the Benue receives, on the right bank, the Gongola, which rises in the Bauchi highlands and after a great curve north-east turns southward. It is over 300 m. long, and at flood time is navigable for about half of its course. In its lower course the Benue is joined by several other streams; its valley is bordered by ranges of hills.

As the Niger and the Benue have different gathering grounds, they are not in flood at the same time. The upper Niger rises in June and decreases in December. The middle Niger, however, reaches its maximum near Timbuktu only in January and April–July is the low water season. The Benue reaches its greatest height in August or September, begins to fall in October, falls rapidly in November and slowly in the next three months, and reaches its lowest in March and April. The flood rises with great rapidity, and reaches 50, 60 or even 75 ft. above the low-water mark.

Below the Benue confluence the Niger is at its lowest in April and May; in June it is subject to great fluctuations; about the middle of August it usually begins to rise; and its maximum is reached in September. In October it sinks, often rapidly. A slight rise in January, known as the *yangbe,* is occasioned by water from the upper Niger. Between high and low-water mark the difference is as much as 35 ft.

History and Exploration.—Vague ideas of the existence of the river were possessed by the ancients. The great river flowing eastward reached by the Nasamonians as reported by Herodotus can be no other than the Niger. Pliny mentions a river Nigris, of the same nature with the Nile, separating Africa and Ethiopia, and forming the boundary of Gaetulia; and it is not improbable that this is the modern Niger. In Ptolemy, too, appears along with Gir (possibly the Shari) a certain Nigir (Νίγειρ) as one of the largest rivers of the interior; but so vague is his description that it is impossible definitely to identify it with the Niger. Arabian geographers, such as Ibn Batuta, who were acquainted with the middle course of the river, called it the Nile of the Negroes. At the same time contradictory opinions were held as to the course of the stream. It was supposed by some geographers to run west, an opinion probably first stated by Idrisi in the 12th century. Idrisi gave the Nile of Egypt and the Nile of the Negroes a common source in the Mountain of the Moon. Fountains from the mountain formed two lakes, whence issued streams which united in a very large lake. From this third lake issued two rivers—the Nile of Egypt flowing north, and that of the Negroes flowing west (*see* R. Dozy and M. J. de Goeje's *Edrisi,* Leiden, 1866: Premier Climat, 1st four sections). From Idrisi's description it would appear that he regarded the Shari, Lake Chad, the Benue, Niger and Senegal as one great river which emptied into the Atlantic. From 1405 to 1413 a Frenchman, Anselme d'Isalguier, lived at Gao, a city on the Niger 400 m. below Timbuktu; the account of his travels was never printed and is lost. Knowledge of his adventures, never widely known, was completely forgotten until brought to light by Ch. de la Roncière (*see* his *Découverte de l'Afrique au Moyen Âge,* vol. iii., Cairo, 1927). Leo Africanus visited the Niger regions in 1513–15 without settling the question as to the direction of the river. The belief that a western branch of the Nile emptied itself into the Atlantic was held by Prince Henry of Portugal, who instructed the navigators he despatched to Guinea to look for the mouth of the river, and when in 1445 they entered the estuary of the Senegal, the Portuguese were convinced that they had discovered the Nile of the Negroes (*see* Azurara's *Discovery and Conquest of Guinea,* Beazley and Prestage's translation, vol. ii., London, 1899, chap. lx. and lxi., and introduction and notes). The Senegal being proved an independent river and the eastward flow of the Niger assumed, the theory that it ran into the Nile was revived.

That the vast network of rivers on the Guinea coast, of which the Nun was the chief, known as the Oil rivers, formed the delta of the Niger does not appear to have been suspected before the beginning of the 19th century. Consequently it was from the direction of its source that the river was first explored in modern times. In 1795 Mungo Park (*q.v.*), sent out by the African Association, landed at the Gambia, and struck the Niger near Segu on July 20, 1796, where he beheld it "glittering in the morning sun as broad as the Thames at Westminster and flowing slowly to the eastward" (*Travels,* 1st ed., p. 194). He descended the river some distance, and on his return journey went up stream as far as Bamako. In 1805 Park returned to Africa for the purpose of descending the Niger to its mouth. From Bamako he sailed down the river for over 2,000 miles and on the eve of the successful accomplishment of his undertaking lost his life during an attack on his boat by the natives at Bussa (Nov. or Dec. 1805). Park held to the opinion that the Niger and Congo were one river, though in 1802 C. G. Reichard, a German geographer, had suggested that the Rio Nun was the mouth of the Niger. Owing to Park's death the results of his second journey were lost, and the work had to be begun afresh. In 1822 Maj. A. G. Laing (who had reached Timbuktu by way of Tripoli) obtained some accurate information concerning the sources of the river, and in 1828 the French explorer René Caillié went by boat from Jenné to the port of Timbuktu. In 1826 Bussa was reached from Benin by Hugh Clapperton, and his servant Richard Lander. On Clapperton's death Richard Lander and his brother John led in 1830 an expedition which went overland from Badagry to the Niger. Canoeing down the river from Yauri—60 m. above Bussa—to the mouth of the Rio Nun they finally settled the doubt as to the lower course of the stream.

Heinrich Barth (1851–54) made known to Europe the course of the river from Timbuktu to Say. Later, the extension of French influence throughout the western Sudan led to an accurate knowledge of the river above Timbuktu. From 1880 onwards Col. (afterward General) Gallieni took a leading part in the operations on the upper river, where in 1883 a small gunboat, the "Niger," was launched for the protection of the newly

established French posts. In 1885 a voyage was made by Capt. Delanneau past the ruins of Sansandig, as far as Diafarabe. In 1887 the "Niger" made a more extended voyage, reaching the port of Timbuktu. A more important expedition was that of Lieut. Hourst, who, starting from Timbuktu in Jan. 1896, navigated the Niger from that point to its mouth.

In addition to the main stream, the Niger basin was made known during the last quarter of the 19th century and the early years of the 20th. The journeys of the German traveller G. A. Krause (north from the Gold Coast, 1886–87) and the French Capt. Binger (Senegal to Ivory Coast, 1887–89) first defined its southern limits by revealing the unexpected northward extension of the basins of the Guinea coast streams, especially the Volta and Komoe, a fact which explained the absence of important tributaries within the Niger bend. The exploration of the Benue dates from the middle of the 19th century. In 1851 Barth crossed the Benue at its junction with the Faro, but the region of its sources was first explored by the German E. R. Flegel (1882–84), who traversed the whole southern basin of the river and reached Ngaundere. The Benue itself had been ascended 400 mi. by the "Pleiad" expedition in 1854 and in 1889 the river was traced to 13½° E., and Kebbi to Bifara by Maj. (afterward Sir Claude) Macdonald, further progress toward the Tuburi marsh being prevented by the shallowness of the water. In 1903, a French officer, Capt. E. Lenfant (who had in 1901 succeeded in navigating the Bussa rapids on the Niger) ascended the Kebbi and discovered the Lata fall, continuing up the river to its point of issue from Tuburi. Crossing the marshes he found and navigated the narrow river leading to the Logone.

From Kulikoro (which is connected by railway with the port of Dakar) downward, the French have undertaken works on the Niger with a view to deepening the channel, and they maintain a regular steamer service to the port of Timbuktu. In 1910 the British began dredging with the object of obtaining in the lower river a minimum depth of 6 ft. of water; however, while there is still a large river traffic the building of railways in Nigeria has deprived the lower Niger and the Benue of their importance as highways of commerce to the far interior.

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NIGERIA, a British colony and protectorate in West Africa, occupying the basin of the lower Niger and adjacent regions. Area 338,593 sq.mi.; pop. (1931 census) 19,928,171. Administratively attached to Nigeria is that part of the Cameroons under British mandate, which has an area of some 34,081 sq.mi. and a population of (1939 est.) 868,637. Nigeria is bounded south by the Gulf of Guinea; west by Dahomey; north by the French Niger Colony; and east by the French sphere of the Cameroons. It includes the former British colony and protectorate of Lagos (*q.v.*), and is nearly seven times the size of England. The following particulars do not include the British sphere of the Cameroons (*q.v.*).

Physical Features.—Nigeria is divisible, broadly, into zones parallel with the coast: (1) the delta, (2) forest region, (3) a zone of comparatively open country giving place to (4) the plateau region. The coast-line, some 500 m. in length, extends along the Gulf of Guinea from 2° 46′ 55″ E. to 8° 45′ E., ending at the Rio del Rey, where the great bend eastwards of the continent ceases and the land turns south. The Niger (*q.v.*), which enters the country at its north-west corner and flows thence south-east to the Atlantic, receives, 250 m. from the sea, the Benue, which, rising in the mountains of Adamawa south of Lake Chad, flows west across the plateau. Into the huge delta of the Niger several other rivers (the "Oil Rivers") empty themselves; the chief being, on the west, the Benin (*q.v.*), and, on the east, the Brass. East of the Niger delta is that formed by the Imo or Opobo, Bonny and other streams, and still farther east is the Calabar estuary, mainly formed by the Cross river (*q.v.*).

The delta region is swampy, and forms, for a distance of from 20 to 60 m. inland, a network of interlacing creeks and broad sluggish channels fringed with monotonous mangrove forests. Beyond the delta firm ground takes the place of mud and the mangroves disappear. The land rises gradually at first, becoming, however, in many districts very hilly, with heights of 3,000 ft., and is covered with dense evergreen or rain forests which give place to deciduous forest as the rainfall decreases. The evergreen and deciduous forests form part of the great West African forest belt; the trees are straight, tall and cylindrical and there is little undergrowth, though often bound together by creepers. The forest belt extends 50 to 100 m. and is succeeded by park-like land, the savannah and orchard forests much more extensive than the dense forest, with strips of deciduous forest going through it along the river banks.

North of the Niger-Benue confluence, which is but 250 ft. above sea-level, are hills forming the walls of the plateau which extends over the major part of the country and is part of the great plateau of North Africa. This plateau, broken only by the valleys of the rivers, does not attain an elevation approaching that of the plateaux of South Africa, the culminating point (apart from particular mountain districts), situated in about 10° N., reaching a height of 3,000 ft. only. The valleys of the Niger and Benue, especially the latter, are much lower, the town of Yola on the Benue, some 400 m. inland, lying at an altitude of little over 600 feet. The surface is generally undulating, with isolated "table mountains" of granite and sandstone often rising abruptly from the plain. It is clothed largely with thin forest, but becomes more open to the north until, towards the French frontier, the arid steppes bordering the Sahara are reached. Much of the country north of Zaria (11° N.) is covered with heavy, loose sand. The most mountainous districts are northern Bauchi (a little N. of 10°), where there are heights rather above 4,000 ft.; parts of Muri, along the north bank of the Benue; and the southern border of the Benue basin, where the hills consist of ironstone, quartz and granite. On the east the plateau sinks to the plains of Bornu (*q.v.*), which extend to Lake Chad. Tributaries of the Niger traverse the western portion of the country, the most noteworthy being the Gublin Kebbi, or Sokoto, river and the Kaduna, which flows through a valley not more than 500 ft. above the sea. The north-eastern part of the country drains to Lake Chad by the Waube or Yo, an intermittent stream, which in its lower course forms the Anglo-French boundary. The western portions of Lake Chad (*q.v.*) belong to the protectorate, which contains no other large lake. The water parting between the Chad and Niger systems runs north-west and south-east from about Katsina in 13° N. to the Bauchi hills.

Geology.—Except in the coast belt, which is composed of superficial deposits, crystalline rocks are the fundamental formation. From the edge of the coast belt to near the Niger-Benue confluence, these rocks are overlain by unfossiliferous sandstones, lying undisturbed, and possibly of the age of the sandstone of the

Congo basin. Much of the plateau—with its flat-topped hills and red earths—consists of what is called the fluvio-volcanic series. The alluvial deposits here are often unconnected with the present drainage lines. On the Bauchi plateau are large deposits of cassiterite (tin) mostly found in the detrital deposits resulting from the great denudation over the plateau. Limestones, with fossils indicating a Tertiary age, have been found near Sokoto. Recent alluvium and a thick deposit of black earth border the upper reaches of the Benue and cover wide areas around Lake Chad. Coal measures are found in the Enugu district east of the Niger and south of the Benue, and in the Bende district near the Cross river; there are large deposits of lignite in the younger Tertiary group in the Niger valley and in the neighbourhood of the Benue, where they are interstratified with white clays; rock phosphates are found north of Lagos and there is a belt of auriferous country north of Minna (towards the Kaduna river).

Climate.—Though Nigeria lies wholly within the tropics, there is a distinct difference in the climate of the northern and southern regions. In the south the climate is typical of the tropics; in northern Nigeria it resembles that of Egypt and may be described as sub-tropical. In the south the temperature varies comparatively little, from 70° to 100° F, and averages over 80° F. The air is both hot and humid; the rainy season is sometimes prolonged to ten months or more, the rainfall in the delta being from 100 to 140 or more inches a year. (At Bonny in 1923 the fall was 150·59 in., rain occurring on 151 days.) The prevailing wet season wind is from the south-west. From November to March the *harmattan*, a dry, dust-laden north-east wind, coming from the Sahara, blows intermittently, and this is the dry season, when at Lagos humidity has been known to fall to 26% against a mean of 90%. At Lagos the usual rainfall is 77 in. a year. Tornados occur at the beginning and end of the *harmattan*. Malaria is still a scourge in these southern districts and the country is unhealthy for Europeans. In the north the temperature is still high, but for nine months of the year the air is dry, "the dry air of the desert, the intense parching dryness of which is almost inconceivable by anyone who has not experienced it" (O. T. Faulkner, director of agriculture, Nigeria). July–September are the rainy months in the north, the fall being usually 25 to 30 in. a year, though in places it is as much as 60 inches. The *harmattan* begins in the north in October and lasts till April. In this season variations in temperature are great. At Hadeija, in 1922, a minimum of 35° F and a maximum of 115° F were recorded. In some parts of the plateau Europeans can live in comparative comfort, the climate resembling that of an unusually fine English summer, often with cool nights. Between the southern and northern regions there is an intermediate zone with a normal rainfall of from 40 to 50 in. a year and still considerable humidity.

Fauna and Flora.—There are many large and small mammals. They include the elephant, lion, leopard, giraffe, West-African buffalo, many kinds of antelope and gazelle and smaller game. The chimpanzee, the drill ape, the baboon and many kinds of monkeys are found in the forests and snakes are common. They are many varieties of squirrel, some finely coloured. The camel is found in the northern regions. In the rivers are rhinoceros, hippopotamus and crocodile. The manatus is also found. The birds include the ostrich, marabout, vultures, kites, hawks, ground hornbill, great bustard, guinea fowl, partridge, lesser bustard, quail, snipe, duck widgeon, teal, geese of various kinds, paraquets, doves, blue, bronze and green pigeons and many others. Domestic animals include the horse and donkey in the plateaux, but baggage animals are rare in the coast-lands, where the tsetse fly is found. Mosquitoes are abundant throughout the delta. There are the remarkable hammer-headed fruit-bat and other varieties of bats and a curious kind of dormouse. Many species of butterfly and spiders are recorded.

The mangrove is the characteristic tree of the swamps. North of the swamps the oil palm (*Elaeis guineensis*) flourishes abundantly. It is common as far as about 7° N. The evergreen and deciduous forests contain a great wealth of timber. Among the trees are mahogany, cedars and scented cedars, walnut, rosewood, satinwood, ebony, African teak and other valuable species. There are also African maple, shingle-wood, cork-wood, cotton-wood and other general utility woods, including the *abura* whose timber is acid resisting. Rubber vines are also found in these forests. Other trees found, chiefly on the plateaux, are the baobab, the shea-butter tree, the locust tree, gambier, palms, including the date and dum palm (Hyphaene), the tamarind, and, in the arid regions, the acacia and mimosa.

Inhabitants.—The vast majority of the inhabitants are typical negroes. In the south-west the Yorubas (*q.v.*) are the chief race. They occupy the country behind the coast-lands, from Dahomey to Benin, and have a considerable degree of civilization. In the delta district and the forest zone, besides the people of Benin, are the Jekri, living on the lower part of the Benin river and akin to the Yorubas, the Ijos, living in the delta east of the main mouth of the Niger, and the Ibos, occupying a wide tract of country just above the delta and extending east from the Niger to the Cross river. South of the Ibos live the Aros, a tribe of relatively great intelligence, who dominated many of the surrounding tribes and possessed an oracle or *ju-ju* of reputed great power. On the middle Cross river live the Akuna-kunas, an agricultural race, and in the Calabar region are the Efiks, Ibibios and Kwas. All these tribes are fetish worshippers, though Christian and Muslim missionaries have made numerous converts. The Efiks, a coast tribe which early came into contact with white men, have adopted several European customs, and educated Efiks are employed in Government service. The great secret society called Egbo is an Efik institution.

In the northern parts of Nigeria the inhabitants are of more mixed blood, owing to the invasion of Fula, Berber and Arab or Arabized people. But the bulk of the people are negroes. The most important of these negro peoples are the Hausa (*q.v.*), among whom the superior classes adopted Mohammedanism in the 13th and 14th centuries. The Hausa are keen traders and make excellent soldiers. The Fula tribe, besides providing the ruling families in many of the Hausa States, form a separate caste of cattle-rearers. Arab merchants live in some of the larger Hausa towns.

In general, the people living in the river valleys have been little or not at all affected by Muslim propaganda, either in blood or religion. Thus along the banks of the Niger, Benue and other streams, the inhabitants are negro and pagans, and generally of a primitive though often rather fine type. Of these the Munshi, who inhabit the district nearest the junction of the Benue with the Niger, were long noted for their intractability and hostility to strangers, whom they attacked with poisoned arrows. The Yorag-

FROM E. D. MOREL, "NIGERIA"

A GROUP OF HAUSAS CARRYING THE SHORT-HANDLED HOES IN THE ANCIENT HOE DANCE

hums, their neighbours, were cannibals. Nearer Yola live the Battas, who also had a bad reputation. In the central hilly region of Kachia are other pagan tribes. When first met by Europeans they wore no clothes, and their bodies are covered with hair. South of the Benue, near the Niger confluence, dwell the Okpotos, Bassas and other tribes, which had a reputation for savagery and war-lust. In the districts of Illorin and Borgu, west of the Niger, the inhabitants are also negroes and pagan, but of a more advanced type than the tribes of the river valleys. According to some native traditions, the people of Borgu claim to have a Coptic

origin. In Bornu (*q.v.*) the population consists of (1) Berberi or Kanuri, the ruling race, containing a mixture of Berber and negro blood, with many lesser indigenous tribes; (2) so-called Arabs, and (3) Fula.

A complete list of the tribes in Nigeria would run into many scores, and each has its separate language. In the old province of Bauchi alone as many as 60 different languages are spoken. The most widely diffused languages are Hausa and Yoruba. Arabic is the court and official language in the Fula emirates. In the ports many natives speak English.

The European inhabitants number (1929) some 5,000. They are chiefly officials, traders and missionaries. On the tin-fields are some 700 whites including over 100 women.

Chief Towns.—A large proportion of the people are town-dwellers. The ports, with the exception of Lagos, are all on the rivers. From west to east the ports reached by ocean steamers are Lagos (*q.v.*), the capital of Nigeria; Forcados, at the mouth of the Forcados branch of the Niger and the main port of entry for the river, having 18 ft. of water over the bar; Burutu, 5 m. above Forcados and the port of the Niger Co.; Warri 30 m. above Forcados; Koko and Sapele, on the Benin river, but reached by way of Forcados. All these ports are west of the Nun mouth of the Niger, where on the west bank is Akassa (14 ft. of water). East of the Nun mouth are Brass town (on the Brass river) and Bonny, at the mouth of the Bonny river. The three last-named ports, once flourishing, are now little used. Some 40 m. up the Bonny river is Port Harcourt (*q.v.*), second in importance of the ports of Nigeria. Farther east are Opobo (13 ft. of water), on the Imo river, richest of the oil-rivers of Nigeria, Degema (18 ft.), and Calabar (*q.v.*). On the river Niger, at the head of the delta, are Asaba (west bank) and Onitsha (east bank); farther north is Idah (east bank) in the palm-oil zone; Lokoja (*q.v.*) is at the Niger-Benue confluence; Baro, 70 m. above Lokoja, is on the railway system; and still farther north, on the river, are Egga, Jebba and Bassa (*q.v.*).

The largest cities are found in Yorubaland. Of these Ibadan (pop., 1953, 416,174), the largest native city in Africa, Ilorin and Abeokuta are separately noticed. Other Yoruba cities are Ogbomosho (pop. 86,744), Oshogbo (pop. 49,599), Iwo (57,191), Ede (52,392) and Ogo (48,733). Other towns in the south are Benin (*q.v.*), west of the Niger and Bende, and Enugu, east of the river. Enugu (pop. 40,878) is the centre of the Udi coalfield.

In northern Nigeria, where the larger towns have generally a population of from 40,000 to 50,000, the chief city is Kano (*q.v.*), the commercial capital, situated in 12° N., 8° 32′ E. Sokoto, the religious and political centre of the Fula, is some 220 m. W.N.W. of Kano. Katsina (*q.v.*), near the frontier and 84 m. N.W. of Kano, has a reputation as an educational centre; other chief Hausa towns are Zaria (*q.v.*), Bauchi (or Yakoba); Beda; and Yola (*q.v.*) The chief towns of Bornu are Kukawa or Kuka (*q.v.*), near Lake Chad, Maidugari and Dikwa (Dikoa). The administrative capital of northern Nigeria is Kaduna; Jos, a modern town with European amenities, is the centre for the Bauchi tin-fields.

Communications.—Railways are now the chief means of transport, the shallowness of the Niger and Benue for a large part of the year rendering them an uncertain means of communication. There is still, however, a considerable river traffic, and in the delta the rivers remain the great highways. There is a regular steamer service between Forcados and Lagos, and between Lagos and Dahomey by the lagoons. From Forcados two steamers ascend the main Niger to Jebba, a distance of 530 miles. On the Benue there is steamer traffic as far as Yola. But between May and October navigation is only possible to vessels drawing not more than 3 ft. of water. There are navigable stretches of several other rivers—the Cross river can be ascended for 240 miles. For the main part the river services are (except in the delta) auxiliary to the railways.

Railway building began in 1896, with a line from Lagos to Ibadan, a distance by rail of 123 miles. This line was finished in 1900. In 1906 a forward policy was adopted, and since then progress has been rapid. The railways have been built and are owned and worked by the Nigerian Government and are of the standard African 3 ft. 6 in. gauge, unless otherwise stated. In 1929 some 1,900 m. of railway were open, the system consisting of:—(1) A western line running from Lagos to Kano (705 m.), via Abeokuta, Ibadan, Ilorin, Kaduna and Zaria. The Niger is crossed at Jebba—where there is an island—by two bridges, together 1,795 ft. long. The bridges, the last part of the line to be built, were completed in 1914. A branch line (111 m.) runs from Minna to Baro, on the Niger. Another branch line runs from Zaria, by Guasu to Kaura Namoda (142 m.), and in 1928–29 the main line was extended from Kano to Hadejia (102 miles). (2) An eastern line (built 1913–26) from Port Harcourt to Enegu, for the Udi coalfields, and Kaduna (569 m.), where it joins the western railway. The Benue is crossed at Makurdi, pending the completion of a bridge, by train ferry. A short branch line running to Jos, for the tin-fields, was opened in April 1927, and since then all the tin is sent to Port Harcourt. Jos was formerly served by a light line (2 ft. 6 in. gauge) from Zaria, on the western railway. This light line now carries cotton. In 1928 the building of a trunk railway to Lake Chad, at an estimated cost of some £5,000,000, was sanctioned. The capital cost of the railways, up to March 1928, had been £18,104,000 of which sum £15,245,000 had been raised by loan on the London market, at an average rate of interest under 5%. The railways are worked as a business concern, but the ultimate profits go to the colonial treasury. Motor traffic has to a large extent superseded other methods of road travel. Some 3,000 m. of all-the-year-round motor roads were being maintained in 1928 by the Public Works Department alone. There are, additionally, many miles of dry-season motor roads in the north.

There is regular steamship communication by several lines between Europe and Lagos and other Nigerian ports; direct cable communication with Europe and South Africa, an extensive system of inland telegraphs, and a wireless station at Lagos. The principal passenger and mail service is by the Elder Dempster line from Liverpool to Lagos, the voyage taking 15 days. A regular service between British ports and Nigeria has been maintained since 1852.

Administration.—The country is divided into three parts; the colony of Nigeria (the old Lagos colony) with an area of 1,400 sq.m. only; and the northern and southern provinces (78,600 sq.m. and 255,700 sq.m. respectively) which form the Protectorate of Nigeria. At the head of the administration is a governor; there is a lieut.-governor for the northern and for the southern provinces, and, since Oct. 1927, a separate administrator for the colony. Certain important services, *e.g.*, the railways, function throughout Nigeria. The governor, whose headquarters are in Lagos, is aided by an executive council of officials, and for the colony and the southern provinces there is a legislative council on which, since 1923, elected members have sat to represent the towns of Lagos and Calabar. (The franchise is conferred on adult males with an income of £100 a year or more.) On the council are also members nominated by various commercial bodies and others nominated to represent African interests. The legislative council is given control of expenditure in the northern provinces derived from the revenues of the central Government. The number of provinces has varied from time to time. As far as possible the system of indirect rule is observed; that is, the native governments existing before the British occupation are retained, each with its own treasury and judiciary, the rulers being guided by the advice of a British resident, under whom are district officers. This indirect rule prevails in almost all the northern provinces and also in Yorubaland. In these native states direct taxation and a fixed income for the emirs and other paramount chiefs has led to the abolition of many abuses. Fifty to 70% of the direct tax goes to the native treasuries.

Education and health are departments of primary value. There are Government elementary and technical schools, and King's college, Lagos, founded 1909, provides secondary education. At Katsina is a training college for native teachers, opened 1922, and there are training colleges in southern Nigeria, including two for women teachers. Education remained, however, chiefly in the hands of Christian missions; the Hope Waddell institute at Calabar, a Scottish missionary enterprise, has a high reputation for

industrial training. Both the missions and State schools now pay special attention to practical agricultural training. Some of the native administrations have their own schools. The Yoruba have for long shown an eagerness for education; after the World War the demand for education among the natives generally greatly increased. The health department has done a great and successful work in fighting malaria, dysentery, yellow fever and plague, and in insisting upon better housing and better food for Europeans. As one result the death rates of whites fell between 1903 and 1926 from over 20 per 1,000 to under 9 per 1,000.

Before amalgamation the administration of northern Nigeria required grants-in-aid to meet expenses, which were partly furnished by her richer neighbour, southern Nigeria. Since amalgamation, Nigeria has been self-supporting, though revenue in some years falls short of expenditure. In 1914 revenue was £3,048,000 and expenditure £2,967,000; in 1923–24 revenue had risen to £6,260,000 and expenditure to £5,501,000. The figures for 1926–27 were, revenue £7,734,000, expenditure £7,584,000. Revenue is derived from customs duties on imports fixed at 15% *ad valorem* in 1922; on the chief exports (this duty was first imposed in 1916); by direct taxation; and, in the colony only, and since 1927, income tax. It may be noted that a special West African currency is in circulation and that for purposes of trade between natives it has been necessary to mint a coin valued at one-tenth of a penny. The Bank of British West Africa and the Colonial Bank have agencies in the chief towns. British weights and measures are in use.

Economic Conditions.—There is a very large internal trade, as to which no statistics are available, but it is believed to exceed in value the external trade. The great majority of the people are agriculturists, including, in the north, cattle-rearing. Native manufactures are of minor importance—they include in the Hausa States the making of "Morocco" leather; mining (tin and coal) owes its development to the British. Fishing is largely followed in the delta. In a broad generalization the products of southern Nigeria are sylvan, palm oil and palm kernels taking the leading place. Cocoa and cotton are other products. From the middle belt come benniseed and shea-butter—both adding to the oil output. From northern Nigeria come groundnuts (a basis for margarine), hides and skins, cattle, and, in increasing quantities, cotton. (Cotton and maize are the only crops common to the northern and southern provinces.) Add to the products named coal and tin and timber, and the leading exports have been stated.

The coast peoples, since the 15th century, had traded directly with the European merchants who came to their ports, but the dense forest belt cut off intercourse with the interior—though the Niger and Benue might have afforded means of penetration. But up to the middle of the 19th century the trade of Hausaland and Bornu (that is northern Nigeria) was either with the Mediterranean by caravan across the Sahara, or east and west to other parts of the Sudan. Direct, but, at first, very limited, trade with the interior followed the efforts of the British government and merchants to open up the country by sending expeditions up the Niger and Benue. Modern developments date from the founding of the Royal Niger company by Sir George Goldie and the conquest of the Fula emirates by Sir F. D. (Lord) Lugard. (*See* p. 442, *History.*) The trade of Lagos and the oil rivers, the last the eastern part of southern Nigeria, partly through having been long established, was, up to 1928 at least, more valuable than that of northern Nigeria, which contains large areas sparsely peopled and little cultivated, and was not fully opened to trade with the south until the beginning of the 20th century. (This trade via the Gulf of Guinea, together with minor causes, almost killed the trade via the Sahara.) In 1901 when the total external trade of the southern regions was valued at over £4,000,000 that of northern Nigeria was probably (statistics are lacking) not £250,000. With the completion of the railway to Kano in 1911, there was a great increase in trade in the north. Since the amalgamation of southern Nigeria (including Lagos) with northern Nigeria in 1914 statistics are given for the country as a unit. In that year the imports were valued at £6,276,000 and the exports at £6,420,000. In 1924, when normal conditions following the World War were considered to be restored, the figures were:—imports £10,948,000; exports £14,460,000. In 1927 the external trade was nearly £30,000,000—imports being £14,146,000 and exports £15,654,000. These figures exclude specie.

Almost all sylvan and agricultural work in Nigeria is done by native owners, peasant farmers with small holdings, usually about 3 acres. The main concern of the farmer is to produce food crops—guinea corn and millet, yams and bananas, and maize—for himself and his family; he works for sale only in his spare time and to get luxuries. The great occupation in the delta is the production of palm oil and palm kernels. The yearly export is about 100,000 tons of oil and double that weight of kernels. Native methods of treating the fruit waste about half of the oil; up to 1928 only one factory had been started to deal with the fruit. Cocoa plantations were started in south Nigeria about 1905; the production of cocoa grew by 1928 to 40,000 tons in the year. Cotton growing for export dates from the early years of the 20th century; in 1912 an American variety of cotton was introduced and found suitable. In the centre and south a native cotton is also grown for export. By 1925 the export had reached 35,000 bales; two or three poor seasons followed; the 1925 output was nearly reached again in 1928, and the acreage under cotton increased. Many ginneries have been set up. The cultivation of groundnuts in northern Nigeria—climate and soil are well suited to the crop—grew rapidly with increased transport facilities. In the year 1927–28 (April and March inclusive) the railways carried 96,000 tons of nuts as against 4,800 tons of cotton. Generally, farming in Nigeria is not on a high level, partly because fertilizers are not used. The exhaustion of much land within easy reach of transport caused grave concern to the Government which from 1926 onward took measures to instruct the farmers in the use of manures and other fertilizers. There are, however, good stock farms in the north with large herds of cattle and flocks of sheep and goats.

The chief industries which are owned by Europeans are the tin and coal mines. The ascertainment of the richness of the tin-fields in Bauchi in 1902 led to a speedy development of the mines (which employ 30,000 to 35,000 natives), and the output of coal from Ude, which began in 1915, is of much importance. The coal mines are worked by the railway department for the Government; they supply the fuel for the tin mines, for their own railway and for the Gold Coast railways, and still have a surplus for the Government marine and the shipping companies. The output for the year ended March 31, 1928, was 345,000 tons. The tin-fields (*see* BAUCHI) are worked by private enterprises, mostly for companies registered in London. The timber-cutting concessions are also in the hands of Europeans. There are 200,000 sq.m. of forest in Nigeria; the timber exported is mainly mahogany, cedar and walnut, the mahogany chiefly from the Benin forests. Gum arabic is obtained from Bornu and other northern provinces. "Wild" rubber is still tapped, and plantation rubber is exported. The relative value of the chief exports is shown in the following figures for 1927:—Palm oil, £3,617,000; palm kernels, £4,574,000; groundnuts £1,633,000 (£2,342,000 in 1926); cocoa, £1,968,000; cotton lint, £611,000 (£1,182,000 in 1926); tin, £2,403,000.

The imports are of a most miscellaneous character; they may be classed under the main heads of cigarettes, cotton goods (both from the United Kingdom), provisions, hardware, salt, kola nuts (from the Gold Coast), petrol, and alcoholic liquors (mostly gin from Holland). (Though the import of "trade spirits" has been prohibited since 1919, and no alcoholic liquors, save for Europeans, are allowed into northern Nigeria, the growing wealth of the natives of southern Nigeria led to an increased demand for ordinary spirits and beer.) With regard to the direction of trade the figures for 1927 showed that 53·5% was done with the United Kingdom—which supplied 62% of the imports and took 45·6% of the exports. In that year Germany had 15% and the United States 10% of the total trade. Of the exports the palm kernels—largely used as cattle food—go to Germany and England, and the groundnuts to Germany, 60%, and France. The United States supplies kerosene, petrol and unmanufactured tobacco, and takes about 25% of the palm oil, and 30% of the cocoa.

Bibliography.—*Handbook for Nigeria*, 7th ed. (1926), Sir W. M. N. Geary, *Nigeria under British Rule* (1927); the annual reports published by the Colonial Office, London; *The Times* West African Supplement, Oct. 30, 1928. (F. R. C.)

Defence.—With a population approaching 19,000,000, order is maintained in Nigeria, and defence provided for the colony, by the Nigeria regiment of the West African frontier force (*see* Great Britain: *Colonial Forces*). This force, which was raised in 1901, consists of officers and non-commissioned officers of the British Army and other ranks recruited locally for 6 years with the colours and 3 in the reserve, with facilities for re-engagement. Training is on the lines of the British army. Regimental transport is by native carriers; transport animals are not used. The Nigeria regiment includes 1 battery of artillery (3·7 inch howitzers), 4 battalions of infantry, 1 light mortar unit, a signal school, and a depot. The establishment is 3,599, with a reserve of 682. There are also armed police with an establishment of 1,260 in the northern provinces, 2,105 in the southern. These police are liable for military service, and distributed in 7 territorial divisions, each under a senior commissioner.

See also League of Nations *Armaments Year-Book* (Geneva, 1928). (G. G. A.)

HISTORY

Of the early history of the races inhabiting the coast lands little is known. The Beni appear to have been the most powerful race at the time of the discovery of the coast by the Portuguese in the 15th century, and the kings of Benin in the 17th century ruled a large part of the south-western portion of the existing British protectorate (*see* Benin). The Benin influence does not seem to have reached east of the Forcados mouth of the Niger. In the greater part of the delta region each town owned a different chief and there was no one dominant tribe. Among these people, who occupied a low position even among the degenerate coast negroes and who were constantly raided by the more virile tribes of the interior, trading stations were established by the Portuguese, and later on by other Europeans, British traders appearing as early as the 17th century. There was no assertion of political rights by the white men, who were largely at the mercy of the natives and who rarely ventured far from their ships or the "factories" established on the various rivers.

By the end of the 18th century British enterprise had almost entirely displaced that of other nations on the Niger coast. But the principal trade of all Europeans was still in slaves. After the abolition of the slave-trade in the 19th century palm oil formed the staple article of commerce, and the various streams which drain the Niger coast near the mouth of the great river became known as the "Oil rivers." The opening up of the interior was in the meantime promoted, chiefly by the efforts of British travellers and merchants. Mungo Park traced the Niger from Segu to Bussa, where he lost his life in 1805. From Bussa to the sea the course of the river was first made known in 1830 by the brothers Richard and John Lander. Maj. Dixon Denham and Capt. Hugh Clapperton entered the country now known as Northern Nigeria from the north in 1823, crossing the desert from Tripoli. Clapperton in 1826–27 made a second journey, approaching the same territory from the Guinea coast. Dr. Barth, travelling under the auspices of the British Government, entered the country from the north and between 1852 and 1855 made the journeys whose record still remains the principal standard work for the interior. Macgregor Laird first organized in 1832 the navigation of the River Niger from its mouth to a point above the Benue confluence. During the next 25 years expeditions were despatched into the interior and a British consul was posted at Lokoja. Possession was also taken, in 1861, of Lagos island, with the object of checking the slave traffic still being carried on in that region. But the deadly climate discouraged the first efforts of the British Government, and, after the parliamentary committee of 1865 had recommended a policy which would render possible the ultimate withdrawal of British official influence from the coast, the consulate of Lokoja was abandoned, but re-established a few years later to meet the still steadily growing requirements of British trade upon the river.

The Royal Niger Company.—In 1880 the international "scramble for Africa" led to the establishment under the recognized protection of the French Government of two French firms which opened upwards of 30 trading stations on the Lower Niger. The establishment of these firms was admittedly a political move which coincided with the extension of French influence from Senegal into the interior. Nearly at the same time a young Englishman, George Goldie-Taubman, afterwards better known as Sir George Goldie (*q.v.*), having some private interests on the Niger, conceived the idea of amalgamating all local British interests and creating a British province on the Niger. To effect this end the United African Company was formed in 1879 and trade was pushed upon the river with an energy which convinced the French firms of the futility of their less united efforts. They yielded the field and allowed themselves to be bought out by the United African Company in 1884. At the Berlin Conference held in 1884–85 the British representative was able to state that Great Britain alone possessed trading interests on the Lower Niger, and in June 1885 a British protectorate was notified over the coast lands known as the Oil rivers. Germany had in the meantime established itself in Cameroons, and the new British protectorate extended along the Gulf of Guinea from the British colony of Lagos on the west to the new German colony on the east, where the Rio del Rey marked the frontier. In the following year, 1886, the United African Company received a royal charter under the title of the Royal Niger Company. The territories which were placed by the charter under the control of the company were those immediately bordering the Lower Niger in its course from the confluence at Lokoja to the sea. On the coast they extended from the Forcados to the Nun mouth of the river. Beyond the confluence European trade had not at that time penetrated to the interior.

The interior was held by powerful Mohammedan rulers who had imposed a military domination upon the indigenous races and were not prepared to open their territories to European intercourse. To secure British political influence, and to preserve a possible field for future development, the Niger Company had negotiated treaties with some of the most important of these rulers, and the nominal extension of the company's territories was carried over the whole sphere of influence thus secured. The movements of Germany from the south-east, and of France from the west and north, were thus held in check, and by securing international agreements the mutual limits of the three European Powers concerned were definitely fixed. The principal treaties relating to the German frontiers were negotiated in 1886 and 1893; the Anglo-French treaties were more numerous; those of 1890 and 1898, which laid down the main lines of division between French and British possessions on the northern and western frontiers of Nigeria, having been supplemented by many lesser rectifications of frontier. It was not until 1909 that the whole of the frontier between Nigeria and the French and German possessions had been definitely demarcated. Thus, mainly by the action of the Royal Niger Company, and with the employment of a force of 500 Hausa trained under European officers, a territory of vast extent, into which the chartered company itself was not able to carry either administrative or trading operations, was secured for Great Britain.

The Protectorate.—Owing to pressure of foreign nations on the company's frontiers, a situation had arisen which the resources of a private company were inadequate to meet. In 1897 relations with France on the western border became so strained that Mr. Chamberlain, who was then secretary of state for the colonies, thought it necessary to raise a local force, afterwards known as the West African Frontier Force, for the special defence of the frontiers of the West African dependencies. In these circumstances it was arranged that in consideration of compensation for private rights the company should surrender its charter and transfer all political rights in the territories to the Crown. The transfer took place on Jan. 1, 1900, from which date the company, which dropped the name of "royal," became a purely trading corporation. The southern portion of the territories was amalgamated with the Niger Coast protectorate, the whole district taking the name of the Protectorate of Southern Nigeria,

while the northern portion, extending from a line drawn slightly above 7° N. to the frontier of the French possessions on the north and including the confluence of the Niger and the Benue at Lokoja, was proclaimed a protectorate under the name of Northern Nigeria.

The company, during its tenure of administrative power under the charter, had organized its territories south of the confluence into trading districts, over each of which there was placed a European agent. The executive powers in Africa were entrusted to an agent-general with 3 provincial and 12 district superintendents. There was a small judicial staff directed by a chief justice, and there was a native constabulary of about 1,000 men, trained and drilled by white officers. The company kept also upon the river a fleet of about 30 steamers. The entire direction of the proceedings of the company was, however, in the hands of the council in London, and the administrative control of the territories was practically from first to last vested in the person of Sir George Goldie. The local work of the representatives of the company was mainly commercial.

Southern Nigeria, 1885–1906.—While the development of the Royal Niger Company's territories was proceeding in the manner described, the regions under direct British control were also being opened up and law and order introduced. In 1893, when the title Oil Rivers Protectorate was changed to that of Niger Coast Protectorate, a regular administration was established (subject to the Foreign Office in London) under Sir Claude Macdonald, who was succeeded as commissioner and consul-general in 1896 by Sir Ralph Moor (1896–1904). Under these officials peace was gradually established between various tribes, trade routes opened, and progress made in civilization. The work was one of extreme difficulty, largely because there was no central native authority with which to deal. Small military expeditions had constantly to be employed to break up slave-raiding gangs or reduce to order tribes which blocked trade routes or made war on other tribes living peaceably under British protection. The most serious military operations were against the Beni, a peaceful mission to the king of Benin having been massacred in the bush in Jan. 1897. The operations were completely successful and the Benin country was added to the protectorate (*see* BENIN). The administration improved the condition of the natives without undue interference with customary law. The submission of the Aros to the Government in 1902 brought to an end the system of tribal warfare for the purpose of making slaves, while a proclamation of 1901 prohibited the buying, pawning, or selling of slaves. Trade steadily developed, and owing to the large sums paid as duty on imported spirits the revenue of the protectorate was sufficient to cover the expenditure.

Northern Nigeria.—In Northern Nigeria at the time of the transfer (1900) British authority had still to be established. The man selected for the post of first high commissioner was Colonel (Lord) Lugard, who had conducted one of the Royal Niger company's most successful expeditions into the western portion of the interior and had already been employed by the British Government to raise and organize the West African Frontier Force.

On Jan. 1, 1900, the Union Jack was hoisted at Lokoja, and the formation of a local administration was entered upon. The headquarters of the West African Frontier Force had been at Jebba, not far from the point at which Mungo Park had lost his life upon the river. Neither Jebba nor Lokoja was considered suitable for the permanent capital of the protectorate and survey parties were sent out to find a more suitable site, with strict orders to avoid conflict with the nominally friendly natives. This was selected on a branch of the Kaduna river in the southwestern corner of the province of Zaria, at a place of which the native name of Zungeru was retained. The ruler of Zaria, while professing friendliness, was, however, unable or unwilling to restrain the rulers of Kontagora and Nupe from aggression. These two potentates raided for slaves to the borders of the rivers and openly threatened the British position on the Niger. The Ashanti War of 1900 claimed the despatch of a strong detachment of the West African Frontier Force, and it was not until the return of the troops in Feb. 1901 that Nupe and Kontagora could be effectively dealt with. In that year both provinces were subdued, their emirs deposed, and letters of appointment given to new emirs, who undertook to rule in accordance with the requirements of humanity, to abolish slave-raiding and slave dealing, and to acknowledge the sovereignty of Great Britain. Illorin and Borgu with a portion of Kabba were already under British rule. The rulers of other neighbouring provinces offered their allegiance, and by the end of the year 1901 nine provinces, Illorin, Kabba, Middle Niger, Lower Benue, Upper Benue, Nupe, Kontagora, Borgu and Zaria had accepted the British occupation. An initial system of administration was organized and British residents were appointed to each province. Seventeen legislative proclamations were enacted in the first year dealing with the immediate necessities of the position and providing for the establishment of a supreme and provincial court of justice, for the legalization of native courts of justice, and for regulating questions of slavery, importation of liquor and firearms, land titles, etc. In the autumn of 1901 the emir of Yola (the extreme eastern district in the territories bordering upon the Benue) was, in consequence of the aggressions upon a trading station established by the Niger Company, dealt with in the same manner as the emirs of Nupe and Kontagora, and a new emir was appointed. In 1902 Bauchi and Bornu were brought under British rule. Military stations were established in each and both were included in the system of British administration. Later in the same year an act of treachery culminating in the murder of a British resident, Captain Moloney, in the province of Nassarawa, led to the military subjugation of that province. By the end of the year 1902 British administration had been extended to the whole of the provinces in the south, east, and west of the protectorate. The important Mohammedan states of Sokoto, Gando, Kano, and Katsena remained independent. These states were regarded as the stronghold of Fula supremacy. The emir of Sokoto held the position of religious as well as political head of all the lesser states of Northern Nigeria, and in response to friendly overtures on the part of the British administration had declared that between Sokoto and Great Britain there could be nothing but war. Katsena was the centre of local learning, while Kano was at once the commercial and the military centre of power. By the end of 1902 it had become evident that a trial of strength between the Mohammedan powers and the new British administration was inevitable. The Mohammedan rulers were themselves of comparatively recent date. In fighting them there was no question of fighting the whole country. On the contrary it was presumed with justice that their overthrow would be hailed with satisfaction by many of the subject peoples. Every attempt was made to settle the question at issue by conciliatory methods, but, these having failed, a campaign against Kano and Sokoto was entered upon in Jan. 1903. It was entirely successful. The capital of Kano, a walled and fortified town of great extent and formidable strength, fell to a British assault in Feb. 1903. Sokoto submitted after a battle which took place on May 17. The sultan fled, and on May 21 a new sultan, chosen by the council of elders, was installed by the British high commissioner, after he had publicly accepted the conditions imposed by the British Government, namely, that all rights of conquest acquired by the Fulani throughout Northern Nigeria passed to Great Britain, that for the future every sultan and emir and principal officer of state should be appointed by Great Britain, that the emirs and chiefs so appointed should obey the laws of the British Government, that they should no longer buy and sell slaves, nor enslave people, that they should import no firearms, except flintlocks, that they should enforce no sentences in their courts of law which were contrary to humanity, and that the British Government should in future hold rights in land and taxation. When these conditions were accepted by the Fulani chiefs the supremacy of Great Britain was established over the entire country. Katsena and Gando followed the example set for them by Kano and Sokoto. After the conquest of the Hausa states in 1902–3 the King's writ ran—with the exception of a few districts inhabited by primitive savages—through the whole area known as Northern Nigeria.

THE AMALGAMATION OF NIGERIA

Union of Lagos and Southern Nigeria.—In 1904 it was decided to unite the two Nigerias and Lagos under one government, and as a first step in that direction Sir Walter (then Mr.) Egerton was appointed both governor of Lagos and high commissioner of Southern Nigeria. This was followed in Feb. 1906 by the amalgamation of these two administrations under the style of "the Colony and Protectorate of Southern Nigeria," with headquarters at Lagos town. The former colony and protectorate of Lagos (*q.v.*) became the western or Lagos province of the new administration. In the year of amalgamation the revenue reached a record figure, the amount collected being £1,088,000, to which Lagos province contributed £424,000. Over 80% of the revenue was derived from customs. In the same year the expenditure from revenue was £1,056,000.

Northern Nigeria Railway.—Northern Nigeria continued to be a separate protectorate, and in 1907 Sir Frederick Lugard was succeeded as high commissioner by Sir Percy Girouard. In August of that year the British Government, on administrative, strategic, and commercial grounds decided on a railway to give the cities of Zaria and Kano direct communication with the perennially navigable waters of the Lower Niger. In view of the approaching unification of Southern and Northern Nigeria, the money needed, about £1,250,000, was raised as a loan by Southern Nigeria. The route chosen for the line was that advocated by Sir Frederick Lugard. This important work, essential for the welfare of the northern territories, was begun under the superintendence of Sir Percy, the builder of the Wadi Halfa-Khartoum railway. At the same time the Lagos railway was extended to join the Kano line near Zungeru, the Niger being bridged at Jebba.

Land Tenure.—Sir Percy Girouard gave much attention to the land tenure, probably the most important of administrative questions in West Africa. He adopted the land policy of Sir Frederick Lugard and recommended "a declaration in favour of the nationalization of the lands of the protectorate." This was in accord with native laws—that the land is the property of the people, held in trust for them by their chiefs, who have not the power of alienation. In 1909 he was succeeded as Governor (the title High Commissioner having been changed) by Sir H. H. J. Bell; and meanwhile the secretary for the colonies had appointed a strong committee, which, after hearing much evidence, issued a report in April 1910 in substantial agreement with his recommendations. This policy was adopted by the Colonial Office and the natives of Nigeria were secured in the possession of their land—the Government imposing land taxes, which are the equivalent of rent. The exclusion of the European land speculator and denial of the right to buy and sell land and of freehold tenure was held by all the authorities to be essential for the moral and material welfare of the inhabitants of a land where the duty of the white man is mainly that of administration and his material advantages lie in trade.

Amalgamation of Northern Nigeria.—The constitution of Southern Nigeria (1906) left the protectorate still divided into two very different, and, for political purposes, distinct dependencies of the Crown. Southern Nigeria, with an area of about 76,000 sq.m., stretched inland from the Guinea coast through a tropical belt of generally dense forest land to a line irregularly corresponding with the latitude of 7′10″ N. Northern Nigeria, with an area of 255,700 sq.m., composed largely of open prairie, hill country, and dry desert plains, extended from the latitude of 7′10″ to the frontiers of the French and Zinder territory on the north, to French Dahomey on the west, and to the German Cameroons on the east. The population of Southern Nigeria was about 8,000,000 and the population of Northern Nigeria, with more than three times the area, was about 9,000,000. In both divisions primitive and very backward races had been overrun and influenced by civilizations of a higher type. In the south the new civilization had been European and Christian; in the north, Arab and Mohammedan.

The interdependence of these two regions was obvious and their amalgamation had long been urged upon the Imperial Government. It was not, however, until 1911 that the secretary for the colonies, Mr. L. V. Harcourt, determined to adopt the policy. Sir F. (Lord) Lugard, who had been the first high commissioner for Northern Nigeria, was asked to initiate and carry out a scheme of amalgamation, being in 1912 appointed governor at the same time of both Southern and Northern Nigeria. The preliminary work was completed in about 18 months, and on Jan. 1, 1914, the governments of Southern and Northern Nigeria were formally amalgamated, Sir Frederick Lugard receiving the personal title of governor-general. The geographical divisions of north and south were maintained. Two lieutenant-governors were appointed, one for the northern and one for the southern province. An administrator was appointed to the colony, the executive council of which became the executive council of the protectorate, while the jurisdiction of the legislative council was confined to the narrow limits of the colony's 1,400 sq.m.

At the time of amalgamation Northern Nigeria was divided into 12 provinces, the native communities being for the most part each under its native ruler, the five principal native states being known as first-class emirates, while each independent chieftainship, however small, retained its treasured liberty, and this system of government was maintained. The southern provinces at that period consisted of three divisions under provincial commissioners. They were the territories east of the Niger, west of the Niger, and the hinterland of Lagos. The native races in the hinterland of Lagos and to the east of the Niger were in a much less advanced state of tribal organization than were the tribes in the north and scarcely fitted for any form of enlightened self-rule. Fetish worship, cannibalism, and barbarous practices were rife. On the west of the Niger, however, three native states, Yoruba, Egbe, and Benin, were strongly organized. They were induced to renounce the exceptional position they enjoyed, under treaties made with Great Britain, and to accept conditions similar to those of the first-class emirates of the north. The introduction of the new system was accompanied by some difficulty, and in 1918 an easily suppressed rising in Egbeland gave momentary uneasiness. Indirect rule has now been fully accepted in both Egbeland and Yorubaland and the report of 1924 stated that it was working admirably in Benin. The way for the extension of such indirect rule as might be found possible was prepared by the division of Southern Nigeria into nine provinces (later increased), each under a British resident, as in the north.

The World War.—The outbreak of the World War within seven months of amalgamation postponed the consolidation of the new system. Patriotic sentiment in the protectorate ran high. Every department was depleted by volunteers for active service, and it was with difficulty that the administrative machine was held together with the remnant of overworked staff retained. For four years, the first thought of every Englishman in Nigeria was given to the war. And not of the Englishmen only. The War served at once to test and to exemplify the solid results of British rule. Throughout the War period the great native chiefs of the north were constant and unflagging in their loyalty.

The native troops of the West African Frontier Force did gallant service, both in the arduous campaign carried out under the leadership of Generals Dobell and Cunliffe in the Cameroons, and in what was to them foreign service in East Africa. The Cameroons campaign which opened in August and September 1914, with reverses all along the British line, at Mora (Aug. 25) and Garua (Aug. 29) in the north, and at Nsanakang (Sept. 6) in the south, lasted until Feb. 1916. It was a severe test for the troops engaged. The fighting was heavy, but they stood it well. Early in 1915 the campaign, in which French troops took an active part, was reorganized. British forces in the north were placed under the command of General Cunliffe, and the final taking of Garua and the storming of Banyo Hill under his leadership on Nov. 6, 1915, in face of a hail of dynamite bombs, was a feat of which any regiment might be proud. The conquered territory was divided between France and Great Britain, to be administered under mandate according to the provisions of the Treaty of Versailles. The portion taken by Great Britain was 31,000 sq.m., with an estimated population of 600,000 (*see* CAMEROONS).

Reforms.—While the war by arresting material development also delayed the application of schemes for the moral welfare of the native population, some progress was made. The judicial and legal systems of the two protectorates were, on amalgamation, combined. One chief justice for the whole of Nigeria and four puisne judges were appointed, and each lieutenant governor was provided with a legal adviser. The reorganization of the two systems and the revision of the laws of the two protectorates, was a long and heavy job. The first reforms were initiated in 1914. Notwithstanding the difficulties of the moment, an education ordinance was promulgated in 1916 having for its object the reform and co-ordination of the systems of the north and south. It set a definite standard, of which the principal aim was to substitute self-discipline and the formation of character for set examinations in literary subjects, and generally to fit local education to local needs. A forestry ordinance of the same year (1916) dealt with the rapid destruction of the forests, which constitute the principal wealth of the southern provinces.

Not the least achievement of the war period was the elimination of the traffic in foreign "trade spirits," on which the revenue of the southern provinces had largely depended. It was the declared policy of the amalgamated government to kill this trade by gradually raising the duty. Conditions of war hastened the process. Before the war the revenue from this traffic formed 34.26% of the revenue of southern Nigeria. By the end of the war it had fallen to a proportion of 1.23. It was held that this result established two important conclusions. First, that the government of Nigeria could dispense with revenue derived from spirits; secondly, that the produce trade could be conducted successfully without them. As from Feb. 1, 1919, the importation of trade spirits was formally prohibited in all the West African colonies and protectorates.

Constitutional Changes.—Sir F. (later Lord) Lugard retired at the end of the war, and Sir Hugh Clifford succeeded him as governor of Nigeria in July 1919. It was an era of prosperity, and at the end of Clifford's term of governorship great economic progress had been made. Sir Hugh's tenure of office was also notable for two modifications in the system of administration. The first was the extension and reorganization of the central secretariat, a step which in practice tended to curtail the responsibility and initiative of the lieutenant governors and residents of provinces. The second was the abolition of an advisory Nigerian council established under the amalgamation scheme, and the restoration of the jurisdiction of the legislative council for the colony over the whole of the southern provinces. In the new and enlarged council the elective principle was introduced. The introduction of this elective principle, of which experience in the West Indies has not been altogether encouraging, was new to West Africa, though it has since been applied to Sierra Leone and the Gold Coast. The new council retains an official majority, but includes three elected unofficial members representing the municipal area of Lagos, and one elected unofficial member representing the municipal area of Calabar. The unofficial element also includes members chosen by the three chambers of commerce (Lagos, Port Harcourt, and Kano) and the chamber of mines, two members representing respectively the banking and shipping interests, and eight the otherwise unrepresented African population of the colony and the southern provinces. The first elections for this council were held in Sept. 1923.

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NIGHT, that part of the natural day of 24 hours during which the sun is below the horizon, the dark part of the day from sunset to sunrise (*see* DAY). The word in O. Eng. takes two forms *neaht* and *niht*, the latter form apparently being established by about the 10th century.

The word is common in varying forms to Indo-European languages. The root is usually taken to be *nak-*, to perish, the word meaning the time when the light fails (cf. Gr. *νέκυς*, Lat. *nex*, death; *nocere*, to hurt).

It was customary in former times to reckon periods of time by nights, and "fortnight" (O. Eng. *feowertyne niht*, 14 nights) is still used, but "se'n-night" (7 nights) has been displaced by "week" (*q.v.*).

NIGHTHAWK, an insect-hunting bird closely related to the goatsuckers of the old world, and less closely to the swifts and humming birds. The nighthawk (*Chordeiles virginianus*) belongs to the family Caprimulgidae, goatsuckers, so called from the fancy that they sucked the milk of goats. The wide skull, soft plumage, noiseless flight and nocturnal vision connect these birds with the owls.

The nighthawk wanders in migration from the Arctic ocean to southern South America, and breeds in eastern North America from Florida to Labrador. The eggs are laid on the ground or on the flat roof of a building. The Texan nighthawk (*Ch. acutipennis texensis*) has rusty-brown spots on the flight feathers.

NIGHTINGALE, FLORENCE (1820–1910), an Englishwoman, is generally accepted as being the originator and founder of modern nursing. Of almost equal importance are her achievements in the field of public health, especially those relating to the sanitary condition of hospitals and barracks, while by her example, her personality and her attainments she did more than perhaps any other one woman to bring about the emancipation of women.

The second daughter of wealthy and cultured parents, she was born in Florence, It., on May 12, 1820, and called after that city. Her character was complicated. To a mind of great power she united an intensely emotional temperament and a capacity for introspection amounting to self-torture, and from childhood her life was one of inner conflict.

Even at the age of six Florence felt herself frustrated and miserable in the idle luxury of her home. Her mother was socially ambitious, and when Florence grew up witty and pretty enough to be called a beauty, it was intended that she should make a brilliant marriage. Such ambitions were vain, however. In 1837, at the age of 17, Florence Nightingale received a call from God. It was not an inward revelation. She heard, as Joan of Arc heard, the voice of God speaking to her in human words and calling her to his service. A period of perplexity followed: what form of service was she to undertake? By 1844 her vocation had become clear, she was to tend the sick, to nurse.

A desperate struggle with her family ensued. Nursing at that time was disreputable, and nurses were frequently drunken prostitutes. Florence met furious opposition, was reproached, bullied, sent to Coventry and brought to the verge of mental collapse. Nevertheless she would not be turned from her determination. When Richard Monckton Milnes, later Lord Houghton, repeatedly pressed her to marry him, she refused even though she describes him as "the man I adore." Everything had to be sacrificed to her vocation. Even the ties of friendship might, she thought, weaken her will. Years passed in misery and frustration. It was not until 1851 that she was allowed to gain her first nursing experience with the Protestant deaconesses at Kaiserswerth in Germany and not until 1853, 16 years after her first call, that she left home to take her first post, the reorganization of a small hospital in Harley street, London, the Institution for the Care of Sick Gentlewomen in Distressed Circumstances.

The years had not been wasted. Studying in secret and corresponding with hospital authorities all over Europe she had made herself an expert in hospital administration. And she had acquired an iron self-control. The reorganization was a brilliant success, and it was her work in Harley street that led Sidney Her-

bert, secretary at war in the British cabinet and her intimate friend, to invite her to undertake a mission to the Crimea. War with Russia had been declared in March 1854; by October England was ringing with the horrible state of the British military hospitals revealed by the special correspondent of the *Times* (London). Florence Nightingale sailed for the Crimea with 38 nurses on Oct. 21, 1854, and within a month found that she had more than 5,000 men in her charge. The so-called hospitals were vast dilapidated buildings, filthy, bare, not merely lacking medical equipment but destitute of every convenience for common decency. By superhuman efforts she brought order out of chaos, working day and night, often on her feet for 20 hours at a stretch and hindered at every turn by official jealousy and intrigue. Every night she made a personal inspection and walked round the vast wards with her lamp—the barrack hospital alone had four miles of beds. It was this practice which inspired Longfellow to write his poem "Santa Filomena" and earned Florence Nightingale the title of "the Lady with the Lamp." But she did more than make the hospitals sanitary, she brought about a revolution in the treatment of the private soldier. In the words of an eyewitness, "she taught officers and officials to treat the soldiers as Christian men," and the army regarded her with something approaching worship.

When the story of her achievements and her tenderness to the wounded men reached home, there was a great outburst of enthusiasm, she became a national heroine and £45,000 was raised by public subscription as a testimonial and placed at her disposal.

But when she returned from the Crimea she insisted on going into retirement. She had dedicated her life to the welfare of the private soldier and she believed that her popularity would prejudice the government against her. She retired so completely that the public thought that she had died. In fact, however, with Sidney Herbert's help, she had embarked on a crusade for army reform; and in 1857, encouraged by Queen Victoria, she obtained a commission to inquire into the sanitary condition of the army. For the first time in history the food, housing and health of the soldier in peacetime were scientifically examined, and the commission marks the dawn of a new age in the health administration of armies. In 1858 she published an immense volume, *Notes on Matters Affecting the Health, Efficiency and Hospital Administration of the British Army*, which remains the standard work of its kind. In 1859 a commission was set up to inquire into the sanitary condition of the army in India, and in 1863 its report was submitted to Miss Nightingale. The amount of work that she did was almost incredible: the papers of the Indian sanitary commission alone filled two vans, and work for the army had gradually become only a part of her activities. Military hospitals had led her to civil hospitals, military nursing to civil nursing, military health to public health. In July 1860, with the sum subscribed as a testimonial, she opened the Nightingale training school for nurses at St. Thomas's hospital. From this date modern nursing may be said to commence. Every probationer entering the school was interviewed by her and remained under her close supervision. The strain was too great. Her health, shaken by her enormous exertions in the Crimea, gave way. She suffered a series of collapses and became an invalid. Nevertheless, though almost bedridden she continued to work and, living for work herself, became a ruthless taskmaster to others. Sidney Herbert had long been in poor health but, urged on by Miss Nightingale and by his wife, he struggled to perform the impossible. In 1861 he died from kidney disease aggravated by overwork. Yet Miss Nightingale toiled on. Her work still grew. The war office had come to lean on her advice, all sanitary papers were sent to her, she drew up regulations, framed warrants, reported on barrack plans. She was an acknowledged authority on India though she had never been there, and viceroy after viceroy came to her for his "Indian education." As the years went by thousands of nurses came under her control; after 1862 district nursing was brought into being under her guidance and the work involved in that alone would have occupied the whole time of an ordinary woman. Not until 1872, when she said that she "went out of office," did the fury of her work slacken. Then she became interested in mysticism, assisted Benjamin Jowett in the translation of the dialogues of Plato and compiled a book of extracts from the Christian mystics. Personal relationships, especially with young people, became of increasing importance and she enjoyed a tranquil old age, darkened only by the gradual loss of her sight. In 1907 she was awarded the Order of Merit. The announcement came as a surprise; most people thought she had died half a century before. She died on Aug. 13, 1910. By her express wish the offer of a national funeral and burial in Westminster abbey was refused, and her coffin was carried to the family grave in the little country churchyard of East Wellow, Hampshire, by six sergeants of the British army.

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NIGHTINGALE, the bird celebrated beyond all others by European writers for the vocal powers which, contrary to usual belief, it exercises at all hours of the day and night during some weeks after its return from its winter quarters in the south. The song itself is indescribable, though several attempts, from the time of Aristophanes to the present, have been made to express in syllables the sound of its many notes.

Poets have descanted on the bird (which they nearly always make of the feminine gender) leaning its breast against a thorn and pouring forth its melody in anguish. But the cock alone sings, and there is no reason to suppose that the cause and intent of his song differ in any respect from those of other birds' songs (*see* Song Birds.)

In contrast with the nightingale's voice is the inconspicuous coloration of the bird's plumage, which is alike in both sexes, and is of a reddish-brown above and dull grayish-white beneath, the breast being rather darker and the rufous tail showing the only bright tint.

The range of the European nightingale, *Luscinia megarhyncha*, is peculiar. In Great Britain it is abundant in suitable localities to the southeast of a line stretching from the valley of the Exe, in Devonshire, to York, but it does not visit Ireland, Wales or Scotland.

On the continent of Europe it does not occur north of a line stretching irregularly from Copenhagen to the northern Urals, and it is absent in Brittany. Over south Europe otherwise it is abundant.

The nightingale reaches Iran, and is a winter visitor to Arabia, Nubia, Abyssinia, Algeria and as far south as the Gold Coast. The larger eastern *L. philomela* is russet-brown in both sexes, and is a native of eastern Europe. *L. hafizi* of Iran is probably the Perso-Arabic bulbul of poets.

The nightingale reaches its English home about the middle of April, the males (as is usual among migratory birds) arriving several days before the females.

Poets and novelists are apt to command at will the song of this bird, irrespective of season. If the appearance of truth is to be regarded, it is dangerous to introduce a nightingale as singing in England before the 15th of April or after the 15th of June. The "early nightingale" of newspaper paragraphs is generally a thrush.

On the cocks being joined by their partners, the work for which the long and hazardous journey of both has been undertaken is speedily begun, and before long the nest is completed. This is of a rather uncommon kind, being placed on or near the ground, the outworks consisting chiefly of a great number of dead leaves ingeniously applied together so that the plane of each is mostly vertical. In the midst of the mass is wrought a deep cuplike hollow, neatly lined with fibrous roots, but the whole is so loosely constructed, and depends for lateral support so much on the stems of the plants among which it is generally built, that a very slight touch disturbs its beautiful arrangement.

Herein from four to six eggs of a deep olive colour are duly laid, and the young subsequently hatched. The nestling plumage of the nightingale differs much from that of the adult, the feathers above being tipped with a buff spot, just as in the young of the

redbreast, hedge sparrow and redstart, thereby showing the natural affinity of all these forms. Toward the end of summer the nightingale disappears to its African winter haunts.

The name nightingale has been applied to several other birds. The so-called "Virginian nightingale" is a species of grosbeak (*q.v.*); the "Pekin nightingale" or "Japanese nightingale" is a small babbler (*Liothrix luteus*) of the Himalayas and China.

The nightingale holds a place in classical mythology. Procne and Philomela were the daughters of Pandion, king of Attica, who in return for warlike aid rendered him by Tereus, king of Daulis in Thrace, gave him the first-named in marriage. Tereus, however, being enamoured of her sister, feigned that his wife was dead, and induced Philomela to take her place. On her discovering the truth he cut out her tongue to hinder her from revealing his deceit; but she depicted her sad story on the robe which she sent to Procne; and the two sisters then contrived a horrible revenge for the infidelity of Tereus, by killing and serving to him at table his son Itys. Thereupon the gods interposed, changing Tereus into a hoopoe, Procne into a swallow, and Philomela into a nightingale, while Itys was restored to life as a pheasant, and Pandion (who had died of grief at his daughters' dishonour) as a bird of prey (*see* OSPREY). The fable has several variants. Ovid's version may be seen in the 6th book of his *Metamorphoses* (lines 412–676).

NIGHTJAR or **GOATSUCKER** (*Caprimulgus europaeus*, Linn.), a bird erroneously believed since very ancient days to have the habit implied by its second name. It is characterized by its flat head, wide mouth fringed with bristles, large eyes, soft plumage and consequently noiseless flight. It arrives in Europe from Africa late in the spring, returning in the early autumn. Its food consists of insects, chiefly moths and cockchafers, which it catches on the wing at night. When resting on a bough the nightjar sits along its length. In this position the cock bird utters his curious burring note. The eggs are laid on the ground, and number two; the young are clad in dark-spotted down, rendering them, like their parents, exceedingly difficult to see when crouching on the ground.

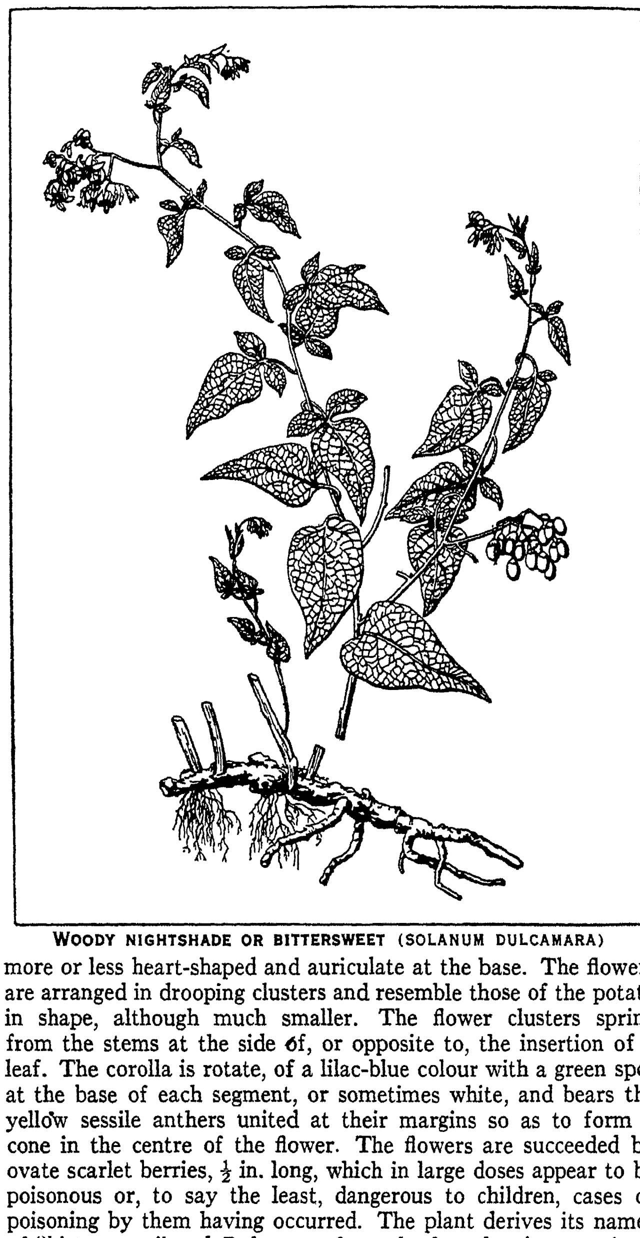
FROM KOEHLER, "MEDIZINAL PFLANZEN"

DEADLY NIGHTSHADE OR DWALE (ATROPA BELLADONNA), SHOWING BRANCH WITH FLOWERS AND FRUIT

A second species, *C. ruficollis*, occurs in Spain and Portugal and others are found throughout the old world. In America their place is taken by the allied genus, *Antrostomus*, one member of which, *A. vociferus*, is the whip-poor-will (*q.v.*). The nighthawk (*q.v.*) is another common American species, with a voice quite different from that of the whip-poor-will.

The family Caprimulgidae is almost cosmopolitan, but is not represented in New Zealand and Polynesia.

NIGHTSHADE, a general term for plants of the botanical genus *Solanum* (family Solanaceae). The species to which the name of nightshade is commonly given in England and North America is *Solanum Dulcamara* which is called also bittersweet or woody nightshade. It is a common plant in damp hedgebanks and thickets, scrambling over underwood and hedges. It has slender slightly woody stems, with alternate lanceolate leaves more or less heart-shaped and auriculate at the base. The flowers are arranged in drooping clusters and resemble those of the potato in shape, although much smaller. The flower clusters spring from the stems at the side of, or opposite to, the insertion of a leaf. The corolla is rotate, of a lilac-blue colour with a green spot at the base of each segment, or sometimes white, and bears the yellow sessile anthers united at their margins so as to form a cone in the centre of the flower. The flowers are succeeded by ovate scarlet berries, $\frac{1}{2}$ in. long, which in large doses appear to be poisonous or, to say the least, dangerous to children, cases of poisoning by them having occurred. The plant derives its names of "bittersweet" and *Dulcamara* from the fact that its taste is at first bitter and then sweet. It is a native of Europe, North Africa and temperate Asia, and is widely naturalized.



WOODY NIGHTSHADE OR BITTERSWEET (SOLANUM DULCAMARA)

The black nightshade, *S. nigrum,* differs from *S. Dulcamara* in having white flowers in small umbels and globose black berries. It is a common and well nigh cosmopolitan weed in gardens and waste places, growing about 12 or 18 in. high, and has ovate, entire or sinuate or toothed leaves. The berries have been known to produce poisonous effects when eaten by children, and owe their properties to the presence of solanine. In most tropical countries the leaves are eaten as a pot herb. (*See* SOLANUM.)

Deadly nightshade, dwale or belladonna (*Atropa belladonna*) is a tall bushy herb of the same plant family. It grows to a height of 4 or 5 ft., having leaves of a dull green colour, with a black, shining, berry fruit, about the size of a cherry, and a large tapering root. The plant is a native of central and south Europe,

extending into Asia, and is found locally in England, chiefly on chalk and limestone, from Westmorland and southward. The entire plant is highly poisonous, and accidents not infrequently occur because children and unwary persons eat the attractive looking fruit. Its leaves and roots are largely used in medicine on which account the plant is cultivated, chiefly in south Germany, Switzerland and France.

The name nightshade is applied to plants of different genera in other countries.

NIGRA, COSTANTINO, Count (1828–1907), Italian diplomatist, was born at Villa Castelnuovo, in the province of Turin, on June 11, 1828. During the war of 1848 he interrupted his studies to serve as a volunteer against Austria, and was wounded at the battle of Rivoli. On the conclusion of peace he entered the Piedmontese foreign office; he accompanied Victor Emmanuel and Count Camillo Benso di Cavour to Paris and London in 1855, and in 1856 he took part in the conference of Paris by which the Crimean War was brought to an end. After the meeting at Plombières between Cavour and Napoleon III, Nigra was sent to Paris as an agent of Cavour. After the breach with Napoleon he was secretary of state to the prince of Carignano, viceroy of the Neapolitan provinces. When Napoleon recognized the kingdom of Italy in 1861, Nigra returned to France as minister resident, and for many years played a most important part in political affairs. In 1876 he was transferred to St. Petersburg with the rank of ambassador, in 1882 to London, and in 1885 to Vienna. In 1899 he represented Italy at the first Hague peace conference. In 1904 he retired, and he died at Rapallo on July 1, 1907. He was created count in 1882 and senator in 1890.

NIHILISM, the name commonly given to the earliest Russian form of revolutionary anarchism. It originated in the early years of the reign of Alexander II. The term was first used by Ivan Turgenev in his celebrated novel, *Fathers and Sons,* published in 1862. (*See* Russia: *History* and Anarchism.)

NIIGATA, the chief town and capital of the prefecture of Niigata, Japan. Pop. (1950) 220,901. It occupies an area of rather more than 1 sq.mi., and consists of five long parallel streets intersected by cross streets, which in most cases have canals running down the middle and communicating with the river, so that the internal traffic of the city is mainly carried on by water. The town has been brought within the railway circuit, and the production of petroleum has been developed in the district. There is a large manufacture of lacquer ware in the town, and since 1931 modern industries have been developed.

The prefecture of Niigata has an area of 4,856 sq.mi. and a population (1950 census) of 2,460,997.

NIJAR, a town of southeastern Spain, in the province of Almería; on the southern slope of the Sierra Alhamilla, and on the small river Artal, which flows into the Mediterranean sea 6 mi. S.W. Pop. (1940) 1,925 (mun., 10,071). Lead, iron and manganese are mined near by; the fertile plain watered by the Artal yields an abundance of wheat, fruit, olives and esparto grass; fine porcelain and woollen and cotton goods are manufactured there.

NIJMEGEN, or Nijmwegen, a residential town in the province of Gelderland, the Netherlands, on the left bank of the Waal, 24½ mi. S.E. of Tiel by rail. Pop. (1940), 94,103. It has regular steamboat communication with Rotterdam, Cologne and Arnhem, and is very prettily situated on the slopes of five low hills rising from the riverside. Steps are necessary to lead to the higher portions of the town. In 1877–84 the old town walls were demolished, a promenade and gardens taking their place, and subsequently a new quarter grew up on the south side with a fine open place called the Emperor Charles's plain. On the east of the town is the beautiful park called the Valkhof, which marks the site of the old palace of the Carolingian emperors. The palace was ruined by the French bombardment of 1794, and only two portions of it remain. These are a part of the choir of the 12th century palace-church, and a 16-sided baptistry originally consecrated by Pope Leo III in 799 and rebuilt in the 12th or 13th century. Close by is the lofty tower of the Belvedere, dating from 1646. The *Groote Kerk* of St. Stephen forms with its tall square tower one of the most striking features of the town. Originally built about 1272, it dates in its present condition mainly from the 15th and 16th centuries. The interesting Renaissance town hall was built in 1554 (restored in 1879). There is also an interesting museum of antiquities. Other buildings of note include the old weighhouse and Flesher's hall, probably built in 1612 and restored in 1885.

Nijmegen is the seat of a Roman Catholic university.

Beer, Prussian blue, leather, tin, pottery, cigars and gold and silver work are the chief industrial products. The town was occupied by Germany during World War II.

NIJNI-NOVGOROD (now called Gorky), chief town of Gorky region, Russian S.F.S.R., at the confluence of the Oka and Volga rivers in 56° 24′ N., 44° E. Pop. (1939) 644,116. The city owes its importance to its position at the junction of the navigable rivers between which, to the west of it, was the flourishing Moscow region, though the development of its trade, at first mainly in furs, was much hampered by Tatar raids, which did not cease until the second half of the 16th century. After the last raid in 1536 it became a depot for goods brought from the southeast, and the conquest of Kazan in 1552 and of Astrakhan in 1556 opened free navigation on the Volga. The thick forests of the district provided material for shipbuilding and a yearly "caravan" of boats under military protection began to carry the products of Moscow and the north to the Caspian and to return laden with the products of the south and east.

The Fair.—From remote antiquity Russian merchants were accustomed to meet in summer with those from the east at different places on the Volga between the mouths of the eastward flowing Oka and the westward flowing Kama, the fair changing its site with the increasing or decreasing power of the nationalities which struggled for the possession of the middle Volga. Bolgari, Nijni-Novgorod, Kazan and Vasilsursk have been successively the site of the fair since the 10th century. From 1641 its seat was at a monastery 55 mi. below Nijni and close to Makaryev; this situation later proved inconvenient, and after the destruction of the shops by fire, the fair was transferred to Nijni in 1817 and has remained there ever since.

The long distances in Russia, the poor network of communications, the seasonal nature of production and river transport, the dependence of the peasant on handicrafts as a supplement to agriculture, the close link between Russia and the orient, are some of the factors which have tended to preserve the importance of fairs as a medium of exchange and barter. In the more industrialized regions of the south and west, with their better railway facilities and higher level of literacy, fairs are gradually dying out, but in other regions they are still of the greatest importance for home trade. The state grants special customs exemptions to goods destined for the Nijni fair and gives cheaper transport facilities and special credits to traders. Products of the peasant home industries from every region in which they are at all developed are increasingly taking an important place in the fair.

Until the 1880s Russian manufacturers depended largely on barter trade in tea from Kiakhta and its price at the fair regulated output. Later the price of raw cotton and madder from Asia at the fair influenced the output of the growing textile industry of the central productive region. The owners of the iron works in the Ural district sent "caravans" of boats laden with iron goods to Nijni, where the purchases of iron made for Asia and middle Russia determined the amount of credit on which they could depend for the next year's work. Similarly the corn and salt trade of the south and the general trade of Siberia and Turkistan depended on the prices obtaining at the fair.

The fair reached its highest development between 1880 and 1884, when the turnover was 21,500,000 lb. In 1910 the turnover was 15,900,000 lb. During the 1914–1922 war and civil war, the trade of Nijni was interrupted, and when the fair re-opened in 1923, conditions had altogether changed. Private trade, though not entirely suppressed, had been markedly reduced and the various state trading departments and local goods exchanges had taken over much of the regulation between supply and demand, formerly largely dependent on the fair. Only 647 firms took part in the 1923 fair and the turnover was small, but

trade has gradually adapted itself to the changed conditions and in 1927 the turnover was 20,300,000 lb., and the number of firms taking part was 2,549.

Trade with the Ural metal region via the Kama, with Siberia and with the corn, salt, wine and naphtha regions of the Caspian has revived. The duration of the fair is fixed for Aug. 1 to Sept. 15. A horse fair is held in June, and one in January on the ice of the river Oka for wooden goods made by the peasants, the river being frozen from November to April.

In addition to its trading activities the town has shipbuilding and repair yards and manufactures machinery, telephones, chemicals, sewn goods, matches, bricks, flour, confectionery and alcoholic drinks. These industries are now supplied with electricity from the Balakhna peat fuel plant. Another established industry is the making of radio sets, in connection with which there is an experimental station. The town has railway links through Vyatka with Perm and Sverdlovsk, and also with Kotlas, which will probably be linked with Murmansk via Soroka at no distant date, with Moscow, and, by a branch line to Arzamas, with the trans-Siberian railway. There is also a short branch to Pavlov. Steam navigation on the Volga began in 1821, and developed rapidly after 1845. A bi-weekly air service between Moscow and Nijni-Novgorod was established, with daily services during the period of the fair.

The Town consists of three parts. The upper city is built on three hills on the right bank of the rivers (490 ft.). On one of them is the ancient citadel or Kremlin, first erected as a palisaded fort in the second half of the 14th century, and rebuilt in the early 16th century, with a wall 2,300 yards long, 65 to 95 ft. high and having 11 towers. Within it are the law courts, the former governor's residence, the arsenal, barracks, etc., a museum and the Preobrazhensky and Archangel cathedrals, dating from 1225 and 1222 respectively, but much spoilt by later restorations. Kózma Minin Sukhorukov, a cattle-dealer of the town, who organized the army that saved Moscow from Polish dominion in 1612, is buried in the Preobrazhensky cathedral, and a square in the Kremlin contains a monument to Minin and Pozharsky erected in 1826. The view from the Kremlin of the broad Volga with its low-lying and far-spreading left bank is very striking. Near the Kremlin are two monasteries, the Pechersky, built in the first half of the 16th century to replace one founded in 1330 and destroyed by a landslip in 1596, and the Blagovyeshchensk (1370, rebuilt 1647). Five descents lead to the lower town, the Nijni bazaar, built on the alluvial terrace 30 to 35 ft. above the banks of the Oka and Volga.

The fair is held on the flat sandy tongue of land between the rivers, connected with the town by a bridge of boats, 1,500 yards long, which is taken to pieces in winter. The shops of the fair, 4,000 in number, built of stone in regular rows, are surrounded by a canal and cover half a square mile, and there are more than 4,000 other shops outside this inner fair. There are salt, grain and timber wharves and rough goods are landed on an island in the Volga. Tea boxes and temporary shelters for the tea tasters accumulate in the Siberian harbour during fair time. The point of the peninsula is occupied by the storehouses of the steamboat companies, while metal wares and corn are discharged on a long island in the Oka, at the iron harbour, and in the Grebnovskaya harbour. The railway from Moscow has its terminus close to the fair buildings, to the south of which is the Kunavino pleasure suburb. On the fair side are the Alexander Nevsky cathedral (1881) and the "Fair" cathedral (1822). The climate is harsh and continental, average January temperature 10.6° F., July 64° F., extreme readings −40° F. and +104° F.

History.—The confluence of the Oka and the Volga, inhabited in the 10th century by Mordvinian tribes, began to be coveted by the Russians as soon as they had occupied the upper Volga, and as early as the 11th century they established a fort, Gorodets, 20 mi. above the mouth of the Oka. In 1221, the people of Suzdal, under Yuri Vsevolodovich, prince of Vladimir, erected a fort on the hill now occupied by the Kremlin. Until the beginning of the 14th century Nijni-Novgorod, which grew rapidly as the Russians colonized the banks of the Oka, remained subject to Suzdal; it enjoyed, however, almost complete independence, being ruled by its popular assembly. Until 1390, it elected its only princes. Ill-protected by its palisaded walls, it was plundered in 1377 and 1378 by the Tatars, supported by the Mordvinians.

In 1390 Prince Vasili of Moscow, in alliance with Toktamish, khan of the golden horde of the Mongols, took Nijni and established his own governors there; in 1417 it was definitely annexed to Moscow, becoming a stronghold for the further advance of that principality toward the east. It was fortified in 1508–1511, and was able to repel the Tatars in 1513, 1520 and 1536. In 1606–1611 the trading classes took an active part in the expeditions against the revolted serfs. A Nijni cattle-dealer, Sukhorukov, helped to deliver Moscow from the Poles in 1612. In 1667 the city withstood an attack by Stenka Razin. During the 17th century the country became the seat of a vigorous religious agitation, and in its forests the Raskolniks established hundreds of their monasteries and communities, those of the Kerzhenets playing an important part in the history of Russian nonconformity.

Nijni-Novgorod had some part in the literary movement of the end of the 18th century; its theatre also was of some importance in the history of the Russian stage. It has a growing university and a Workers' Scientific institute opened since the 1917 revolution.

The city was renamed Gorky in 1932 after the writer Maxim Gorky, born in Nijni-Novgorod on March 16, 1868.

NIKĒ, the goddess of victory (Gr. νίκη, Lat. *Victoria*). She does not appear personified in Homer. In Hesiod (*Theog.* 384) she is the daughter of the giant Pallas and Styx, and is sent to fight on the side of Zeus against the Titans. Nikē does not appear to have been the object of a separate cult at Athens. She was at first inseparably connected and confounded with Pallas Athena, the dispenser of victory, but gradually separated from her. As an attribute of both Athena and Zeus she is represented as a small figure carried by those divinities in their hand. Athena Nikē was always wingless, Nikē alone winged. In works of art she appears carrying a palm branch or a wreath (sometimes a Hermes staff as the messenger of victory) erecting a trophy or recording a victory on a shield, or, frequently, hovering with outspread wings over the victor in a competition, since her functions referred not only to success in war but to all other human undertakings. In fact, Nikē gradually came to be recognized as a sort of mediator of success between gods and men.

At Rome Victoria was worshipped from the earliest times. Evander was said to have erected a temple in her honour on the Palatine before the foundation of Rome itself (Dion. Halic. i, 32, 33). She was identified with the obscure Sabine goddess Vica Pota and others. Special games were held in her honour in the circus, and generals erected statues of her after a successful campaign. She came to be regarded as the protecting goddess of the senate, and her statue (originally brought from Tarentum and set up by Augustus in memory of the battle of Actium) in the Curia Julia (Dio Cassius li. 22; Suetonius, *Aug.* 100) was the cause of the final combat between Christianity and paganism towards the end of the 4th century. Victoria had altars in camp, a special set of worshippers and colleges, a festival on Nov. 1, temples at Rome and throughout the empire. Representations of Nikē-Victoria in art are very numerous. *cf.* GREEK ART (fig. 3).

See L. R. Farnell, *Cults of the Greek States,* i (1896); G. Wissowa, *Religion und Kultus* (2nd ed. 1912) (bibl.); Roscher's *Lexikon,* arts. "Niké," "Victoria."

NIKISCH, ARTHUR (1855–1922), Hungarian conductor, was a precocious child, making a public appearance as a pianist at eight years old. He studied at the Vienna Conservatoire from 1866 to 1873, and while there he composed a symphony and other works. In 1877 he began as assistant conductor at the Leipzig opera and two years later became chief conductor. His brilliant success in Leipzig gave him a world-wide reputation. Nikisch was conductor of the symphony orchestra at Boston, U.S.A., from 1889 to 1893; and subsequently, after having been director at the Budapest opera, at the Leipzig Gewandhaus. He died in Leipzig on Jan. 23, 1922.

See F. Pfohl, *Arthur Nikisch* (Hamburg, 1925).

NIKKO, a small town in Tochigi prefecture. One of the chief centres of pilgrimage and sightseeing in Japan, it lies 91 mi. N. of Tokyo by rail, in a valley below the range called Nikko-Zan (Mountains of the Sun's Brightness). Its natural beauties and the splendour of its monuments gave rise to a popular saying: "Do not say 'splendid' (*Kekkō*) until you have seen Nikko." A Shinto shrine seems to have existed from time immemorial and in 767 its first Buddhist temple was founded by Shōdō Shōnin (the subject of many legendary adventures); but the main celebrity of the place is due to the sepulchres and sanctuaries of Iyeyasu and Iyemitsu, the first and third shoguns of the Tokugawa dynasty. Iyeyasu was buried with amazing pomp in 1617, and Iyemitsu, his grandson, was slain in 1650 while visiting his tomb. From 1644 to 1868 the "abbots" of Nikko were always princes of the imperial blood; thirteen of them are buried within the sacred grounds.

NIKOLAYEV, a seaport of the Ukrainian S.S.R., situated a little above the confluence of the Ingul and Bug rivers, at the head of the Bug estuary in 46° 58′ N., 31° 58′ E. Pop. (1939) 167,108. Vessels have to pass the bar of the Dnieper to reach the Ochakov channel, and dredging has been carried out to a depth of 25 ft., so that vessels of 24 ft. draught can pass without lightening their loads. Two icebreakers are now working so as to keep the estuary of the Dnieper and the channel of the Bug open for navigation from the Black sea to Nikolayev all the year round. There is a government commercial quay and a harbour for coasting vessels. The Varvarovka jetty was damaged during the civil war. There are floating elevators and a railway grain elevator. The chief imports are cement, iron, steel, machinery and general merchandise, and the exports are grains, oilseeds, sugar, wool, iron ore, manganese and timber.

In common with other Black sea ports, Nikolayev suffered from the effects of the civil war and the war of intervention and from the decrease in Black sea trade due partly to change of frontiers and partly to war damage and loss of ships and the cessation of repairs and construction until 1923. The town has ship yards where steamers for the admiralty and for the commercial fleet are built, the construction of armoured ships and torpedo boats dating back to 1870, and being carried out mainly along the bank of the Ingul river. Ochakov and Kimburn are potential forts to protect the double estuary in case of attack. The industrial enterprises of Nikolayev include the manufacture of machinery, ploughs, nails, glass, footwear, macaroni, tobacco and alcoholic drinks. The town is linked by rail with the general railway net to the north, and also has a branch to Kherson.

The remains of the Greek colony *Olbia* have been discovered close to the confluence of the Ingul with the Bug, 10 m. S. of Nikolayev. After the fall of Ochakov, Prince Potemkin established (1789) a wharf on the Ingul which received the name of Nikolayev.

NIKOLAYEVSK: *see* PUGACHEVSK.

NIKON [NIKITA MININ] (1605–1681), 6th patriarch of Moscow, Russian reformer and statesman, son of a peasant farmer named Mina, was born on May 7, 1605, in the village of Valmanovo, 90 versts from Nijni-Novgorod. Misery pursued the child from his cradle, and prematurely hardened a character not naturally soft; he ran away from home to save his life from an inhuman stepmother. He took orders, and became a popular preacher in Moscow, then, seeing in the loss of his three little children a providential warning to seek the higher life, he first persuaded his wife to take the veil, and then withdrew himself first to a desolate hermitage on the isle of Anzersky on the White Sea, and finally to the Kozhuzersky monastery, in the diocese of Novgorod, of which he became abbot in 1643. On becoming a monk he took the name of Nikon. In his official capacity he had frequently to visit Moscow, and in 1646 made the acquaintance of the pious and impressionable Tsar Alexius, who fell entirely under his influence. Alexius appointed Nikon archimandrite, or prior, of the wealthy Novospassky monastery at Moscow, and in 1648 metropolitan of Great Novgorod. Finally (Aug. 1, 1652) he was elected patriarch of Moscow. It was only with the utmost difficulty that Nikon could be persuaded to become the archpastor of the Russian Church, and he only yielded after imposing upon the whole assembly a solemn oath of obedience to him in everything concerning the dogmas, canons and observances of the Orthodox Church.

Ecclesiastical reform was already in the air. A number of ecclesiastical dignitaries, known as the party of the protopopes (deans), had accepted the responsibility for the revision of the church service-books inaugurated by the late Patriarch Joasaf, and a few other very trivial rectifications of certain ancient observances. Nikon was bolder and more liberal. He consulted the most learned of the Greek prelates abroad; invited them to a consultation at Moscow; and finally the scholars of Constantinople and Kiev opened the eyes of Nikon to the fact that the Muscovite service-books were heterodox, and that the ikons actually in use had very widely departed from the ancient Constantinopolitan models, being for the most part imitations of later Polish and Frankish (West European) models. He at once (1654) summoned a properly qualified synod of experts to re-examine the service-books revised by the Patriarch Joasaf, and the majority of the synod decided that "the Greeks should be followed rather than our own ancients." A second council, held at Moscow in 1656, sanctioned the revision of the service-books as suggested by the first council, and anathematized the dissentient minority, which included the party of the protopopes and Paul, bishop of Kolomna. Heavily weighted with the fullest oecumenical authority, Nikon's patriarchal staff descended with crushing force upon the heterodox. His scheme of reform included not only service-books and ceremonies but the use of the "newfangled" ikons, for which he ordered a house-to-house search to be made. His soldiers and servants were charged first to gouge out the eyes of these "heretical counterfeits" and then carry them through the town in derision. He also issued a *ukaz* threatening with the severest penalties all who dared to make or use such ikons in future. This ruthlessness goes far to explain the unappeasable hatred with which the "Old Ritualists" and the "Old Believers," as they now began to be called, ever afterwards regarded Nikon and all his works.

From 1652 to 1658, Nikon was not so much the minister as the colleague of the tsar. Both in public documents and in private letters he was permitted to use the sovereign title. Such a free use did he make of his vast power, that some Russian historians have suspected him of the design of establishing "a particular national papacy"; and he himself certainly maintained that the spiritual was superior to the temporal power. He enriched the numerous and splendid monasteries which he built with valuable libraries. His emissaries scoured Muscovy and the Orient for precious Greek and Slavonic mss., both sacred and profane. But his severity raised up a whole host of enemies against him, and by the summer of 1658 they had convinced Alexius that the sovereign patriarch was eclipsing the sovereign tsar. Alexius suddenly grew cold towards his "own familiar friend." Nikon thereupon publicly divested himself of the patriarchal vestments and shut himself up in the Voskresensky monastery (19th of July 1658). In February 1660 a synod was held at Moscow to terminate "the widowhood" of the Muscovite Church, which had now been without a pastor for nearly two years. The synod decided not only that a new patriarch should be appointed, but that Nikon had forfeited both his archiepiscopal rank and his priest's orders. Against the second part of this decision, however, the great ecclesiastical expert Epifany Slavenitsky protested energetically, and ultimately the whole inquiry collapsed, the scrupulous tsar shrinking from the enforcement of the decrees of the synod for fear of committing mortal sin.

For six years longer the Church of Muscovy remained without a patriarch. Every year the question of Nikon's deposition became more complicated and confusing. At last the matter was submitted to an oecumenical council, which opened its sessions on Nov. 18, 1666, in the presence of the tsar. On Dec. 12 the council pronounced Nikon guilty of reviling the tsar and the whole Muscovite Church, of deposing Paul, bishop of Kolomna, contrary to the canons, and of beating and torturing his dependants. His sentence was deprivation of all his sacerdotal functions;

henceforth he was to be known simply as the monk Nikon. The same day he was sent as a prisoner to the Therapontov Byelozersky monastery. Yet the very council which had deposed him confirmed all his reforms and anathematized all who should refuse to accept them. Nikon survived the tsar (with whom something of the old intimacy was resumed in 1671) five years, expiring on Aug. 17, 1681.

See R. Nisbet Bain, *The First Romanovs* (1905); S. M. Soloviev, *History of Russia* (Rus.), vol. x (1895, etc.); A. K. Borozdin, *The Protopope Avvakum* (Rus.) (1898); V. S. Ikonnikov, *New Materials concerning the Patriarch Nikon* (Rus.) (Kiev, 1888); William Palmer, *The Patriarch and the Tsar* (1871–76). (R. N. B.)

NIKOPOLI or NICOPOLIS (Bulgarian *Nikopol*), the chief town of a subprefecture in the district of Plevna (Pleven), Bulgaria. Pop. (1934) 5,040. Nikopoli is picturesquely situated on the south bank of the Danube, where it receives the Osem. The chief industries are tanning and fishing. As a military post the town has for centuries been important. A ruined castle still dominates the place, and fortifications stretch down to the river.

Nikopoli occupies the site of the ancient Asamus, but by some mediaeval confusion bears the name of Nicopolis ad Istrum, which was founded by Trajan several miles down the river, at the inflow of the Iatrus or Yantra, at the spot still called Nikup. The following are the chief points in the modern history of the place: —capture of the fortress by Sigismund of Hungary in 1392 and 1395; defeat of Sigismund and his hosts in 1396 by Bayezid I; siege of the town by King Ladislaus I of Hungary in 1444; defeat of the Turks by Bathori in 1595 and by Michael of Walachia in 1598; capture of the town by Pasvan-oglu in 1797; occupation of the fortress by the Russians under Kamensky in 1810; destruction of the Turkish flotilla by Govarov in 1829; capture and burning of the town by the Russians under Krüdener, June 15, 1877.

NIKŠIĆ, a romantically situated town of Montenegro, Yugoslavia, in the valley of the Zeta, which forms the main source of communication between north and south Montenegro. Pop. (1931) 4,164. Wheat, maize, rye and potatoes are cultivated, and there are two breweries, cloth and cotton mills in the town, which is an important mart for timber, hides, farm produce and livestock. The chief road, to Podgorica (*q.v.*), is entered by a long viaduct, the gift of Russia, to obviate the flooding which formerly often rendered it impassable. The town, of white houses, is built round a square with four radiating streets, and is dominated by the pale yellow cupola of the Byzantine cathedral, another gift from Russia. Close by stands a royal palace and on one of the heights are the ruins of an old Turkish fortress.

Nikšić was occupied by Italian troops in 1941. About 12 mi. S.E. is the famous shrine of Ostrog (*see* MONTENEGRO).

NILE, an African river whose basin is the dominant feature of the northeastern quarter of the continent. Its length as the water flows from its most distant source to the entry of the Rosetta branch into the Mediterranean is about 4,160 mi. This source is the head of the Luvironza in lat. 3° 50′ S. and about 40 mi. E. of Lake Tanganyika. There is a probability that the Nile may be the longest river in the world. The Mississippi-Missouri was once taken to be the longest, but the U.S. army engineers later gave the length from the most remote source of the Missouri to the sea as 3,891 mi. There is reason to think that the Amazon is more than 4,000 mi. long, but its length is taken from maps on a scale of 1:1,000,000, while the Nile has been measured from maps on scales ranging from 1:100,000 to 1:250,000. More detailed maps of the Amazon on a larger scale would be likely to increase its estimated length because of the effect of sinuosity. The name Nile comes from the Latin *Nilus* and Greek Νεῖλος, whose origin is unknown. Αἴγυπτος in the Odyssey is the name of the Nile (masc.) as well as of the country of Egypt (fem.) through which it flows and survives both in the name Egypt and in the name Copt (*gupti* in the Arabic of Upper Egypt). At the present time the Nile in Egypt and in the northern Sudan is called en-Nil, or el-Bahr ("the river"), or el-Bahr en-Nil.

General Account.—The basin covers approximately 1,100,000 sq.mi. or about one-tenth of the area of Africa. Politically it includes Uganda, parts of Kenya, of Tanganyika and of the Belgian Congo, most of the Sudan, part of Ethiopia (Abyssinia) and the cultivated portion of Egypt. Its rapidly increasing population was estimated as roughly 40,000,000 in 1954, of whom more than half live in Egypt. It is possible to travel by car in the dry season over most of the basin; but south of lat. 15° N. over the plains of the Sudan motor transport is not usually possible from May to November. In the higher country leading up to the Lake plateau and the Nile-Congo watershed and on the Lake plateau there are all-weather roads.

Three principal streams form the Nile. The largest in volume is the Blue Nile which draws practically all its water from Ethiopia and contributes four-sevenths of the total supply of the main stream. Next comes the White Nile, which is the longest branch and supplies two-sevenths of the total; its headstreams flow into Lakes Victoria and Albert; and lower down in the Sudan it receives the Sobat, which obtains its water mainly from Ethiopia. The White Nile and Blue Nile join at Khartoum. Lastly there is the Atbara, draining the northwestern part of Ethiopia and joining the main stream 200 mi. N. of Khartoum, and contributing the remaining one-seventh. The Blue Nile and Atbara are both muddy streams in flood time and bring down the soil which has made the cultivable land of Egypt and is still adding to it. From the Atbara junction to within a few miles of the Mediterranean there is not enough rain to produce any crops, and so this area depends entirely on irrigation by Nile water. The river is navigable from the sea to Wadi Halfa (about 960 mi.), and the Aswan dam and the barrages are passed by locks. Between Halfa and Khartoum the river is broken up by the cataracts, and ordinarily navigation is only possible in short stretches. From Khartoum the White Nile is navigable for 1,100 mi. to Rejaf, 100 mi. from the Uganda border, the Jebel Aulia dam (25 mi. S. of Khartoum) being passed by a lock. From Rejaf to the Uganda border the river is again beset with rapids, but there is navigation from Nimule on the border into Lake Albert and up the Victoria Nile to the foot of the Murchison falls. Between Lakes Albert and Victoria there are two successions of rapids with a navigable stretch which includes Lake Kyoga (Kioga) between them. The Blue Nile is navigable during flood for 400 mi. as far as Roseires, though it is interrupted by the Sennar dam which has no lock. During the flood season the Sobat is navigable up to Gambela and the Bahr el-Ghazal up to Wau. Regular air services operate on important routes throughout the Nile basin, including Ethiopia.

The White Nile.—The main stream of the White Nile begins on the Lake plateau of East Africa, where there are two separate river systems, the Victoria Nile and the Lake Albert system. Most of this country lies 4,000 ft. or more above sea level and on this account enjoys a pleasant climate. Two rivers, the Niavarongo (Nyawarongo) and Ruvuvu, may justly be considered the headwaters of the White Nile, since they join together to form the Kagera, the most important tributary of Lake Victoria. The Kagera is a stream 510 mi. long from the source of the Luvironza to its mouth and 70 m. wide near its mouth. Of the other tributaries of Lake Victoria the largest from the point of view of discharge is the Nzoia in the northeast, which has rather less than half the discharge of the Kagera and is torrential, with only a small flow in the dry season; it draws its water from Mount Elgon and the high country to the northeast of Lake Victoria. The lake has an area of about 27,000 sq.mi. inclusive of islands and is like a small sea insomuch as it is subject to considerable storms. The Nile leaves Lake Victoria by the Ripon falls, which are now submerged because of the dam at the Owen falls a mile or more lower down.

At this point the supposed connection between the level of Lake Victoria and sunspots may be mentioned. From 1896 to 1927 maximum and minimum lake levels coincided with maximum and minimum sunspot numbers, thus giving rise to the theory of a connection. Later, however, this regularity disappeared. Moreover on theoretical grounds the connection is unlikely, so the coincidence in the first part of the records must be considered as accidental. Indeed, by the middle of the 20th century no connection between sunspot activity and any portion of the Nile had yet been established. The river below the lake known as the Victoria Nile

FROM A MAP COMPILED BY THE SURVEY OF EGYPT

is first beset with rocks and rapids but becomes navigable just above Namasagali (50 mi. from the lake). Soon it crosses the mouth of Lake Kyoga, the centre of an important district whose products are collected by steamers navigating the lake. Lake Kyoga is a shallow piece of water with many swampy arms, having an area of open water of about 680 sq.mi. (1,760 sq.km.). Many of the arms are practically filled with swamp vegetation, and parts of the open lake are covered with water lilies whose stems go down to the bottom a metre or more below. Below Kyoga the Nile is navigable until it turns westward, after which there is a series of rapids finishing with the Murchison falls. Here the Nile passes through a narrow cleft in the rock and falls a distance of about 140 ft. A short distance from the Murchison falls the Victoria Nile enters Lake Albert. Lake Albert is at the tail end of another river system which starts from near some of the Kagera sources but on the northern side of the Mfumbiro volcanoes. The principal headstream of this system is the Ruchuru river, which runs along the Rift valley northward to Lake Edward. Lake George, which is much smaller, is joined to Lake Edward by a broad channel. The Semliki river, a fair stream, connects Lake Edward with Lake Albert. It flows in places through thick forest along the western side of Ruwenzori, of which it receives the drainage. Lake Albert lies between the high escarpments of the Rift valley, which in places come down abruptly to the water. It has an area of about 2,040 sq.mi. Below Lake Albert the river is known as the Albert Nile or Bahr el Jebel (river of the mountains), by which name it is known in the Sudan. For about 140 mi. the Bahr el Jebel is a placid stream, often with swampy edges abounding in mosquitoes; but at Nimule on the Sudan-Uganda boundary it ceases to be navigable for nearly 100 mi. as it descends from the plateau to the Sudan plains. Just below Nimule are the Fola rapids, a fine sight, where the river rushes through a confined channel between rocks. After its arrival in the plains of the Sudan the country is flat except for rare rocky hills outcropping from the plain. Between Lake Albert and the plains the river receives some tributaries of a torrential nature, of which the principal is the Aswa from the southeast. The principal feature of the Bahr el Jebel when it reaches the plain is the large swamps of the Sudd region, where half its water is lost. Through these swamps the river winds between walls of high vegetation, papyrus, reeds and elephant grass, which except for lagoons and side channels extend from the river to the dry ground on either side, which may be miles away. Very few people are seen when once the river enters the swamps since only occasionally does it touch the higher ground. The country on the edge of the swamps provides good grazing, which lasts into the dry season, as the river, when high, floods a lot of country that is not permanent swamp. Most of the tribes of these southern plains, Nuers, Dinkas and Shilluks, are cattle-owning people living in a very primitive fashion. In the 19th century the Bahr el Jebel was frequently closed by vegetation. A block (Arabic *sudd*) is formed by masses of floating vegetation uprooted from the shallow lagoons by strong winds and blown into the main stream, where they may collect at a bend until they stretch across the whole river. More floating islands of vegetation come down and some get sucked under the surface block to constrict the channel still further. Ultimately the block becomes a solid mass over which even elephants can cross. Sometimes the pressure of the rising water carries it away, sometimes the river breaks away sideways to form a fresh channel. Between 1899 and 1904 the river, which had been completely blocked over long distances, was cleared. Since navigation became regular and frequent these blocks have only very rarely been formed in the main stream, though less-frequented streams are occasionally blocked. About halfway through the swamps a separate channel, known as the Bahr el Zeraf ("river of giraffes"), has been formed near the edge of the dry ground on the east and follows an independent course to the White Nile. In former times it was sometimes connected with the Bahr el Jebel, and a permanent connection has been made by means of two cuts dug by a dredger where the two streams are close together. At the tail end of the swamps the Bahr el Jebel is joined by the Bahr el Ghazal from the west and the two together flow eastward as the White Nile, being joined later by the Zeraf. The Bahr el Ghazal ("river of gazelles") is formed by the junction of a number of torrents coming from the southwest and west. The main stream is the Jur, which is navigable in flood up to a point south of Wau, the capital of the Bahr el Ghazal province. Next to the Jur in size is the Lol, into which a number of tributaries flow. It ends in swamps to the west of the Jur; other streams end in swamp to the east. The effect of the swamps is that very little water flows out of the mouth of the Bahr el Ghazal into the White Nile. In the southern part of the Bahr el Ghazal basin the principal tribe is that of the Azande,

who came originally from the Congo and are agriculturalists and craftsmen.

The Sudd region and country of large permanent swamps ends at the junction of the Bahr el Ghazal and the Bahr el Jebel, although there is some swamp fringing the White Nile nearly as far as the mouth of the Sobat. The Sobat draws the greater part of its water from the Ethiopian plateau, though a little comes from the south. It is formed of two main streams, the Baro flowing from east to west and the Pibor from the south. From the Ethiopian mountains to the White Nile the country is flat grass plain liable to be flooded in the rains and in parts waterless in the dry season. The Sobat is in flood from July to October on its headwaters and, as a result of the inflow from flooded areas, remains high at its mouth until December. It is navigable in flood to Gambela on the Baro and to Pibor Post on the Pibor, but the journey for the greater part is monotonous. The Pibor is occasionally blocked by vegetation. From the Sobat mouth to Khartoum the White Nile is a wide placid stream with a very small slope and often a narrow fringe of swamp. After Jebelein the country gradually becomes more arid and savanna forest gives place to thorn scrub, until near Khartoum it is almost desert. At Kosti the railway from Khartoum that follows the Blue Nile southeastward to Sennar and then turns southwestward on its way to El Obeid crosses the White Nile on a bridge with an opening span. Twenty-five miles from Khartoum is the Jebel Aulia dam, which forms a reservoir the effect of which, when full, extends beyond Renk, 280 mi. upstream.

Between Malakal and Khartoum end the regions of Negro people speaking their own languages—Bantu in the far south and then Sudanic—and begins a region where the people are of mixed Arab and Negro descent and speak Arabic. Actually Arabic is understood by riverside people and people on the main routes all over the southern Sudan, while in Uganda and East Central Africa the *lingua franca* is Swahili.

The Blue Nile.—The Blue Nile is the source of nearly 70% of the Nile flood. The reputed source of the Blue Nile is a spring to the south of Lake Tana in Ethiopia, from which flows the little Abai or Abbai, the principal tributary of the lake. The lake is in a basin at an altitude of about 6,000 ft. (1,840 m.), but with high mountains at no great distance. It has an area of about 1,200 sq.mi. (3,000 sq.km.) and is shallow. The Blue Nile leaves the lake over a series of rapids and very soon drops into a deep gorge in places 4,000 ft. below the general level of the plateau. Tracks descend to the river at places where at low stage there are fords. It is usually a two days' journey with mules to descend, cross the river and climb up the other side of the canyon. Tributary streams have cut similar ravines, and the scenery is magnificent both in its scale and in its ruggedness. The actual course of the river has not been followed as it is not possible to travel along the bottom of the gorge and its course is continually interrupted by rocks and rapids. There is a bridge at Shafartak where the road from Addis Ababa to Gojjam used to cross the river by a ford. Only a small portion of the Blue Nile water comes out of Lake Tana; by far the greater part is from tributaries, some of which are important streams, for example the Bashilo, Jamma, Guder, Didessa, Dabus, Balas, Dinder and Rahad. The water is derived from the rain which falls on the Ethiopian plateau and not from melting snow as has sometimes been stated. The highest mountains in Ethiopia reach 15,000 ft. but snow falls on them only occasionally and quickly disappears.

Halfway between Roseires and Khartoum is the Sennar dam, by means of which an area of 1,000,000 ac. in the Gezira between the Blue and the White Niles is irrigated. The water is impounded in flood and used in February and March. It is a good example of co-operation—originally between the government, a foreign company holding a concession and the native African tenants, then, after the concession had terminated, between the government and the tenants only. The scheme is well planned, and irrigation is based on careful measurement by weirs and other devices of the quantities of water entering the feeders from the main canal. The principal crops are cotton, millet and *lubia* (a kind of bean). Between Sennar and Khartoum the Blue Nile receives two tributaries: the Dinder and the Rahad. These, like the Blue Nile, are torrential but unlike the Blue Nile, dry up entirely except for pools (though both are considerable streams in flood).

The Main Nile and the Atbara.—The main Nile from Khartoum northward flows between deserts with a narrow strip of vegetation on either side. Where the soil permits, the banks and neighbouring flat land are cultivated by the use of Nile water and support a small population. These conditions continue as far as a little distance north of Aswan. In this stretch the Nile receives its last tributary, the Atbara, which in flood is a large muddy river and in the dry season is a string of pools. Its principal tributaries are the Setit or Takazze (Takkaze) and the Bahr es Salaam. From Abu Hamed onward the valley is often rocky and desolate, particularly in the neighbourhood of the Fourth cataract and for more than 100 mi. S. of Wadi Halfa, where the country is known as the Batn el-Hagar (belly of stones). Wadi Halfa is just below the Second cataract and is within the area affected by the heightened Aswan reservoir, which ponds water up as far back as the cataract. The Aswan dam, which has been heightened twice, now has a height of nearly 40 m. (130 ft.) and a length of 2 km. ($1\frac{1}{4}$ mi.) and stores 5,300,000,000 tons of water.

From Aswan northward to Cairo the river is bordered by a flood plain of alluvium gradually increasing to a maximum width of about 12 mi. which is cultivated by irrigation. Outside this is the desert. At the beginning of the 20th century basin irrigation was practised up to the head of the delta. In this system the land is watered by short canals, which can only receive water when the river is in flood. These deliver the muddy water on to the land, which is divided into compartments or basins by cross banks running from the river bank to the higher desert edge. The water is held in these basins to a depth of several feet for some weeks and deposits its mud. During this time the land is well soaked, the river falls, and the remaining water is then returned. After this seeds are planted in the mud to produce the single annual crop, which gets only such extra water as can be lifted from wells. This system was in use for thousands of years without any deterioration of the soil; but with an uncontrolled river the area that could be watered was variable and liable to be reduced in a low flood, with the possibility of famine. In perennial irrigation as distinguished from flood irrigation much smaller quantities of water are run on to the land every two or three weeks and two or three crops are grown in the year. This began to develop on a large scale from canals in the time of Mohammed Ali Pasha, toward the middle of the 18th century. A necessary feature is the barrages or low dams which have been built across the Nile at various points to enable its level to be raised so that it can flow at all times into main canals, whose heads are just above the barrages. From the main canals there are branch canals, and these again divide into smaller canals called distributaries, which deliver the water to irrigation ditches and so to the land. By the end of the 19th century cultivation in the delta itself was all perennial, depending on the Mohammed Ali barrage (below Cairo at the head of the delta), above which the three main canals of Lower Egypt begin. During the 20th century barrages were built at Asyut and Nag Hammadi in Upper Egypt, by means of which a large part of Upper Egypt was converted to the perennial system; and another barrage at Esna improved basin irrigation. During the time of low supply, when all the water is needed for irrigation, the Rosetta branch is closed at the barrage and the Damietta branch nearly so, while both are completely closed near the sea—the first by the Edfina barrage with its sluices, the second by an earth bank built each year by February and washed away by the rising flood in August (during this time waterborne traffic in the delta follows the canals). The crops grown during the low stage of the river are cotton, rice, sugar cane, groundnuts, sesame and millet. In the flood season the principal crop is maize; and in the winter the crops are wheat, barley, clover, beans, flax, onions and lentils. Cotton is the most valuable crop and occupies more than one-quarter of the total cultivated area. It is also Egypt's principal export. The Nile from Aswan to the sea is controlled in the interests of irrigation, though control is not complete in flood time.

Climate and Health.—In Egypt the months May to October are hot in the daytime, but there is a considerable drop in temperature after sunset. The winter months usually have clear bright days with cool or even cold nights. The climate of the northern Sudan is similar except that the temperatures are higher. Upper Egypt and the northern Sudan are characterized by low humidities, and the region from Halfa to Atbara is one of the driest in the world. In the central Sudan from Khartoum to Renk or Roseires during the months of December, January and February the days are not unduly hot, and the nights are cool, while at the same time the humidity is low; then the temperature increases until May or June, after which the onset of the rains causes it to drop; September and October are liable to be oppressive months. In the southern Sudan the average temperature is lower than further north and varies less through the year; the highest temperatures occur from January to April and the lowest are in July and August. The climate of the high country of Ethiopia and central Africa is temperate, and above 5,000 ft. the nights are cold. Round Lake Victoria the temperature does not vary very much through the year.

The principal features of the rainfall are as follows. (1) There is a little rain on the Mediterranean coast (from 150 to 200 mm. annually) and over the delta, but this decreases rapidly with distance from the sea, being only 30 mm. in Cairo; it falls usually in the months from November to March. (2) A region extending from just south of Cairo to just north of Atbara is practically rainless. (3) There is next a steady increase of rainfall southward of the rainless region. (4) Regions of fairly heavy rainfall are found on the Ethiopian and Lake plateaus, where a total of more than 1,600 mm. is reached in places, the average rainfall of both plateaus being about 1,200 mm. or 50 in. On the whole the rainfall of the Nile basin is scanty, and hence for the size of its basin the discharge of the Nile is small. From Khartoum southward over the Sudan plain and in Ethiopia the maximum of rainfall is in July and August, but the rainy season is increasingly long toward the south and as the altitude of the country increases. On the Lake plateau there is no month when rain may not fall. There are two minima and maxima, the minima being in January and June-July.

In order to keep in good health in the Nile basin it is necessary to take precautions against diseases and, in the case of visitors and foreign residents, particularly against those prevalent in hot countries. In the southern and central parts of the basin malaria is a common disease and is carried by anopheline mosquitoes. All over the basin dysentery and typhoid fevers are common. The parasites which cause these are usually taken in food, while water and flies are also a means of carrying the infection. In Egypt and some other parts of the basin bilharziasis and ankylostomiasis, diseases due to microscopic worms, are common. They are either contracted by drinking infected water or by wading or bathing in it. In certain districts relapsing fever occurs, transmitted by the bite of a tick that lives in cracks in the ground and in native houses and comes out at night. Sleeping sickness occurs over a wide area of the southern Nile basin and was formerly responsible for the deaths of great numbers of people. Now, however, as a result of stringent measures of control, it has practically disappeared from many districts in which it was formerly a serious danger. It is carried from one person to another by the bites of species of tsetse flies. Flies of the same genus carry trypanosomiasis of animals and so cause mortality among cattle, horses and donkeys.

Vegetation.—The desert region outside the Nile valley extends from the Mediterranean to about the latitude of Atbara. Much of this area is almost rainless, and there is no vegetation except in favoured places such as the oases, where underground water comes to the surface, or along drainage lines where after rain the subsoil may remain moist for a long period. As regions of scanty but regular rainfall are reached, the country becomes dotted with small thorny shrubs, mostly acacias. These begin about the latitude of Atbara and grow increasingly thick toward the south. After rain the country becomes green with grasses and small herbs but these rapidly dry up after the rain ceases.

South of this are types of savanna country. The first is thorny savanna containing small thorny trees and after the rains grass and herbs. This covers much of the central Sudan from latitude 10° to 15° N.

South of this is found true savanna country, consisting of open grass plains on which trees are rare except in a few places near the rivers, and on which the grass may grow from 6 to 10 ft. high. During the rains these plains are often swampy. True savanna covers a good deal of country from Malakal to Bor and from the Bahr el Jebel to the foothills of the Ethiopian plateau. During the dry season, which lasts about half the year, the grass dries, and over all the southern Sudan and parts of the Lake plateau it is burned every year. This kills many species of trees and so limits the vegetation and moreover stunts the growth of the remainder. In the savanna zone the rivers are often fringed with reed swamp, more particularly the Bahr el Jebel in the Sudd region from Lake No to Bor and also the lower Bahr el Ghazal. In this swamp grow papyrus, bulrushes, tall bamboolike grasses, "um soof" (*Vossia cuspidata*), the thorny tree called "ambatch" (*Herminiera elaphroxylon*), whose wood is like pith, and floating vegetation such as the water lettuce (*Pistia stratiotes*). Papyrus swamps are also found in the valleys of the Lake plateau.

The true savanna country changes into savanna forest, which fringes the Blue Nile near Roseires and southward and covers the western slopes and parts of the plateau of Ethiopia, the southern parts of the Bahr el Ghazal basin and large areas of Uganda, the Lake plateau and its slopes. Savanna forest consists of trees of medium height casting little shade, while the ground is covered with grass and perennial herbs. Tropical rain forest does not exist in great quantity in the Nile basin, but it is found in river valleys along the Nile-Congo divide and in patches on the Lake plateau and in Ethiopia. Rain forest is characterized by a large number of species and several stories of vegetation, so that practically all the space is utilized and a wonderful luxuriance of plant life results.

History of Exploration.—The earliest traces of man are stone implements found in many parts of the basin, some of which were made perhaps 100,000 years ago. The most recent in Egypt are found with early pottery and come down to *c.* 4,500 B.C. The historical period begins *c.* 3,400 B.C. and follows a period known as predynastic in which metal instruments began to be used as well as those of stone. When the early flint-implement people lived, the climate of North Africa was warm and humid. Lakes and rivers existed in what is now desert and the country was covered with vegetation and inhabited by animals now only found in tropical Africa. The mildness of the climate allowed men to live in shelters made of reeds or branches and did not force them to live in caves, as in northern countries, where traces of their occupation would have been preserved. Consequently the only remains of these early men are their durable flint instruments which are widespread over northeastern Africa. Gradually the climate became drier, the rivers shrank and ultimately, perhaps 20,000 years ago, desert conditions were established as they are at present. The result of this change was to concentrate people on the edges of the Nile valley. In the valley itself the river probably covered most of the land when in flood and left huge marshes when it fell again and retired to its trough. In these marshes primitive people living on the edges of the valley hunted hippopotami, water-loving antelopes and wild fowl. As the rainfall over North Africa decreased and the country became arid, the Nile shrank to something like its present volume, and the beginnings of agriculture probably started on the edges of the valley.

Actual history in the basin begins in Egypt 5,000 or 6,000 years ago and is based on deductions from pottery and utensils found in tombs. Later there are the inscriptions, pictures and carvings on the monuments which record contemporary events, and so down through ancient Egyptian, Greek, Roman and Arab times to the present. Little is known of the early history of the Nile basin outside Egypt and this comes from the excavations in the northern Sudan and occasional references on Egyptian monuments to people farther south. It seems likely that the ancient Egyptians, although they traded down the Red sea as far as Somaliland and up the Nile beyond Khartoum, knew nothing of the source of the river. Herodotus, who visited Egypt *c.* 460 B.C. and travelled up

to Aswan, has left some account of the country and a little about what lay to the south as far perhaps as the beginning of the Sudd region. Eratosthenes, one of the mathematicians and geographers of the Alexandrian school in the 3rd century B.C., says that the Nile is formed by three streams, two of which issue from lakes in the east and the third from some lakes to the south. By the 1st century A.D. trade down the Red sea to India and the east coast of Africa was well established, and this must have led to trade with the interior. It was probably due to this that rumours of snow-capped mountains and great lakes in the interior reached the Mediterranean. Because of the difficulties of travel in the Sudan it seems unlikely that the connection of the Nile with these was actually established; it was probably an intelligent guess. Strabo about the beginning of the era says that it was well known that the annual rise of the Nile was due to rain on the high mountains of Ethiopia. Claudius Ptolemaeus, who lived in Alexandria in the 2nd century A.D. and wrote treatises on astronomy and geography, thought that the White Nile came from the high snow-covered mountains in central Africa, called the Mountains of the Moon, and passed through two lakes. His map corresponds in a general way with what actually exists and must have been a collation of information then current as travellers' tales.

With Portuguese expeditions to Ethiopia in the 15th and 16th centuries more definite knowledge was obtained, and the first European to see the source of the Blue Nile was Father Pedro Paez, a Portuguese Jesuit, who visited it in 1613. Later, about 1770, James Bruce spent some time near Lake Tana and the head waters of the Blue Nile and then returned from Gondar to the Blue Nile at Sennar and so down the Nile to Cairo.

Modern exploration of the Nile basin begins with the conquest of the northern and central Sudan by Mohammed Ali Pasha and his sons from 1821 onward. As a result of this the Blue Nile was known as far as its exit from the Ethiopian foothills, and the White Nile as far as the Sobat mouth. During his last visit to the Sudan about 1837 Mohammed Ali gave orders for the exploration of the White Nile so as to solve the problem of its origin, which had interested the civilized world for 2,000 years. Three expeditions under a Turkish officer, Selim Bimbashi, were made between 1839 and 1842 and two got to the point about 20 mi. beyond the present port of Juba, where the country rises, and rapids make navigation very difficult. These expeditions were accompanied by Georges Thibaut (Shawki Ibrāhim), Jacques Pons d'Arnaud (Arnaud Bey) and Ferdinand Werne who published accounts of their journeys. After these expeditions traders and missionaries penetrated the country and established stations in the southern Sudan. From an Austrian missionary, Ignaz Knoblecher, in 1850 came reports of lakes farther south. In the 1840s the missionaries Johann Ludwig Krapf, Johannes Rebmann and J. Erhardt travelling in East Africa saw the snow-topped mountains Kilimanjaro and Kenya and heard from traders of a great inland sea which might be a lake or lakes.

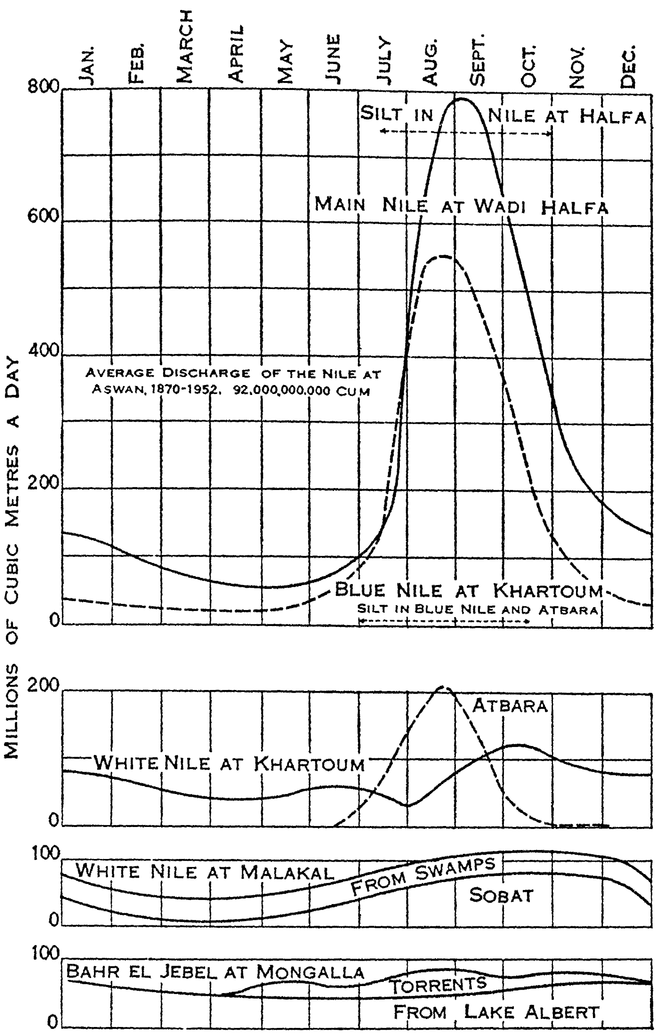
These reports led to fresh interest in the Nile source and to an expedition by Richard Burton and J. H. Speke, who followed a trade route of the Arabs from the east coast and reached Lake Tanganyika. On the return journey Speke went north and reached the southern end of Lake Victoria, which he thought might be the origin of the Nile. This was followed in 1860 by another expedition by Speke and J. A. Grant under the auspices of the Royal Geographical society. They followed the previous route to Tabora and then turned toward Karagwe, the country west of Lake Victoria. Here they saw the high Mfumbiro mountains 100 mi. to the west (they thought that they might be the Mountains of the Moon) and discovered the Kagera river. From the information that he was able to collect Speke thought that the Kagera must be the principal tributary of the lake. Continuing around the lake he finally reached the Ripon falls (1862), at which point he wrote "I saw that old Father Nile without any doubt rises in Victoria Nyanza." Speke then made his way northward with Grant, for part of the way along the Nile, until they reached Gondokoro, nearly opposite the present Juba. They heard rumours on the way of another large lake to the west but were unable to visit it and passed the information on to Sir Samuel Baker, who met them at Gondokoro, having come up from Cairo. Baker then continued his journey south and discovered Lake Albert. Neither Speke nor Baker had followed the Nile completely from the Ripon falls to Gondokoro, and Baker, who saw the northern half of Lake Albert, was told that it extended a very long way to the south. The discoveries of Speke and Baker are now commonly held to have settled the origin and course of the Nile, but at the time the unexplored gaps and the very elementary state of the science of hydrology led people to think that there was still an element of doubt. The question was settled when, between 1874 and 1877, Gen. C. G. Gordon and his officers followed the river and mapped part of it. In particular Lake Albert was mapped and Col. Charles Chaillé-Long, an American, discovered Lake Kyoga. In 1875 H. M. Stanley travelled up from the east coast and circumnavigated Lake Victoria. His attempt to get to Lake Albert was not successful, though he travelled up the Katonga swamps and got as far as the escarpment above Lake George, from which he was forced to turn back by threat of war. Finally he marched to Lake Tanganyika and travelled down the Congo to the sea. In another memorable journey in 1889 to relieve Emin Pasha, Stanley travelled up the Congo and across to Lake Albert, where he met Emin and persuaded him to evacuate his Equatorial province, which had been invaded by the Khalifa's forces. They returned to the east coast by way of the Semliki valley and Lake Edward, and Stanley saw the snowy peaks of Ruwenzori for the first time.

Thus by 1890 the main features of the Nile basin were known, though there still remained much to be explored and also the business of map-making, which 60 years later was still not fully complete in detail. The penetration of central Africa by British and German settlers from the east coast and the establishment of settled conditions in the Sudan led to detailed exploration by district officers and to the creation of survey departments, which began systematically to map the region. Since 1900 the expansion of perennial irrigation in Egypt and its commencement in the Sudan have created demands for more water when the river is low. These have led to hydrological studies and surveys, whose results are described below.

Hydrology.—Nile studies may be said to have begun at a very early date, as the ancient Egyptians recorded river levels on Nilometers some of which still remain. However, before the 20th century there was very little detailed knowledge about the Nile water supply and its origin, and the greatest developments took place after World War I. The levels and discharges of the principal tributaries and of the main stream are now measured at many points from the Kagera, beyond Lake Victoria, to the sea, with the exception of the Blue Nile beyond the Sudan boundary. Before the 20th century, discharges of the Nile were obtained by the use of surface floats, but in 1901 current meters were first used to measure velocity, leading to much more accurate results. For the first time the discharges of the three main tributaries, the Blue and White Niles and the Atbara, were accurately measured and their relative importance discovered. After the Aswan dam was finished a large tank was built below it, which was used to measure the discharge of a sluice under different heads and openings. By comparing one kind of sluice with another it was found possible to deduce the discharge of the river, which was thus based on a measure of volume. The measurements by current meters and sluices, carried on for many years, agree closely. Between 1901 and 1904 Sir William Garstin made a hydrological reconnaissance of the White Nile from Lake Victoria to Khartoum, and C. E. Dupuis examined the Atbara and also the Rahad and the Dinder (tributaries of the Blue Nile) and visited Lake Tana. The results of these reconnaissances, with recommendations for the improvement of Egypt's water supply, were published in 1904 in a report on the basin of the upper Nile. In 1906 Sir Henry Lyons published his *Physiography of the Nile Basin*, in which was collected all the information from travellers and scientific explorers available at the time. In the previous year the Sudan branch of the Egyptian Irrigation service had been formed, which with the Physical department was to continue studies of the upper Nile. In 1925 the Sudan formed an Irrigation service, and in 1947 Uganda started a hydrological survey.

The principal feature of the Nile regime is the annual flood.

The river at Wadi Halfa, where it enters Egypt, usually begins to rise in June, reaches its maximum at the beginning of September and then falls away at a decreasing rate. It is low from February to the middle of July, and during this time its natural supply is insufficient for the irrigation requirements of Egypt. Although the flood is a fairly regular phenomenon it varies both in volume and in date. These variations are important, since a very high flood brings danger of flooding in Egypt and the northern Sudan, and a low one may mean a shortage of irrigation water later.



FROM MINISTRY OF PUBLIC WORKS, EGYPT

AVERAGE DISCHARGES OF THE NILE

The flood is caused by the Blue Nile and Atbara, whose water comes from rainfall on the Ethiopian highlands and brings down mud washed off the land surface into the many small streams which it forms. The Blue Nile and Atbara come down in flushes, which are gradually smoothed as they travel down the river. The average flows of the river and its principal tributaries are shown in the accompanying figure. It is clear that the greatest part of the total flow is contributed by the Blue Nile and the least by the Atbara, but at the low time of the year the White Nile is the most important stream. The White Nile also receives some water from the Ethiopian highlands, which altogether produce 84% of the Nile supply while the remaining 16% comes from the Lake plateau of central Africa. When the Blue Nile is rising rapidly it holds up the White Nile discharge, and only when the rise slows down does the White Nile's discharge begin to increase. The effect of the Blue Nile is therefore to make a natural reservoir of the White Nile, and this effect is now produced artificially on a greater scale by the Jebel Aulia dam, situated some little distance up the White Nile. The dam raises the river level to beyond Renk, a distance of 280 mi., and adds 2,000,000,000 cu.m. to Egypt's low-stage supply. The Atbara draws its supply from the northern part of the Ethiopian plateau, but little is known of the hydrology of its tributaries. The rainfall that causes its flood comes from the same source as that falling in the Blue Nile basin, and this is probably the South Atlantic (*see* below). In flood its level fluctuates rapidly like that of the Blue Nile, and after the flood it soon ceases to flow. The Blue Nile receives two tributaries in the Sudan, both coming from Ethiopia, the Rahad and the Dinder. They are strong streams in flood but, like the Atbara, are reduced to pools later. When at their maximum, they produce together about 10% of the Blue Nile's discharge. Of the tributaries of the Blue Nile outside the Sudan practically nothing is known from a hydrological point of view. Lake Tana has been studied and only produces about 7% of the discharge of the Blue Nile. The lake is important because it offers the possibility of an economical reservoir for the joint use of the Sudan and Egypt, where excess evaporation losses would be small.

About half of the discharge of the White Nile is provided by the Sobat, about half by the Bahr el Jebel and an insignificant portion by the Bahr el Ghazal. The Sobat is formed by two main streams, the Baro coming from Ethiopia and the Pibor coming from the south, though its main tributaries also come from Ethiopia. Flushes occur on the headstreams of the Sobat, but when they reach the plains they overflow and flood large areas of country. The effect of this is to smooth out all the peaks and to delay the arrival of the maximum at the mouth by a couple of months. The Sobat, like the Blue Nile and Atbara in flood time, brings down mud from Ethiopia, though only a small amount gets into the main Nile. The figure shows the average contributions of the Sobat and Bahr el Jebel (called Swamps) to the White Nile. It will be noticed that the Bahr el Jebel's discharge varies very little throughout the year. This is due to the regulating effect of the large swamps of the Sudd region on the Bahr el Jebel. When a rise occurs upstream of the swamps, most of it flows out of the river into the marshes and only a very small part of the increase is left at their tail. As large areas are below the river level, the water which enters them is lost by evaporation and by transpiration from the luxuriant vegetation, with the result that the Bahr el Jebel loses nearly half its water in the swamps. In the case of the Bahr el Ghazal, which drains a large area having a fair rainfall, the tributary streams in their upper courses carry considerable volumes of water in flood (from July to October) although they are practically dry from January to April. Of this quantity which drains into the tributaries, estimated to be rather more than the discharge of the Sobat, only a trickle reaches the mouth of the Bahr el Ghazal. The Bahr el Jebel derives its water mainly from the equatorial lakes, but there is in addition a contribution averaging about 17% of the total from torrential tributaries joining between Lake Albert and Mongalla, which rise and fall quickly. During the dry season their contribution is negligible. The Bahr el Jebel immediately below Lake Albert does not fluctuate rapidly, since it is entirely controlled by the lake, which because of its size can only change its level slowly. Lake Albert receives supplies from two main sources, the Victoria Nile and the Semliki. The latter comes from Lake Edward and receives on its way the drainage from the western side of Ruwenzori and some small streams from the Belgian Congo. The Victoria Nile comes from Lake Victoria through Lake Kyoga and provides about 80% of the inflow into Lake Albert. There is a small amount of drainage from swampy valleys into the Victoria Nile and Lake Kyoga, which in seasons of heavy rain may be considerable; but on the average the system is a source of loss.

Lake Victoria has an annual average outflow of 21,000,000,000 cu.m. A water balance sheet for the lake shows that rainfall and evaporation are approximately equal and about five times the outflow by the Victoria Nile or inflow from tributaries. The approximate equality of rainfall and evaporation makes the large lakes of central Africa valuable as potential storage reservoirs. Lake Victoria has been made into a reservoir by the Owen Falls dam on the Victoria Nile, just below its outfall from the lake. In this the surplus discharges of high years can be stored to meet the deficit of low ones. It was planned moreover to use the head for a hydro-

electric scheme to provide power for industries in Uganda.

Origin of the Nile Flood.—It has already been said that the greater part of the Nile water comes from rainfall in Ethiopia. The development of meteorology in the 20th century made it clear that the causes of such phenomena as the Indian monsoon and other tropical rains must be sought in the general circulation of the atmosphere. In 1910 J. I. Craig put forward the theory that the Ethiopian rainfall is caused by a current of moist air coming from the South Atlantic across Africa. The following is the evidence. The possible sources of rain in Abyssinia are the Mediterranean sea, the Red sea, the Indian ocean and the South Atlantic ocean. The Mediterranean and Red seas are ruled out because of intervening deserts and the fact that there is no stream large enough to reach the sea on the eastern side of the highlands. On the whole the winds of the rainy season blow across Africa from the Gulf of Guinea to Ethiopia. The rainfall is heaviest over the coast and the Congo basin, falls off over the Sudan plains and is again fairly heavy on the Ethiopian plateau. South and east of the plateau, rainfall is scanty and large areas are desert or semi-desert.

Periodicity and Prediction.—Much work has been devoted to the search for periodicities in natural phenomena and the long series of records of the Roda (Cairo) Nilometer have afforded valuable material. The most complete portion extends, with gaps, from A.D. 622 to A.D. 1522 and gives maximum and minimum levels. In spite of uncertainties due to repairs and renewals of the gauge, to changes of the river channel, to vagaries of gauge observers and to defects in the records, much useful information can be extracted from them. When the maximum levels are plotted in order the principal feature is the occurrence of terms of years when, on the whole, floods are above the average and of others when they are below; but there is no obvious regularity about their occurrence. Low floods may occur among high ones and vice versa. For example in the latter half of the 19th century a very low and a very high flood occurred in successive years, with a difference at Aswan of 9 ft. between their peaks. Many people have analyzed the records, and periodicities have been found varying from 2 to 240 years in length, but all of them have small amplitudes of the order of 10 cm. The largest so far found has an amplitude of 17 cm., or 34 cm. between minimum and maximum floods. These periodicities are completely masked by irregularities such as the one already mentioned and, although they may have theoretical importance, are of no use for the practical business of attempting to forecast the flood. Forecasts of the river, when they can be made, are of considerable value in the practice of irrigation. Attempts to relate the flood discharge to the general circulation of the atmosphere have been partially successful, and relations have been found between the volume of the flood and temperatures in Alaska and Samoa, and the pressure at Port Darwin in Australia. On these a formula can be based which will account for rather less than half the variation of the flood; the rest results from causes outside the formula. By the middle of the 20th century this was about as far as such statistical research could go. If the flood could be traced to two or three causes which could be measured, a fairly exact formula could be deduced. So far, however, only symptoms of such causes had been found.

Two other types of forecast are successful and in regular use. The first depends on the time taken by rises or falls of the river to travel downstream and on the flattening that they undergo as they proceed. Past records of river levels have been analyzed, and from this analysis curves and tables have been made showing how long a well-marked change of level takes to travel over the various reaches of the river and how much is lost on the way. This varies with the height of the river. For example the time from Roseires on the Blue Nile to Aswan, a distance of 1,540 mi., varies from 10 days at the top of the flood to 35 days at the lowest levels. This type of forecast is very useful when the Blue Nile and Atbara begin to rise, and plans must be made for the sowing of crops. The amount of these depends on the amount of available water, of which some must be retained in the Aswan reservoir so that it is not empty before the natural supply of the rising river is sufficient for the crops. If the flood is a high one, this type of forecast is again useful to predict the height to which the river is likely to rise in Lower Egypt, so that suitable measures can be taken to prevent breaches of the river banks. The other successful type of forecast is based on the fact that when the rains in Ethiopia are over, usually by the end of October, the Blue Nile falls regularly in much the same manner each year. Consequently the discharge in one month influences those in the following months. Something of the same sort applies to the White Nile. By tabulating the sequences of past years a forecast can be made in November for the following months up to May or even June. This forecast improves as time goes on, and a better one can be made in December than in November and so on. It is extremely useful as it gives an idea of the water which will be available for summer crops and whether the prospects are favourable for a large area under rice.

Utilization of the Water and Irrigation Projects.—In Egypt in 1950 about 5,750,000 ac. were cultivated by irrigation, of which 1,000,000 were on the basin system of flood irrigation. In the Sudan about 1,000,000 ac. were irrigated in the Gezira by water taken into a canal just above the Sennar dam; about 300,000 ac. were irrigated by pumps drawing from the river; and an area in the Northern province, varying from 10,000 ac. in poor years to 100,000 in good ones, was watered by flooding. Elsewhere in the basin of the Nile cultivation by irrigation is practically non-existent.

The division of water between Egypt and the Sudan was the subject of the Nile Waters agreement of 1929 between Great Britain and Egypt. This defined the amount of water that could be taken by the Sudan without interference with the amount used by Egypt in the past; if more water was to be taken for the Sudan, Egypt's preliminary consent was to be obtained. Egypt moreover was not to undertake conservation works without first agreeing on measures to safeguard the interests of the Sudan. Subsequent agreements were made for Egypt to build the Jebel Aulia dam (1932) and a dam at the Fourth cataract (1952), that the amount stored in the Sennar reservoir might be increased and that Egypt and the Sudan should share equally in the cost and benefit of the project for a dam at Lake Tana.

The irrigation year may be divided into two parts, which are roughly from August to January when the river supply is in excess of requirements, and from February to July when it is necessary to add to the natural flow of the river by water stored from the previous time of excess. The storage of water in the Jebel Aulia reservoir begins in August when there is definitely an excess in Egypt. This is White Nile water, which is free from silt, and it is used for irrigation in Egypt as soon as the natural river is insufficient. The Sennar dam is in use from the middle of July to the end of March. Its reservoir is first of all filled to the level required to supply the Gezira canal and later to full storage level. During February and March the canal takes only water previously stored in the reservoir, since at this time Egypt has a right to all the natural flow. Further water is stored for Egypt in the Aswan reservoir from October, and this is drawn upon after the supply from the Jebel Aulia reservoir is exhausted. At the height of the flood the silt content of Nile water averages about 2,500 parts per 1,000,000 by weight, and for the whole flood period from July to October about 1,600 parts per 1,000,000. This is much less than is carried by many other rivers, for example the Colorado, the Missouri and the Indus. Most of this has passed by the time that the Aswan reservoir begins to be filled. It occasionally happens, however, that the reservoir is partially filled at the top of a high flood to reduce the maximum levels in Egypt. So far only an insignificant amount of mud has been deposited in the reservoir by this procedure. Nile water contains on the average about 170 parts per 1,000,000 of dissolved salts. This is not a great amount and is only about half that in the Thames, but more than in many other British rivers.

By the middle of the 20th century the rapidly increasing populations in Egypt and the Sudan had made further conservation works on the Nile urgent. Proposals for these were made in 1946 in *The Nile Basin*, vol. vii, by H. E. Hurst, R. P. Black and Y. M. Simaika and were accepted as the policy of the Egyptian government in 1949. They involved as a main principle over-year storage, the theory of which was worked out by Hurst (*Trans. American Society of Civil Engineers*, Paper 2447 [1951]). Over-year storage was essential, since in 1913–14, for instance, the whole discharge of the river had been less than the requirements of Egypt and the Sudan were in the middle of the 20th century. The projects comprised, in the first place, a large reservoir in Lake Victoria, produced by the Owen Falls dam, which would form the main reservoir for over-year storage and would also provide hydro-electric power for use in Uganda; by means of this reservoir water would be stored in good years to supplement the supply of bad ones. An adjunct to this reservoir was to be a regulator or low dam near the outlet of Lake Kyoga; by keeping this partially filled an increased

discharge from Lake Victoria could be passed on immediately (instead of gradually as Lake Kyoga filled to the required level), thus avoiding a delay of two or three months. Thirdly, a reservoir in Lake Albert was required to control (1) both water from the Semliki river and the large quantity coming in seasons of unusually heavy rainfall from the tributaries of Lake Kyoga and (2) the amount of water sent down to the Sudan and Egypt. Fourthly, in view of the losses of water in the swamps of the Bahr el Jebel, as it was obviously useless to provide large storage reservoirs if half their outflow would be lost, the Jonglei diversion canal was designed to by-pass the swamps; this would leave the Bahr el Jebel at Jonglei below Bor and join the White Nile between the mouths of the Bahr el Zeraf and the Sobat; a regulator would divert about half the discharge down this canal, and the remainder would flow down the Bahr el Jebel at a level that would reduce the losses to normal, so that there would be a gain of water in addition to the regulated distribution produced by the Lake reservoirs. The Jebel Aulia reservoir was to continue to act as it already did and to store water mainly from the Sobat flood. Fifthly, a projected dam at the outlet of Lake Tana, if the lake could be used to its full capacity, would provide water for the increase of cultivation in the Sudan, a measure of over-year storage and also a reserve in case of emergency in Egypt, such as might be caused by a very low flood. Finally a large dam on the main Nile below the Atbara would provide a reservoir for flood protection with, in addition, some stored water from all floods except the low ones, for use in the following low stage.

These projects could only be carried out after agreements between Egypt, the Sudan, Ethiopia, the Belgian Congo and the East African territories. Work on the Owen Falls dam was begun in 1949, and Egypt and the Sudan agreed on the building of a large dam in the Fourth cataract. Moreover the Sudan undertook a far-reaching investigation into the effects of the Equatorial Nile projects on the country and its people.

Since the above-mentioned proposals were accepted, a project for a reservoir in the Wadi Rayan, a depression in the desert south of the Fayum, was restudied. This would give a measure of flood protection and store some additional water from the flood. A proposal for a very high dam above the present Aswan dam was being studied in 1953. It was appreciated that, if this could be realized, it would produce a reservoir capable of performing some over-year storage on the main Nile and also of producing large quantities of hydroelectric power, by means of which Egypt might develop industry on a large scale. It would create a reservoir which at its maximum level would extend 90 mi. south of Wadi Halfa. The proposal was revolutionary in its departure from previous ideas and raised many difficulties which needed a considerable amount of detailed study, for which in part the material was yet to be collected. The Sudan government meanwhile was studying a project for a dam upstream of Roseires to store water from the flood so that cultivation on the Blue Nile could be increased. A hydroelectric scheme had already been undertaken at the existing Aswan dam. Any of the dams already mentioned offered possible sites for the development of power, but a drawback in some cases was the distance between the places where the power could be produced and those where it could be usefully employed. In the case of a reservoir filled and emptied annually, as were the existing reservoirs except that in Lake Victoria, there was the disadvantage that the available power fell to a small quantity during the time that the reservoir was empty.

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NILE, BATTLE OF THE. The battle of the Nile was fought in Aboukir Bay, near Alexandria, on Aug. 1, 1798. It arose out of Napoleon's famous Egyptian Expedition, the first news of which had reached Jervis, off Cadiz, earlier in the year, in the shape of rumours of great activity in the port of Toulon. In the previous year the first European coalition against revolutionary France had been finally dissolved by the elimination of Austria, the result being that in 1798 France was at war with England only, and this eastern expedition with its proposed, though unlikely, result of an attack on India, was considered by Napoleon to be the most hopeful means of embarrassing England, while at the same time keeping himself in the limelight. As soon as Jervis heard of the preparations at Toulon, the object of which was, of course, unknown to him, he despatched Nelson with a small force to reconnoitre, and soon afterwards he had an opportunity of reinforcing him. Pitt was trying to build a new coalition against France, and was approaching Austria who made England's re-entry into the Mediterranean, which she had been forced to evacuate, a condition of acceptance. Jervis was thus ordered to send a detachment through the Straits of Gibraltar with instructions to find out whether a re-entry into the Mediterranean was feasible; what he did was to reinforce Nelson so as to bring his strength up to 14 ships, 13 of them seventy-fours and one a fifty.

Before Nelson was joined by his reinforcements and while he commanded only three seventy-fours and some frigates, he was forced from his station, off Toulon, by a gale. He suffered severely in this and—perhaps worst misfortune of all—was separated from his frigates which went to Gibraltar in the expectation that the admiral would go there to refit. The absence of "the eyes of the fleet" during the ensuing search for the French was obviously a great handicap. The remaining ships were repaired somehow and by May 31 they were back off Toulon, having been absent ten days, but the French were gone. The direction of the wind led Nelson to believe that the kingdom of the two Sicilies was the danger-point, and that the French had not made for the Straits of Gibraltar as it was believed in England they would. Consequently he made for the Bay of Naples, and on June 7 was joined by the reinforcements from Jervis. Malta was the next point at which it was decided to aim, but, while the fleet was in the neighbourhood of Cape Passaro, news reached it that the island had fallen to the French. It was this news that shook the public confidence, generally so strong, in Nelson, and for a time it was considered that he was being out-manoeuvred. The problem before him was certainly a hard one. With the intuition, however, for which he was so famous, he decided on Egypt as Napoleon's next stopping-place, and made sail for Alexandria. He found it empty and impetuously left, on June 30, to search elsewhere. On the following day the French arrived, actually sighting the topsails of the last ships of the departing English fleet, which ranged the coast of Asia Minor in its search and finally arrived at Syracuse. Here, by the kind influence of Lady Hamilton with the Neapolitan court, the fleet was entirely revictualled and immediately sailed again for the East. After further searching, Nelson decided to try Alexandria once more, and this time was rewarded by the sight of the republican tricolour floating over the town. A little later the French fleet could be seen anchored in Aboukir Bay. The long search was ended.

Aboukir Bay is situated about fifteen miles north-east of Alexandria and is about fifteen miles wide, extending from Aboukir Point on its westerly side to the Rosetta mouth of the Nile. The bay was silted up and its western curve offered exactly the sort of refuge de Brueys, the French Admiral, was seeking for the protection of his fleet which consisted of nine seventy-fours, three eighties, "L'Orient" of 120 guns, and four frigates. He had hoped to station this fleet in such a manner that it would be impossible for an attacking enemy to do more than fight him from seawards. The curving shoals seemed to offer him such a position, and he had drawn up his fleet facing north and north-west in a very obtuse angle, with his own ship, "L'Orient," at the apex, and the ships at the extremities of the line close to the shallows. The frigates he placed between this line and the shoals. So certain was de Brueys that this arrangement would prevent the British getting between him and the land that his ships were not even prepared for action on the landward side. An ordinary attack on his seaward side would, he thought, favour him, since the enemy would be under sail and, further, he had prepared batteries ashore which would enfilade their position. To Nelson's experienced eye, however, a weakness in these dispositions was at once apparent. The French ships were anchored in such a manner that there was nothing to prevent them swinging, and, as Nelson himself put it, "where there is room for a Frenchman to swing, there is room for a Briton to anchor"; in other words it would, for all de Brueys's care, be possible to attack the French on the landward side, either by cutting in between the leading ship and the shoals, or by breaking through between two ships. The British fleet was approaching from the

north with the wind a little west of north, so that there was nothing to prevent their doing either or both. Nelson's orders were that part of the fleet was to get to landward of the enemy and part was to remain to seaward; the northern end of the line was to be attacked first and the English ships were to anchor only by the stern so that, by merely paying out cable, they would be able, as each French ship was demolished, to move on to deal with others which would, owing to the direction of the wind, have found it impossible to come to the assistance of those attacked first.

It was nearly dark when Captain Foley, of the "Goliath," leading the English line, took his ship between the "Guerrier," the leading French ship, and the shore. Raking the "Guerrier" in passing, he went on to anchor on the port quarter of the next French ship, the "Conquérant." Captain Hood, who followed, in the "Zealous," anchored on the port bow of the "Guerrier." The three following ships, the "Audacious," the "Theseus" and the "Orion" broke through the French line and took up positions between the enemy and the shoals. Next came Nelson, in the "Vanguard," and his was the first ship to take up her station to seaward, anchoring opposite the "Spartiate," the third French ship, which was already receiving the attentions of the "Theseus" on the other side and was thus doomed to an eventual surrender. All the remaining ships took up their positions to seaward of the French, with the exception of the "Majestic" and the "Alexander," which broke through, and of the "Culloden," commanded by Nelson's friend, Troubridge, which was unfortunate enough to run ashore on a projecting sandbank before getting into action. Even this was not without its blessings, since, by hanging out signal lights, Troubridge was able to warn the ships following against suffering a similar fate, and they all escaped it. The enormous "Orient" was engaged first by the "Bellerophon" and then by the "Swiftsure" and "Alexander," which were the last ships into action, one on each side of her. The French flagship fought stubbornly, but she was set on fire and at ten o'clock blew up with a colossal explosion. Surrenders to the British were now becoming frequent, and as each ship was taken, the victors were able to move on and engage others which, no doubt mystified and confused in the darkness, were complacent enough to wait their turn. In this way the entire French fleet was accounted for with the exceptions of the two rear battleships and two frigates which made off in time; it is interesting to note that they were all taken or destroyed in subsequent actions. The victory of the Nile was one of the most complete in the annals of naval history, and was rich in results. It enabled England to capture Minorca and Malta; it completely restored her position and prestige in the Mediterranean; and this, in turn, enabled Pitt to conclude successfully his negotiations for the formation of a new coalition.

See Southey, *Life of Nelson,* ed. G. A. R. Callender (1922, bibl.).

(G. A. R. C.; J. G. B.)

NILES, a city of Berrien county, Michigan, U.S.A., 93 mi. E. of Chicago, on the St. Joseph river. Four main highways cross in Niles, federal highways 31, 112 and state highways 40 and 60. It is served by the Michigan Central railroad (a division of the New York Central railway), the Big Four railroad and motorbus lines, and has a municipal airport. The population in 1950 was 13,145; in 1940 it was 11,328 (97% white, 2% Negro and 1% foreign) by the federal census. It is in the St. Joseph valley, a rich fruit-growing, farming and dairying region. There are diversified industries which make Niles an important manufacturing centre.

On or near the site of Niles, French Jesuits established a mission in 1690, and the French government in 1697 erected Fort St. Joseph, which was captured from the English by the Indians in 1763 and in 1781 was seized by a Spanish party from St. Louis. The present city was founded in 1826 and incorporated in 1859.

NILES, a city of Trumbull county, O., U.S., on the Mahoning river, 10 mi. above Youngstown; served by the Baltimore and Ohio, the Erie and the Pennsylvania railways. Pop. (1950) 16,773; (1940) 16,273. It is an important industrial centre, manufacturing especially steel sheets, glass, metal stampings and fabricating, chemicals and firebrick, with a factory output in 1949 valued at $75,000,000.

Niles was settled in 1832, incorporated as a village in 1865 and chartered as a city in 1895. It was named (1834) after Hezekiah Niles (1777–1839), founder and editor of *Niles's Register* (1811–49); and was the birthplace of Pres. William McKinley, to whose memory a memorial was erected there.

NILGAI ("blue bull"), the largest antelope (*Boselaphus tragocamelus*) found in India, where it represents the kudu and eland group of Africa. Only the bulls have horns, and these are short. The general colour of old bulls is bluish-grey, but younger bulls and cows are browner. It is about the size of a mule (*see* ANTELOPE).

NILGIRIS, THE (Blue Mountains), a system of hills in southern India, which gives its name to a district of the Madras Presidency. The Nilgiris form a plateau rather than a range, rising abruptly from the plains on most sides, with a general elevation about 6,500 ft. above sea-level.

The DISTRICT OF THE NILGIRIS is the smallest administrative district in Madras. It was formerly confined to the plateau, but was increased by the addition of portions of the Wynaad, making a total area of 982 sq.m. The administrative headquarters are at Ootacamund (*q.v.*). There is an abrupt descent of about 6,000 ft. from the plateau to the plains, save on the north, where the base of the mountains rests upon the elevated land of Wynaad, and Mysore, standing between 2,000 and 3,000 ft. above sea-level. The Ochterlony valley and Wynaad country consist of a series of broken valleys, once forest-clad throughout, but now studded with tea and coffee-gardens. The highest peak is Dodabetta, 8,760 ft. There are six well-known passes or *ghats* by which the district communicates with the neighbouring plains, three of which are practicable for wheeled traffic. The chief rivers are the Moyar, Paikara and Calicut, none of which is navigable. The forests consist of fine timber trees, and eucalyptus and Australian wattle have been extensively planted in the higher grounds of the Wynaad. Large game animals of many kinds are numerous. The hill tribes include Todas, Badagas and Kotas. The population of the district in 1921 was 126,519. The commercially important products are coffee, tea and cinchona. The latter is cultivated by the government, and also in private gardens, and there is a government quinine factory. The climate of the Nilgiri hills is extremely equable. A branch of the Madras railway runs from Podanur to Mettupalaiyam, whence a metre-gauge line on the rack principle goes to Coonoor, where there is a silk-farm, and Ootacamund. The Lawrence Memorial School at Ootacamund is maintained by government. The military quarters are at Wellington.

NILOTES, certain peoples of the Anglo-Egyptian Sudan, of whom the Shilluk and Dinka, best known representatives of these tall "black"-skinned dolichocephals, have an average stature of about 1·78m. (about 70in.) or perhaps a little more, and a cephalic index which varies around 72. In these tribes, as well as in the Nuer and Anuak, there is an Hamitic element, and although the majority have coarse features, with broad noses, among the Shilluk and probably the Anuak men with shapely features, including thin lips, long, relatively high-bridged, narrow noses, and well modelled foreheads are not uncommon.

The languages of the Nilotes form a sub-group of the family of languages called by Meinhof "Sudanic," characterized by the absence of inflection and grammatical gender and by the use of tone rather than accent, while typically each word consists of one syllable (*see* AFRICAN LANGUAGES). Shilluk so closely resembles Anuak that the two peoples can understand one another, and the same probably holds for Dinka and Nuer.

Mode of Life.—The Nilotes are essentially pastoral and largely riverain, their interest in their cattle being so far predominant that they usually grow scarcely enough grain to supply themselves till the next harvest. For the most part the men go absolutely naked, the women wear a pair of leather aprons reaching from waist to knee. The forehead is often scarred, and the lower incisors are generally removed. The skin is commonly smeared with the ash of wood and cattle dung. Ivory armlets are worn and the hair may be worked into elaborate head-dresses. Cannibalism is unknown and human sacrifice is almost entirely absent. The number of cattle constituting the bride price is a matter of

great importance, and this is usually paid in instalments. Certain iron-making groups of Dinka living near the Nile-Congo Divide, having few or no cattle, pay for their wives in iron. Widows are inherited by their husband's heirs, the children that they bear being counted as children of the first husband. Psychically the Nilotes, especially the Dinka, are distinguished from all other groups in their extreme aloofness and pride of race, showing absolutely no desire for European clothes or trade objects.

The social organization of the Shilluk is into a number of exogamous groups, but whether these are totemistic must be left for future investigation. Among the Dinka, who consist of a congeries of independent tribes, there are typical totemistic clans with descent in the male line, the totem being an animal, plant or even a natural object such as a meteor or fire. Almost all the clans whose totem is an animal derive their origin not from the animal itself but from a man born as one of twins, his fellow twin being an animal of the totem species, though sometimes the association is not quite so close, as when the totem animal lays certain commands upon members, offering in return certain privileges.

Religion.—Among the Dinka and Shilluk, the only two Nilotic tribes of whose religious ideas there is definite knowledge, the king (Shilluk *ret*) or chief (Dinka *baiñ*) is the rain-maker and belongs to the class of rulers called by Sir James Frazer Divine Kings, *i.e.*, there is immanent in each a divine spirit upon which depends the fertility and well-being of the universe. Such divine kings are not allowed to go to battle and were formerly killed ceremonially with their own consent when they showed signs of ill-health, or sometimes even of diminishing strength, lest the decline in vigour of their body—the living shrine of the divine spirit—should entail the weakness of the latter, when the cattle would sicken and fail to bear their increase, the crops would rot in the fields, and men, stricken by disease, would die in ever increasing numbers. The Shilluk king is indeed the classical example of the divine king, and two stages of his treatment can be traced; the earlier, preserved alone in folklore, refers to a time when anyone could kill the king and become his successor until he in turn was killed by a stronger, while in more recent times the killing of the king has become a ceremonial affair, the leading part being assigned to certain families called the Ororo.

In the case of the Shilluk the divine spirit incarnate in each king is *Nyakang*, the historic founder of the Shilluk kingdom and their culture hero. Like so many divine or semi-divine characters he did not die but vanished in a great storm. He has ten cenotaph tombs, the most sacred perhaps being that of Fenikang, the village in which he lived for a great part of his life. It is the presence of the divine spirit of Nyakang in the ruling king which enables the latter to move the High God, Juok, to send rain.

See W. Hofmeyer, *Die Shilluk* (1925); C. G. Seligman, "The Cult of Nyanking," *Fourth Report of the Wellcome Laboratory*, 1911, Vol. B. (C. G. S.)

NILSSON, CHRISTINE (1843–1921), Swedish singer, was born at Wederslöff, near Wexiö, Sweden, on Aug. 20, 1843, of poor parents. She studied in Paris, where she made her début in the rôle of Violetta at the Théâtre Lyrique on Oct. 27, 1864. Between that date and 1872, when she married M. Auguste Rouzaud, she was the leading prima donna. Her first appearance in London was in 1867. A year later, on the 9th of March, she made her first appearance in the Paris Opera house as Ophélie in *Hamlet;* and she visited the United States in 1870. After her marriage her appearances in public were rare. After her second marriage in 1887, with Count A. de Casa Miranda, she retired from the stage.

Madame Nilsson died at Copenhagen on Nov. 22, 1921.

NIMBUS: *see* AUREOLA.

NÎMES, a city of southern France, capital of the department of Gard, 174 mi. S. by W. of Lyons on the P.L.M. railway, between Avignon and Montpellier. Pop. (1946) 91,667.

Nîmes, the ancient *Nemausus*, was named from the sacred wood in which the Volcae Arecomici (who surrendered to Rome in 121 B.C.) held their assemblies. Strabo states that it was the metropolis of a district containing 24 dependent towns, and that it was independent of the proconsuls of Gallia Narbonensis. Constituted a colony of veterans by Augustus, and endowed with numerous privileges, it built a temple and struck a medal in honour of its founder. The medal, which afterwards furnished the type for the coat of arms granted to the town by Francis I, bears on one side the heads of Caesar Augustus and Vipsanius Agrippa (the former crowned with laurel), while on the other there is a crocodile chained to a palm-tree, with the legend COL. NEM. Agrippa built the public baths, the temple of Diana and the aqueduct of the Pont du Gard. The city walls, erected by Augustus, were nearly 4 mi. in circuit, 30 ft. high and 10 ft. broad, flanked by 90 towers and pierced by ten gates. Hadrian on his way back from Britain erected at Nîmes two memorials of his benefactress Plotina. In the very height of its prosperity the city was ravaged by the Vandals; the Visigoths followed, and turned the amphitheatre into a stronghold, which at a later date was set on fire along with the gates of the city when Charles Martel drove out the Saracens. Nîmes became a republic under the protection of Pippin the Short; and in 1185 it passed to the counts of Toulouse, who enclosed it with ramparts, less extensive than that of Augustus, still to be traced in the boulevards. The city took part in the crusade against the Albigenses in 1207. Under Louis VIII it received a royal garrison into its amphitheatre; under Louis XI it was captured by the duke of Burgundy, and in 1420 was recovered by the dauphin (Charles VII). On a visit to Nîmes Francis I enriched it with a university and a school of arts. By 1558 about three-fourths of the inhabitants had become Protestants, and in 1567 a massacre of Catholics took place on St. Michael's day. From the accession of Henry IV till the revocation of the edict of Nantes (1685) the Protestant community devoted itself to active industry; but after that disastrous event great numbers went into exile or joined the Camisards. Louis XIV built a fortress (1687) to keep in check the disturbances caused by the rival religious parties. Nîmes passed unhurt through the storms of the Revolution; but in 1815 Trestaillon and his bandit followers pillaged and burned and plundered and massacred the Bonapartists and Protestants.

Nîmes lies at the foot of the Garrigues, a range of barren hills on the north and west. The most prominent of these is the Mont Cavalier, on the summit of which is the Tour Magne, a ruined Roman tower. To the south and east the town overlooks the plain of the Vistre, largely used for the vine. The central and oldest part of the town consists of low buildings and is encircled by boulevards, which occupy the site of the old fortifications. Here are to be found the majority of the Roman remains for which Nîmes is remarkable. The most celebrated is the amphitheatre, the best preserved in France. It dates from the 1st or 2nd century A.D. and was used as a fortress for some time during succeeding centuries. Occupied during the middle ages by a special quarter, with a church, it was cleared in 1809. It is built of large stones fitted together without mortar. In form it is elliptical, measuring approximately 440 by 336 ft. externally; the arena is 227 by 126½ feet. The elevation (70 ft. in all) consists of a ground story of 60 arches, an upper story of 60 arches and an attic with consoles pierced with holes for supporting the *velarium* or awning. The building, which was capable of holding nearly 24,000 persons, has four main gates, one at each of the cardinal points; and 124 doorways gave exit from the 35 tiers of the amphitheatre to the inner galleries. Originally designed for gladiatorial shows, naval spectacles, chariot races, wolf or boar hunts, the arena has in recent times been used for bull-fights. The celebrated Maison Carrée, a Roman temple 82 ft. long by 40 wide, is a famous monument, and according to an inscription is dedicated to Gaius and Lucius Caesar, adopted sons of Augustus, and dates from the beginning of the Christian era. In contains a collection of antique sculptures and coins. The so-called temple of Diana, which adjoins the Fountain gardens, was probably connected with the baths of which remains are visible near by. Two Roman gates, the Porte d'Auguste, consisting of two large archways flanked by two smaller ones and dating from A.D. 16, and the Porte de France remain. The Tour Magne (Turris Magna) is still 92 ft. in height, and was formerly higher. It is the oldest monument of Nîmes, but its use it not clear. It was turned into a fortress in the middle ages by the counts of Toulouse. Near the

Tour Magne was discovered the reservoir from which the water brought by the Pont du Gard (*see* AQUEDUCTS) was distributed throughout the city.

With its capital, the temple of Augustus, the basilica of Plotina erected under Hadrian, the temple of Apollo, the baths, the theatre, the circus, constructed in the reign of Nero, the Campus Martius and the fortifications built by Augustus, Nîmes must have been one of the richest of the Roman cities of Gaul. The cathedral (St. Castor), occupying, it is believed, the site of the temple of Augustus, is partly Romanesque and partly Gothic in style. The churches of St. Paul and St. Baudile are modern. The Fountain gardens owe their name to a spring of water which fluctuates considerably in volume, and discharges into the Vistre; the town water comes from the Rhône. Alphonse Daudet and the Provençal poet Jean Reboul were natives of the town.

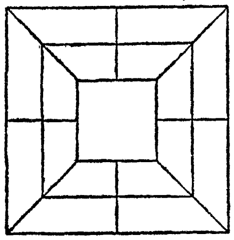
The city is the seat of a bishop under the archbishop of Avignon, a prefect, a court of appeal and a court of assizes, and has tribunals of first instance and of commerce, a board of trade-arbitrators and a chamber of commerce. At the close of the middle ages the industries of Nîmes received an impetus from a colony from Lombardy and Tuscany, and maintained their importance, so that before the revolution about half of the whole community were engaged in manufactures, chiefly that of silk. Upholstery materials, shawls, carpets, handkerchiefs, tapes and braidings, brandy, hosiery, leather, clothes, candles, machinery and boots and shoes are now manufactured, and there are a number of foundries. Nîmes is, besides, a great market for wine and brandy, and there is a good trade in grain, groceries and colonial wares. Quarries of hard limestone, used for the amphitheatre and other Roman buildings, are still worked in the vicinity.

NIMROD is described in Genesis x, 8–12 as the first "to be a mighty one in the earth," which Skinner in his commentary paraphrases as "originator of the idea of the military state, based on arbitrary force." Apart from 1 Chron. i, 10, which quotes this description, the only other reference to Nimrod in the Old Testament is Micah v, 6, where Assyria is called the land of Nimrod. Unlike the other names in the Genesis context, which are names of peoples, Nimrod is that of an individual. He is a son of Cush, which cannot mean, as it usually does, Ethiopia, but possibly stands here for the Kashshu, a people who conquered Babylon in the 18th century B.C. The beginning of Nimrod's kingdom is said to be Babel, Erech, Accad and Calneh, in the land of Shinar. Babel is Babylon; Erech, a city of Babylonia, is the present-day Warka; Accad, "Agade," the royal city of Sargon I., was the capital of a district of the same name in N. Mesopotamia; Calneh is unknown. Shinar, which the O.T. sometimes identifies with Babylonia, was, as Egyptian and Hittite records show, a distinct country, probably in N. Mesopotamia, which was prominent 1500–1200 B.C. Nimrod is said to have built Nineveh, Calah, an Old Assyrian town on the left bank of the Tigris, south of Nineveh, Rehoboth-Ir and Resen, both of which are unknown. It is in accordance with historical truth that Assyria was developed from Babylonia. The description of Nimrod as a "mighty hunter before the Lord," that is, a supreme hero of the chase, is an intrusion in this context, but probably, like the historical notices, derived from some old Babylonian saga. The Assyrian kings were noted for their prowess in hunting. But though we may feel reasonably sure that the Nimrod traditions were derived from Babylonian sources no equivalent of the name has yet been found in the cuneiform records. In character there is a certain resemblance between Nimrod and the hero Gilgamesh. Jensen, and later, with some hesitation, Jirku, suggested that the name NIN-IB of a Babylonian god might be read phonetically Namurtu, and compared with Nimrod. But Clay (*The Origin of Biblical Traditions*, p. 22 *seq.*) seems to have demonstrated that the correct reading is Nin-martu. Meyer says that the name Nimrod is common in Libya, but his theory that the saga was Libyan, and came to Israel via Egypt, seems improbable. (W. L. W.)

NINEBARK, any shrub of the genus *Physocarpus* of the rose family (Rosaceae). One of the best known is *P. opulifolius,* native from Quebec to Manitoba, south to Georgia and Kansas, and commonly planted for ornament. It grows from 5 to 10 ft. high, with strong, recurving stems, exfoliating bark and small, white or pinkish flowers, in umbel-like clusters, followed by clustered, inflated, reddish follicles. There are variegated and dwarf varieties.

NINE MEN'S MORRIS, a game played with counters on a board, also known as Muhle (Germany and Austria), Marelle (France), Mylla (Iceland), Siegen Wulf Myll (Poland) and The Mill, Morelles, Merry Peg, etc., in England.

The board (*see* diagram) comprises three concentric squares and several transversals, making 24 points of intersection. Two players, each provided with nine counters of his own colour, lay pieces alternately upon the points, the object being to get three in a row upon any line. On doing so, the player is entitled to remove from the board one adverse counter, but not one that is in a "mill," a row of three. Having placed all their counters, the players continue moving alternately, with the same object. A "mill" may be opened by moving one piece off the line; returning the piece to its original squares counts as a new "mill." The player who first captures all the adverse pieces wins. A move is limited from one point to the next along a line, but the rule is often made that when a player has only three pieces left he may move them from any point to any point regardless of the lines. In modern play the diagonal lines of the board are usually omitted, to lessen the advantage of the first player.



THE MILL BOARD

In modern play the diagonal lines are usually omitted

The mill board has been found carved or painted on innumerable relics of antiquity—on the steps of the Acropolis at Athens, on a Roman tile dug up at Silchester, England, on the deck of a Viking vessel discovered at Gokstad, on a tombstone in the Isle of Man. The game has been known since ancient times in India and China, among many African tribes, and on the Amazon, where it is called Trique and is held to be of Indian origin. The Greek game Petteia, played with pebbles upon an identical board, was supposed to have been invented by Palamedes prior to the siege of Troy, but later research indicates that this pebble game was played by shepherds in western Asia for centuries before the age of Homer. Some hold that mill, tit tat toe, pachisi, draughts (checkers), and chess all had a common ancestor.

The mill game is often played by shepherds with stones upon a diagram cut into the turf. Shakespeare alludes to this practice in *Midsummer Night's Dream* (Act II, scene I):

> The nine men's morris is fill'd up with mud,
> And the quaint mazes in the wanton green
> For lack of tread are indistinguishable.

This passage made "Nine Men's Morris" the best-known among many English variant names. "Morris" (*i.e.,* Moorish), is the name of a square dance to which the pebble game bears a fanciful resemblance. (G. MH.)

NINEVEH. The ancient capital of the Assyrian empire lay on the right bank of the Tigris opposite the modern city of Mosul. It consists of two great mounds, Kouyunjik and that on which today is the reputed tomb of the prophet Jonah (Nebi Yunus). The river has now shifted a short distance to the west so that the mounds are isolated from the present bed, although in ancient times the city abutted on the river. The city is situated on the northwest corner of a plain about 25 by 15 mi. in extent, formed by the Tigris and its tributaries, the Khosr on which Nineveh was built, which bounds the plain on the northwest, the Gomal, which forms the northeastern boundary, and the Upper Zab on the southeast. The western and south flank is protected by the Tigris itself. The whole plain slopes gently to the Tigris and provides a strong position, being protected by the foothills and the Gomal on the northeastern side, and on the south and west by the Tigris and the Upper Zab. The Khosr, although impassable enough when flooded forms at other times no barrier to attack. The position of Nineveh therefore astride this stream at its confluence with the Tigris is of great strategic importance. The Khosr was used to supply water to fill the protective works of the city and elaborate measures of river conservancy were taken to protect the plain against its most destructive inundations. Although the country is a fertile and prosperous wheat growing land, a fact which no doubt accounts for the many ancient cities so close to one another, owing to the slope of the plain the city itself is badly supplied with water and Sennacherib was compelled to build water conduits to conduct water from the hills into the Khosr and its canal system. The city then, although formerly, as is its modern descendant Mosul, the centre of a rich district, was suited particularly to military efficiency.

The city itself was surrounded by immense walls, which enclosed an irregularly shaped space, about three mi. long and about a

mile broad at the north where the walls were double, narrowing to about three quarters of a mile at the southern end. The walls were pierced by 15 gates. As in so many walled cities the actual dwellings did not occupy the whole of the space within the walls, there were parks watered by the elaborate aqueducts which brought water from the Khosr and other open spaces. The two great mounds formed two great fortified strongholds, and were joined together by a wall, part of which formed the west wall of the city. The mound of Kouyunjik, explored by R. Campbell Thompson on behalf of the British Museum contains an important series of buildings. On the north lay the palace of Assur-bani-pal. South of this lay the Temple of Nabu.

On this spot a rectangular building was found, 100×80 ft. which probably included part of the temple buildings and of the courtyard. Directly south of this again is today a broad pit which may possibly represent the site of the temple of Ishtar which is known to have existed on the mound. To the east is a building of Sennacherib, whose purpose does not seem to have been identified. Finally at the southwestern extremity of the mound is the palace of Sennacherib. This palace is of great architectural magnificence and is especially remarkable for the bas-reliefs which have so far been discovered. On the other mound Sennacherib built a military depot; his son Esar-Haddon built himself a palace on this mound, which has not at present been fully explored.

Although the greatness of Nineveh covers a comparatively short period there are indications that the city was Sumerian in origin. and early pottery and obsidian flakes have been found on the site. It has been suggested that possibly the Sumerians occupied this whole area before migrating south. The true history of Nineveh however begins at a comparatively late date. Hammurabi restored a temple of Ishtar, probably in Nineveh and Shalmaneser I, nearly 1,000 years later, about 1300 B.C. restored the temple again but although Sennacherib states that some of his ancestors were buried there the city was small and unimportant. He built the great building and walls which have been described and made a great triumphal way. His son Esar-Haddon rebuilt the temple of Ashur but started to rebuild Babylon, and did not carry out Sennacherib's purpose of making Nineveh the capital city of the Assyrian empire. Assur-bani-pal enriched the city with some of its greatest treasures, including a great library of clay tablets. In 612 B.C. the men of Nineveh were defeated by the Medes and the city was looted and destroyed. It seems probable that Mespila, referred to by Xenophon in the Anabasis refers to this site, and if so the spot was deserted at this time, but the name of Nineveh was applied to the site even in the middle ages, so an ancient tradition must have existed as to the location of the town. The site however did not become of any importance again till the time of the Arab conquest, when it lay on the opposite bank of the Tigris. (For later history *see* MOSUL.) The site has been attacked by numerous excavators from Layard onwards. In 1903–05 it was excavated by L. W. King and R. Campbell Thompson.

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NINGPO ("City of the peaceful waves"), an important Chinese city and chief commercial centre of the province of Chekiang, lying in a fertile plain backed by mountains on the south side of Hangchow bay, and about 12 mi. upstream from the mouth of the River Yung. The district of Ningpo, covering an area of 21 sq.mi., has a population of about 680,000, of whom 212,397, according to the census of 1928, live in the city. The city is of great antiquity and has occupied its present site since A.D. 713. It was one of the earliest centres of European settlement in China, the Portuguese arriving there about 1520. The early colony, known as Liampo, flourished until 1545, when the traders, owing to their illegalities, were driven out by the Chinese. Subsequent regulations and restrictions made foreign trade with Ningpo virtually impossible. In 1840 British war-vessels blockaded Ningpo and the following year, after the fall of Chinhai, a fortified town at the mouth of the Yung river, it was entered without resistance. In 1842, by the treaty of Nanking, Ningpo was opened to foreign trade, and the question then arose as to whether Shanghai or Ningpo should become the commercial metropolis in this region of the coast. Shanghai assumed that rank and since then has impeded the growth of Ningpo's trade. The opening of Wuhu (1877) and Hangchow (1896) also contributed to the diversion of this trade. After World War I, however, the value of the trade increased considerably. After the outbreak of the war in 1937 Ningpo remained one of the few ports in Chinese hands open to trade and while its import trade remained about the same, its export and interport trade increased considerably. Figures for foreign trade are given in Table I.

TABLE I—*Values of Foreign Trade*

	1937	1938	1939
Imports	$620,602 (U.S.)	$ 258,907 (U.S.)	$ 198,032 (U.S.)
Exports	7,507 (U.S)	1,018,412 (U.S.)	1,166,082 (U.S.)

Table II shows values of interport trade for 1936 and 1939.

TABLE II—*Values of Interport Trade*

	Imports	Exports	Re-exports
1936	$5,009,884 (U S)	$4,748,101 (U.S)	$ 20,822 (U.S.)
1939	4,427,097 (U.S)	2,680,949 (U S.)	2,271,504 (U.S)

Ningpo was formerly the port of shipment for cotton grown in the neighbouring districts; the annual export to Shanghai amounting to about 180,000 bales, for native drugs, tea, and more especially, fish and fish products. It had about 1,500 "couples" of junks engaged in the sea fisheries around the Chusan archipelago and supplied large numbers of fishermen. Ningpo was also noted for its grass mats, made of reed or grass grown locally. These mats found a market even in Japan, despite keen competition, owing to their cheapness. Rush is also specially grown and made into braids for straw hats, while laces are knitted in the neighbourhood and shipped chiefly to Shanghai. On the import side, Shanghai supplied Ningpo with considerable quantities of cotton yarn and cotton piece-goods. There were also large imports of kerosene oil and drugs. The total value of the sugar trade of Ningpo was approximately $1,500,000 a year; 70% of the sugar came from foreign sources and the remainder from Fu-kien province. Inland waterway communication in the vicinity of the city is provided by the Yung and the Fenghwa-kiang, as well as by canals. There was a daily steamer service to Shanghai, and regular sailings to Chusan and as far afield as Wenchow. Railway connection with Hangchow, the capital of Chekiang province and about 100 mi. distant, was made by the Shanghai-Hangchow-Ningpo Railway. The chief crops in the district around Ningpo, in order of importance, are rice, beans, wheat, cotton, rush and reed.

Various modern manufacturing industries had been established in the city. Of the cotton mills the Ho Fêng was the largest, drawing the bulk of its raw cotton supply from the neighbouring district of Yuyao. Its yarns were sold chiefly on the local market or elsewhere in Chekiang. About 1,000 looms in small factories and households produced each year 30–40,000 pieces of silk, the bulk of which was dyed in Shanghai. There were, in addition, electrical supplies, hardware, knitting and sewing companies, candle, soap, and canning factories, and numerous tinfoil makers.

The city is encircled by a fine old wall, having six gates, and from 4–5 mi. in length. Among its most prominent features are the many tall ice-houses, the picturesque T'ien-fêng-t'a or Ningpo pagoda, a tall white tower rising to a height of 160 ft., and the Drum tower, many centuries old. The city has long been famous as a centre of learning and religion, and many temples, monasteries and colleges are representative of old Ningpo.

NINIAN, ST., a Briton, probably from Strathclyde, who was trained at Rome and founded a church at Whithorn on the west side of Wigtown Bay. Whithorn has been identified with the Leukopibia of Ptolemy, but this is uncertain. Bede, writing three centuries after Ninian, ascribes the name Ad Candidam Casam to the fact that the church of Ninian was built of stone. We are told by Bede that St. Ninian dedicated his church to St. Martin of Tours, who died between 397 and 400, but Ailred of Rievaulx is our only authority for the statement that St. Martin supplied him with masons. The legends of his work in Ireland probably

arise from the influence exercised in that country by the church of Whithorn.

The date of Ninian's death is given by Archbishop Ussher as 432, but there is no authority for this statement.

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NINUS, in Greek mythology, the eponymous founder of the city of Nineveh (*q.v.*), and thus the city itself personified. He was said to have been the son of Belos or Bel, to have conquered in 17 years the whole of western Asia with the help of Ariaeus, king of Arabia, and to have founded the first empire. During the siege of Bactra, he met Semiramis, the wife of one of his officers, Onnes, whom he took from her husband and married. The fruit of the marriage was Ninyas; *i.e.*, "the Ninevite." After the death of Ninus, Semiramis, who was accused of causing it, erected to him a temple tomb, 9 stades high and 10 stades broad, near Babylon.

According to Castor (*ap. Syncell.* p. 167), the reign of Ninus lasted 52 years, its commencement falling 2189 B.C., according to Ctesias.

Another Ninus is described by some authorities as the last king of Nineveh, successor of Sardanapalus.

NIOBE, in Greek mythology, daughter of Tantalus and Dione, wife of Amphion, king of Thebes. Proud of her sons and daughters (numbers variously given by different authors), she boasted of her superiority over Leto, the mother of only two children, Apollo and Artemis. As a punishment, Apollo slew her sons and Artemis her daughters. Their bodies lay for nine days unburied, for Zeus had changed the people to stone; on the tenth day they were buried by the gods.

Out of pity for her grief, the gods changed Niobe herself into a rock on Mt. Sipylus in Phrygia, in which form she continued to weep (Homer, *Iliad*, xxiv, 602–617; Apollodorus iii, 5; Ovid, *Metamorphoses*, vi, 146–312). This "Niobe," described by Pausanias (i, 21) and Quintus Smyrnaeus (i, 293–306), both natives of the district, was the appearance assumed by a cliff on Sipylus when seen from a distance and from the proper point of view (*see* Jebb on Sophocles, *Antigone*, 831). It is to be distinguished from an archaic figure still visible, carved in the northern side of the mountain near Magnesia, to which tradition has given the name of Niobe, but which is really intended for Cybele.

According to some, Niobe is the goddess of snow and winter, whose children, slain by Apollo and Artemis, symbolize the ice and snow melted by the sun in spring; according to others, she is an earth goddess, whose progeny—vegetation and the fruits of the soil—is dried up and slain every summer by the shafts of the sun god. C. E. Burmeister regarded the legend as an incident in the struggle between the followers of Dionysus and Apollo in Thebes, in which the former were defeated and driven back to Lydia. W. Heffter built up the story round the dripping rock in Lydia, really representing an Asiatic goddess but taken by the Greeks for an ordinary woman. Enmann, who interpreted the name as "she who prevents increase" (in contrast with Leto, who made women prolific), considered the main point of the myth to be Niobe's loss of her children. He compared her story with that of Lamia, who, after her children had been slain by Zeus, retired to a lonely cave and carried off and killed the children of others. The appearance of the rock on Sipylus gave rise to the story of Niobe having been turned to stone. The tragedians used her story to point the moral of the instability of human happiness; Niobe became the representative of human nature, liable to pride in prosperity and forgetfulness of the respect and submission due to the gods.

The tragic story of Niobe was a favourite subject in literature and art. Aeschylus and Sophocles wrote tragedies upon it; Ovid has described it at length in his *Metamorphoses*. In art, the most famous representation was a marble group of Niobe and her children, taken by Sosius to Rome and set up in the temple of Apollo Sosianus (Pliny, *Historiae Naturalis*, xxxvi, 4).

What is probably a Roman imitation of this work was found in 1583 near the Lateran, and was later placed in the Uffizi gallery at Florence.

NIOBIUM: *see* COLUMBIUM.

NIORT, a city of France, chief town of the department of Deux-Sèvres, 42 mi. E.N.E. of La Rochelle by rail to Saumur. Pop. (1946) 32,752.

Up to the 7th century the Niort plain formed part of the Gulf of Poitou, and the mouth of the Sèvre lay at the foot of the hills now occupied by the town which grew up round the castle erected by Henry Plantagenet in 1155. The place was captured by Louis VIII in 1224. By the peace of Brétigny it was ceded to the English, but its inhabitants revolted against the Black Prince and most of them were massacred when his troops recovered the town by assault. In 1373 the French regained the town. Protestantism made numerous proselytes at Niort, and Gaspard de Coligny made himself master of the town, which successfully resisted the Catholic forces after the battle of Jarnac but surrendered without striking a blow after that of Moncontour. Henry IV rescued it from the league. It suffered severely by the revocation of the Edict of Nantes. Niort is on the Sèvre Niortaise.

The tower of the church of Notre-Dame (15th and 16th centuries) has a fine stone spire and a north doorway with a carved balustrade. The old Renaissance hôtel de ville contains a collection of antiquities. Near Niort are the feudal remains of the fortress of Coudray-Salbart. Niort is the seat of a prefect and a court of assizes. Tanning, currying, chamois dressing, glovemaking and the manufacture of brushes and boots are the staple industries.

NIPIGON, a lake and river of Thunder Bay district, Ontario, Can. The lake is 30 mi. N. of the bay of the same name on Lake Superior, at an altitude of 852 ft. above the sea. It is 70 mi. long and 50 mi. wide, contains more than 1,000 islands, is very deep and has a much-indented shore line measuring about 580 mi.

The river, which drains the lake, descends 250 ft. in the 40 mi. of its course and is the largest stream flowing into Lake Superior. It is widely known for its trout fishing.

NIPISSING, a lake of the district of the same name in Ontario, Can., situated nearly midway between Lake Huron and the Ottawa river, at an altitude of 644 ft. above the sea. It is of irregular shape, with bold shores, and contains many islands; from the north it receives the waters of Sturgeon river. It is 50 mi. in length and 20 mi. in breadth, discharges its waters by French river into Lake Huron and is separated by a low watershed from the Mattawa river, a tributary of the Ottawa.

NIPPON, the Japanese pronunciation of the Chinese name of Japan, "sun origin."

See JAPAN.

NIPPON GINKO: *see* JAPAN, BANK OF.

NIPPUR, an ancient sacred city of Mesopotamia. Nippur lay on the bank of the old course of the Euphrates in 32° N., 45° E. The old bed of the river is represented by present Shatt-al-Nil, whose dry bed now separates the two main groups of ruins. The city lies in the very heart of Sumeria, between the northern cities of Kish, Cutha and Babylon, to which it is nearest in position, and the cities of the south. It was the centre of the national cult of the god Enlil, and no doubt because of its position was the ecclesiastical rival of the southern cities, especially Eridu. The possession of Nippur was an essential for every great dynasty, because the rulers of all the cities throughout the whole of Sumer and Akkad ultimately derived their authority from Enlil, and it is essential in studying the ancient geography of Mesopotamia to remember that the monarchy of the region took its rise from prince-priests, and that even the most powerful monarchs could never afford to separate themselves from the powerful and dominant priesthood. Nippur, therefore, although probably never a lay capital except possibly in later times, throughout its long history always played a very prominent part in Mesopotamian history, and, because of the passion exercised by the priests for recording every transaction, however minute, on clay tablets, has

left us a most complete record both of its life and of the part which it played in national politics. To-day the wide gap between the two rivers has made the irrigation problem a very difficult one but in ancient times the twin rivers approached one another more closely. The narrow strip between the rivers, scarcely more than thirty miles, could be irrigated by water run from the Euphrates to the Tigris and the land between the Euphrates on which there lay a string of cities and the Tigris was of great agricultural value. Nippur, therefore, apart from its sacred position was a land of great wealth.

The prehistoric city was built on the west bank of the Euphrates, and was grouped about the temple of the earth god. The mound now lies on the east bank of the Shatt al Nil. Extensive remains of cremation have been found in all the earlier pre-Sargonic periods and as a matter of comparison it is interesting to note that in the earliest graves at Ur cremation appears to be a purely ritual survival, and that so far at Kish, even in the earliest graves, no signs of cremation have been found. Painted pottery was also found. In the period of Ur-nina, that is, the end of the fourth millennium B.C., the temple area was enlarged and a great rectangular terrace of plano-convex bricks was built. This terrace extended far beyond the temple area and was large enough to include both the temple and its stage tower (*ziggurat*) at the southern end. There were also store houses, cloisters and priests' rooms on the terrace and a large court north of the temple. This building had an inner court, which was surrounded by thick walls and included rooms in which the temple archives were stored.

The restoration of the original form of the city, especially in later times, is made possible by the discovery of a tablet of the Kassite period, now unfortunately lost, which had upon it a sketch plan of the city. It shows part of the city east of the river and enclosed within its own walls, like the forbidden city of Peking, which lies within its own walls and surrounded by the city itself. This inner city formed an irregular square, with sides about 900 yards long and was surrounded by canals, with quays along the walls. The inner city was itself also divided into two by a canal. The temple enclosure was oriented, its angles pointing towards the cardinal points of the compass. The tower of the pre-Sargonic period was on the north side of the inner court. On the east side, next to the tower, was the temple of Ekur, with its chapels and other buildings.

All the important kings held this temple in great veneration and considered its repair and reconstruction as a very necessary pious duty. Under the Semitic occupation Naram-sin rebuilt the temple and the city walls. His building was partly destroyed by Ur-Engur, whose restoration gave the area the form in which we have it recorded. His terrace of sundried bricks covered an area of about eight acres. The ziggurat at the northwestern edge was approached by an inclined plane on the south-east side and was made of crude bricks faced with burnt bricks, set in bitumen. It contained three stages. The city walls built by Ur-Engur followed the general lines of the walls built by Naram-Sin.

The whole sanctuary was later restored by Assur-bani-pal of Assyria in the 7th century. The city had previous to this time been allowed to fall into comparative decay, partly owing to the predominance of Marduk, the god of Babylon, when that city was politically dominant, but it enjoyed a period of renewed splendour under the Kassite dynasty, but this was only a temporary respite. Assur-bani-pal's restoration however gave it a form in some ways more magnificent than it had ever enjoyed, his great ziggurat measuring 128×190 feet. This was the end of Nippur's glories.

It gradually fell into decay. In the Seleucid period it became a fortress, and was used as such until the close of the Parthian period, in the middle of the third century A.D. From this time onwards the city ceased to be of any importance. It degenerated into a mere village, while some of the old sacred area was used, as in so many Sumerian cities as a cemetery. In the tenth century A.D. the site again became of some importance as a Jewish settlement, although it is possible that there may have been Jews settled on the site even earlier, possibly at the time of the exile. In the 12th century it was the site of a Christian bishopric.

The condition of the ruins is thus described by Langdon. "They are not so extensive as Kish but more compact and massive. . . . The grandeur of these lofty unbroken lines of mountainous ridges, whose concealed buildings lie deep beneath the plain level, cannot be described to conjure sufficiently the imagination of the reader. They do not belie the fame of Nippur in cuneiform inscriptions."

ANCIENT DOCUMENTS

The excavators of the site were particularly fortunate in the number of ancient documents discovered. The ancient temple library and its archives were not in the temple itself but in a mound to the south. West of the temple there was a commercial and residential quarter, and here, separated from the temple by a canal, were found the important archives of the Kassite kings and business houses of the Neo-Babylonian and Persian periods.

These archives show that the district was a great centre of the cattle industry. Cattle and sheep were driven to Nippur for the different feast days and careful records of every transaction were kept. The details are so full that an issue is recorded of barley porridge to such humble members of the temple staff as the dogs. There were three main sources of revenue for the temple. First there were a series of tolls or dues of various forms. Secondly the temple was a great owner of property and received considerable revenues as rent. Thirdly cattle breeding was carried on. Nippur under the Kassites was an administrative centre, possibly even a capital city. The taxes, which were paid in kind, were either stored here or at the chief city of the district. The record of these taxes is instructive for the side lights thrown on the economic geography of Mesopotamia nearly four thousand years ago. The products which were paid included wheat, sesame, oil, dates, flour and live stock.

The majority of these temple archives of Nippur have been found at Tal Duraihim (Drehem) a city site about six miles south of Nippur, and three miles S.E. of the modern village of Afaj. This city apparently served as the collecting place for the animals used for sacrifices at Nippur. These animals formed part of the taxes payable under the kings of the third dynasty of Ur, and the records are therefore of the greatest value in giving lists of the towns at the time and their assessable value. The ruins of this site consist of a large crescent-shaped mound, some 300 feet from north to south, and 200 feet in width, while the height above the plain is about 40 feet. Langdon is of opinion that whatever the building under this mound may prove to be it is certainly not a temple.

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NIRVĀNA, in Buddhist dogmatics, means literally "blowing out," *i.e.*, the blowing out or extinction of the fire of passion in one who attains release. Whether such a person became extinct at death is classed in the Scriptures among the questions which the Buddha refused to answer. The term is probably originally Buddhist, but it is also found in Vedānta to express union with Brahma. (*See* BUDDHA AND BUDDHISM.)

NISH, the capital of the Nish department of Serbia, Yugoslavia. Pop. (1931) 35,465, comprising Serbs, Turks, Albanians, Bulgars, Greeks and Jews. The city is not only important commercially, but also strategically since (1) it commands the only two valleys affording easy access from central Europe to the Aegean, (2) it is the meeting-point of several of the chief Balkan highways, and (3) it is the junction on the Belgrade-Nish railway for both Sofia and Salonika, and fortunately, in this respect, is within easy reach of good coal supplies. The town during World War II was one of Yugoslavia's main defense areas and was a principal fortress, the perimeter of the entrenched camp being about 30 mi. with outlying modern works. The surrounding heights were fortified after 1886. The Turkish town, on the N. bank of the Nishava, contains the citadel and many mosques and

picturesque old houses among its winding alleys. It is connected by three bridges with the more modern Serbian town on the south bank, which has wide, fairly well-paved streets, a royal palace surrounded by gardens, a cathedral, government offices, banks and several trading associations. Here too, are the government railway repairing sheds, factories for trucks, engines and carriages, an iron foundry, a pork factory, steam flour mills and an electric power station. The barracks are outside the town. Nish is the see of a bishop and the seat of a district prefecture and a tribunal.

The ancient Roman city *Naissus,* which probably superseded a Celtic settlement, was mentioned as an important place by Ptolemy of Alexandria, and the old fortress on the right bank of the river is believed to have been erected on its site. Under its walls in A.D. 269 the Emperor Claudius destroyed the army of the Goths, and within it, in A.D. 274, Constantine the Great was born. The emperor Julian improved its defences but the town was destroyed by the Huns under Attila in the 5th century, and restored by Justinian. In the 9th century the Bulgarians conquered it, but ceded it to the Hungarians in the 11th century, from whom the Byzantine emperor Manuel I. took it in 1173. Towards the end of the 12th century the town was in the hands of the Serbian prince Stephen Nemanya, who there received hospitably the German emperor Frederic Barbarossa and his Crusaders. In 1375 the Turks captured Naissus from the Serbians. In 1443 the Hungarians and the Serbians retook it from the Turks, but in 1456 it again came under Turkish dominion, and remained for more than 300 years the most important Turkish military station on the road between Hungary and Constantinople. In the frequent wars between Austria and Turkey during the 17th and 18th centuries, the Austrians captured Naissus twice (in 1689 and 1737) but were unable to retain it long. In the first Serbo-Turkish rising, the Serbians, defending the approach to Nish in 1809, fired their magazine and destroyed themselves and the enemy. The Turks built a brick tower in which they embedded 900 Serbian skulls. The ruins are still called *Tyele-Koula* (Tower of Skulls). In the Russo-Turkish war (1877–8) the Serbians captured Nish and the town was ceded to them by the treaty of Berlin (1878). Here the National Assembly, before the Constitution of 1901, was regularly held. During World War I the government withdrew to Nish (1915) when Belgrade was occupied by the enemy, but it was not able to stay there. During World War II, the Germans occupied Nish in April 1941.

NISHAPUR, a town in the province of Khurasan in Iran, 3,920 ft. above sea level, in 36° 12′ N., and 58° 40′ E., 50 mi. W. of Meshed in one of the most fertile districts of Iran, which produces much grain and cotton. The town, which has shifted its position with the ages, has a circuit of two miles. It has moderately good caravanserais and public baths. Pottery making is a special industry. Nishapur in the old Persian is *Nev-shapur-nev*. The second element of the name is that of its traditional founder Shapur (A.D. 241–272). It was once one of the four great cities of Khurasan (*q.v.*), rivalling Rai (Rhages), but the population is now 22,000 (est.). It was an important place in the 5th century, for Yazdajird (438–457) resided there mostly. During the later Sasanids it is seldom mentioned and when the Arabs came to Khurasan (641–642) it was of so little importance that, as the historian Tabari relates, it did not even have a garrison. But under the Tahirids (820–872) it became a flourishing city and rose to importance during the Samanids (874–999). Toghrul, the first Seljuk ruler, made Nishapur his residence in 1037. In 1153, the Ghuzz Turkmans overran the country and partly destroyed it. In 1208 most of the town was destroyed by earthquake and was hardly rebuilt when it was again destroyed by the Mongols. It was rebuilt, suffered again at the hands of the Mongols (1269) and from another earthquake in 1280, and never rose again to its former greatness.

A few miles to the east stands a fine domed mausoleum, the Gadam Gar (1643). Expeditions of the Metropolitan Museum of Art, New York (1934–40) disclosed rich and significant architectural and artistic remains of both Seljuk and pre-Seljuk times. *See* "Excavations at Nishapur, 1934–35," *Bulletin,* Metropolitan Museum of Art, vol. xxxi; xxxii, sec. 2 (1936); xxxiii, sec. 2 (1937); and vol. xxxvii, (1938–40). Four mi. S.E. of the town, adjacent to the mosque of the Imamzadeh Mahruk (a Moslem saint of the 8th century), is the tomb of the astronomer-poet Omar Khayyam, a fine marble shaft and sarcophagus built in 1934. Nearby is the grave of the celebrated poet and mystic Farid ud Din Attar. At Madan, 32 mi. N.W. of Nishapur, at an elevation of 5,100 ft., are the famous mines which have supplied the world with turquoises for at least 2,000 years.

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NISIBIS (NUSAYBIN), a frontier fortress and trading town of Turkey on the Syrian border about 130 mi. N.W. of Mosul, Iraq. It lies on the borderland between the mountains and the plain in 37° N. 41° E. at the point where the Yaghyagha (called in ancient times the Mygdonius) passes through a narrow canyon and enters the plain.

In ancient times, and indeed until the 11th century A.D., the plain regions below the town are said to have been wooded and the town was famous for its agricultural products. Strategically, like Edessa (*q.v.*), it commanded the entrance of the valley country from the mountains and has been the site of fighting since Assyrian times to even as late as the 19th century. It also lies on the upper trade route from Mosul to the west and in times of peace has been of importance on this line.

Nisibis has been directed east or west according to the dominant empire of the time. During the Assyrian empire it formed a frontier fort against aggressions from the north, and occupied a similar position in Seleucid times. From the middle of the second century B.C. until the early years of the Christian era it was the residence of the kings of Armenia. Owing to its strength the fortress was of considerable importance during the struggle between Rome and Parthia. It became in early Christian times a religious centre with a Nestorian and a Jacobite bishop. Under the Caliphs it was a frontier fortress and the scene of continuous fighting.

Finally it lost most of its prosperity owing to internal troubles, and according to the Arab chroniclers, the compulsory substitution of wheat for fruit crops. It is probable that an insufficient control of the Bedouins of the desert was responsible for much of Nisibis' lost prosperity. It is now (1945) only a small town of 2,311 inhabitants but the railway to Konia has rendered the site of significance.

NISI PRIUS, in English law, a term used to denote generally all actions tried before judges of the king's bench division. For the history and meaning of this term *see* ASSIZE. In the United States a trial at *nisi prius* is a trial of a civil action in a court of record before a judge and jury.

NISUS, the name of two Greek legendary figures. (1) Son of Pandion of Athens and king of Megara. He had a purple lock of hair, and as long as it grew on his head the city was safe against all attacks. When Minos (*q.v.*) was besieging the city, Scylla (*q.v.*), daughter of Nisus, was bribed by him or fell violently in love with him, and to gain his favour cut off the purple lock and gave it to him, thus betraying the city. Nisus fell, or killed himself, during the sack and was turned into a sea eagle; Scylla swam after Minos' ship, or in punishment for her treachery was tied to the stern and dragged after it, and became a creature called *κεῖρις* or *κίρρις* (*ciris*), usually said to be a bird, as yet unidentified, but sometimes a fish; she is constantly pursued by her father.

Nisus is the eponym of Nisaea, the harbour of Megara; Scylla is sometimes confused with the monster of the same name (*see* ODYSSEUS); the story is one quite common in Greek and other folklore; a combination of External Soul (*see* Frazer, *Golden Bough* 3rd ed., xi, chap. x.) with Maiden Castle (*see* Rose, *Handbook of Mythology,* chap. viii, ix.).

See Roscher's *Lexikon, s.v.,* for identification of the *ciris;* and D'Arcy Thompson in *Class. Quart.,* xix, 155 ff.

(2) A Trojan, son of Hyrtacus, friend of Euryalus, with whom he is killed in an attempt to get through the besieging force and communicate with Aeneas, Virgil, *Aen.* ix.

NITERÓI: *see* NICTHEROY.

NITHARD (d. 844), Frankish historian, was the illegitimate son of Angilbert, the friend of Charlemagne, by Bertha, a daughter of the great emperor. He was educated at the imperial court and became abbot of St. Riquier *in commendam,* never taking the vows. He fought for Charles the Bald at Fontenoy in June 841, and died as the result of wounds received while fighting against the Northmen near Angoulême. The date of his death was probably June 14, 844.

In the 11th century his body, with the fatal wound still visible, was found in the grave of his father, Angilbert. Nithard's historical work consists of four books on the history of the Carolingian empire under the turbulent sons of the emperor Louis I, especially during the troubled period between 840 and 843. This *Historiae* or *De dissensionibus filiorum Ludovici pii,* dedicated to Charles the Bald, is valuable for the light which it throws upon the disintegration of the Carolingian empire.

The *Historiae* has been printed several times. Perhaps the best edition is in Band ii of the *Monumenta Germaniae historica: Scriptores;* it has also been edited by A. Holder (Freiburg, 1882). It has been translated into German by J. von Jasmund (1851; new edition by W. Wattenbach, Leipzig, 1889); and into French in tome iii of Guizot's *Collection des mémoires* (Paris, 1824).

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NITHSDALE, WILLIAM MAXWELL, 5TH EARL OF (1676–1744), Jacobite leader, was a member of the family of Maxwell (*q.v.*), being a son of Robert, the 4th earl (d. 1696), and a collateral relation of Robert Maxwell (d. 1646), who was created earl of Nithsdale in 1620. His wife was Winifred, daughter of William Herbert, 1st marquess of Powis.

After becoming earl in 1698, he served the exiled house of Stuart in secret, and was suspected as a Jacobite conspirator. In 1712 he resigned his estate to his son William (d. 1776), reserving a life rent to himself. When the Jacobite rising took place in 1715, he joined his friends in the north of England and was taken prisoner at Preston, being sent to London for trial.

The countess of Nithsdale, who was at Terregles when she heard of the capture of her husband, followed him to London, making part of the journey on horseback in bitter winter weather. The earl and the other Jacobites were brought to trial in Westminster hall on Jan. 19, 1716, and condemned to death on Feb. 9. The execution was fixed for Feb. 24.

The countess presented a petition to George I which he refused to receive, and when she knelt before him and took hold of the skirts of his coat he dragged her half across the room before he could break away. Finding that no pardon could be obtained, the countess laid a plan to rescue her husband from the Tower of London. With the help of two Jacobite ladies, she cleverly extricated her husband from his cell on the night before the day fixed for the execution by disguising him as a woman.

The earl escaped from England and was followed by his wife after she had gone back to Scotland to rescue important legal papers which proved the transfer of the estate to their son. After a short stay in France, the earl and countess went to Rome, where they lived in poverty and obscurity. The earl died on March 20, 1744, and the countess in 1749.

Their son, William Maxwell, regained the possession of the family property after his father's death in 1744, since the government could only confiscate his father's life interest; but the title was forfeited, and he died childless.

See Sir A. Fraser, *The Book of Carlaverock* (Edinburgh, 1873).

NITON: *see* RADON.

NITRE, a name given to naturally occurring potassium nitrate; "cubic nitre" is sodium nitrate. The word is adapted from Lat. *nitrum,* which is itself adapted from Gr. *νίτρον.* These terms were originally applied to the naturally occurring sodium carbonate; the connection with potassium nitrate (*sal petrae* or *sal petrosum*) may be traced to Raimon Lull's name sal nitri, which he distinguished from nitrum. In the 16th century the ancient nitrum became altered to natron, a term used for native sodium carbonate, while nitrum, and its adaptation nitre, were retained for potassium nitrate or saltpetre (*see* NITRIC ACID AND NITRATES).

NITRIC ACID AND NITRATES. Nitric acid, HNO_3, an important mineral acid, was one of the earliest of the nitrogen compounds to be prepared and used. Its preparation by the distillation of a mixture of nitre (potassium nitrate), alum and blue vitriol is reported in *De inventione veritatis,* ascribed to Geber (*q.v.*). A similar method was described by Albertus Magnus in the 13th century and by Raimon Lull, who prepared the acid by heating nitre and clay and called it "eau forte."

In 1648 J. R. Glauber devised the process in common use for many years, viz., by heating a nitrate with concentrated sulphuric acid. The true nature of nitric acid was not determined until the 18th century when A. L. Lavoisier (1776) showed that it contains oxygen, while in 1784 H. Cavendish synthesized it by passing a stream of sparks through humid air, proving that nitrogen is also a constituent. In 1816 J. L. Gay-Lussac and C. L. Berthollet established its exact composition. Nitric acid has been known as *aqua dissolutiva, aqua prima, spiritus acidus nitri, spiritus nitri fumans Glauberi* and *aqua fortis.*

Free nitric acid, formed in moist air by the discharge of atmospheric electricity (lightning), is found to a very slight extent in rain water and is also formed in the soil by the oxidation of nitrogeneous organic matter. It is neutralized by the basic substances in the soil to form nitrates, principally saltpetre, KNO_3, and Chile saltpetre, $NaNO_3$, the latter being found in greater abundance and concentrations.

Physical Properties.—Pure 100% nitric acid is a colourless liquid whose specific gravity at 25° C. relative to water at 4° C. is 1.50269, melting point -41.59° C., and boiling point 86° C. at one atmosphere of pressure. It fumes strongly on contact with moist air and is miscible with water in all proportions.

A water solution containing 68% of the acid, which is the approximate composition of the concentrated acid of commerce, is a constant boiling or azeotropic mixture at atmospheric pressure with a boiling point of 120.5° C. and a specific gravity of 1.41. A solution containing less than 68% nitric acid may be separated by distillation at atmospheric pressure into the constant boiling mixture and a distillate of more dilute acid; one with more than 68% nitric acid yields a residue of the constant boiling mixture and a distillate of the more concentrated acid. The very concentrated or pure acid undergoes decomposition when boiled and, with the water formed, may be converted to the constant boiling mixture by repeated distillation. The composition of the constant boiling mixture varies with the pressure at which it is distilled.

Chemical Properties.—Pure nitric acid or its concentrated solutions decompose slowly into water, nitrogen dioxide and oxygen: $4HNO_3 = 2H_2O + 4NO_2 + O_2$; the rate of the decomposition is increased by light and by higher temperature. The concentrated acid is therefore usually coloured yellow due to the presence of part of the nitrogen dioxide which remains in the solution. Nitric acid forms two compounds with water in the solid phase, the monohydrate, $HNO_3.H_2O$, melting point $-37.68°$ C., and the trihydrate, $HNO_3.3H_2O$, melting point $-18.47°$ C.

Nitric acid may be considered to be the hydrate of nitrogen pentoxide although it is almost never prepared by hydration of the oxide. Conversely the pentoxide is normally prepared by dehydrating the concentrated acid with phosphorous pentoxide: $2HNO_3 + P_2O_5 = N_2O_5 + 2HPO_3$. Nitrogen pentoxide is a white solid which is easily sublimed and which decomposes readily into nitrogen dioxide and oxygen.

Nitric acid is a strong acid; in dilute water solutions it is almost completely ionized to hydrogen ions, H^+, and nitrate ions, NO_3^-. Its salts with strong bases are not hydrolyzed in aqueous solution and are neutral to indicators. It neutralizes hydroxide bases and salts of weak acids to form nitrates (*see* below). Due to its strong oxidizing properties, a dilute solution of the acid does not

yield hydrogen when treated with metals, but is reduced to one of the oxides of nitrogen, or to nitrogen or ammonia. However, with very active metals (magnesium, for example), some hydrogen is liberated along with the other reduction products.

Most of the nitric acid produced is consumed in the manufacture of explosives, plastics, lacquers, synthetic fabrics and dyes by the reaction of the acid on organic compounds. In one type of reaction, organic nitrates and water are formed when alcohols and other compounds containing OH groups react with the acid. Glycerol trinitrate, commonly called nitroglycerine, is made by the treatment of glycerine with a mixture of concentrated nitric and sulphuric acids: $C_3H_5(OH)_3+3HNO_3=C_3H_5(NO_3)_3+3H_2O$. The sulphuric acid combines with the water, thus increasing the yield by preventing the reaction of the latter with the product. Cellulose in the form of cotton or wood fibres is similarly treated to obtain cellulose nitrates. The extent of nitration (*i.e.*, the number of nitrate radicals combining with a unit of the cellulose) is controlled to produce either guncotton (smokeless powder) or, with less nitration, the base for pyroxalin lacquers and plastics and certain types of fibres. In the organic nitrates the nitrogen atom is bonded to an oxygen atom which in turn is linked to a carbon. Another type of reaction of nitric acid and organic compounds involves the formation of nitro compounds in which the nitrogen atom of the group $-NO_2$ is bonded directly to the carbon atom.

Methyl benzene (toluene) reacts with nitric acid in the presence of concentrated sulphuric acid to form trinitrotoluene, more commonly known as TNT: $C_6H_5CH_3+3HNO_3=CH_3C_6H_2(NO_2)_3+3H_2O$. (*See* EXPLOSIVES.)

Nitric acid is a powerful oxidizing agent; it oxidizes nearly all of the metals except platinum, rhodium, iridium, tantalum and gold, and a number of the nonmetals such as carbon, sulphur and phosphorus. In its reaction with most of the metals the nitrates are produced, but with tin, arsenic, antimony, wolfram and molybdenum the oxides of the metals are formed. The behaviour of the acid as an oxidizing agent is complex because of the number of possible reduction products which may be obtained. The oxidation or valence number of the nitrogen in nitric acid is $+5$; it may be reduced to nitrogen dioxide, NO_2 ($+4$), nitric oxide, NO ($+2$), nitrogen, N_2 (0), or to ammonia, NH_3 (-3), depending upon the temperature, the concentration of the acid, the presence of catalysts and the activity of the metal or other reducing agent involved.

In general, the more concentrated the acid the less the change in the oxidation number of the nitrogen. For example, copper reduces the concentrated acid to NO_2: $Cu+4HNO_3$ (concentrated) $=Cu(NO_3)_2+2NO_2+2H_2O$, and the dilute acid to NO: $3Cu+8HNO_3$ (dilute) $=3Cu(NO_3)_2+2NO+4H_2O$. A stronger reducing agent may cause a greater change in the oxidation number of the nitrogen, as: $4Zn+10HNO_3$ (dilute) $=4Zn(NO_3)_2+NH_4NO_3+3H_2O$, wherein the reduction product, ammonia (NH_3) combines with the acid to form ammonium nitrate, NH_4NO_3.

On the other hand, the concentrated acid may oxidize the metal or nonmetal to a higher valence stage than does the dilute acid, as:

$S+6HNO_3$ (concentrated) $=H_2SO_4+6NO_2+2H_2O$, and

$3S+4HNO_3$ (warm, dilute) $=3SO_2+4NO+2H_2O$

When iron, copper or chromium is placed in contact with concentrated nitric acid it becomes inactive or passive to the acid and to certain other substances with which it normally reacts; passive iron reduces neither hydrogen ion nor cupric ion, and the passive copper does not reduce silver ion. Passivity may be destroyed by scratching the surface, by the action of reducing agents, or by the effect of a strong magnetic field. It was thought at mid-20th century that the formation of a film of the oxide on the surface of the metal was the cause of the phenomenon.

Nitric acid is highly toxic if taken internally, producing a widespread gastroenteritis, burning pain in the oesophagus and abdomen, and bloody diarrhoea. Death may occur from collapse or from secondary destructive changes in the intestinal canal. On the skin a characteristic yellow staining appears, due to the formation of xanthroproteic acid. Copious quantities of water and mild bases such as sodium bicarbonate solution will assist in neutralizing the effects of internal and external exposures.

Manufacture.—In the laboratory pure anhydrous nitric acid is prepared by gently heating an equimolal mixture of pure concentrated sulphuric acid and pure sodium nitrate under vacuum and condensing the evolved gaseous acid at a temperature near or below its melting point. The reaction is: $H_2SO_4+NaNO_3=NaHSO_4+HNO_3$ (gas).

Commercially, nitric acid is manufactured by three processes. The older method, practically obsolete at mid-20th century, is similar to the laboratory method. Chile saltpetre, a commercial form of sodium nitrate, is heated with an equimolal amount of concentrated sulphuric acid under reduced pressure in iron retorts. Nitric acid boils out of the reaction mixture and is condensed in glass containers. An attempt to bring about a reaction between another molecule of sodium nitrate with the second hydrogen in the sulphuric acid molecule results in decomposition of the nitric acid because of the high temperatures necessary to make the reaction go.

The second and most common method of manufacturing nitric acid is by catalytic oxidation of ammonia. Ammonia can be synthesized as cheaply per pound of nitrogen as Chile saltpetre can be mined and purified, and as a result it largely supplanted the latter as a source material. A mixture of 10% ammonia and 90% air is heated to 300° C., and passed over a platinum gauze catalyst which is heated initially to 900°–1,000° C. Heat liberated in the reaction is sufficient to maintain the catalyst temperature. About 90% of the ammonia is oxidized to nitric oxide: $4NH_3+5O_2=4NO+6H_2O$. From the catalyst the gases pass into absorption towers where two reactions take place: $2NO+O_2=2NO_2$, and $3NO_2+H_2O=2HNO_3+NO$.

The third method of nitric-acid manufacture involves the direction union of atmospheric oxygen and nitrogen in an electric arc: $N_2+O_2=2NO$, followed by the last two reactions of the ammonia process. Equilibrium in the arc reaction favours formation of nitric oxide only at very high temperatures. For example, at 3,900° C. the reaction is only 10% complete at equilibrium. However, if the reaction mixture is quenched quickly to a temperature below 1,000° C. it may be frozen at the high temperature equilibrium proportions. Under the most favourable conditions, the yield of nitric oxide is only about 2.5%; it seemed doubtful at mid-century whether the process could be made commercially feasible even in locations where electric power was cheap. (*See* NITROGEN, FIXATION OF.)

Nitrates.—Inorganic nitrates are chemical compounds with the type formula $Me(NO_3)_n$, where Me represents a metal atom and n may be one, two, or more depending on the valence or combining power of the metal under consideration. Nitrates are crystalline solids at ordinary temperatures. They may be white or coloured, depending on the metallic constituent. As a group they are the most water soluble of all metallic salts. Nitrates are prepared by reaction of the desired metal, its oxide, or its carbonate with nitric acid.

Nitrates of base metals decompose according to the equation: $2NaNO_3=2NaNO_2+O_2$, when heated, whereas nitrates of the less active metals are converted to oxides under the influence of heat: $2Cu(NO_3)_2=2CuO+4NO_2+O_2$. When heated to high temperatures, nitrates are strong oxidizing agents comparable to nitric acid.

Many nitrates are hygroscopic; *i.e.*, they absorb atmospheric moisture if left unprotected. Potassium nitrate is an important exception. Some nitrates contain water of crystallization when precipitated from aqueous solution, one or more water molecules per nitrate molecule forming an integral part of the crystalline structure of the solid material. The amount of water varies with the substance and the temperature. Upon heating the hydrated salts there is a partial to complete conversion to oxide, depending on the metallic constituent. Nitric acid is driven off as a gas.

Nitrates are determined qualitatively by reduction with ferrous ion, Fe^{++}, to nitric oxide and subsequent formation of $FeNO^{++}$, a complex ion with a characteristic deep brown colour. The reaction takes place in the presence of concentrated sulphuric acid which is added slowly to a mixture of the unknown and ferrous sulphate so that the two do not mix. A brown layer at the interface indicates the presence of nitrate ion. Quantitative de-

termination of nitrate ion is usually accomplished by reduction to ammonia by aluminum in alkaline solution, distillation of the ammonia into excess standardized sulphuric acid and back titration with standardized sodium hydroxide solution. (For other nitrogen compounds, *see* NITROGEN.)

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NITRIDES are binary compounds of nitrogen with the elements. They apparently do not occur in nature, although F. A. Bannister reported the presence of titanium nitride, TiN, in the mineral osbornite found in the Bustee meteor. The simple nitrides may be regarded as derivatives of ammonia in which the hydrogen atoms are replaced by a metallic or nonmetallic element. Their composition may be represented by formulas corresponding to the normal valence (oxidation number) of the elements based upon their position in the periodic classification; for example, Group I, Li_3N; Group II, Mg_3N_2; Group III, AlN; Group IV, Si_3N_4. Where an element is capable of existing in several oxidation states, corresponding nitrides may be capable of existence; for example, PN and P_3N_5.

In addition to these simple nitrides, compounds with nitrogen are formed by such transition elements as chromium, iron and cobalt, whose structure and composition are more complex and do not conform to valence rules.

Reference is also made to three classes of binary nitrogen compounds which differ markedly from the simple nitrides: (1) the hydronitrogens, compounds of hydrogen and nitrogen which formally resemble the hydrocarbons (*see* AMMONIA); (2) compounds with the more electronegative elements such as oxygen, sulphur and the halogens which are discussed under the respective elements and (3) the trinitrides, containing the N_3 radical which are derivatives of hydrazoic acid, one of the hydronitrogens (*see* HYDRAZOIC ACID).

Preparation.—Many of the nitrides can be prepared by direct combination of the elements with nitrogen, but such reactions take place much less readily, and then usually only at higher temperatures, than the corresponding oxidation reactions. A few elements, notably lithium, magnesium and the alkaline earth metals burn in air to give mixtures of the oxides and nitrides. Nitride formation is aided by use of active nitrogen, by reducing the elements to a fine state of subdivision, by employing the amalgams (*see* MERCURY) and by use of catalysts such as lithium nitride. Nitride formation by direct combination has been observed to take place with the following elements: Mg, Ca, Sr, Ba, Li, Be, B, Al, La, Ce, Pr, Nd, Ti, Zr, Th, V, Cb, Ta, Cr, Mo, W, U, Mn, Fe, Co, Ni, Si, Ge and P. Despite their high reactivity, sodium, potassium, rubidium and caesium do not appear to form nitrides by direct combination. In general, elements of the B subgroups of the periodic classification show little inclination to react directly with nitrogen.

Nitrides may also be prepared by indirect methods, of which the following are the more important:

(1) Mixtures of the oxides with carbon can be converted to nitrides by heating in a nitrogen atmosphere. This procedure is used for the preparation of aluminum nitride in accordance with the equation $Al_2O_3+3C+N_2 \rightarrow 2AlN+3CO$ and constitutes the basis for the Serpek process for the fixation of atmospheric nitrogen (*see* NITROGEN, FIXATION OF). In some cases carbides can be heated directly with nitrogen as in the production of beryllium nitride: $Be_2C+2N_2 \rightarrow 2Be_3N_2+C$.

(2) Gaseous ammonia may serve as the nitriding agent for conversion of certain metals, oxides, sulphides and, in some instances, halides into nitrides. Cuprous oxide reacts with ammonia at 300° C. to yield some cuprous nitride, Cu_3N; at 600° C. zinc is converted into zinc nitride, Zn_3N_2.

(3) Amides and imides of many elements undergo thermal decomposition to yield the nitrides. Nonmetallic halides, in particular, react with gaseous or liquid ammonia at ordinary temperatures to give the amides or imides which may be heated to effect deammonation (removal of ammonia, analogous to dehydration by which hydroxides are converted to oxides), eventually to give the nitrides. Thus, treatment of boron trichloride with ammonia gives first the diboron tri-imide, $B_2(NH)_3$, which on heating loses ammonia to form the nitride, BN.

$$BCl_3 \xrightarrow{NH_3} B_2(NH)_3 \xrightarrow[125^\circ\text{ C.}]{\text{above}} BN$$

The amides of such metallic elements as magnesium, calcium, strontium, barium, zinc, cadmium, nickel and cobalt precipitate when potassium amide is added to solutions of their salts in liquid ammonia. These products likewise undergo deammonation at higher temperatures.

$$M^{++} \xrightarrow{KNH_2} M(NH_2)_2 \xrightarrow{\text{heat}} M_3N_2$$
$$(\text{where } M=\text{Mg, Ca, Sr, Ba, Zn, Cd, Ni, Co})$$

The amides of the alkali metals, with the exception of lithium, do not give nitrides on heating.

(4) Reaction of certain metallic salts with potassium amide in liquid ammonia as the solvent medium affords a procedure whereby nitrides may be obtained which are unstable at the temperatures required to effect direct combination of metal with nitrogen. The following nitrides are precipitated from liquid ammonia solution under these conditions: mercuric nitride, Hg_3N_2, thallous nitride, Tl_3N, bismuth nitride, BiN.

$$\left.\begin{array}{l} Hg^{++} \\ Tl^{+} \\ Bi^{+++} \end{array}\right\} \text{in liquid } NH_3+NH_2^- \text{ (from } KNH_2) \rightarrow \begin{array}{c} Hg_3N_2 \\ Tl_3N \\ BiN \end{array}$$

For methods by which nitrides can be obtained using liquid ammonia as the solvent medium, together with a discussion of nitrides as derivatives of ammonia, *see* E. C. Franklin, *The Nitrogen System of Compounds* (1935). (*See* also AMMONIA and SOLUTIONS.)

(5) Aqueous ammonia converts the oxides of silver, gold and the platinum metals into highly explosive compounds which are assumed to be nitrogen compounds, possibly nitrides. These are often referred to as the "fulminating metals."

(6) Careful decomposition of the alkali and alkaline earth azides by heating gives mixtures of nitrides with the respective metals. (*See* HYDRAZOIC ACID.)

A large number of nitrides have been described in the chemical literature. These may be listed conveniently on the basis of type formula with *M* representing the element with which nitrogen is combined.

Nitrides of the Elements

Type Formula	where *M* =
MN	B, Al, Sc, Y, La, Ce, Pr, Nd, Sm, Er, Ga, In, Si Te, Zr, P, As, Sb, Bi, V, Ta, Cb, Cr
MN_2	V, W
M_2N	Cb, Cr, W, Fe
M_3N	Li, Na, K, Rb, Cs, Cu, Tl
M_3N_2	Be, Mg, Ca, Ba, Sr, Ra, Zn, Cd, Hg, Ge, Zr, Cr, Mo, Mn, Co, Ni
M_3N_4	C, Si, Te, Zr, Th, Ge, U
M_3N_5	P, Cb, Ta

A number of other nitrides have been described, but the identity of some of these is questionable: Si_2N_3, U_5N_4, U_5N_2, W_2N_3, Mu_5N_2, Mn_7N_2, Fe_8N, Fe_4N. For details concerning the nitrides see Gmelins *Handbuch der Anorganischen Chemie*, 8th edition, especially vol. 4 (*Nitrogen*) (1936); also Joseph Mellor's *A Comprehensive Treatise on Inorganic and Theoretical Chemistry* (1922–37).

Properties and Uses.—Nitrides, like oxides, vary considerably in their stability and reactivity.

The nitrides of the noble metals (for example, Hg_3N_2 and BiN) decompose explosively into the elements on heating, whereas the nitrogen compounds of boron, silicon, titanium, zirconium, vanadium, tantalum and molybdenum (as examples of the nitrides of Groups III, IV, V and VI) are characterized by their remarkable stability at high temperatures.

Most nitrides react with water to liberate ammonia as, for instance, $Mg_3N_2+6H_2O \rightarrow 3Mg(OH)_2+2NH_3$, although the tendency to do so depends not only on the specific nitride but also on

the method of preparation and the subsequent thermal history of the compound.

Thus, many of the nitrides prepared at lower temperatures by deammonation of the amides or imides hydrolyze rapidly; if these same nitrides are sintered by heating to a high temperature, they become relatively inert to attack by chemical agents (for example, boron nitride, BN). Structural changes to highly polymerized aggregates are involved. It should be noted, however, that high-temperature treatment changes in some instances the composition of the nitrides to correspond to products of lower nitrogen content; for example, trititanium tetranitride, Ti_3N_4, is converted into titanium nitride, TiN.

Certain nitrides such as those of boron, BN, silicon, SiN, titanium, TiN, zirconium, ZrN, and tantalum, TaN, are extremely refractory materials with melting points near or above 2,500° C. Where this property is combined with chemical inertness such nitrides have found use in the manufacture of crucibles and other equipment which must withstand chemical action at high temperatures. O. Meyer found that crucibles of titanium nitride, TiN, are especially resistant to attack by various molten ferrous metals. The nitrides of boron, titanium, zirconium and tantalum are furthermore characterized by their extreme hardness, above 8 on the Moh hardness scale, and are used either alone or in admixture with borides and/or carbides for hard-metal alloys and abrasive compositions. (The patent literature must be consulted for specific disclosures concerning compositions used for such purposes.) Investigation also revealed that these refractory nitrides possess high electrical conductivity resembling metallic conduction. They may therefore be considered as interstitial compounds with the relatively small nitrogen atoms occupying positions in the expanded crystal lattice of the element, thus accounting for the unusual properties of these substances.

Formation of such interstitial or metallic-like nitrides is also involved in the nitriding process in which steel and its alloys are heated in an atmosphere of ammonia above 800° C. to produce a surface film possessing great hardness, resistance to wear and to chemical attack. (*See* H. J. Emeléus and J. S. Anderson, *Modern Aspects of Inorganic Chemistry* (1938) for a discussion of refractory nitrides.) (L. F. A.)

NITROBENZENE, the simplest aromatic nitrocompound, $C_6H_5NO_2$, was first isolated in 1834 by E. Mitscherlich, and is prepared commercially by the action of a mixture of concentrated nitric and sulphuric acids upon benzene at a temperature of 50° C.—55° C. The oily product, which separates, is washed with alkali, and then distilled. It is a yellowish liquid possessing a strong smell similar to that of oil of bitter almonds. It boils at 210.9° C., and melts at 5.7° C. The products of its electrolytic reduction vary with the conditions: in 50% sulphuric acid solution it yields p-aminophenol (L. Gattermann, 1893); in alkaline solution it yields azoxybenzene, azobenzene, hydrazobenzene or aniline, depending upon the material of which the cathode is constructed, upon the solvent, upon the applied voltage and current density and upon the total amount of current allowed to pass through the solution; in an approximately neutral aqueous or alcoholic solution, it yields β-phenylhydroxylamine; and, in acid alcoholic solution, it yields some benzidine together with other products. With chlorine, in the presence of iodine or antimony chloride, it yields meta-chloronitrobenzene. It occasionally acts as an oxidizing agent, as in the preparation of quinoline and fuchsine (magenta, *q.v.*). It is used commercially for the preparation of aniline (*q.v.*); and of benzidine (*q.v.*); and in perfumery (oil of mirbane).

Dinitrobenzenes, $C_6H_4(NO_2)_2$.—Ortho-dinitrobenzene, produced in small quantity in the preparation of meta-dinitrobenzene, forms colourless crystals which melt at 116.5° C. and boil at 319° C. (773 mm.). When boiled with aqueous sodium hydroxide, it yields ortho-nitrophenol. Meta-dinitrobenzene is formed by the direct nitration of nitrobenzene with fuming nitric acid, the product being poured into water and recrystallized from dilute alcohol. It forms practically colourless needles which melt at 89.7° C., and boil at 302.8° C. It is used for the preparation of metaphenylenediamine. Para-dinitrobenzene results from the action of nitrogen peroxide on an ethereal solution of quinone dioxime; it crystallizes in colourless needles, which melt at 171°–172° C.

Trinitrobenzenes, $C_6H_3(NO_2)_3$.—Asymmetrical (1:2:4) trinitrobenzene results from the action of fuming nitric and sulphuric acids on para-dinitrobenzene. It forms yellow crystals, which melt at 57.5° C. When boiled with dilute aqueous sodium hydroxide it yields 2:4-dinitrophenol. Symmetrical (1:3:5) trinitrobenzene is formed by the further nitration of meta-dinitrobenzene with fuming sulphuric and nitric acids; or by the action of water on 2:4:6-trinitrobenzoic acid (German patent 77,353). It crystallizes in prisms which melt at 121° C.

NITROCELLULOSE (or cellulose nitrate) is the name given to the nitric esters of cellulosic materials, in practice largely cotton linters and wood pulp.

T. J. Pelouze discovered in 1838 that cotton could be converted into a violently inflammable substance by the action of concentrated nitric acid. C. F. Schönbein in 1845 demonstrated the use of this material as an explosive and improved the manufacturing method by adding sulphuric acid to the nitric acid. Nitrocellulose began to be used as an ingredient of gun powders (bulk powders) in the 1860s; gelatinized nitrocellulose propellants (*q.v.*) were introduced in the 1880s. E. A. Brown discovered in 1868 that dry and even moist nitrocellulose could be exploded by a detonator; this discovery started the use of the substance as a high explosive.

The history of its uses is punctuated by many disastrous explosions, caused largely by the failure to appreciate that nitrocellulose is an unstable material and is subject to catalytic decomposition caused by its own decomposition products. This reaction, if not checked in time, results in explosions. Sir Frederick Abel demonstrated in 1868 that the then prevalent methods of washing nitrocellulose after nitration were inadequate and that the residual acid was causing high instability. The introduction of the pulping process and other changes in the washing procedure led to significantly improved nitrocellulose. However, explosions of smokeless powder magazines continued; and in modern practice, which goes back to the researches of Paul Vieille, special stabilizers are added to nitrocellulose; the function of these is to neutralize catalytically active decomposition products. The results of this practice are the modern stable and reliable propellants.

Cellulose molecules consist of thousands of anhydroglucose units, $C_6H_{10}O_5$, linked into chains; therefore the nitration process may be schematically represented by the equation:

$$C_6H_{10}O_5 + xHNO_3 = C_6H_{10-x}O_{5-x}(NO_3)_x + xH_2O$$

Here x is a variable quantity which depends on the composition of the nitrating mixture and on the time and temperature of nitration. Theoretically x can reach the value of three, corresponding to 14.14% nitrogen in the product; but with mixtures of sulphuric and nitric acids such a high degree of nitration is seldom achieved.

The manufacture of nitrocellulose, in principle if not in practice, is a relatively simple process. Cotton linters or sulphite-process wood pulp are dipped into a large excess of nitric-sulphuric acid mixture; after a prescribed length of time, the product is separated from the bulk of the acid, for instance by centrifuging. The nitrocellulose is then "drowned" quickly in excess water and is subjected to boiling in acidified water to eliminate unstable by-products of nitration.

The next step consists in pulping to disintegrate the fibres and to facilitate a subsequent washing, in which the last traces of acid must be removed. Cotton linters were for a long time preferred for the manufacture of gun propellants; but, starting in World War I, wood pulp became more and more accepted. A high content of alphacellulose in wood pulp appears to be essential to ensure high quality of smokeless powders.

Nitrocellulose is a fluffy, white substance, retaining some of the fibrous structure of untreated cellulose. It is rather unstable to heat and even carefully prepared samples will ignite on a brief heating to temperatures in excess of about 150° C.

Nitrocellulose is insoluble in water and in hydrocarbon solvents. It is soluble in acetone, in ethyl acetate, etc. Only the material

with a low content of nitrogen is soluble in alcohol or ether, but intermediate grades are soluble in ether-alcohol mixtures.

Collodion or pyroxylin nitrocellulose, with a nitrogen content not in excess of 12%, is used chiefly for lacquers and celluloid plastics. Materials with a nitrogen content in the neighbourhood of 11.5% were used once, after denitration, as artificial silk, but have been replaced in this role by other materials, such as viscose rayon. This same material continued to be used for the manufacture of photographic films, although the use of safety film, made of cellulose acetate plastics, undermined its popularity.

Collodion nitrocellulose with 12% nitrogen is finding much use in the manufacture of propellants and of gelatin dynamites. The highest degree of nitration which still gives a product soluble in mixed alcohol-ether solvents is 12.6%. This material, discovered by Dmitri Mendeleyev and known as pyrocellulose, is extensively used for the manufacture of propellants. Guncotton, with more than 13% nitiogen and soluble in acetone only, is also used for propellants, either alone or in combination with lower grades of nitrocellulose. Moist guncotton was once widely used as a high explosive (*q.v.*), but it has been replaced by safer materials.

The nitration of cellulose is accompanied by a varying degree of depolymerization of the large molecules. For the manufacture of gun propellants, the depolymerization is largely avoided, but with materials intended for the manufacture of lacquers it is deliberately encouraged since depolymerized nitrocellulose gives solutions of low viscosity which are desirable for this application. (*See* EXPLOSIVES; PROPELLANTS.)

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NITROCELLULOSE POWDER: *see* GUNCOTTON.

NITRO COMPOUNDS. Organic compounds in which one or more hydrogen atoms are replaced by the NO_2 or nitro group are called nitro compounds. Two main classes of such compounds are recognized—aromatic and aliphatic.

Aromatic Nitro Compounds.—Aromatic nitro compounds contain a benzene ring in which one or more hydrogen atoms have been replaced by a nitro group.

Examples are nitrobenzene, $C_6H_5NO_2$, α-nitronaphthalene and 2, 4, 6-trinitrotoluene (T.N.T.).

The first preparation of an aromatic nitro compound was carried out in 1834 by the German chemist Eilhardt Mitscherlich who prepared nitrobenzene by heating together benzene and nitric acid. Although conditions vary with the compound being nitrated, aromatic nitro compounds have been prepared ever since by essentially similar processes.

Sulphuric acid is commonly used to aid the reaction by combining with the water formed. Nitrations are carried out on a commercial scale in large cast-iron vessels equipped with devices through which cooling water can be circulated to remove the heat of reaction. As much as 1,000 gal. of benzene is nitrated at one time. As successive nitro groups are introduced into an aromatic compound, more drastic conditions must be employed. Thus, the preparation of T.N.T. (*q.v.*) is usually carried out in three successive steps in each of which higher temperatures and stronger acids are used.

Many aromatic nitro compounds cause pronounced physiological reactions and care should be taken to avoid breathing their vapour and also to avoid contact with the skin. Aromatic nitro compounds are heavier than and practically insoluble in water. Most are solids, although a few, including nitrobenzene, are liquids. Commercial preparations of nitrobenzene are yellow, but the completely purified compound is colourless. Nitrobenzene has a slightly sweetish odour; it boils at 210.9° C.

Except as explosives, the uses of the aromatic nitro compounds as such are rather limited. They are used to some extent in perfumery, as solvents and as special oxidizing agents. N,2,4,6-tetranitroaniline (tetryl), T.N.T. and ammonium picrate, as well as other aromatic nitro compounds, are used extensively as explosives.

In peacetime by far the greater part of the aromatic nitro compounds produced is converted into various derivatives. The nitro group is frequently reduced as one step in the preparation of these derivatives.

Aromatic nitro compounds are the starting point in the manufacture of many commonly used dyes. Derivatives of aromatic nitro compounds are also widely used as pharmaceuticals and to some extent as photographic chemicals and as chemicals used in the manufacture of rubber articles.

The presence of a nitro group on the benzene ring influences the reactivity of the other atoms or groups attached to the ring. Ordinarily, positions ortho or para to the nitro group are activated. Examples of this are the oxidation of *m*-dinitrobenzene by potassium ferricyanide to 2,6- and 2,4-dinitrophenols and the reactivity of halogen atoms ortho or para to an aromatic nitro group. Such halogen atoms may be rather easily caused to react with bases, for example, to give nitro phenols.

Most aromatic nitro compounds undergo a reaction known as the Piria reaction when heated with a sulphite and then with a mineral acid. In this reaction, the nitro group is reduced and the benzene ring is also sulphonated.

Thus nitrobenzene gives by this reaction a mixture of aniline and sulphanilic acid.

The most characteristic reaction which aromatic nitro compounds undergo is that of reduction. The products obtained vary according to the conditions employed. Under acid conditions the $-NH_2$ group is usually formed, while neutral or basic conditions generally lead to intermediate reduction products. Nitrobenzene is reduced to aniline, $C_6H_5NH_2$, by the use of iron plus a small amount of acid.

By the use of proper neutral or basic conditions it is possible to reduce nitrobenzene to phenylhydroxylamine, C_6H_5NHOH, azoxybenzene, $C_6H_5N{=}NOC_6H_5$, azobenzene, $C_6H_5N{=}NC_6H_5$, or hydrazobenzene, $C_6H_5NHNHC_6H_5$. Meta-dinitrobenzene is reduced to meta-mitroaniline by the use of sodium hydrosulphide. Meta-nitroaniline is used in the preparation of dyes and of the explosive T.N.A., 2,3,4,6-tetranitroaniline. The fact that aromatic nitro compounds are easily reduced indicates that they are oxidizing agents. This property is made use of in the Skraup synthesis of quinoline in which nitrobenzene serves as an oxidizing agent. The explosion of T.N.T. is an oxidation by the nitro groups of the carbon and hydrogen present in the molecule.

Aliphatic Nitro Compounds.—In aliphatic nitro compounds (commonly called nitroparaffins) the nitro group is attached to an alkyl radical. Thus, nitroethane, $CH_3CH_2NO_2$, is a typical member of the class.

Interest in this class of compounds was stimulated in 1872 by the announcement by the German chemists Victor Meyer and Otto Stüber of the synthesis of nitropentane, $C_5H_{11}NO_2$, by the action of silver nitrite on amyl iodide. This is a general synthesis for many aliphatic nitro compounds, but it does not lend itself to commercial practice, and the fact that the aliphatic hydrocarbons are much more resistant to direct nitration than the aromatic hydrocarbons hindered the development of the nitroparaffins for many years. Finally, in 1940, the first nitroparaffins were produced on a commercial scale by a process employing high-temperature contact between the vapour of propane (C_3H_8, found in natural gas) and nitric acid vapour. The nitration is carried out in a stainless steel tube at temperatures of 300° C.–500° C., and the reaction takes place in a fraction of a second. When propane is nitrated 1-nitropropane ($CH_3CH_2CH_2NO_2$), 2-nitropropane ($CH_3CHNO_2CH_3$), nitroethane and nitromethane (CH_3NO_2) are formed.

The lower nitroparaffins are colourless liquids of mild odour. In contrast with the aromatic nitro compounds the nitroparaffins have about the same toxicity as petroleum naphtha. The nitroparaffins are only slightly soluble in water. The boiling points of the four lowest members, nitromethane, nitroethane, 2- and 1-nitropropane, are, respectively, 101.2° C., 114° C., 120.3° C. and 131.6° C.

The nitroparaffins are used as solvents for such materials as vinylite and cellulose-acetobutyrate resins. They are also used for special solvent purposes such as the purification of pyrethrum, used in fly sprays. Various derivatives are made from the nitro-

paraffins, and the more important of these are considered below.

Nitroparaffins fall into three classes: primary, secondary and tertiary. These have, respectively, two or three, one, and no hydrogen atoms attached to the carbon atom holding the nitro group. These hydrogen atoms take part in various reactions. Thus, primary and secondary nitroparaffins behave as weak acids and form metallic salts. In the presence of small amounts of bases, nitro compounds of these two classes react with aldehydes as shown:

$$\underset{\text{Nitroethane}}{CH_3CH_2NO_2} + \underset{\text{Formaldehyde}}{2HCHO} = \underset{\text{2-Nitro-2-methyl-1, 3-propanediol.}}{CH_3C(CH_2OH)_2NO_2}$$

Aliphatic nitro groups are readily reduced to amino groups, and nitro alcohols produced as shown in the above equation can be reduced to amino alcohols which find important uses as emulsifying agents, constituents of resins and of emulsion-type paints.

By the use of a strong mineral acid at temperatures of 100° C.–150° C., the primary nitroparaffins are converted to fatty acids and a salt of hydroxylamine. Salts of hydroxylamine find use in the preparation of antiskinning agents for paints, vulcanization accelerators for synthetic rubber, and dyes.

When primary or secondary aliphatic nitro compounds are treated with a halogen in the presence of a base, the active hydrogen atoms are replaced by the halogen. This is probably the best way of making chloropicrin, CCl_3NO_2, which finds large-scale use as an insecticide.

Powerful insecticides are made by condensing aromatic nitro alcohols with chlorobenzene, as illustrated in the equation:

$$p\text{—}ClC_6H_4CHOHCHNO_2CH_3 + ClC_6H_5 \xrightarrow{H_2SO_4} (p\text{–}ClC_6H_4)_2CHCHNO_2CH_3.$$

(*See* BLASTING; EXPLOSIVES; NITROGLYCERIN; T.N.T.)

(E.B.HE.)

NITROGEN is a colourless, odourless, tasteless gas, which is incombustible, does not support combustion or respiration, and is one of the most widespread elements. It occurs free in the atmosphere and in various compounds, some of which are found in the proteins of plants and animals and others of which constitute important drugs, dyes and other chemicals. Symbol N, atomic number 7, atomic weight 14.008. Its existence was first recognized by K. Scheele (1772), who showed that common air is a mixture of two gases, which he called "foul air" (nitrogen) and "fire air" (oxygen). He obtained the foul air by removing the fire air in combination with various combustible or oxidizable materials, and showed that the residue would not support combustion or respiration.

Nitrogen was also, independently, discovered by Joseph Priestley and Daniel Rutherford about the same time. Antoine Lavoisier named the gas "azote," from its inability to support life, and recognized that it is an element. The name nitrogen was introduced by J. A. C. Chaptal (1790) to indicate that the element is a constituent of nitre.

Nitrogen occurs in the atmosphere to the extent of approximately 78% by volume and 75.5% by weight, and serves to dilute the oxygen. Free nitrogen is also found in many meteorites and in volcanic gases and gases in mines; its presence in the sun and in certain stars and nebulae is shown by the spectroscope. In combination, it is found in nitre or saltpetre (potassium nitrate), Chile saltpetre (sodium nitrate), ammonia and ammonium salts in the atmosphere, in rain, soil and guano, and as complex organic compounds (proteins) with an average of 16% of nitrogen, in living organisms.

Preparation and Uses.—Nitrogen may be prepared (1) from atmospheric air by removal of the oxygen, or (2) from its compounds. Atmospheric nitrogen contains about 1% of inert gases (argon, etc.).

1. The oxygen is removed from air by exposure to phosphorus at ordinary temperature (burning phosphorus is not so effective), to moist iron filings, an alkaline solution of pyrogallol, an acid solution of chromous chloride or cuprous chloride, or metallic copper in presence of hydrochloric acid or ammonia, or by passing air over red-hot copper.

On the large scale, nitrogen is made almost entirely by the fractional distillation of liquid air, in which process, since it has a lower boiling point than oxygen, it tends to evaporate first. The gas is marketed in gray cylinders under a pressure of about 120 atm. This gas contains most of the helium and neon present in air (*see* ATMOSPHERE), but the argon, which has nearly the same boiling point, mostly remains with the oxygen. Some industrial nitrogen may be made by passing air over heated copper, the copper oxide being afterward reduced by heating in a current of water gas.

2. Pure nitrogen is made from its compounds: (a) By passing chlorine into ammonia solution, $2NH_3+3Cl_2=N_2+6HCl$; (b) by heating a slightly acid solution of ammonium nitrite (or a mixture of sodium nitrite and ammonium chloride), $NH_4NO_2=N_2+2H_2O$; (c) by heating ammonium dichromate, $(NH_4)_2Cr_2O_7=N_2+Cr_2O_3+4H_2O$; (d) by passing a mixture of nitric oxide and ammonia gas over red-hot copper, $6NO+4NH_3=5N_2+6H_2O$; (e) in a very pure state by heating sodium or barium azide in a vacuum, $Ba(N_3)_2=Ba+3N_2$. The gas may be collected over water.

Nitrogen gas is used in filling the larger or cheaper kinds of electric bulbs (argon [*q.v.*] is used for the smaller, more expensive ones) to prevent blackening of the bulb by volatilized metal from the filament, which can thus be run at a higher temperature. High-temperature mercury thermometers may contain compressed nitrogen. Large quantities of nitrogen are used to make synthetic ammonia and other nitrogen compounds (such as nitric acid) which are needed in the production of dyes, drugs, explosives and fertilizers.

Properties.—Nitrogen gas is only slightly soluble in water, but one volume of liquid oxygen dissolves about 450 vol. of the gas. On strong cooling under pressure, nitrogen forms a colourless liquid, boiling at −195.81°±0.02° C. (F. Henning and W. Heuse, 1924), at which temperature its specific gravity is 0.8042 g. per millilitre. The critical temperature is −147.13° C. and the critical pressure 33.49 atm. On rapid evaporation under reduced pressure the liquid freezes to a colourless solid melting at −210.5° C. under a pressure of 86 mm. The density of nitrogen gas at 0° C. and 760 mm. pressure is 1.25051 g. per litre (E. Moles and J. M. Clavera, 1924); the mean value given by several different observers is 1.25056 g. per litre at 0° C., 760 mm., and g=980.665.

The accepted value for the atomic weight is N=14.008 (O=16); the element has two stable isotopes with masses 14 and 15, enrichment in N^{15} being achieved by an exchange reaction between ammonia gas and ammonium sulphate solution. Rutherford showed that the nitrogen atom is disintegrated by the impact of swift α-particles, and protons (hydrogen nuclei) are expelled from its nucleus. Radioactive isotopes with mass numbers 13 and 16 have been formed artificially; *e.g.*, N^{13} by bombarding carbon with deuterons.

Nitrogen gas is somewhat inert, since the heat of dissociation of the nitrogen molecule into atoms is large, but it can unite directly under certain conditions with several elements, including hydrogen, oxygen, boron, silicon, lithium, magnesium, calcium, barium, titanium, vanadium, tantalum, tungsten and manganese. The compounds with metals (nitrides) may be decomposed by water under various conditions, with evolution of ammonia.

Active Nitrogen.—When a current of nitrogen gas containing a trace of oxygen or other impurity is exposed at low pressure to a high-tension electric discharge, the gas beyond the discharge glows with a yellow light and is more active chemically than ordinary nitrogen (Lord Rayleigh, 1911). It does not react with molecular hydrogen or oxygen but forms ammonia with atomic hydrogen, combines with sulphur, phosphorus and several metals, forming nitrides, decomposes nitric oxide into oxygen and nitrogen, and forms hydrocyanic acid with acetylene. The nature of this so-called active nitrogen is still uncertain, but it probably contains nitrogen atoms, both normal and excited. In a bulb coated with metaphosphoric acid, the glow persists for several hours.

The Nitrogen Cycle.—Animals derive the nitrogen of their tissue proteins partly from animal proteins and partly (sometimes

wholly) from vegetable proteins of food. Plants synthesize their proteins from inorganic compounds in the soil and to some extent from free nitrogen in the atmosphere. Daniel Berthelot found that sterilized soils do not take up nitrogen from the air, hence he concluded that microorganisms are concerned with the assimilation. These were found (S. Vinogradsky, 1895; M. W. Beijerinck, 1901) to be a *Clostridium* (*C. pasteurianum*), which is anaerobic; *i.e.*, incapable of functioning in presence of oxygen unless protected by certain bacteria, and several species of bacteria of which the most active is *Azotobacter chroococcum.* The amount of nitrogen fixed by these bacteria increases by 30% if certain Protozoa are present in the soil, although Protozoa feed on bacteria.

Atmospheric nitrogen is also fixed by the co-operative action of bacteria and certain plants, chiefly Leguminosae, such as peas, beans and clover. The parasitic bacteria are present in small nodules on the root hairs of the plants, which are grown on a large scale in order to restore the nitrogen content of soils.

Nitrogen is also fixed in the form of oxides by electrical discharges in the atmosphere, and conveyed to the soil in the form of nitric and nitrous acids by rain, these acids forming nitrates and nitrites in the soil. Altogether about 250,000 tons of nitric acid are said to be formed in this way in 24 hours. Some observations show, however, that the nitrogen content of rain does not increase during a thunderstorm. Nitrites and ammonium salts are often of little use as plant foods and must first be oxidized to nitrates by special soil bacteria, the process being known as nitrification.

Other kinds of bacteria decompose nitrogen compounds in the soil and, by this process of denitrification, return free nitrogen to the air. The combined nitrogen content of cultivated soil is generally enriched and renewed by means of nitrogenous fertilizers such as nitrates and ammonium salts.

Compounds of Nitrogen and Hydrogen.—Nitrogen forms three compounds with hydrogen, ammonia (*q.v.*), NH_3; hydrazine, N_2H_4; and hydrazoic acid or azoimide, HN_3. Ammonia and hydrazine normally function as bases and form secondary compounds, N_4H_4 and N_5H_5, respectively, with hydrazoic acid. With alkali metals, ammonia and hydrazine form compounds in which part of their hydrogen is replaced by a metal.

Hydrazine (*q.v.*), N_2H_4, with the structure $H_2N.NH_2$ (diamide), was originally obtained by T. Curtius (1887) from organic compounds containing two nitrogen atoms linked together. It is made commercially by a process devised by Friedrich Raschig (1907). Sodium hypochlorite solution is mixed with a small quantity of glue and warmed with excess of concentrated ammonia. An intermediate compound called chloramine, NH_2Cl, is formed, which reacts with the excess of ammonia to form hydrazine. After addition of sulphuric acid and cooling, hydrazine sulphate, $2N_2H_4,H_2SO_4$, crystallizes. When this is distilled under reduced pressure with concentrated potassium hydroxide solution, a colourless fuming liquid, called hydrazine hydrate, is obtained. From this, anhydrous hydrazine is obtained by distilling with solid sodium hydroxide or barium oxide (which remove water) under reduced pressure. It is a colourless liquid, boiling point 113.5° C., which freezes to a white crystalline solid, melting point 1.4° C. Hydrazine decomposes on heating, $3N_2H_4=N_2+4NH_3$, and reacts violently with halogens, forming nitrogen and halogen hydracids, $N_2H_4+2I_2=N_2+4HI$. Hydrazine rapidly destroys cork and rubber and when hot attacks glass. It is a weaker base than ammonia, forming two series of salts; *e.g.*, N_2H_4, HCl and N_2H_4, 2HCl. Hydrazine and its salts are poisonous. They are very powerful reducing agents, precipitating many metals from solutions of their salts.

Hydrazoic acid (*q.v.*), HN_3, also discovered by Curtius (1890), is formed by the action of an oxidizing agent; *e.g.*, nitric acid, on hydrazine, $3N_2H_4+5O=2HN_3+5H_2O$. The sodium salt is formed on passing nitrous oxide over heated sodamide, $NaNH_2+N_2O=NaN_3+H_2O$. Pure hydrazoic acid is a colourless liquid (boiling point 37° C., freezing point −80° C.), with a very unpleasant odour. It is very dangerously poisonous and explosive, decomposing with a blue flash on heating. The solution is acid and dissolves many metals forming salts called azides, which, especially those of the heavy metals, are explosive; lead azide (*q.v.*) is used as a detonator instead of mercury fulminate. In its action on metals hydrogen is not evolved (except a trace with magnesium), but nitrogen is, and part of the acid is reduced to ammonia. With ammonia and hydrazine it forms the colourless crystalline compounds NH_3,HN_3 (or N_4H_4) and N_2H_4,HN_3 (or N_5H_5). The group $-N_3$ in hydrazoic acid behaves like a halogen; azides give a white precipitate of AgN_3 with silver nitrate. From X-ray spectra it is shown that the three nitrogen atoms in the group are in a straight line, not, as formerly supposed, in a ring.

Oxides of Nitrogen.—The oxides of nitrogen are: nitrous oxide, N_2O; nitric oxide, NO; dinitrogen trioxide, N_2O_3; nitrogen dioxide, NO_2, and its polymer, dinitrogen tetroxide, N_2O_4; dinitrogen pentoxide, N_2O_5; and a higher oxide of uncertain formula, perhaps NO_3 or N_2O_6. They form a good example of the Law of Multiple Proportions.

Nitrous oxide, N_2O, was discovered by Joseph Priestley (1772) by exposing "nitrous air" (NO) to iron or alkali sulphides, when the gas diminished in volume and became a better supporter of combustion than common air. It was studied by Sir Humphry Davy (*q.v.*) (1799), who called it nitrous oxide and prepared it by heating ammonium nitrate, $NH_4NO_3=N_2O+2H_2O$, the method now used. He showed that it has anaesthetic properties, in some cases preceded by peculiar effects which led to its name "laughing gas." Nitrous oxide can be synthesized from its elements only with difficulty and under special conditions (D. L. Chapman, R. A. Goodman and R. T. Shepherd, 1926). It is produced by the reduction of nitric acid under certain conditions; *e.g.*, by the action of zinc on the dilute acid. In the pure state it is made by the action of hydroxylamine hydrochloride on sodium nitrite in equimolecular proportions in solution, hyponitrous acid (*q.v.*) being an intermediate product, $NH_2OH+HNO_2=N_2O+2H_2O$. It is formed in special circumstances by the oxidation of ammonia.

Nitrous oxide is a colourless gas with a pleasant sweetish odour and taste, density 1.977 g. per litre, $1\frac{1}{2}$ times that of air. At 15° C. one volume of water dissolves 0.7778 vol. of nitrous oxide, forming a neutral solution. It is more soluble in alcohol (3.268 vol. at 15° C.). Nitrous oxide supports combustion better than common air (it kindles a glowing chip, like oxygen), because it decomposes into a mixture of one volume of oxygen and two volumes of nitrogen at a fairly low temperature (beginning at 520° C.). It is an endothermic compound; *i.e.*, contains more energy than its elements and can be decomposed into oxygen and nitrogen by the explosion of a detonator. The molecule is linear, the two nitrogen atoms being adjacent. On cooling or under pressure (50 atm. at 15° C.) it forms a colourless liquid, boiling point −88.7° C., on rapid evaporation of which a white solid, melting point −102.3° C., is formed. The critical temperature is 36.5° C. and the critical pressure 71.66 atm.

The chief use of nitrous oxide is as an anaesthetic in operations of short duration, but prolonged inhalation of the pure gas causes death. About 22 l. is required to produce insensibility, and oxygen is usually administered as well. A very pure gas must be used; it is made by the decomposition of ammonia nitrate by heat, the temperature being carefully regulated to avoid the formation of ammonia and nitric oxide, and minimize the formation of nitrogen.

The gas is washed with solutions of ferrous sulphate and potassium hydroxide, and with milk of lime, and the gas is dried and liquefied by pressure in steel cylinders. One kilogram of ammonium nitrate gives 182 l. of the gas. Nitrous oxide may be used in making artificially whipped cream, being dissolved in the cream under pressure and liberated in small bubbles when the pressure is released.

Nitric oxide, NO, which is formed from its elements by the action of electric sparks or a high temperature, $N_2+O_2=2NO$, was first obtained by Jean Baptiste van Helmont about 1620, but was more carefully studied by Priestley (1772), who called it "nitrous air," and obtained it by the action of dilute nitric acid on copper or mercury, $3Cu+8HNO_3=3Cu(NO_3)_2+2NO+4H_2O$. Copper turnings and a mixture of equal volumes of nitric acid and

water may be used. The gas so prepared contains nitrogen and nitrous oxide. The pure gas is obtained by shaking a mixture of nitric acid and concentrated sulphuric acid with mercury, or by dropping a solution of potassium (or sodium) nitrite and potassium ferrocyanide into dilute acetic acid, $K_4Fe(CN)_6 + KNO_2 + 2CH_3COOH = K_3Fe(CN)_6 + NO + H_2O + 2CH_3COOK$. The colourless gas may be collected over water, or, if required pure, over mercury. It has a density of 1.3402 g. per litre, slightly greater than that of air. At 15° C., one volume of water dissolves only 0.051 vol. of the gas. It is not easily liquefied and has a boiling point of −150.2° C. and a melting point of −163.6° C. The liquid and solid are distinctly blue. The critical temperature is −96° C. and the critical pressure 64 atm. The molecule contains an odd electron in its structure, and nitric oxide is paramagnetic, its susceptibility being half that of oxygen.

Nitric oxide, although it is endothermic, is the most stable oxide of nitrogen, being dissociated into its elements only to about 3.5% at 1,000° C. Consequently, burning substances continue to burn in the gas only if they have previously attained a high temperature. A taper, burning sulphur, and feebly burning phosphorus is extinguished, but brightly burning phosphorus burns brilliantly in the gas. A mixture of nitric oxide and carbon disulphide vapour burns with a brilliant lilac-coloured light, very rich in actinic rays. Nitric oxide combines rapidly with oxygen to form the dioxide, NO_2, which appears as red fumes when nitric oxide is exposed to air. The reaction involves three molecules, $2NO + O_2 = 2NO_2$, and slows down appreciably in its later stages, so that a short time of contact is necessary for complete oxidation, and with dilute gases several minutes may be needed. This is important in technology (*see* NITROGEN, FIXATION OF). Nitric oxide dissolves to form a black liquid in cold ferrous sulphate solution, but is expelled again on warming. The best solvent is a slightly alkaline solution of sodium sulphite, when the compound $Na_2(NO)_2SO_3$ is formed. At the temperature of liquid oxygen, it reacts with fluorine to form *nitryl fluoride*, $4NO + F_2 = 2NO_2F + N_2$, a halogen derivative of nitric acid (melting point −166° C., boiling point −72.4° C.). The compounds NO_3F and NO_2Cl are also known. Nitric oxide and all higher oxides of nitrogen are poisonous.

Dinitrogen trioxide (nitrous anhydride), N_2O_3, was obtained by J. R. Glauber (1648). When nitric acid (56%) is distilled with arsenious oxide or starch, and the red vapour cooled in a freezing mixture, dark-blue liquid N_2O_3 is obtained, $2HNO_3 + As_2O_3 = N_2O_3 + H_2O + As_2O_5$. On evaporation, the liquid decomposes almost completely into nitric oxide and nitrogen dioxide, but these recombine on liquefaction by cooling: $N_2O_3 \rightleftarrows NO + NO_2$. Although the gas is mainly a mixture of nitric oxide and nitrogen dioxide, only about 2% of N_2O_3 being present at 15° C., it is absorbed by solutions of alkalies with formation of nitrites, and by concentrated sulphuric acid with formation of nitrososulphuric acid ("chamber crystals"), thus behaving as if it consisted of N_2O_3. As absorption proceeds, the equilibrium is displaced to the left in the above equation. Only traces of nitrous acid are formed by the action of water, since the acid is unstable and decomposes, partly into dinitrogen trioxide (to which the blue colour of the solution is due) and water, and partly into nitric oxide and nitric acid: $3HNO_2 = HNO_3 + 2NO + H_2O$. According to H. B. Baker and M. Baker (1900), when liquid dinitrogen trioxide is dried by long exposure to phosphorus pentoxide, the vapour formed from it consists of N_4O_6 molecules, but other workers could not repeat this experiment.

Sodium nitrite, $NaNO_2$, an important salt used in many organic preparations (*e.g.*, of dyestuffs), is now mostly manufactured by absorbing higher oxides of nitrogen formed by the oxidation of ammonia in alkali solutions. Older methods of preparation are by heating molten sodium nitrate with metallic lead, $NaNO_3 + Pb = NaNO_2 + PbO$, or by adding sulphur to fused sodium nitrate and sodium hydroxide, $3NaNO_3 + S + 2NaOH = 3NaNO_2 + Na_2SO_4 + H_2O$. Nitrites are reducing agents, forming nitrates, usually in acid solution, but they also liberate iodine from acidified potassium iodide, being reduced to nitric oxide, $2KI + 2KNO_2 + 2H_2SO_4 = 2K_2SO_4 + I_2 + 2NO + 2H_2O$.

The chloride of nitrous acid, *nitrosyl chloride*, NOCl, is a yellow gas formed by the direct combination of nitric oxide and chlorine, by the action of phosphorus pentachloride on sodium nitrite, by heating nitrososulphuric acid with sodium chloride, or (together with chlorine) by heating a mixture of concentrated nitric and hydrochloric acids (aqua regia): $HNO_3 + 3HCl = NOCl + Cl_2 + 2H_2O$. It has been used for bleaching flour.

Nitrogen dioxide, NO_2, and *dinitrogen tetroxide*, N_2O_4 (the mixture being often incorrectly called "nitrogen peroxide"), formed as a red gas by the direct union of nitric oxide and oxygen (*see* above), are usually prepared by heating dry lead nitrate, $2Pb(NO_3)_2 = 2PbO + 4NO_2 + O_2$, and condensing the red gas to a liquid in a tube cooled in a freezing mixture, the oxygen passing on. A very pure gas is made by warming nitrososulphuric acid with potassium nitrate: $SO_2(OH).O.NO + KNO_3 = KHSO_4 + 2NO_2$, or by adding fuming nitric acid and phosphorus pentoxide to liquid dinitrogen trioxide, and distilling: $N_2O_3 + N_2O_5 = 2N_2O_4$. Dinitrogen tetroxide in a good freezing mixture solidifies to nearly colourless crystals (the liquid supercools), melting at −9.04° C. to a honey-coloured liquid. Both these forms consist mainly of N_2O_4. On warming, the liquid becomes red, because of formation of nitrogen dioxide molecules, $N_2O_4 \rightleftarrows 2NO_2$, and boils at 21.9° C. to form a red vapour. On heating, the colour of the gas deepens, because of further dissociation, and at 140° C. it is nearly black, dissociation being then complete. At still higher temperatures, nitrogen dioxide dissociates into nitric oxide and oxygen, this being complete at 620° C., when the gas is colourless, $2NO_2 = 2NO + O_2$. On cooling, all these changes are reversed. Since the volume increases, the extent of dissociation may be calculated from the density of the gas. At atmospheric pressure it varies from about 15% at the boiling point to 89.3% at 100° C., and 100% at 140° C.

The gas kindles a glowing chip and supports the combustion of brightly burning phosphorus. A mixture with hydrogen is reduced to ammonia when passed over heated platinum. In contact with water, the liquid, or gas, forms nitric and nitrous acids, $2NO_2 + H_2O = HNO_3 + HNO_2$, and the nitrous acid decomposes as explained above. With ice-cold water, blue liquid dinitrogen trioxide separates.

In the absorption of nitrous fumes in water, as in the preparation of nitric acid by the oxidation of ammonia, the evolution of nitric oxide necessitates adequate oxidation space for its reoxidation to nitrogen dioxide. Alkalies absorb the gas with formation of nitrite and nitrate, $2NO_2 + 2KOH = KNO_2 + KNO_3 + H_2O$, the process being somewhat slower than in the case of dinitrogen trioxide. Liquid dinitrogen tetroxide forms a violently explosive mixture with gasoline or other hydrocarbons, which has been used for aerial bombardment. The gas diluted with air is used in bleaching flour.

Dinitrogen pentoxide (nitric anhydride), N_2O_5, discovered by E. H. Sainte-Claire Deville (1849), is best prepared by adding phosphorus pentoxide to cooled concentrated nitric acid, then distilling the product in a current of ozonized oxygen, drying the gas with phosphorus pentoxide and condensing in a receiver cooled in solid carbon dioxide and ether: $2HNO_3 + P_2O_5 = N_2O_5 + 2HPO_3$.

It is also formed by passing ozonized oxygen into cooled liquid dinitrogen tetroxide: $N_2O_4 + O_3 = N_2O_5 + O_2$. The colourless crystals are stable below 0° C., but are very hygroscopic. On warming, they melt with decomposition into nitrogen dioxide and oxygen, and also decompose on exposure to light. Rapid heating causes explosion. Phosphorus and potassium burn in the liquid on warming, and charcoal burns if previously ignited. With water, nitric acid is formed.

Trinitrogen tetroxide, N_3O_4, is said to be formed as a greenish solid by passing nitric oxide into liquid oxygen, or by the action of air on solid nitric oxide at the temperature of liquid air. It decomposes into dinitrogen trioxide and nitric oxide above the temperature of liquid air (R. L. Hasche, 1925). A higher oxide of nitrogen, perhaps NO_3 or N_2O_6, is apparently formed by the action of an electric discharge on a mixture of nitrogen and oxygen, and has a characteristic absorption spectrum.

Hyponitrous acid, $H_2N_2O_2$, with the structure $HO.N=N.OH$, is formed by the action of nitrous acid on hydroxylamine (*see* above), but is best obtained as a salt by the reduction of a solution of sodium nitrite with sodium amalgam: $2NaNO_2+4Na+2H_2O=Na_2N_2O_2+4NaOH$ (Edward Divers, 1871). The free acid is obtained in colourless crystals, which at once decompose with feeble explosion, $H_2N_2O_2=N_2O+H_2O$, by the action of dry hydrogen chloride in ether on silver hyponitrite, and evaporation at room temperature. The acid and its salts are reducing agents. An isomer of hyponitrous acid is *nitramide,* perhaps with the formula $NH_2.NO_2$. *Hyponitric acid* (nitrohydroxylamic acid), $H_2N_2O_3$, is known in the form of salts.

Nitrogen Halides.—*Nitrogen trifluoride,* NF_3, is a colourless gas, melting point −216.6° C., boiling point −119° C., formed by the electrolysis of ammonium hydrogen fluoride (O. Ruff and L. Staub, 1928). *Nitrogen trichloride,* NCl_3, is a yellow, very explosive oil, formed by the action of chlorine on ammonium chloride solution, or the action of excess of chlorine on ammonia (P. L. Dulong, 1811): $NH_3+3Cl_2=NCl_3+3HCl$. In the last reaction, two intermediate compounds are formed, viz., *monochloramine,* NH_2Cl, which has been obtained pure in colourless explosive crystals, melting point −66° C., and *dichloramine,* $NHCl_2$, known only in solution. Nitrogen trichloride boils at 71° C., but easily decomposes with violent explosion on heating. The vapour has a pungent smell and attacks the eyes and mucous membranes. The liquid explodes on exposure to bright light, and in contact with many solids. It is decomposed by ammonia. A solution in benzene is fairly stable.

The existence of *nitrogen tribromide* is doubtful. *Nitrogen iodide* was obtained by B. Courtois (1812) as a black powder by the action of ammonia solution on iodine, and drying at room temperature on filter paper. Its formula is NI_3NH_3 (F. D. Chattaway, 1900). It is very explosive, detonating when gently pressed, with evolution of violet fumes of iodine. It is an oxidizing agent. *Nitrogen tri-iodide,* NI_3, is a black powder obtained by the action of ammonia gas on potassium iodobromide, $KIBr_2$, washing with water, and drying (H. W. Cremer and D. R. Duncan, 1930). (*See* also AMMONIA; HYDRAZOIC ACID; HYDRAZINE; HYDROXYLAMINE; NITRIC ACID; NITROGEN, FIXATION OF.)

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NITROGEN, FIXATION OF. The term "fixation of nitrogen" has been given to any chemical process whereby "free" nitrogen, one of the elements, is caused to combine chemically with other elements to form nitrogen compounds. The atmosphere is a great reservoir of nitrogen, this element accounting for nearly four-fifths of the volume.

Nitrogen is chemically inert, and, under ordinary conditions, does not react with other elements. A number of rather drastic processes have been discovered for "fixing" nitrogen (*i.e.,* causing it to enter into chemical combinations) but these are processes one would not expect to find operative in nature. Yet, nitrogen in combined form is found in all fertile soils, in every living thing, in many foodstuffs, in silk, wool and feathers, in coal and in such naturally occurring chemicals as saltpetre and ammonia. Fixed nitrogen is found in the basic substance of living matter, the protoplasm; it is present in the nucleus of every living cell.

During the early decades of the 19th century, Nicolas Théodore de Saussure, Jean Baptiste Boussingault, Justus von Liebig and others demonstrated that growing plants obtain their fixed nitrogen from the soil. Animals, in turn, secure their fixed nitrogen through the consumption of plants or of other animals which use plants as food. The astonishing fact was discovered, however, that when crops were removed from a field, the decrease in the fixed-nitrogen content of the soil was less than the amounts accounted for by the crop removals. Liebig rightly concluded that the fixed-nitrogen supply of the soil was replenished from the atmosphere, but he contended that the process did not involve any fixation of free atmospheric nitrogen. Since he knew that rain water always contains traces of dissolved nitrogen compounds, and that both animal and vegetable matter release ammonia during decay, Liebig postulated that the released ammonia was returned to the earth in rain water. This "ammonia cycle," from earth to atmosphere and return to earth, does occur, but it accounts for only a small part of the fixed nitrogen that the soil receives from the atmosphere. Not until 1886 was it known that certain microorganisms are able to fix atmospheric nitrogen and thus replenish the soil's supply. Of these, the most important are the *Rhizobium* genera of bacteria and the *Azotobacter.* The former are found on the roots of leguminous plants and the latter live independently in the soil. The process by which these bacteria fix nitrogen was not known at mid-20th century. It was virtually certain, however, that bacteria do not use any of the known chemical methods for the fixation of nitrogen.

Although Liebig and his contemporaries did not arrive at a correct explanation as to the source of fixed nitrogen in the soil, they did make clear the importance of fixed nitrogen in agriculture. Nitrogenous materials long had been used as fertilizers without understanding of the reason for the beneficial effects. As a result of the new knowledge, ammonia released in making coke from coal was thenceforth recovered and utilized as a fertilizer, as was sodium nitrate from the deposits discovered in Chile. Wherever agriculture was practised intensively, there developed a demand for nitrogen compounds to supplement the natural supply of the soil.

In addition to the demand for fixed nitrogen in agriculture, there were other urgent and growing needs for nitrogen compounds. The increasing quantity of saltpetre used in the manufacture of gunpowder led to a world-wide search for natural deposits of this nitrogen compound. Industrial demands and the advent of high explosives called for an ever larger supply of fixed nitrogen. By the end of the 19th century it was clear that recoveries from the coal-carbonizing industry and the importation of Chilean nitrate could not meet the future agricultural and industrial demands for nitrogen compounds. Moreover, it was obvious that in the event of a major war, a nation cut off from the Chilean supply soon would be unable to manufacture munitions in adequate amounts. The problem of fixed-nitrogen supply had become an exceedingly important one, and it appeared that the fixation of atmospheric nitrogen offered the only solution. During the final decade of the 19th century and the opening decade of the 20th century, intensive efforts culminated in the development of commercial nitrogen fixation processes.

Fixation of Nitrogen as the Oxide.—Air is essentially a mixture of one volume of oxygen with four volumes of nitrogen. Both gases are in the free, or elemental, condition and do not react with each other under ordinary conditions. If, however, air or any other mixture of oxygen and nitrogen is heated to a very high temperature, a small portion of the mixture reacts to form the gas nitric oxide. On allowing the gas mixture to cool slowly, the nitric oxide decomposes almost completely into oxygen and nitrogen. At any given temperature there exists a dynamic equilibrium among the three gases. This may be expressed chemically thus:

$$O_2+N_2 \rightleftarrows 2\,NO-43{,}200\text{ Cal.}$$

The arrows indicate that the reaction may proceed in either direction as conditions change. Although all chemical reactions are of this sort in theory, conditions are often such that the reaction proceeds almost exclusively in one direction. The chemical expression may then be written as an equation. In the reaction now under consideration, both the forward and reverse reactions must be taken into account. Change of pressure has no effect on the equilibrium, but when the temperature is increased the equilibrium shifts to the right; *i.e.,* a larger proportion of nitric oxide is formed. At ordinary temperatures practically no nitric oxide is present, but at the temperature of an electric arc a small percentage of nitric oxide is formed. Inasmuch as the nitric oxide decomposes into its elements on cooling, it would appear that an

"arc" process could not serve as a commercial method of nitrogen fixation. It can serve as a practical process, however, when advantage is taken of the rates of the reactions involved. The chemical expression given above is for an equilibrium. It reveals nothing as to the time required to establish the equilibrium. It is well known that most chemical reactions are greatly accelerated as the temperature of the reactants is increased and, conversely, are retarded as the temperature is decreased. In the present case, equilibrium is reached quickly at the very high temperature of the arc. If the mixture of gases then is cooled rapidly, the rate of the reverse reaction drops to nil; *i.e.*, the decomposition of the nitric oxide virtually ceases, and the high-temperature equilibrium is, so to speak, "frozen."

The nitric oxide does not remain long as such in the cooled gas mixture but begins to react with the free oxygen present when the temperature falls below about 600° C., thus:

$$2\ NO + O_2 \rightleftarrows 2\ NO_2.$$

The indicated reaction proceeds from left to right until nearly all the nitric oxide has been converted to the dioxide, NO_2. The latter polymerizes partially to set up another equilibrium, thus:

$$2\ NO_2 \rightleftarrows N_2O_4.$$

And, when the $NO_2-N_2O_4$ mixture is brought into contact with water, nitric acid (*q.v.*) is formed.

The foregoing facts form the basis for a practical process of nitrogen fixation.

In 1772 the English chemist, Joseph Priestley, observed that the passage of an electric spark through a small volume of air confined over water brought a decrease in gas volume, and that the water became acidic. Priestley did not interpret this result correctly and two years elapsed before the correct interpretation was given by another English chemist, Henry Cavendish. Thus was discovered what later became known as the "spark" or "arc" method of nitrogen fixation. At that time, however, electrical energy was far too costly to permit the use of such a process.

By the end of the 19th century, mechanical means of generating large quantities of electric energy had been evolved, and the use of water power to drive electric generators finally brought the cost of electric energy down to a range where nitrogen fixation by the spark or arc method became economically feasible. Many experimenters then turned attention to the problem, and by 1902 Charles S. Bradley and D. R. Lovejoy had a small plant using a spark process in operation at Niagara Falls, N.Y. This venture failed commercially, however. In 1904 Christian Birkeland of Oslo, Nor., and Samuel Eyde, an engineer, used an arc method in a small plant that was the forerunner of large and commercially successful plants. In 1908 a large arc process plant was established at Notodden, Nor.

In the Birkeland-Eyde process an electric arc was spread into a disk of flame by means of a magnetic field. Air was blown through the disk and then mixed immediately with cold air, thus "freezing" the high-temperature equilibrium.

Several modifications of the arc process were developed in the first two decades of the 20th century, and small plants were built in countries other than Norway. The arc process was, however, inherently inefficient in the use of energy, and the absorption towers required for the reaction of the nitrogen oxides with water were large and costly. Better methods of fixing nitrogen were soon discovered and the process was eventually abandoned.

In the decade 1940–50 new interest was aroused in the fixation of nitrogen as the oxide through the use of the high temperature and rapid heat exchange and heat economy possible in a "Royster stove." This piece of equipment is a modification of the heat exchange stoves long in use on blast furnaces, the essential difference being the substitution of small pieces of highly refractory material for the usual brick checkerwork in the stoves. In the process two or more Royster stoves are used. The refractory filling in one such stove is brought up to a high temperature by burning gas therein. Air is then passed through the stove and, at the high temperature prevailing, a small portion of nitric oxide is formed. The high temperature equilibrium is then "frozen" by passing the hot gas into an unheated stove. The nitric oxide in the cool gas issuing from the second stove may then be recovered.

When most of the heat in the first stove has been transferred to the second stove, the direction of air flow through the two stoves is reversed. Inasmuch as the heat transfer between the two stoves cannot be quite complete without disturbing conditions necessary in the process, one stove must be reheated occasionally with gas.

Fixation of Nitrogen as a Cyanide.—Another chemical method of fixing nitrogen was discovered about 1828 by Desfosses, who observed that potassium cyanide was formed when a stream of nitrogen was passed through a red-hot mixture of potash and carbon in an iron tube. In 1842 a small plant using the cyanide method was built in France and was operated for a few years. Many other attempts were made to find a practical process based on cyanide formation, the latest during World War I, but no commercially successful cyanide process had been adopted at mid-20th century.

Fixation of Nitrogen as a Nitride.—At high temperatures nitrogen will combine directly with some metals to form their nitrides (*q.v.*), most of which can be hydrolyzed to form the metal hydroxides and ammonia. During the decade 1909–19, unsuccessful attempts were made to apply a nitride process developed by O. Serpek in which nitrogen, aluminum oxide and carbon were heated together to form aluminum nitride.

Fixation of Nitrogen as a Cyanamide.—During the period 1895–98, Adolph Frank and Nikoden Caro conducted investigations directed toward the improvement of methods for producing cyanides. In the course of this work they discovered that crude calcium carbide and nitrogen would react at 1,000° C. to form calcium cyanamide rather than a cyanide. The chemical reaction may be written thus:

$$CaC_2 + N_2 = CaCN_2 + C.$$

Pure carbide reacts slowly, if at all, but the reaction is catalyzed by alkalies or alkaline earths. Calcium fluoride is the catalyst commonly used. Crude calcium cyanamide may be used directly as a fertilizer.

A large calcium cyanamide plant was built in Italy in 1907. Within the next five years, large plants were built in Germany, Dalmatia, France, Switzerland, Norway, Canada and Japan. The cyanamide process was the first nitrogen fixation process to be so widely used. During World War I the United States government built a very large cyanamide plant near Wilson dam, Ala.

Calcium carbide and nitrogen are the raw materials for the cyanamide process. The nitrogen may be obtained by the partial liquefaction and fractional distillation of air. The carbide is made by the heating of coke and high-grade lime in an electric furnace, the chemical reaction being:

$$CaO + 3\ C = CaC_2 + CO.$$

The carbon monoxide gas escapes from the furnace. The carbide is drawn off in molten form, cooled, ground and then heated to 1,000° C. and treated with nitrogen. The nitrifying reaction is exothermic and continues spontaneously once started. The resultant mass of crude cyanamide is cooled, ground and granulated for use as a fertilizer, or the cyanamide may be hydrolyzed and the fixed nitrogen liberated as ammonia: $CaCN_2 + 3H_2O = CaCO_3 + 2NH_3$.

The cyanamide process is an elaborate one. The electric energy required to produce the necessary carbide is relatively large per ton of fixed nitrogen finally obtained, although it is not so large as the energy required in the arc process.

The development of new manufacturing processes has been rapid during the 20th century. Within a decade after the erection of the first plant using the arc process, that process was fast becoming obsolete, and the cyanamide process was also to become obsolete within a decade after its development. Subsequent to World War I, no new cyanamide plants were built, although some of those then extant were still in operation at the beginning of World War II.

Fixation of Nitrogen as Ammonia.—The direct synthesis

of ammonia from elemental nitrogen and hydrogen has proved to be the most economical method discovered for the fixation of nitrogen. This method is being utilized in many countries and has become one of the largest and most basic processes of chemical industry the world over.

During the closing decade of the 19th century and the early years of the 20th century many investigators studied the gaseous system nitrogen-hydrogen-ammonia. Among those prominent in this work in the period 1904–08 were F. Haber, G. van Oordt, R. LeRossignol, W. Nernst, F. Jost and K. Jellinek.

The research of Haber and his associates convinced the Badische Anilin- und Sodafabrik that it was economically feasible to manufacture ammonia. The German firm then threw its great engineering and technical resources into the project and in 1910 a pilot plant was put into operation. This was the forerunner of a commercial plant which came into production in 1913 with a capacity of 7,000 tons of fixed nitrogen per year.

It was well known when Haber and his associates began their research on ammonia synthesis that no ammonia is formed when nitrogen and hydrogen are brought together under ordinary conditions of temperature and pressure. It was known that a trace of ammonia is formed when a silent electric discharge is passed through a mixture of nitrogen and hydrogen. It had also been observed that complete decomposition of ammonia cannot be effected by heat. Regardless of these clues to the existence of a true equilibrium, such as represented by the expression:

$$N_2 + 3\ H_2 \rightleftarrows 2\ NH_3 + 24{,}000\ \text{Cal.},$$

several investigators of note contended that no such equilibrium could be found. The situation was, therefore, one of confusion until Haber and his co-workers clearly demonstrated the existence of the equilibrium and measured the concentrations of the gases under several conditions of temperature and pressure.

Inasmuch as the foregoing expression of equilibrium indicates that one volume of nitrogen and three volumes of hydrogen combine to form two volumes of ammonia it follows, according to the Le Chatelier principle (*see* LE CHATELIER, HENRY LOUIS), that the higher the pressure on the system the larger the proportion of ammonia at equilibrium; that is, the equilibrium is shifted toward the smaller volume. It will be recalled that this effect of pressure is different from the case of the nitrogen-oxygen-nitric oxide equilibrium, on which a change in pressure had no effect. The effect of temperature on the equilibrium in the two cases is reversed. In the nitrogen-oxygen-nitric oxide equilibrium, the higher the temperature the larger the proportion of nitric oxide, whereas in the nitrogen-hydrogen-ammonia equilibrium the higher the temperature the smaller the proportion of ammonia.

The following table shows the effect of temperature and of pressure on the percentage of ammonia formed at equilibrium when one volume of nitrogen and three volumes of hydrogen are caused to react.

Percentage of Ammonia at Equilibrium

(Data obtained by the U.S. Fixed Nitrogen Research Laboratory)

Temperature ° C.	Pressure in atmospheres						
	10	30	50	100	300	600	1,000
200 . . .	50.66	67.56	74.38	81.54	89.94	95.37	98.29
250 . . .	28 34	47.22	56.33	67 24	81.38	90.66	96.17
300 . . .	14.73	30.25	39.41	52.04	70.96	84.21	92.55
350 . . .	7.41	17.78	25 23	37.35	59.12	75.62	87.46
400 . . .	3.85	10.15	15.27	25.12	47.00	65.20	79.82
450 . . .	2.11	5.86	9.15	16.43	35.82	53.71	69.69
500 . . .	1 21	3.49	5.56	10.61	26.44	42.15	57.47
550 . . .	0.76	2.18	3.45	6.82	19.13	31.63	41.16
600 . . .	0.49	1.39	2.26	4.52	13.77	23 10	31.43
650 . . .	0.33	0.96	1.53	3.11	9.92	16.02	20.70
700 . . .	0.23	0.68	1.05	2.18	7.28	12.60	12.87

From the foregoing table it is apparent that an ammonia synthesis process should be carried out at a temperature as low and at a pressure as high as may be practical and economical. Again, the rates of reaction toward equilibrium must be taken into account. At ordinary temperatures the rate of reaction is virtually zero and is negligibly low even at 500° C. unless a catalyst is used. Obviously, the use of a catalyst in ammonia synthesis is extremely important in permitting the reaction to be carried out at a lower temperature than would be practical with no catalyst. In commercial plants temperatures in the range 450° C. to 500° C. are used. The best catalyst known is prepared from pure iron plus small proportions of alumina and potash.

The decision as to the pressure at which to carry out the ammonia synthesis is an economic matter. Plants have been built to operate at pressures as low as 100 atm. and as high as 1,000 atm., but most of the plants use pressures in the range 200 to 350 atm.

Steps in the Synthetic Ammonia Process.—Four major steps are involved in the synthetic ammonia process as it is carried out in large commercial plants. The initial step comprises the preparation of nitrogen and hydrogen or a mixture of these two gases. Where natural gas is available at relatively low cost, this material is used as a source of hydrogen. Most of the plants, however, use air, steam and coke to obtain a mixture of nitrogen and hydrogen along with carbon monoxide, carbon dioxide and other impurities. This mixture is then further processed with steam to convert most of the carbon monoxide to hydrogen and carbon dioxide. A few plants obtain hydrogen through the electrolysis of water, and a few others use coke oven gas as a source of hydrogen. In all plants, the necessary nitrogen is obtained from air.

In the second step of the process, the gas mixture is compressed and then freed from undesired gases by means of an elaborate system of equipment, leaving a purified mixture of nitrogen and hydrogen in the correct proportion for the ammonia synthesis.

In the third major step the nitrogen-hydrogen mixture is passed through a bed of catalyst at a temperature of about 500° C. and at a pressure from 100 to 1,000 atm. Some ammonia is thus formed, the proportion depending on the temperature and pressure used, the activity of the catalyst and time of contact of the gases with the catalyst.

In the fourth and final step, the ammonia is removed, usually by refrigeration. That part of gas mixture which remains uncombined is then recycled through the catalyst bed after the addition of sufficient fresh nitrogen-hydrogen mixture to compensate for the ammonia removed from the system.

Although the synthetic ammonia process may seem to be one of relative simplicity, it actually represents engineering achievement in the usage of materials and in construction unknown before the 20th century. Nevertheless, the process assures ample supplies of ammonia, which has become the cheapest form of fixed nitrogen available to industry and to agriculture, and is the raw material from which numerous nitrogenous chemicals are manufactured.

The success of the synthetic ammonia plants built in Germany during World War I, led to a rapid expansion of the industry and the construction of plants in many countries other than Germany. The initial plant at Oppau, Ger., was expanded to a capacity of 120,000 tons per year during World War I and a second large plant built at Leuna, near Merseburg, Ger. Various modifications of the original Haber or Haber-Bosch process were devised, such as the Claude process in France, the Casale process in Italy, the American and the Nitrogen Engineering processes in the United States. During World War II, ten new synthetic ammonia plants were built in the U.S. to meet an anticipated demand for ammonia in the production of munitions. The output of some of these plants was diverted to the production of agricultural fertilizer in the form of ammonium nitrate. At the close of World War II, most of the German synthetic ammonia plants lay in ruins; the United States had become the world leader in ammonia production, with a fixed nitrogen capacity of more than 1,000,000 tons per year.

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NITROGEN HARDENING, a process for the surface hardening of steel more commonly known as nitriding. It consists of heating special alloy steels in contact with ammonia at temperatures below the transformation range for steels, usually between 950° F. and 1,050° F., for periods of from 5 to 100 hrs., depending upon the depth of case desired. The steels used must contain nitriding-forming elements (such as aluminum, chromium or molybdenum) dissolved in the iron. During the nitriding cycle, nitrogen from the ammonia diffuses into the steel and forms alloy nitrides, which are precipitated along the crystal planes of the iron. This precipitation causes an increase in hardness, which is dependent upon temperature and the amount and nature of the nitride-forming elements in the steel. Aluminum is the most effective hardening element. A steel containing approximately 1% aluminum and 1% chromium nitrided at 975° F. will have a surface hardness of approximately 1,100 Vickers-Brinell.

The advantages of nitriding compared with other methods of surface hardening are as follows: (1) a much harder and more wear-resistant case is produced; (2) distortion is low primarily because the process is carried out below the transformation range; and (3) the resistance to fatigue failures, particularly notch fatigue, is greatly increased because nitriding results in surface compressive stresses which resist crack formation. The disadvantages of the process are: (1) an alloy steel must be used, which is more expensive than plain carbon steels; and (2) the time required to produce a case is long compared with other methods of surface hardening such as carburizing, cyaniding or induction hardening. (C. F. F.)

NITROGLYCERIN, an explosive first obtained in 1846 by A. Sobrero by treating glycerol (*see* GLYCERINE) with a mixture of concentrated nitric and sulphuric acids at ordinary temperature.

This reaction is strongly exothermic, and precautions must be taken that it does not get out of control, particularly in large-scale operations. Nitroglycerin is an ester of nitric acid, having the systematic name of glyceryl trinitrate and the formula is $CH_2(ONO_2)$-$CH(ONO_2)$-$CH_2(ONO_2)$.

It is an oily substance which is colourless when pure, but which is usually of a pale yellow colour, of specific gravity 1.60 at 15° C. Its melting point is 13.2° C., but the liquid is easily supercooled. Nitroglycerin is scarcely soluble in water and in glycerol, fairly soluble in ethyl and methyl alcohols and is miscible in all proportions with ether, acetone, benzene, etc. It dissolves and swells nitrocellulose and is therefore used as an ingredient in double-base propellants. It is used either alone or in mixtures with other ingredients as an explosive. Liquid nitroglycerin is extremely sensitive to shock and should be regarded as a hazardous substance. Evidence as to whether crystalline nitroglycerin is less or more hazardous is conflicting. However, for the prevention of freezing of nitroglycerin on storage in cold places, more use is being made of the so-called "low-freezing" nitroglycerin, which is obtained by nitration of partly polymerized glycerol or of glycerol mixed with other polyhydric alcohols.

Therapeutics.—Nitroglycerin has a sweet burning taste and is somewhat poisonous. Its vapour produces violent headache but most persons become accustomed to nitroglycerin after periods of weeks or months, and the headaches disappear thereafter. Although a nitrate, its pharmacological actions when it is taken internally resemble those of nitrites such as amyl nitrite. The explanation is that, in an alkaline medium at body temperature, nitroglycerin yields a nitrite, probably as a preliminary stage of decomposition. This gradual conversion in the tissues is a valuable property of nitroglycerin, since its effects take longer to disappear than is the case with amyl and other nitrites. Nitroglycerin is administered as a preventive in cases of cardiac pain, such as angina pectoris. (*See* EXPLOSIVES; PROPELLANTS.)

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(G. B. K.)

NITROSOBENZENE, C_6H_5NO, first obtained by the action of nitrosyl bromide or chloride on mercury diphenyl, is prepared by the oxidation of β-phenylhydroxylamine with chromic acid. It results from the oxidation of aniline by monopersulphuric acid (H. Caro). It forms colourless crystals which melt at 68° C. to an emerald-green liquid. It is very volatile, and its vapour and solutions are green. The colour changes which nitrosobenzene exhibits are explained by the fact that in the solid state, in which it is colourless, it exists in the form of dimeric molecules $(C_6H_5NO)_2$; whereas, in the liquid and vapour states, in which it is green, it has the monomeric form C_6H_5NO.

NITTI, FRANCESCO SAVERIO (1868–1953), Italian statesman, was born at Melfi (Potenza). He was already known as a barrister and as professor of financial science at the University of Naples when he entered parliament in 1904. He made his reputation as an authority on economic and financial questions, and was minister of agriculture, industry and trade in the Giolitti cabinet of 1911–14. When the United States entered World War I in 1917, he was entrusted with an economic mission to that country, and certain of his utterances and acts in this connection were severely criticized. He became minister of the treasury in the Orlando cabinet from Oct. 1917 to Jan. 1919. On the fall of the Orlando ministry, which he helped to bring about in June 1919, he succeeded as premier. Nitti's adoption of the system of proportional representation resulted in an important increase in the Socialist and Popolari deputies at the elections of Nov. 1919, but he failed to conciliate either group. An epidemic of strikes and disorders seriously weakened his position, and he felt forced to resign on March 12, 1920. But no other statesman being willing to assume the succession, he reconstructed his cabinet; defeated in the chamber of deputies after the San Remo meeting of the supreme council presided over by him, to prepare the peace with Turkey, he resigned a second time but again reconstructed his cabinet. The arrest ordered by him of the Dalmatians and Fiumani in Rome provoked further irritation. He resigned for the last time on June 9, 1920, leaving the door open for Giovanni Giolitti's return. On retiring from office he returned to journalism. In parliament he opposed Giolitti, splitting the democratic forces, which helped fascism. Nitti was re-elected in 1921, but did not stand in the 1924 elections held under Benito Mussolini's auspices. He lived abroad after the advent of fascism in Italy, returning to Italy after World War II. He was a member of the *assemblea nazionale,* 1946–48, and in 1948 became a member of the Italian senate. He died in Rome on Feb. 20, 1953.

Nitti wrote several books on economic questions, including one entitled *Nord e Sud* (1900), dealing with what he regarded as the unfair treatment of south Italy by the wealthier north, and *L'Italia all' alba del secolo XX.* (1901). His other works include: *L'Europa senza pace* (Eng. trans., 1922); *La Decadenza dell' Europa* (Eng. trans., 1923); *La Tragedia dell' Europa* (Eng. trans., *They Make a Desert,* 1924); *Meditazioni dell' Esilio* (1947); and *Rivelazioni* (1948). In 1925 his son Vincenzo Nitti published a vindication of his father's policy, *L'Opera di Nitti.*

NITZSCH, KARL IMMANUEL (1787–1868), Lutheran divine, was born near Leipzig on Sept. 21, 1787. He studied at Wittenberg, where he began to teach in 1809. From 1820 to 1822 he was superintendent in Kemberg, and in the latter year he was appointed professor of theology at Bonn, where he remained until called to succeed Philip Marheineke at Berlin in 1847. Subsequently he became university preacher, rector of the university, provost of St. Nicolai (in 1854) and member of the supreme council of the church, in which last capacity he was one of the ablest and most active promoters of the Evangelical union. He died on Aug. 21, 1868. He represented the *Vermittelungstheologie* of the school of Friedrich Schleiermacher, holding "that religion is not doctrine but life, direct consciousness, feeling."

His principal works are: *System der christlichen Lehre* (1829; 6th ed., 1851; Eng. trans., 1849), *Praktische Theologie* (1847–60; 2nd ed., 1863–68). *Akademische Vorträge über christliche Glaubenslehre* (1858) and several series of *Predigten.*

NIUÉ (SAVAGE ISLAND): *see* PACIFIC ISLANDS.

NIVELLE, ROBERT GEORGE (1856–1924), French soldier, was born on Oct. 15, 1856, at Tulle, Corrèze. He entered the Polytechnic in 1876, and left two years later to join the artillery. He served in China in 1900, and then for many years in Algeria. When World War I broke out, he was in command of the 5th artillery at Besançon.

Appointed a general of brigade on Oct. 24, 1914, he fought successfully on the Aisne, and in Jan. 1915 took a prominent part in the attack on Quesnevières. On Dec. 23, 1915, he was placed at the head of the 3rd corps, and in March 1916 was sent to Verdun, where after some remarkable fighting he succeeded in checking the crown prince's first attack. On May 2 he succeeded Gen. Henri Pétain in the command of the 2nd army, and definitely held the enemy before that glorious citadel. It was he who, in orders which have become famous, made the unforgettable declaration: "Ils ne passeront pas." On Dec. 12, 1916, he succeeded Gen. Joseph Joffre as commander in chief of the armies of the north and northeast. In conjunction with the British armies he prepared the great offensive of April 16, 1917, between Soissons and Auberive. After this semidefeat he was replaced by General Pétain in the command of the French armies. On May 15, 1917, he was appointed commander of the armies *chargé de mission,* and on Dec. 23, 1917, took over the French troops in North Africa.

On Oct. 14, 1918, General Nivelle was confirmed in his command despite the rules of superannuation, and on Jan. 30, 1920, was nominated a member of the supreme war council. On March 5, 1920, he gave up the command of the 19th corps, and in Nov. 1920 he was ordered to represent France in the United States at the tercentenary of the arrival of the "Mayflower." He was placed on the retired list on Oct. 11, 1921; he died on March 23, 1924. (M. GU.)

NIVELLES (Flem. *Nÿvel*), town, province of Brabant, Belgium, on the Thines 19 mi. S. of Brussels. Pop. (1947) 11,929.

It manufactures parchment, cardboard and paper. The town is supposed to owe its origin to the foundation of a convent by Itta or Iduberge, wife of Pippin of Landen, and it is the cradle of the Carlovingians. The Romanesque church of St. Gertrude, named after Itta's daughter, dates from the 11th century. On the top of the tower is the effigy of a man in iron who strikes the hours with a hammer. He is called by the townspeople Jean de Nivelles, a celebrated baron of the 15th century whose title eventually became merged in that of the count de Hornes (Horn). Close to Nivelles is Seneffe, where Condé defeated William of Orange in 1674. At Nivelles the French under Marceau defeated the Austrians in 1794.

NIVERNAIS, an old province of France, bounded by Berry, Burgundy, Auxerrois and Gâtinais. Part of the territory of the Aedui before the Roman conquest, Nivernais was, from the end of the Carolingian period, perpetually coveted by the dukes of Burgundy (*see* NEVERS). The first Valois duke of Burgundy, Philip the Bold, became master of it thanks to an inheritance from his father-in-law, Louis of Mâle. After Charles the Bold's death, it became a province and a duchy of the kingdom of France, included in the jurisdiction of the *parlement* of Paris and was a *gouvernement militaire.* After the French Revolution it was embodied almost entirely in the department of Nièvre.

See A. Massé, *Histoire du Nivernais* (Paris, 1938). (M. PAC.)

NIXIE, or NIXY, a female water sprite. The word is adapted from Ger. *Nixe,* the male water sprite being *Nix.* The general term for both the male and female is "nicker," a kelpie. This also appears in Dutch *nikker.* The Old Teutonic *nikus* may be connected with the root which is in Gr. *νίζειν* or *νίπτειν*, "to wash."

NIXON, RICHARD MILHOUS (1913-), U.S. lawyer and politician, was born at Yorba Linda, Calif., Jan. 9, 1913. Educated in the public schools, he graduated from Whittier (Calif.) college (A.B. 1934) and Duke university law school (LL.B. 1937). He practised law in Whittier (1937–42) and in 1939 became a member of the Whittier college board of trustees. He served as attorney in the office of emergency management, Washington, D.C., Jan.–Aug. 1942. He went on active duty with the U.S. navy in August, resigning his commission as lieutenant commander, Jan. 1946. He was elected as a representative to the 80th congress, Nov. 5, 1946, and re-elected to the 81st congress, Nov. 2, 1948. In 1947 he helped draft the Taft-Hartley bill, and with Rep. Karl Mundt of South Dakota sponsored the subversive activities control bill in an attempt to curb undercover communist activities in the U.S. He was associated with the citation for contempt of congress of Gerhard Eisler and conducted an inquiry into communism in Hollywood, Calif. In 1948 he was instrumental, as a member of the un-American activities committee, in sending Alger Hiss to prison for perjury. He was appointed U.S. senator from California on Dec. 1, 1950, by Gov. Earl Warren. In July 1952 he was chosen vice-presidential nominee at the Republican national convention at Chicago, Ill., as the running mate of Dwight D. Eisenhower. The Eisenhower-Nixon ticket won decisively in the national election of Nov. 4, 1952.

NIZĀMĪ (1140–1—1202–3). Nizām-uddīn Abū Mohammed Ilyās bin Yūsuf, Persian poet, was born A.H. 535 (A.D. 1140–1). His native place, or at any rate the abode of his father, was in the hills of Kum, but as he spent almost all his days in Ganja in Arrān (the present Elizavetpol) he is generally known as Nizāmī of Ganja or Ganjawī. Nizāmī abandoned himself at an early age to a stern ascetic life, as full of intolerance to others as dry and unprofitable to himself. The first poetical work in which Nizāmī embodied his thoughts on God and man, and all the experiences he had gained, was *Makhzanul Asrār* (*c.* 1165–6) or "Storehouse of Mysteries," and bears the unmistakable stamp of Sūfic speculations. His claim to the title of the earliest Persian romanticist he fully established only a year or two after the *Makhzan* by the publication of his first epic masterpiece *Khosrau and Shīrīn* (*c.* 1175–6), reciting the ancient tale of the loves of Chosroes and Shīrīn. It was composed, according to the oldest copies, in A.H. 576 (A.D. 1180), and inscribed to the reigning atābeg of Azerbaijān, Abū Ja'far Mohammed Pahlavān, and his brother Kizil Arslān, who, soon after his accession to the throne in A.H. 582, showed his gratitude to the poet by summoning him to his court, loading him with honours, and bestowing upon him the revenue of two villages, Hamd and Nijān. In 1188 Nizāmī completed his *Dīwān*, or collection of kasīdas and ghazals (mostly of an ethical and parenetic character), which are said to have numbered 20,000 distichs, although the few copies which have come to us contain only a very small number of verses. About the same time he commenced, at the desire of the ruler of the neighbouring Shīrvān, his second romantic poem, the famous Bedouin love-story of *Laila and Majnūn* (*c.* 1188–9). His *Iskandarnāma* (1191) or "Book of Alexander," also called *Sharafnāma* or *Iqbālnāma-i-Iskandarī* ("The Fortunes of Alexander"), is split into two divisions, the first based on the historical career of Alexander, which is embroidered by many magical tales, among others the voyage of Alexander to the fountain of life in the land of darkness; the second describing him as prophet and philosopher. Nizāmī's last romance *Haft Paikar* (1198–9), or the "Seven Beauties," comprises seven tales in verses related by the seven favourite wives of the Sassānian king Bahrāmgūr. Among these is the tale of the Russian princess used by Gozzi and Schiller, "Turandot." The five mathnawīs, from the *Makhzan* to the *Haft Paikar,* form Nizāmī's so-called "Quintuple" (*Khamsa*) or "Five Treasures" (*Panj Ganj*), and have been taken as pattern by all the later epic poets in the Persian, Turkish, Chaghatāi and Hindustānī languages. Nizāmī died at Ganja in his sixty-fourth year, A.H. 599 (A.D. 1202–3).

BIBLIOGRAPHY.—The fullest account of Nizāmī is given in Dr. W. Bacher's *Nizāmī's Leben und Werke* (Leipzig, 1871; English translation by S. Robinson, London, 1873; reprinted in the same author's *Persian Poetry for English Readers,* 1883, pp. 103–244). All the errors of detail in Bacher's work have been corrected by Dr. Rieu in his *Catalogue of the Persian MSS. in the British Museum* (1881), ii. 563 *sqq.*

Principal Editions.—The whole *Khamsa* (lithographed, Bombay, 1834 and 1838, Teheran, 1845); *Makhzan-ul Asrār* (edit. by N. Bland, London, 1844, lithographed, Cawnpore, 1869, English translation in ms. by Hatton Hindley, in the British Museum Add. 6961); *Khosrau and Shīrīn* (lithographed, Lahore, 1871, German translation by Hammer in *Shīrīn, ein persisches romantisches Gedicht,* Leipzig, 1809); *Laila and Majnūn* (lithographed, Lucknow, 1879; English translation by J. Atkinson, London, 1836); *Haft Paikar* (lithographed, Bombay, 1849, Lucknow, 1873; the fourth tale in German by F. von Erdmann, *Behramgur und die russische Fürstentochter,* Kasan, 1844); *Iskandarnāma,* first part, with commentary (Calcutta, 1812 and 1825, text alone, Calcutta 1853, lithographed with marginal notes, Lucknow, 1865, Bombay, 1861 and 1875, English translation by H. Wilberforce Clarke, London, 1881; compare also Erdmann, *De expeditione Russorum Berdaam versus,* Kasan, 1826, and Charmoy, *Expédition d'Alexandre contre les Russes,* St. Petersburg, 1829); *Iskandarnāma-i-Bahrī,* second part, edited by Dr. Sprenger (Calcutta, 1852 and 1869).

NIZHEGOROD (now GORKY; the name Nizhegorod is an abbreviation from Nijni-Novgorod), a region of the Russian S.F.S.R., bounded on the east by Kirov region and the Marii, Chuvash and Mordovia Autonomous Soviet Socialist republics, on the south by Ryazan region, on the west by the Ivanovo and Yaroslavl regions, and on the north by Vologda region. Area 34,440 sq.mi. Pop. (1939) 3,876,274; urban 1,218,900, rural 2,657,374. The northern portion consists of a pine forest area lying along each side of the Vetluga river from the point where it curves sharply to the south, though the lower course of the Vetluga, and its junction with the Volga, lie in the Marii republic. The forest approaches the left bank closely, but along the right bank there are a series of settlements in the forest-free strip.

South of the Volga is a fertile black earth area, between the Oka on the west, which forms the boundary of the region in the southwest and then flows through the former province of Vladimir, finally turning sharply to the east and flowing through the Gorky region to its junction with the Volga, and the Sura on the east, which flows through the Chuvash republic in the south, but forms the boundary between that republic and the Gorky region in the north of its course. This southern part has little forest and consists of high plains, with river valleys entrenching them, and the valley black earth is the most fertile soil in the entire area of the region.

The southern part is not favourable to grass and meadow cultivation, so that dairying has not developed. Grain cultivation occupies 85% of the ploughed land, the chief crops being rye and oats, with a little wheat, millet and buckwheat. Potatoes, flax

and a little hemp are grown. Fruit and vegetables are cultivated along the Oka and Volga and find a ready market in Gorky (Nijni-Novgorod). Sheep, cattle, horses, pigs and goats are raised. The region is sparsely peopled, especially in the north; the population is mainly Great Russian, though there are Mordvinian and Tatar colonies in the southeast. Bog iron ores, sand, salt and phosphorite are found. The region is rich in peat, and the electric station opened in 1925–26 at Balakhna, on the Volga, north of Gorky, works on peat fuel and has a power of 20,000 kw.

Factory industries include the making of machinery for railway and river transport, and for local peasant industries, flour milling, distilling, sawmilling and the manufacture of cardboard and paper, brewing and the making of eather goods. The poor guarantee for agriculture has led to a great development of koustar (peasant) industry, especially the making of wooden articles (41%) and textiles, including woollen goods and felt (30%). Special peasant industries are wooden spoons in Semenov, cutlery and locks in Gorbatov, spindles in Balakhna, fancy boxes in Makaryev, and furs and leather goods.

NIZHNI TAGIL (NIZHNE-TAGILSK, TAGIL), a city of the Russian S.F.S.R., in the Sverdlovsk region, in 57° 27′ N., 59° 54′ E. Pop. (1939) 159,864. It lies in a valley on the eastern slope of the Ural mountains, within a few miles of the place where the Tagil escapes to the lowlands to join the Tura, a tributary of the Tobol. The southern part of this valley is occupied by the upper Tagil, and its northern portion by the upper Tura, from which the Tagil is separated by a low watershed. The town is connected by railway (the first in Siberia) with Perm and Sverdlovsk, and with mines to the east and west. It was founded in 1725 by the Russian mine-owner Demidov. Nizhni Tagil is a central foundry for iron mines and other works. Gold, platinum and copper are mined at Nizhni Tagil, and there is a brick-making industry. Wagon works with an output of 5,000 wagons per annum have been under construction.

NIZHNIY NOVGOROD: *see* NIJNI-NOVGOROD.

NOAH appears in Genesis v. 29 as son of Lamech and tenth in descent from Adam. The hazardous attempt of the verse to find an etymology for the name in the Hebrew verb "comfort" is an extract from another tradition, and views Noah as repairing in some measure by his discovery of vine-culture, Gen. ix. 20, the disaster of the curse pronounced upon the ground by Yahweh in consequence of the Fall. The story of the Deluge has Noah for its hero. He is represented as the patriarch who, because of his blameless piety, was chosen by God to perpetuate the human race after his wicked contemporaries had perished in the Flood. He receives a divine warning of the impending disaster, and is instructed to build an ark, in which he and his family are preserved alive. In accordance with God's instructions Noah took into the ark specimens of all animals, from which the stocks might be replenished. The story has close affinities with Babylonian traditions, in which Ut-napishtim plays the part corresponding to that of Noah (*see* DELUGE). The narrative of Gen. ix. 18–27 belongs to a different cycle, which seems to know nothing of the Flood story. In the latter Noah's sons are married, and their wives accompany them in the ark; but in this narrative they would seem to be unmarried, living in the tent with their father; nor does the shameless drunkenness of Noah accord well with the character of the pious hero of the Flood story. Three different motives may be traced in Gen. ix. 18–27: first the passage explains to whom agriculture, and in particular the culture of the vine, was due; secondly it attempts to provide in the persons of Noah's three sons, Shem, Ham and Japheth, ancestors for three of the races of mankind, and to account in some degree for their historic relations; in the third place, by its censure of Ham—for whom it is almost certain that Canaan stood in the original text—it reprobates the licentious Canaanite civilization.

(W. L. W.)

NOAILLES, the name of a great French family, derived from the castle of Noailles in the territory of Ayen, between Brive and Turenne in the Limousin, and claiming to date back to the 11th century. In the 16th century, its head, ANTOINE de Noailles (1504–1562), became admiral of France, and was ambassador in England during three important years, 1553–1556, maintaining a gallant but unsuccessful rivalry with the Spanish ambassador, Simon Renard. HENRI (1554–1623), son of Antoine, was a commander in the religious wars, and was made comte d'Ayen by Henry IV. in 1593. ANNE (d. 1678), the grandson of the first count, played an important part in the Fronde and the early years of the reign of Louis XIV., became captain-general of the newly won province of Roussillon, and in 1663 was made duc d'Ayen, and peer of France.

ADRIEN MAURICE (1678–1766), the third duke, served in the wars of Louis XV. in Italy and Germany, and became a marshal in 1734. In the war of the Austrian succession he was beaten by the English at the battle of Dettingen in 1743. He married Françoise d'Aubigné, a niece of Madame de Maintenon, and two of his sons became marshals of France. The elder, LOUIS (1713–1793), who bore the title of duc d'Ayen till his father's death in 1766, when he became duc de Noailles, served in most of the wars of the 18th century, and was made a marshal in 1775. He refused to emigrate during the Revolution and died in Aug. 1793, before the Terror reached its height. On the 4th Thermidor (July 22) the aged duchesse de Noailles was executed with her daughter-in-law, the duchesse d'Ayen, and her granddaughter, the vicomtesse de Noailles. JEAN PAUL FRANÇOIS (1739–1824), the fifth duke, was in the army, but his tastes were scientific, and for his eminence as a chemist he was elected a member of the Academy of Sciences in 1777. He became duc d'Ayen in 1766 on his grandfather's death, and duc de Noailles on his father's in 1793. He lived in Switzerland from 1792 until the Restoration in 1814, when he took his seat as a peer of France.

One other branch of the family deserves notice. PHILIPPE (1715–1794), comte de Noailles, afterwards duc de Mouchy, a younger brother of the fourth duke, served at Minden and in other campaigns, and was made a marshal on the same day as his brother. He was long in great favour at court, and his wife was first lady of honour to Marie Antoinette, and was nicknamed by her Madame Étiquette. This court favour brought down punishment in the days of the Revolution, and the old marshal and his wife were guillotined on June 27, 1794.

PHILIPPE LOUIS MARC ANTOINE, duke of Noailles and prince of Poix (1752–1819), was born on Nov. 21, 1752. In 1789 he was elected deputy of the States-General by the nobility of the *bailliages* of Amiens and Ham, but was compelled to resign in consequence of a duel with the commander of the Garde Nationale at Versailles. He left the country but returned and took part in the revolution of Aug. 10, 1792, after which he again escaped until 1800. At the Restoration he was brought again into favour and became a peer of France. He died at Paris on Feb. 17, 1819.

LOUIS MARIE (1756–1804), vicomte de Noailles, was the second son of the marshal. He served brilliantly under La Fayette in America, and concluded the capitulation of Yorktown. He was elected to the states-general in 1789. He began the famous "orgie," as Mirabeau called it, on Aug. 4, when all privileges were abolished, and with d'Aiguillon proposed the abolition of titles and liveries in June 1790. When the Revolution became more pronounced he emigrated to America. He accepted a command against the English in San Domingo, under Rochambeau. He made a brilliant defence of the mole St. Nicholas, and escaped with the garrison to Cuba; but in making for Havana his ship was attacked by an English frigate, and after a long engagement he was severely wounded, and died on Jan. 9, 1804.

NOAKHALI, a district and town of British India, in the Chittagong division of eastern Bengal province. The town (pop. [1941] 18,575), also known as Sudharam, is on a small river channel 10 mi. from the sea. The DISTRICT OF NOAKHALI has an area of 1,658 sq.mi.; pop. (1941) 2,217,402. It consists of an alluvial tract of mainland and several islands at the mouth of the Meghna. In general, every homestead is surrounded by a thick grove of betel and coconut palms. Rice is the staple of cultivation. The district is fertile and is under continuous cultivation. The delta was swept by a storm wave on Oct. 31, 1876, and about 100,000 lives were lost. The district is served by the Assam-Bengal railway.

NOBEL, ALFRED BERNHARD (1833–1896), Swedish chemist and engineer, was born at Stockholm on Oct. 21, 1833. He spent only two terms in school and thereafter was taught by tutors. About 1850 he was sent on travels to complete his education as an engineer and spent about a year in the United States. He fought against sickness all his life. On his return to Sweden after a stay in St. Petersburg he devoted himself to the study of explosives, and especially to nitroglycerin. He found that when that body was incorporated with an absorbent, inert substance like *kieselguhr* it could be safely used. In 1867 he was granted a British patent for dynamite and in 1868 a U.S. patent. Nobel next combined nitroglycerin with another high explosive, guncotton, and obtained a transparent, jellylike substance which was a still more powerful explosive than dynamite. Blasting gelatin, as it was called, was patented in 1876. It combined the high power of nitroglycerin with the comparative safety in handling of dynamite. About 13 years later Nobel produced ballistite, one of the earliest of the nitroglycerin smokeless powders and a precursor of cordite. Nobel's claim that his patent covered the latter was the occasion of vigorously contested lawsuits between him and the British government in 1894 and 1895; the question was complicated, but eventually the courts decided against Nobel. He resented the verdict since he felt that it was unjust.

An accomplishment of importance equal to that of his explosives was his construction and perfection of detonators for such explosives as could not be made to explode by simple firing. His detonators contained fulminate of mercury. These detonators make it possible to set off the explosive energy of nitroglycerin, guncotton, etc., at will; without detonators such explosives could not be used at all. From the manufacture of dynamite and other explosives, and from the exploitation of the Baku oil fields, he amassed an immense fortune. He never married. He was lonely and this together with his ill health imbued him with pessimism and a satirical view of mankind which was nevertheless combined with benevolence and belief in the future of humanity. At his death on Dec. 10, 1896, at San Remo, Italy, he left the bulk of his fortune in trust to establish five prizes (*see* NOBEL PRIZES).

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NOBEL PRIZES. These prizes, five in number, are awarded annually from the Nobel foundation, a fund established under the will of Alfred Bernhard Nobel (*q.v.*). Distribution was begun on Dec. 10, 1901, the fifth anniversary of the founder's death. The awards are in the fields of physics, chemistry, physiology or medicine, literature and peace. Each consists of a gold medal, a diploma bearing a citation, and a sum of money approximating $33,000, the amount being dependent upon the income of the foundation. The prize may be divided among two or three recipients. Any prize may be withheld for one year or longer and when not distributed its amount reverts to the main fund, or to special reserves for each section. The peace prize has been reserved most frequently and special Nobel institutes have been created with the surplus funds. The Nobel prizes are open to all nationalities and are not competitive. Candidates are nominated by the following agencies: physics and chemistry by the Royal Academy of Sciences in Stockholm, Swed.; physiology or medicine by the Caroline Medical institute in Stockholm; literature by the Swedish Academy of Literature in Stockholm and the academies of France and of Spain; peace by a committee of five elected by the Norwegian *storting* (parliament).

BIBLIOGRAPHY.—Fritz Henriksson, *The Nobel Prizes and Their Founder, Alfred Nobel* (1938); T. W. MacCallum and Stephen Taylor, eds., *The Nobel Prize-Winners and the Nobel Foundation 1901–1937* (1938); Flora Kaplan, *Nobel Prize Winners, Charts, Indexes, Sketches* (rev. ed., 1941). (B. GM.)

WINNERS OF NOBEL PRIZES

(Asterisks denote contributors to *Encyclopædia Britannica*)

Physics

1901	Wilhelm Konrad Röntgen	1845–1923	(German)	Discovery of X-rays
1902	Hendrik Antoon Lorentz	1853–1928	(Dutch)	Influence of magnetism on the phenomena of radiation
	Pieter Zeeman	1865–1943	(Dutch)	
1903	Henri Becquerel	1852–1908	(French)	Discovery of the radioactive elements of radium and polonium
	Pierre Curie	1859–1906	(French)	
	Marie Curie	1867–1934	(French) (born Poland)	
1904	Baron Rayleigh*	1842–1919	(English)	Discovery of argon
1905	Philipp Lenard	1862–1947	(German)	Research in cathode rays
1906	Sir Joseph John Thomson*	1856–1940	(English)	Conduction of electricity through gases
1907	Albert A. Michelson*	1852–1931	(U.S.)	Spectroscopic and metrologic investigations
1908	Gabriel Lippmann	1845–1921	(French)	Photographic reproduction of colours
1909	Guglielmo Marconi	1874–1937	(Italian)	Development of wireless telegraphy
	Karl Ferdinand Braun	1850–1918	(German)	
1910	Johannes Diderik van der Waals	1837–1923	(Dutch)	Equations of conditions of gases and fluids
1911	Wilhelm Wien	1864–1928	(German)	Laws of heat radiation
1912	Nils Gustaf Dalén	1869–1937	(Swedish)	Coast lighting
1913	Heike Kamerlingh-Onnes	1853–1926	(Dutch)	Properties of matter at low temperatures; production of liquid helium
1914	Max von Laue	1879–	(German)	Diffraction of X-rays in crystals
1915	Sir William Henry Bragg	1862–1942	(English)	Study of crystal structure by means of X-rays
	William Lawrence Bragg	1890–	(English—his son)	
1916	(No award)			
1917	Charles Glover Barkla	1877–1944	(English)	Discovery of the characteristic Röntgen radiation of the elements
1918	Max Planck	1858–1947	(German)	Discovery of the elemental quantum
1919	Johannes Stark	1874–	(German)	Discovery of the Doppler effect in canal rays and the division of spectral lines in the electric field
1920	Charles Edouard Guillaume	1861–1938	(Swiss)	Discovery of the anomalies of nickel-steel alloys
1921	Albert Einstein*	1879–	(German)	Founder of theory of relativity and discoverer of law of photoelectric effect
1922	Niels Bohr*	1885–	(Danish)	Study of structure and radiations of atoms
1923	Robert Andrews Millikan	1868–1953	(U.S.)	Work on elementary electric charge and the photoelectric effect
1924	Karl Manne Siegbahn*	1886–	(Swedish)	Discoveries in the area of X-ray spectra
1925	James Franck	1882–	(German)	Laws governing collision between electron and atom
	Gustav Hertz	1887–	(German)	
1926	Jean Perrin*	1870–1942	(French)	Discovery of the equilibrium of sedimentation
1927	Arthur H. Compton*	1892–	(U.S.)	Discovery of the dispersion of X-rays
	Charles T. R. Wilson	1869–	(English)	Method of rendering discernible the courses of electrically charged particles by water condensation
1928	Sir Owen Willans Richardson	1879–	(English)	Discovery of the law known by his name (the dependency of the emission of electrons on temperature)
1929	Louis-Victor de Broglie	1892–	(French)	Wave nature of electrons
1930	Sir Chandrasekhara Raman	1888–	(Indian)	Works on the diffusion of light and discovery of the effect known by his name
1931	(No award)			
1932	Werner Heisenberg	1901–	(German)	Creation of quantum mechanics
1933	Paul Adrien Maurice Dirac	1902–	(English)	Discovery of new fertile forms of the atomic theory
	Erwin Schrödinger	1887–	(Austrian)	
1934	(No award)			
1935	James Chadwick*	1891–	(English)	Discovery of the neutron
1936	Victor Hess	1883–	(Austrian)	Discovery of cosmic radiation
	Carl David Anderson	1905–	(U.S.)	Discovery of the positron
1937	Clinton Joseph Davisson	1881–	(U.S.)	Discovery of diffraction of electrons by crystals
	George P. Thomson	1892–	(English)	
1938	Enrico Fermi	1901–	(Italian)	Artificial radioactive substances
1939	E. O. Lawrence	1901–	(U.S.)	Invention of cyclotron
1940–42	(No award)			
1943	Otto Stern	1888–	(U.S.)	Detection of magnetic movements of protons
1944	Isidor Isaac Rabi	1898–	(U.S.)	Studies of atom's nucleus
1945	Wolfgang Pauli	1900–	(Austrian)	Work on atomic fissions
1946	Percy Williams Bridgman*	1882–	(U.S.)	High-pressure physics
1947	Sir Edward Appleton*	1892–	(English)	Discovery of Appleton layer
1948	Patrick Maynard Stuart Blackett	1897–	(English)	Discoveries in cosmic radiation
1949	Hideki Yukawa	1907–	(Japanese)	Theoretical work on meson
1950	Cecil Frank Powell	1903–	(English)	Photographic method of studying atomic nuclei; discoveries about mesons
1951	Sir John Douglas Cockcroft	1897–	(English)	Transmutation of atomic nuclei by artificially accelerated atomic particles
	Ernest Thomas Sinton Walton	1903–	(Irish)	
1952	Felix Bloch	1905–	(U.S.)	Measure of magnetic fields in atomic nuclei
	Edward Mills Purcell	1912–	(U.S.)	
1953	Frits Zernike	1888–	(Dutch)	Introduction of phase contrast microscopy

Chemistry

1901	Jacobus Henricus van't Hoff	1852–1911	(Dutch)	Laws of chemical dynamics and osmotic pressure
1902	Emil Fischer	1852–1919	(German)	Synthetic work with the sugar and purine groups
1903	Svante Arrhenius	1859–1927	(Swedish)	Theory of electrolytic dissociation
1904	Sir William Ramsay	1852–1916	(English)	Discovery of different gaseous basic materials in the atmosphere and their places in periodic system

Chemistry—Continued

1905	Adolf von Baeyer	1835–1917	(German)	Organic dyes and aromatic hydrocarbon compounds
1906	Henri Moissan	1852–1907	(French)	Isolation of the element fluorine and introduction of Moissan furnace
1907	Eduard Buchner	1860–1917	(German)	Discovery of noncellular fermentation
1908	Sir Ernest Rutherford*	1871–1937	(English)	Decay of elements and chemistry of radioactive substances
1909	Wilhelm Ostwald	1853–1932	(German)	Work on catalysis, chemical equilibrium and reaction velocities
1910	Otto Wallach	1847–1931	(German)	Pioneer work in alicyclic combinations
1911	Marie Curie	1867–1934	(French)	Discovery of basic materials of radium and polonium; isolation of radium in metallic condition
1912	Victor Grignard	1871–1935	(French)	Discovery of the so-called Grignard reaction
	Paul Sabatier	1854–1941	(French)	Method of hydrating organic combinations in presence of finely divided metals
1913	Alfred Werner	1866–1919	(Swiss)	Combined conditions of atoms in molecule; research in inorganic chemistry
1914	Theodore William Richards*	1868–1928	(U.S.)	Exact determination of the atomic weights of numerous chemical substances
1915	Richard Willstätter	1872–1942	(German)	Investigation of dyestuffs in the vegetable kingdom, especially of chlorophyll
1916	(No award)			
1917	(No award)			
1918	Fritz Haber	1868–1934	(German)	Invention of a process of procuring ammonia synthetically from its elements
1919	(No award)			
1920	Walter Nernst	1864–1941	(German)	Thermochemical work
1921	Frederick Soddy	1877–	(English)	Chemistry of radioactive substances; occurrence and nature of isotopes
1922	Francis William Aston*	1877–1945	(English)	Discovery of the conduct of isotope mixtures and the law of complete numbers
1923	Fritz Pregl	1869–1930	(Austrian)	Microanalysis of organic substances
1924	(No award)			
1925	Richard Zsigmondy	1865–1929	(German)	Heterogeneous nature of colloidal solutions
1926	Theodor Svedberg	1884–	(Swedish)	Work on disperse systems
1927	Heinrich Wieland	1877–	(German)	For researches on bile acids
1928	Adolf Windaus	1876–	(German)	Constitution of sterins and their connection with the vitamin group
1929	Sir Arthur Harden	1865–1940	(English)	Fermentation of sugars and the enzymes acting in this connection
	Hans von Euler-Chelpin	1873–	(Swedish)	
1930	Hans Fischer	1881–1945	(German)	The chemistry of pyrrole and the synthesis of haemin
1931	Carl Bosch	1874–1940	(German)	Invention and development of chemical high-pressure methods
	Friedrich Bergius	1884–1949	(German)	
1932	Irving Langmuir	1881–	(U.S.)	Discoveries in surface chemistry
1933	(No award)			
1934	Harold Clayton Urey*	1893–	(U.S.)	Discovery of heavy hydrogen
1935	Frédéric Joliot	1900–	(French)	For artificially producing radioactive elements
	Irène Joliot-Curie*	1897–	(French)	
1936	Peter Debye	1884–	(Dutch)	Theoretic and experimental physics
1937	Walter Norman Haworth*	1883–1950	(English)	Research on carbohydrates and vitamin C
	Paul Karrer	1889–	(Swiss)	Vitamin researches; vegetable dyestuffs
1938	Richard Kuhn	1900–	(German)	Carotinoid study and vitamin research (declined the award)[1]
1939	Adolph Butenandt	1903–	(German)	Work on sexual hormones (declined the award)[1]
	Leopold Ruzicka	1887–	(Swiss)	Polymethylenes and the higher terpen compounds
1940–42	(No award)			
1943	Georg von Hevesy	1885–	(Hungarian)	Discoverer of hafnium
1944	Otto Hahn	1879–	(German)	Atomic fission
1945	Artturi Virtanen	1895–	(Finnish)	Conservation of fodder
1946	James B. Sumner	1887–	(U.S.)	Crystallizing of enzymes
	John H. Northrop	1891–	(U.S.)	Purified production of enzymes and virus products
	Wendell M. Stanley	1904–	(U.S.)	
1947	Sir Robert Robinson*	1886–	(English)	Alkaloids and other plant products
1948	Arne Tiselius	1902–	(Swedish)	Colloid analysis
1949	William Francis Giauque	1895–	(U.S.)	Properties of matter under conditions approaching absolute zero
1950	Otto Diels	1876–1954	(German)	Development of dien-synthesis
	Kurt Alder	1902–	(German)	
1951	Edwin M. McMillan	1907–	(U.S.)	Discoveries of transuranium elements
	Glenn T. Seaborg*	1912–	(U.S.)	
1952	Archer J. P. Martin	1910–	(English)	Separation of chemical compounds
	Richard L. M. Synge	1914–	(English)	
1953	Hermann Staudinger	1881–	(German)	Study of macromolecule

Physiology or Medicine

1901	Emil von Behring	1854–1917	(German)	Serum therapeutics
1902	Sir Ronald Ross	1857–1932	(English)	Malaria from mosquito to human
1903	Niels Ryberg Finsen	1860–1904	(Danish)	Light treatment in disease, especially skin diseases
1904	Ivan Petrovich Pavlov	1849–1936	(Russian)	Physiology of digestion
1905	Robert Koch	1843–1910	(German)	Founded scientific bacteriology and bacterial cultures
1906	Camillo Golgi	1843–1926	(Italian)	Structure of nervous system
	Santiago Ramón y Cajal	1852–1934	(Spanish)	
1907	Charles Louis Alphonse Laveran	1845–1922	(French)	Protozoans as irritants of disease (trypanosomes, etc.)
1908	Paul Ehrlich	1854–1915	(German)	Immunity
	Ilya Mechnikov	1845–1916	(Russian)	
1909	Emil Theodor Kocher	1841–1917	(Swiss)	Physiology, pathology and surgery of thyroid gland
1910	Albrecht Kossel	1853–1927	(German)	Cellular chemistry, especially albumin and nuclein substances
1911	Allvar Gullstrand	1862–1930	(Swedish)	Dioptrics of the eye
1912	Alexis Carrel*	1873–1944	(French)	Vascular seams and organ and blood vessel transplantation
1913	Charles Richet	1850–1935	(French)	Anaphylactic test
1914	Robert Bárány	1876–1936	(Austrian)	Physiology and pathology of human vestibular apparatus
1915	(No award)			
1916	(No award)			
1917	(No award)			
1918	(No award)			
1919	Jules Bordet	1870–	(Belgian)	Discoveries in the realm of immunity
1920	August Krogh	1874–1949	(Danish)	Capillary-motoric mechanism of regulation
1921	(No award)			
1922	Archibald Vivian Hill*	1886–	(English)	Discovery relating to the heat production of muscles
	Otto Meyerhof	1884–1951	(German)	Discovery of correlation between consumption of oxygen and production of lactic acid in muscles
1923	Sir Frederick Grant Banting	1891–1941	(Canadian)	Insulin
	J. J. R. Macleod*	1876–1935	(Scotch)	
1924	Willem Einthoven	1860–1927	(Dutch)	Mechanism of the electrocardiograph
1925	(No award)			
1926	Johannes Andreas Grib Fibiger	1867–1928	(Danish)	Discovery of Spiroptera carcinoma
1927	Julius Wagner-Jauregg	1857–1940	(Austrian)	Therapeutic importance of malaria vaccination in dementia paralytica
1928	Charles Nicolle	1866–1936	(French)	Work on typhus exanthematicus
1929	Christiaan Eijkman	1858–1930	(Dutch)	Antineuritic vitamins
	Sir Frederick Hopkins*	1861–1947	(English)	Growth-promoting vitamins
1930	Karl Landsteiner	1868–1943	(U.S.)	Human blood groups
1931	Otto Heinrich Warburg	1883–	(German)	Respiratory ferment
1932	Edgar Douglas Adrian*	1889–	(English)	Function of the neurone
	Sir Charles Scott Sherrington*	1861–1952	(English)	
1933	Thomas Hunt Morgan*	1866–1945	(U.S.)	Hereditary functions of chromosomes
1934	George Richards Minot	1885–1950	(U.S.)	Liver therapy of anaemia
	William Parry Murphy	1892–	(U.S.)	
	George Hoyt Whipple	1878–	(U.S.)	
1935	Hans Spemann	1869–1941	(German)	Embryonic development
1936	Sir Henry Hallett Dale	1875–	(English)	Chemical transmission of nerve impulses
	Otto Loewi	1873–	(Austrian)	
1937	Albert von Szent-Györgyi von Nagyrapolt	1893–	(Hungarian)	Biological combustion, especially vitamin C and catalysis of fumaric acid
1938	Corneille Heymans	1892–	(Belgian)	Regulation of respiration
1939	Gerhard Domagk	1895–	(German)	Antibacterial effect of prontosil (declined award)[1]
1940–42	(No award)			
1943	Edward Adelbert Doisy	1893–	(U.S.)	Research into and discovery of vitamin K
	Henrik Dam	1895–	(Danish)	
1944	Joseph Erlanger	1874–	(U.S.)	Differentiation of nerves
	Herbert Spencer Gasser	1888–	(U.S.)	
1945	Sir Alexander Fleming*	1882(?)–	(English)	Discovery of penicillin
	Ernst Boris Chain	1906–	(British cit.)	Development of penicillin
	Sir Howard Florey*	1898–	(English)	
1946	Hermann J. Muller*	1890–	(U.S.)	Heredity effects of X-rays
1947	Carl F. Cori	1896–	(U.S.)[2]	Isolation of enzyme initiating conversion of animal starch into sugar
	Gerty T. Cori	1896–	(U.S.)[2]	
	Bernardo A. Houssay	1887–	(Argentine)	Pituitary hormone function
1948	Paul Mueller	1899–	(Swiss)	Properties of DDT
1949	Walter Rudolf Hess	1881–	(Swiss)	Functions of middle brain
	Antonio Egas Moniz	1874–	(Portuguese)	Prefrontal leucotomy
1950	Philip S. Hench	1896–	(U.S.)	Work with cortisone and other adrenal hormones
	Edward C. Kendall*	1886–	(U.S.)	
	Tadeusz Reichstein	1897–	(Swiss)	
1951	Max Theiler	1899–	(South African)	Discoveries concerning yellow fever
1952	Selman A. Waksman	1888–	(U.S.)	Codiscovery of streptomycin
1953	Fritz Albert Lipmann	1899–	(German-U.S.)	Discovery of co-enzyme A
	Hans Adolph Krebs*	1900–	(German-English)	Development of so-called Krebs or citric acid cycle

Literature

1901	René Sully-Prudhomme	1839–1907	(French)	Poet
1902	Theodor Mommsen	1817–1903	(German)	Historian
1903	Björnstjerne Björnson	1832–1910	(Norwegian)	Dramatist, poet, novelist
1904	Frédéric Mistral	1830–1914	(French)	Poet
	José Echegaray	1832–1916	(Spanish)	Dramatist
1905	Henryk Sienkiewicz	1846–1916	(Polish)	Novelist
1906	Giosuè Carducci	1835–1907	(Italian)	Poet
1907	Rudyard Kipling	1865–1936	(English)	Novelist and poet
1908	Rudolf Eucken	1846–1926	(German)	Philosopher
1909	Selma Lagerlof	1858–1940	(Swedish)	Novelist
1910	Paul von Heyse	1830–1914	(German)	Novelist, dramatist, poet
1911	Maurice Maeterlinck	1862–1949	(Belgian)	Dramatist
1912	Gerhart Hauptmann	1862–1946	(German)	Dramatist
1913	Sir Rabindranath Tagore	1861–1941	(Indian)	Poet
1914	(No award)			

[1]By Hitler's decree of Jan. 31, 1937, all Germans were forbidden to accept Nobel prizes.

[2]Born in Prague, in U.S. since 192 , U.S citizens.

Literature—Continued

1915	Romain Rolland	1866–1944	(French)	Novelist
1916	Verner von Heidenstam	1859–1940	(Swedish)	Poet
1917	Karl Gjellerup	1857–1919	(Danish)	Novelist
	Henrik Pontoppidan	1857–1943	(Danish)	Novelist
1918	(No award)			
1919	Carl Spitteler	1845–1924	(Swiss)	Poet and novelist
1920	Knut Hamsun	1859–1952	(Norwegian)	Novelist
1921	Anatole France	1844–1924	(French)	Novelist
1922	J. Benavente y Martínez	1866–1936(?)	(Spanish)	Dramatist
1923	William Butler Yeats	1865–1939	(Irish)	Poet
1924	Wladyslaw S. Reymont	1868–1925	(Polish)	Novelist
1925	George Bernard Shaw*	1856–1950	(Irish)	Dramatist
1926	Grazia Deledda	1875–1936	(Italian)	Novelist
1927	Henri Bergson	1859–1941	(French)	Philosopher
1928	Sigrid Undset	1882–1949	(Norwegian)	Novelist
1929	Thomas Mann	1875–	(German)	Novelist
1930	Sinclair Lewis	1885–1951	(U.S.)	Novelist
1931	Erik Axel Karlfeldt	1864–1931	(Swedish)	Poet
1932	John Galsworthy	1867–1933	(English)	Novelist
1933	Ivan Bunin	1870–1953	(Russian)	Novelist
1934	Luigi Pirandello	1867–1936	(Italian)	Dramatist
1935	(No award)			
1936	Eugene O'Neill	1888–1953	(U.S.)	Dramatist
1937	Roger Martin du Gard	1881–	(French)	Novelist
1938	Pearl Buck	1892–	(U.S.)	Novelist
1939	Frans Emil Sillanpää	1888–	(Finnish)	Novelist
1940	(No award)			
1941	(No award)			
1942	(No award)			
1943	(No award)			
1944	Johannes V. Jensen	1873–1950	(Danish)	Novelist
1945	Gabriela Mistral	1889–	(Chilean)	Poet
1946	Hermann Hesse	1877–	(Swiss)	Novelist
1947	André Gide	1869–1951	(French)	Novelist and essayist
1948	Thomas Stearns Eliot	1888–	(English)	Poet and critic
1949	William Faulkner	1897–	(U.S.)	Novelist
1950	Bertrand Russell*	1872–	(English)	Philosopher, mathematician
1951	Pär Fabien Lagerkvist	1891–	(Swedish)	Novelist and poet
1952	François Mauriac	1885–	(French)	Poet, novelist, dramatist
1953	Sir Winston Churchill	1874–	(English)	Historian and orator

Peace

1901	Jean Henri Dunant	1828–1910	(Swiss)
	Frédéric Passy	1822–1912	(French)
1902	Élie Ducommun	1833–1906	(Swiss)
	Charles Albert Gobat	1843–1914	(Swiss)
1903	Sir William R. Cremer	1838–1908	(English)
1904	Institute of International Law	Founded 1873	
1905	Baroness Bertha von Suttner	1843–1914	(Austrian)
1906	Theodore Roosevelt	1858–1919	(U.S.)
1907	Ernesto Teodoro Moneta	1833–1918	(Italian)
	Louis Renault	1843–1918	(French)
1908	Klas Pontus Arnoldson	1844–1916	(Swedish)
	Fredrik Bajer	1837–1922	(Danish)
1909	Auguste Beernaert	1829–1912	(Belgian)
	Barón Paul de Constant de Rebecque	1852–1924	(French)
1910	International Peace Bureau	Founded 1891	
1911	Tobias Asser	1838–1913	(Dutch)
	Alfred Fried	1864–1921	(Austrian)
1912	Elihu Root*	1845–1937	(U.S.)
1913	Henri la Fontaine	1854–1943	(Belgian)
1914	(No award)		
1915	(No award)		
1916	(No award)		
1917	International Red Cross Committee	Founded 1863	
1918	(No award)		
1919	Woodrow Wilson	1856–1924	(U.S.)
1920	Léon Bourgeois	1851–1925	(French)
1921	Karl Hjalmar Branting	1860–1925	(Swedish)
	Christian Louis Lange	1869–1938	(Norwegian)
1922	Fridtjof Nansen*	1861–1930	(Norwegian)
1923	(No award)		
1924	(No award)		
1925	Sir Joseph Austen Chamberlain	1863–1937	(English)
	Charles Gates Dawes	1865–1951	(U.S.)
1926	Aristide Briand	1862–1932	(French)
	Gustav Stresemann	1878–1929	(German)
1927	Ferdinand Buisson	1841–1932	(French)
	Ludwig Quidde	1858–1941	(German)
1928	(No award)		
1929	Frank B. Kellogg	1856–1937	(U.S.)
1930	Nathan Söderblom	1866–1931	(Swedish)
1931	Jane Addams	1860–1935	(U.S.)
	Nicholas Murray Butler*	1862–1947	(U.S.)
1932	(No award)		
1933	Sir Norman Angell*	1874–	(English)
1934	Arthur Henderson	1863–1935	(English)
1935	Carl von Ossietzky	1889–1938	(German)
1936	Carlos de Saavedra-Lamas	1880–	(Argentine)
1937	Viscount Cecil of Chelwood	1864–	(English)
1938	Nansen International Office for Refugees	Founded 1921	
1939	(No award)		
1940	(No award)		
1941	(No award)		
1942	(No award)		
1943	(No award)		
1944	International Red Cross Committee	Founded 1863	
1945	Cordell Hull	1871–	(U.S.)
1946	Emily Greene Balch	1867–	(U.S.)
	John R. Mott	1865–	(U.S.)
1947	American Friends Service Committee (U.S.); Friends Service Council (London)		
1948	(No award)		
1949	Lord Boyd-Orr	1880–	(English)
1950	Ralph Bunche*	1904–	(U.S.)
1951	Léon Jouhaux	1879–1954	(French)
1952	Albert Schweitzer	1875–	(Alsatian)
1953	George Catlett Marshall*	1880–	(U.S.)

NOBILE, UMBERTO (1885–   ), Italian explorer, was born at Lauro on Jan. 21, 1885. He was educated at the Naples Polytechnic, and became an engineer. Later he obtained a post with the ministry of public works in Rome. He was given a post in the war ministry and was entrusted with the construction of the airship "Roma," with the assistance of Uselli. His airship, the "Norge," was used for the flight with Roald Amundsen to the pole in May 1926, when a landing was made at Teller, Alaska. Nobile was promoted to the rank of general, was made a marquis and appointed a professor at the Naples Technical college. A controversy subsequently arose both with Lincoln Ellsworth and Amundsen with reference to the credit for leadership of the expedition. In May 1928 Nobile set out on a second expedition to the north pole in the airship "Italia," but shortly after passing over the pole on May 24, 1928, the airship crashed on the ice (May 25). The gondola and main cabin were smashed, and the ten men in them thrown out on the ice. Seven of the party were carried away with the balloon and were never traced. On May 30 three of the party, Finn Malmgren, Adalbert Mariano and Filippi Zappi, set out on foot, hoping to reach Cape North. After their departure on June 9, the remainder of the expedition managed to establish wireless communications with rescue parties, and on June 23 Nobile was rescued by an aeroplane belonging to the Swedish expedition. The six men remaining with the party were rescued. Mariano and Zappi were located on July 12 by the Russian airman Tchuknovsky. Malmgren (*q.v.*) died near Brock Island. Nobile was found responsible for the loss of the "Italia" by an Italian commission of inquiry in 1929 and resigned his rank in consequence, but was reinstated in 1945. From 1939 to 1942 he taught in the U.S., returning to Italy in 1943.

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NOBLE, SIR ANDREW, 1ST BART., cr. 1902 (1832–1915), British physicist and artillerist, was born at Greenock on Sept. 15, 1832, and was educated at Edinburgh academy and at the Royal Military academy, Woolwich. In 1849 he entered the royal artillery, attaining the rank of captain in 1855, and in 1857 became secretary to the Royal Artillery institution. About this time the question of the supersession of the old smooth-bores by rifled guns was coming to the fore, and on the appointment of the select committee on rifled cannon in 1858 to report on the matter, he was chosen its secretary. He devised an ingenious method for comparing the probable accuracy of the shooting attainable with each type of gun. In 1859 he was appointed assistant-inspector of artillery, and in the following year he became a member of the ordnance select committee and of the committee on explosives, serving on the latter until its dissolution 20 years later. About the same time he was prevailed upon by Sir William, afterward Lord, Armstrong to leave the public service and take up a post at Elswick. There he became chairman of the company. About 1862 he invented his chronoscope for the measurement of exceedingly small intervals of time and began to apply it in ballistic experiments for ascertaining the velocity with which the shot moves along the barrel of a gun with different powders and different charges. Then he joined Sir Frederick Abel in a classical research on "fired gunpowder," the experimental work being largely carried on at Elswick. The conclusions they reached had a great effect on the progress of gunnery, for they showed increased pressures in the gun. Noble advocated nitro or "smokeless" powders, and the Elswick works provided facilities, which were not offered by the government, for the necessary experimental work of the committee on cordite. Nobel received many honours. His scientific papers were collected as *Artillery and Explosives* (1906). He died in Argyllshire on Oct. 22, 1915.

NOCERA INFERIORE, formerly NOCERA DEI PAGANI (anc. city *Nuceria Alfaterna*), town and episcopal see, Campania, Italy, province of Salerno, at the foot of Monte Albino, 23 mi. E.S.E. of Naples by rail, 135 ft. above sea level. Pop. (1951) 35,688 (commune). In the old castle Helena, widow of Manfred, died after the battle of Benevento. Two miles east near the village of Nocera Superiore is the circular domed church of Sta. Maria Maggiore, dating from the 4th century.

The city early became an episcopal see, and in the 12th century it sided with Innocent II against Roger of Sicily, suffering severely for its choice. A colony of Saracens introduced by Frede-

rick II probably gave rise to the epithet ("of the pagans"), as well as to the town of Pagani, about 1 mi. west.

NOCTURN or **NOCTURNE,** in music a term meaning "night piece," a composition, usually for the pianoforte, of a dreamy, tender, romantic and predominantly sad or wistful character. The name is now inseparably connected with Frederic Chopin's incomparable compositions so described, though it was actually first employed by the once famous Irish composer and pianist, John Field (*q.v.*), for some charming pieces of his own in precisely the same style. "Notturno" (Italian) was used originally as a term for a type of serenade. Wolfgang Mozart wrote a delightful work under this name for strings and two horns, and an exquisite number in Jakob Mendelssohn's "Midsummer Night's Dream" music is also so described.

In the form "nocturn" the word is used as a form of *Nocturnae* or watches of the night. On Sundays there are three nocturns; the first contains 12 psalms and the two others contain three psalms each. A lesson is read at the end of each nocturn and each lesson is divided into three portions.

NODDY, the name applied to a sea bird, *Anous stolidus,* one of the terns (*q.v.*), from its showing so little fear of man as to be accounted stupid. It is heavier in flight than most terns, with shorter wings and less forked tail. The plumage is of a uniform sooty hue, except the light gray crown of the head. The noddy is very generally distributed throughout tropical and subtropical oceans. It breeds in astounding numbers, on low cays and coral islets, making a nest composed of seaweed or small twigs. Other birds of the same genus are the darker Pacific noddy (*A. s. sidgwayi*), the still darker Galapagos noddy (*A. s. galapagoensis*) and the white-headed noddy (*A. leucocapillus*). There is also the white noddy (*Gygis alba*).

See J. B. Watson in *Papers from the Tortugas Laboratory*, No. 8.

NODE [Lat. *nodus,* a loop], in astronomy, one of two opposite points at which a heavenly body passes through the principal co-ordinate plane to which its motion is referred. In the case of the heavenly bodies this plane is commonly that of the ecliptic, but, in special cases, the plane through the origin parallel to the earth's equator or the plane of a planet's orbit is used. The ascending node is that at which the body moves from the south or negative toward the north or positive side of the plane. The moon's nodes are the points in which its path intercepts the plane of the ecliptic. In the geometry of curves, a node is the name given to the loop formed by a continuous curve crossing itself, the point of crossing is termed a "double point," and at it there are two noncoincident tangents to the curve; the remaining species of double points, termed "acnode," "spinode" or "cusp," admits of two coincident tangents (*see* CURVE).

NODIER, CHARLES (1780–1844), French author, was born at Besançon. His father, on the outbreak of the French Revolution, was appointed mayor of Besançon and Charles is said to have been a member of the Jacobin club when he could not have been more than 12 years old. He was sent to Strasbourg, where he lived in the house of Eulogius Schneider, the notorious Jacobin governor of Alsace, but a good Greek scholar. He became librarian in his native town, but his exertions in the cause of suspected persons brought him under suspicion. For a skit on Napoleon, in 1803, he was imprisoned for some months. He then lived a very unsettled life at Besançon, Dôle, where he married, and in other places in the Jura. During these wanderings he wrote *Le Peintre de Salzbourg, journal des émotions d'un coeur souffrant, suivi des Méditations du cloître* (1803). He continued to lead an unsettled life until in 1824 he was appointed to the librarianship of the Bibliothèque de l'Arsenal. He was elected a member of the academy in 1833, and died on Jan. 27, 1844. During his 20 years at the arsenal he was able to supply a centre and rallying place to a knot of young literary men of greater individual talent than himself—the so-called Romanticists of 1830—and to colour their tastes and work very decidedly with his own predilections. Victor Hugo, Alfred de Musset and Charles-Augustin Sainte-Beuve all acknowledged their obligations to him. He was a passionate admirer of Johann Wolfgang von Goethe and of William Shakespeare. The best examples of his work are to be found in the volume entitled *Mélanges tirés d'une petite bibliothèque.*

His *Description raisonnée d'une jolie collection de livres* (1844), which is a catalogue of the books in his library, contains a life by Francis Wey and a complete bibliography of his numerous works. *See* also C. A. Sainte-Beuve, *Portraits littéraires,* vol. ii; G. Brandes, *Main Currents in 19th Century Literature* (1871); Prosper Mérimée, *Portraits historiques et littéraires* (1874); A. Estignard, *Correspondance inédite de Charles Nodier, 1796–1844* (1876); J. Larat, *Bibliographie critique des oeuvres de Charles Nodier, 1780–1844* (1923); and *La Tradition et l'exotisme dans l'oeuvre de Charles Nodier* (1925); J. Vodoz, *La Fée aux Miettes, Essai sur le rôle du subconscient dans l'oeuvre de Charles Nodier* (1925).

NŌ DRAMA. In Japan in the beginning of the 15th century, the *saru-gaku* (lit. "monkey music," consisting of juggling feats and comic remarks with actions to suit) of Yamato province was revolutionized by Kan-nami Kiyotsugu and his son Se-ami Motokiyo, and what is now known as *nō-gaku,* or *nō* music or drama resulted. Not only did these two geniuses, under the encouraging patronage of the Shogun Yoshimasa, build on what was best in their own *saru-gaku,* but they drew freely from *den-gaku* (lit. "rice-field music") which had much in common with the *saru-gaku.* What was graceful in them was ennobled to profundity in the *nō,* while their comical elements developed into *kyogen* (comic performance) usually given in conjunction with the *nō.*

The *nō-gaku* constituted the principal form of entertainment among aristocrats and the warrior class in the feudal Japan. It was sometimes given in the presence of the emperors, and there prevailed a custom for a time to invite the common people to the performances given in commemoration of some happy events by the Tokugawa shoguns, who used the *nō* on all ceremonial occasions.

Staging.—The *nō* is performed on a wooden stage built above the ground, the regular size of which now is 18 ft. square, open on three sides, with a narrow extension on one side for the singers, and another on the back of the stage for the musicians and attendants. To that rear extension is attached aslant a passage called *hashigakari* (a bridge). The players appear from under the curtain at the one end of which the passage slightly slopes down. The stage, too, is very slightly tilted to the front. For acoustic purposes, big ceramic jars are placed, generally seven under the stage and two or more under the passage according to its length. Three pine saplings are planted at intervals along the front of the bridge. The wooden wall called *kagami-ita* (mirror board) on the back of the rear extension, forming a background to the stage, is always decorated with a painting of a pine tree, and the narrow panel adjoining it on the side with that of bamboo. These paintings, together with the saplings, may be taken to indicate that originally the *nō* was performed in the woods.

Character of the Nō Pieces.—The *nō* pieces, which number more than 250, are classified into five groups for convenience: (1) *waki-nō* (pieces in which *waki,* the secondary character, assumes preponderance in the play) generally dealing with Shinto or Buddhist deities; (2) *shura-mono,* which commonly deals with ghosts of warriors; (3) *kazura-mono,* with noble ladies acting the main parts; (4) *genzai-mono,* or present-day piece, dealing with love, insanity and other manifestations of human nature; (5) pieces dealing with demons or goblins as subjects, or those of congratulatory nature with gay and joyous elements. For each program of *nō* performance, which generally lasts a whole day, one from each of the above-mentioned five classes is given in the order mentioned, with a *kyogen* between each and generally a dance in an ordinary dress in addition. The whole program is preceded by a piece called "Okina," which is held in special reverence, the person acting its chief character, Okina, symbolizing the radiant sun goddess.

Construction of Nō Pieces.—The construction of the *nō* piece, though by no means uniform, is generally as follows. A *waki* (the secondary role), generally a monk or a minister of state, first appears and tells who he is. Then he walks a while, singing, suggesting that he is travelling. Coming to a standstill, he announces his arrival at a certain famous spot and takes his

BY COURTESY OF JIRO HARADA

SCENES FROM THE NŌ DRAMA

1. Soga brothers taking leave of their mother before setting out to avenge their father; in *Kosode Soga*. On the Hōshō stage
2. Out in a boat to scare away birds from rice fields; in *Tori Oi*. Hōshō school
3. Benkei and Ushiwaka on the Gojō bridge in Kyoto; in *Hashi Benkei*. Hōshō school
4. Two brothers discussing Buddhistic principles with their enemy; in *Hōkazō*. Kongō school

BY COURTESY OF JIRO HARADA

MASKS WORN IN THE NŌ PERFORMANCES

1. "Okina" used by the principal character in *Okina*. Hōshō
2. "Magojiro" used by a young woman character. Kongo family in Kyoto
3. "Sanko" used for elderly man of common class. Kongo
4. "Daiakujō" used for an elderly man of fierce character. Marquis Maeda's collection
5. "Zō" used for young woman. Marquis Maeda's collection
6. "Hannya" for woman demon. Marquis Maeda's collection
7. "Yamamba" used by the heroine in *Yamamba*. Marquis Maeda's collection

place by the post at the front right-hand corner facing the stage. Then the *maye jite* (the principal character in the first appearance) comes in the form of a farmer, fisherman or priest, etc., describing the scenery of the place, or speaking to the *waki* resting at the post. The *waki* questions him, and the *maye jite* gives a historical account of the place and of heroes connected with it, or relates the origin of the temple or shrine as the case may require, thus furnishing the audience with a necessary background to the play. The *maye jite* then retires in a hurry. He was in reality no other than a Shinto or Buddhist deity, or a ghost of a warrior, in disguise. While the *waki* is startled by the sudden disappearance, there come to the stage common farmers or wood choppers and give in plain language, spoken more or less in the ordinary way, all detailed information concerning the place, generally reiterating what was already given in intonation, and retire. This allows a necessary time for the principal character to change for reappearance. While waiting, the *waki* sings, indicating a lapse of time. When it comes to an end, the *nochi jite* (the principal character in the latter appearance) in proper form and attire as a Shinto or Buddhist deity, or a spirit of a hero, comes to the stage and dances as if in a night stroll, revealing some spiritual attributes. In words and in action he recounts his bravery, his death struggle or his suffering in the underworld, asking for the prayer of the *waki* for the peaceful repose of his soul. The *shite* tells his story as he performs, or he merely dances without any intonation. Generally there is a chorus who intonate either alone or with the performers.

Music and Accessories.—Generally several persons sitting on the side extension sing either in chorus, by themselves or together with the performer. The musicians on the rear extension consist ordinarily of a player each on the transverse flute, the *tsuzumi* (small drum struck with tips of fingers over the shoulder), the *ōkawa* (a slightly larger drum struck on the knee also with tips of fingers) and the drum beaten with two sticks.

The accessories used on the stage in connection with the play are very simple. A fan is much in evidence in the dance and masks are worn by the principal character (*shite*) and the assistant (*shite-zure*).

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(J. HAR.; X.)

NOEL, RODEN BERKELEY WRIOTHESLEY (1834–1894), English poet, son of Noel, Lord Barham, afterward earl of Gainsborough, was born on Aug. 27, 1834. He was educated at Trinity college, Cambridge, and spent two years in the east. His works include *A Little Child's Monument* (1881); *Behind the Veil, and Other Poems* (1863); *Beatrice, and Other Poems* (1868); *The Red Flag* (1872); *Livingstone in Africa* (1874); *Songs of the Heights and Deeps* (1885); *A Modern Faust, and Other Poems* (1888); *Poor People's Christmas* (1890); and *My Sea, and Other Poems* (1896). Roden Noel's versification was unequal and sometimes harsh, but he had a genuine feeling for nature, and the work is permeated by philosophic thought. He died at Mainz, on May 26, 1894.

His *Collected Poems* were edited (1902) by his sister, Victoria Buxton, with a notice by J. Addington Symonds.

NOGALES, a city on the southern boundary of Arizona, U.S., adjoining Nogales, Mexico; a port of entry and the county seat of Santa Cruz county. It is the southern terminus of federal highway 89, and is served by the Southern Pacific railroad, which there meets the Sud Pacifico de Mexico railroad. The population was 6,153 in 1950 and was 5,135 in 1940 by the federal census. Nogales has an altitude of 3,869 ft., and is surrounded by the Patagonia mountains. Stock raising, mining, agriculture and tourist services are the leading occupations of the region.

The old Spanish mission of Tumacacori is 18 mi. N. In 1880 Nogales was a trading post. In 1893 it was incorporated as a town and in 1919 as a city.

NOGARET, GUILLAUME DE (d. 1313), councillor and keeper of the seal to Philip IV of France, was born between 1260 and 1270, the son of a citizen of Toulouse. His family, which took its name from a small property near Saint-Félix de Caramon, was later said by Nogaret's enemies to have adhered to the Albigensian heresy. Guillaume became professor of jurisprudence at the University of Montpellier (1291); entered the king's service as *juge-mage* in the *sénéchaussée* of Beaucaire (*c.* 1294); was made a member of the *curia regis* in Paris (1296) and, as king's commissary, was entrusted with missions to Normandy, Bigorre and Champagne; and went to Rome with an embassy (1300). In 1299 he took the title of knight. He is the best known of the *légistes* and a good representative of those faithful and even fanatical servants of the royal power, but his influence on Philip IV's policy has been greatly exaggerated. His name is mainly connected with Philip's clash with Boniface VIII (*q.v.*). On March 12, 1303, after the publication of the bull *Unam sanctam* Nogaret addressed an assembly in Paris, denouncing the pope as illegitimate and heretical and demanding a general council to try him. He had already (March 7) been commissioned by the king to go to Italy to notify Boniface of the summons and to take him into custody. From the castle of Staggia, between Florence and Sienna, Nogaret prepared the arrest of the pope, who had refused the notification and was preparing the bull *Super Petri solio*, which excommunicated the king. He got in touch with some of Boniface's enemies, several cardinals and the population of Anagni. At dawn on Sept. 7, 1303, he entered Anagni, with a small force under Rinaldo de Supino, captain of Ferentino, the gates having been left open by his supporters. But the Colonnas, under Sciarra Colonna, had been informed of this move and entered the town at the same time in pursuance of their vendetta against Boniface. Nogaret's carefully prepared legal apparatus was broken down by their looting and violence, which brought on the rising of the townsmen on Sept. 9. Nogaret, who had in fact saved Boniface's life, was wounded and had to flee to Ferentino. He returned to France early in 1304 and was rewarded by the king with a pension of 500 *livres*. Nogaret's part in this affair must be understood as the action of an almost fanatical Christian ready to sacrifice anything to free the church from a pope whom he thought unworthy. However, much of the odium of the outrage fell upon him; and on June 7, 1304, the new pope Benedict XI issued a bull *Flagitiosum scelus* against Nogaret and 15 others, though he had already cleared Philip of any responsibility. Nogaret, much embittered, devoted himself to getting his innocence recognized. Eventually the French pope Clement V, whose election he had promoted and whom he threatened with proceedings against the memory of Boniface, absolved him on April 27, 1311. Meanwhile, he had kept Philip's favour: as the keeper of the seal (Sept. 22, 1307, to his death, April 1313), he reorganized the chancellor's office; and in 1305 he was put in charge of the inquiry on the denunciations of the Templars by Esquieu de Floyran. On Oct. 13, 1307, he organized the general arrest of the Templars and directed the seizure of the Paris Temple; and he played a large part in the subsequent proceedings, especially those against the high dignitaries of the order. There is, however, no reason to see Nogaret's hand in all state trials of his time.

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(F. CT.)

NOGENT-SUR-MARNE, a suburb 6.7 mi. E. of Notre Dame de Paris, in the department of Seine, on a hill on the right bank of the Marne. Pop. (1946) 21,547. The Eastern railway crosses the Marne valley there by a viaduct 875 yd. in length. Nogent has a Gothic church with a tower of the Romanesque period, in front of which there is a monument to Antoine Watteau, who died there in 1721. Chemical products are manufactured. The fine situation of the town gained it the name of Beauté, and Charles V built a château there (demolished in the 18th century) which was presented by Charles VII to Agnes Sorel with the title of Dame de Beauté. An island in the Marne to the south of the town is still known as the Ile de Beauté. The increase of population there in recent years is very notable.

NOGUCHI, HIDEYO (1876–1928), Japanese bacteriologist, was born in Inawashiro, Yama, Fukushima, Japan, Nov. 24, 1876. He received the degree of M.D. in 1897 from the Tokyo Medical college and subsequently did postgraduate work in the United States and Europe, becoming connected with the Rockefeller Institute for Medical Research in New York in 1904. He was the first to obtain pure cultures of the spirochaete of syphilis and to establish the syphilitic nature of general paralysis and *tabes dorsalis* by demonstrating the organism in the cells of the central nervous system of persons dying of these diseases. He did considerable work on the analysis of the Wassermann reaction for the diagnosis of syphilis and devised a skin test for syphilis and a method for the detection of syphilitic and other pathological conditions in the spinal fluid. One of the first to recognize the germicidal properties of certain compounds of unsaturated fatty acids for acid-fast micro-organisms, *e.g.*, the tubercle bacillus, he discovered the parasite of yellow fever in 1918 and prepared a prophylactic vaccine and a curative serum for combating this disease. He also isolated the parasite of Oroya fever and *Verruga peruviana*. During his investigations he contracted yellow fever and died in British West Africa on May 21, 1928.

His published works include *Snake Venoms* (1909), *Serum Diagnosis of Syphilis and Luetin Reaction* (1910) and *Laboratory Diagnosis of Syphilis* (1923).

NOISE AND ITS CONTROL. No rigid definition of noise is possible. By analogy with "dirt," it has been called "sound out of place," and it is usually a medley of individual sounds. For measuring noise the most widely used instrument is the sound level meter, which by 1944 had become an American standard built to definite specifications. It measures the intensity level of the noise in decibels (db.). By means of a switching arrangement it can be made also to measure approximately the loudness level of the noise in phons. The phon scale is such that when two noises have the same loudness level they will sound equally loud to a typical person having normal hearing. A technique for measuring the phon loudness level has been adopted as an International standard. It is as follows: The intensity level of a pure tone having a frequency of 1,000 cycles per second expressed in decibels is taken as the reference standard. An instrument is arranged so that the intensity level being presented to an ear can be changed by turning a dial which is calibrated to read directly the level in decibels. When the dial is turned to such a position that the reference tone sounds equally loud to the noise whose phon loudness is desired, then the reading of the dial in db. gives the phon loudness level. The International standard adopted as the zero level for the reference tone is the intensity level in a free progressive wave in which the sound power of 10^{-16} watts (w.) is flowing through each square centimetre of the wave front. This same power has been adopted as a reference power for expressing the intensity level of any sound regardless of its character. This power corresponds to a root-mean-square (r.m.s.) pressure amplitude in the wave of 0.0002 dynes per square centimetre. England and some countries of Europe have used different kinds of noise meters which were designed to measure the phon loudness level more accurately than does the American standard sound level meter. These meters have sometimes been referred to as peak meters but none has yet been developed to the point where it has been adopted as a standard for measuring noise.

For a complete description of noise one must know its sound spectrum—that is, the sound power being carried by the various bands of frequencies in the audible range. Instruments known as sound analyzers are now available for making such measurements. From the data obtained, loudness level can be calculated. Also from such a measured sound spectrum one can find out how much other desired sounds will be masked. For example, a cheering street crowd welcoming home some noted hero may cause a masking equivalent to 70 db. deafness, which means that under such circumstances one can make a neighbour hear speech only by shouting close to his ear. The loudness level of such a noise is approximately 95 phons.

In a survey in New York city the average intensity level of street noise varied from 50 to 85 db. At any one place it varied through a range of about 20 db. The highest level encountered in the streets was 107 db., which was caused by a riveter 35 ft. away from the measuring instrument. In World War II extreme noises were encountered in aeroplanes and tanks. The pilots frequently had to operate in noise levels as high as 130 db.

The following table from the report of the Noise Abatement commission of New York city, *City Noise* (1930), gives typical intensity levels for street noises encountered. Since these values have been taken, the reference point of the meters has been changed so that 6 db. must be added to make them agree with the meters in use in 1946.

NOISE LEVELS OUT OF DOORS DUE TO VARIOUS NOISE SOURCES

SURVEY OF NEW YORK CITY NOISE ABATEMENT COMMISSION		NOISE LEVEL	OTHER SURVEYS	
DISTANCE FROM SOURCE	SOURCE OR DESCRIPTION OF NOISE		SOURCE OR DESCRIPTION OF NOISE	SURVEY NO.
FEET		DB.		
		130	THRESHOLD OF PAINFUL SOUND	4
		120		
2	HAMMER BLOWS ON STEEL PLATE-SOUND ALMOST PAINFUL (INDOOR TEST)		AEROPLANE; MOTOR, 1,600 R.P.M.; 18 FT. FROM PROPELLER	5
		110	AERO ENGINE UNSILENCED—10 FT.	4
		100		
35	RIVETER			
15–20	ELEVATED ELECTRIC TRAIN ON OPEN STRUCTURE	90	PNEUMATIC DRILL—10 FT.	4
			NOISIEST SPOT AT NIAGARA FALLS	2
15–75	VERY HEAVY STREET TRAFFIC WITH ELEVATED LINE	80	HEAVY TRAFFIC WITH ELEVATED LINE, CHICAGO	7
15–50	AVERAGE MOTOR TRUCK		VERY NOISY STREET, N.Y. OR CHICAGO	1
15–75	BUSY STREET TRAFFIC	70	VERY BUSY TRAFFIC, LONDON	4
15–50	AVERAGE AUTOMOBILE			
3	ORDINARY CONVERSATION			
15–300	RATHER QUIET RESIDENTIAL STREET, AFTERNOON	60	AVERAGE SHOPPING ST, CHICAGO	6
			BUSY TRAFFIC, LONDON	4
15–50	QUIET AUTOMOBILE	50	QUIET AUTOMOBILE, LONDON	4
	MINIMUM NOISE LEVELS ON STREET		QUIET ST. BEHIND REGENT ST., LONDON	4
15–500	IN ENTIRE CITY DAY TIME: MIN AVERAGE			
50–500	IN ENTIRE CITY DAY TIME: MIN. INSTANTANEOUS	40		
50–500	IN MID CITY NIGHT: MIN. INSTANTANEOUS			
		30	QUIET ST. EVENING, NO TRAFFIC SUBURBAN LONDON	4
		20	QUIET GARDEN, LONDON	4
			AVERAGE WHISPER—4 FT.	3
			QUIET WHISPER—5 FT.	4
		10	RUSTLE OF LEAVES IN GENTLE BREEZE	3
		0	THRESHOLD OF HEARING	

BY DR. C. STEINBERG, BELL TELEPHONE LABORATORIES

In a survey in the residential section of New York city it was found that noise inside the houses varied from 28 to 52 db. In business offices, factories, department stores, etc., it varied from 40 to 80 db. Approximately 40% of the street noise could be traced to the automobile trucks used for commercial deliveries, 25% to the elevated railway and 20% to the surface cars. The remaining 15% was supplied by private automobiles, taxicabs, automobile horns, horse-drawn vehicles, riveting and excavating machines, alarm signals of the fire and police departments and other occasional noise-producers. At no place on city streets do human speech and human feet make measurable contributions to the noise. At windows street noise decreases with height, but much less so than would be expected from the physical law of attenuation of sounds in the open air, the discrepancy being caused by reflection of the noise between the buildings on the two sides of the street.

It is incorrect to generalize that noise is always harmful to man. Under some circumstances noise may produce greater activity and apparently greater efficiency in performing certain tasks. Practically in every circumstance a greater amount of bodily energy is used up when working in a noise. During World War II it was shown that men in tanks or aeroplanes could operate complicated controls just as efficiently in extreme noise conditions as in the quiet. The main effect upon their operation was that of deafening, which made it very difficult to communicate. Most individuals accustom themselves to living or working in noisy surroundings and only nervous individuals who fail to make this adjustment suffer harmful effects. However, there is no doubt that noisy surroundings where one is expecting quiet are very irritating and consequently have an effect upon the nervous system. During World War II additional evidence was accumulated which indicated that persons immersed continually in very loud noises lose their acuity for hearing although moderate intensity levels seem

to have little effect. Also it was found that the ear could tolerate very much higher levels for a short time without serious injury than it was thought possible before. For example, the intensity level of pure tones as high as 140 db. was impressed upon the human ear without permanent injury although there was a temporary deafness caused for hours or days, depending upon the individual.

Much noise could be prevented by denying use of the streets to vehicles improperly cared for; also by preventing loose, rattling parts on surface cars and by removing loose or wide crossings in the rails of street railways and by restricting the blowing of horns. It is possible that the average street noise of a city could be reduced considerably by adequate enforcement of such regulations. The construction of noise-proof rooms or noise-proof houses is possible on well-known principles of architectural acoustics but is too expensive for general use.

Law.—In law noise may be defined as an excessive, offensive, persistent or startling sound. By the common law of England freedom from noise is essential to the full enjoyment of a dwelling house, and acts which affect that enjoyment may be actionable as nuisances. But it has been laid down that a nuisance by noise, supposing malice to be out of the question, is emphatically a question of degree (*Gaunt* v. *Finney*, 1872, 8 Ch. Ap. 8). The noise must be exceptional and unreasonable. The ringing of bells, building operations, vibration of machinery, fireworks, bands, a circus, merry-go-rounds, collecting disorderly crowds, dancing, singing, etc., have been held under certain circumstances to constitute nuisances so as to interfere with quiet and comfort, and have been restrained by injunction. Noise occasioned by the frequent repetition of street cries is frequently the subject of local bylaws, which impose penalties for infringement. (E. E. F.; HA. F.)

NOLA, an ancient city and see of Campania, Italy, province of Naples, pleasantly situated in the plain between Mount Vesuvius and Apennines, 16¾ mi. E.N.E. of Naples by rail, 121 ft. above sea level. Pop. (1936) 10,733 (town); 18,436 (commune). There is an ancient Gothic cathedral with its lofty tower. July 26 is devoted to a great festival in honour of St. Paulinus (*q.v.*). The church erected by him in honour of St. Felix in the 4th century is extant in part. Giordano Bruno (*q.v.*) was born at Nola in 1548. The Etruscans were in Nola about 500 B C They helped Neapolis against the Roman invasion (328 B.C.). The Romans made themselves masters of it in 313 B.C. In the Social War it was betrayed into the hands of the Samnites. Sulla in 80 B.C. subjected it with the rest of Samnium. Seven years later it was stormed by Spartacus. Nola became a Roman colony under Augustus, who died there. It was sacked by Genseric in 455, by the Saracens in 806 and 904, captured by Manfred in the 13th century, and damaged by earthquakes in the 15th and 16th.

Nola lay on the Via Popillia from Capua to Nuceria and the south, and a branch road ran from it to Abella and Abellinum. While independent it issued an important series of coins, and in luxury it vied with Capua. Its territory was very fertile. A large number of vases of Greek style were manufactured here of pale yellow clay with shining black glaze, decorated with skilfully drawn red figures. Of the ancient city, numerous ruins, an amphitheatre, still recognizable, a theatre, a temple of Augustus, etc., existed in the 16th century. The neighbourhood was divided into pagi or villages, the names of some of which are preserved to us (Pagus Agrifanus, Capriculanus, Lanitanus). (T. A.)

NÖLDEKE, THEODOR (1836–1930), German Semitic scholar, was born at Harburg on March 2, 1836, and studied at Goettingen, Vienna, Leyden and Berlin. In 1859 his history of the Koran won for him the prize of the French Académie des Inscriptions, and he rewrote it in German with additions (*Geschichte des Korans*, Goettingen, 1860). He taught at Goettingen (1861), Kiel (1868) and Strassburg (1872). In the main his work deals with Semitic languages, and the history and civilization of Islam.

Among his best-known works are: *Das Leben Mohammeds* (1863); *Beiträge zur Kenntnis der Poesie der alten Araber* (1864); *Die alttestamentliche Literatur* (1868); *Untersuchungen zur Kritik des Alten Testaments* (1869); *Zur Grammatik des klassischen Arabisch* (1896); *Fünf Mo'allaqat, übersetzt und erklärt* (1899–1901); *Beiträge zur semitischen Sprachwissenschaft* (1904); *Neue Beiträge zur semitischen Sprachwissenschaft* (1910). In the *Encyclopædia Britannica*, he wrote on Persia, the Koran and other subjects.

NOLLEKENS, JOSEPH (1737–1823) British sculptor, was born on Aug. 11, 1737, in Dean Street, Soho, London, where his father, a native of Antwerp, the "old Nollekens" of Horace Walpole, was a painter of some repute. In his 13th year he entered the studio of the sculptor Peter Scheemakers for drawing and modelling. In 1760 he went to Rome, and his marble bas-relief, "Timoclea before Alexander," brought him a prize of 50 guineas from the Society of Arts in 1762. David Garrick and Laurence Sterne were among the first English visitors who sat to him for busts; another important piece belonging to this early period is the "Mercury and Venus chiding Cupid." On his return to England he became an associate of the Royal Academy (1771), and in 1772 a member. By this time he had become known to George III, whose bust he shortly afterward executed, and thenceforward, until about 1816, he was the most fashionable portrait sculptor of his day. He himself thought highly of his early portrait of Sterne. Others were those of William Pitt, Charles Fox, the prince of Wales (afterward George IV), George Canning, Spencer Perceval, Benjamin West and Lords Castlereagh, Aberdeen, Erskine, Egremont and Liverpool. Among his numerous marble groups and statues are the "Bacchus," "Venus taking off her Sandal," "Hope Leaning on an Urn," and (his own favourite performance) "Venus Anointing Herself." His work is remarkable for delicacy, but deficient in vigour and originality. He died in London on April 23, 1823, leaving a large fortune.

NOLLE PROSEQUI, a term of English law now only used of a stay of proceedings by indictment or by information entered by the attorney general. The *nolle prosequi* is a matter purely for his discretion, and will not be granted unless very good ground be shown for his interference. The object of it generally is to obtain a stay of proceedings against an accomplice in order to procure his evidence. This object is, however, more usually effected by the prosecution offering no evidence and the judge directing an acquittal.

In the United States the attorney general has not always the same discretion with which English law invests him. Although in some states the prosecuting officer may enter a *nolle prosequi* at his discretion, in others the leave of the court must be obtained.

NOMADS, "wanderers," primitive pastoral people who have no settled territory.

Nomads seem to exist in every large territory. Some, like the gypsies (*q.v.*), becoming international. There are Asiatic nomads of all types, the chief being the Mongols whose nomadism became highly specialized. The Basques (*see* EUROPE: *Races and Peoples*) are generally supposed to have been nomads from a remote corner of Asia and the report that shifting colonies of Euskera stock are to this day found in South America supports this view. Northern Asia is the home of numerous wandering tribes, whose very names have only recently been recorded. These tribes have a definite relation with the settled peoples over whose territory they roam, as is the case with the African nomads (*see* below). Indo-China has its nomad peoples, and southwest China is an area over which several nomad stocks wander. The change from nomadism to a settled state of occupation in well-defined areas is rare but not unknown. (*See* ASIA: *Ethnology* and *History: Indo-China.*)

Nomads proper are those who roam over different territories in actual quest of sustenance; as the name implies, they are pastoral people depending on grazing for their animals and edible roots and fruits for themselves. (*See* BUSHMEN.) These nomads have extraordinary powers of adaptability and can support long periods of hunger. The Australian aborigines are sufficiently skilled in woodcraft to trap animals by simply stealing upon them quietly and using the most primitive weapons. The pampas Indians are horseback nomads and wander to and fro over large tracts of territory.

The Bedawin (Bedouins) or Arabs of the desert are among the most familiar of all pastoral nomads, and their nomadism has no known beginning. In times of drought and food shortage such nomads as these and the Hottentots (*q.v.*), are compelled to raid their agricultural settled neighbours. The Kirghiz, an Altai people, are the prominent nomads of Central Asia and their ballads tell of their love of wandering and their passion for their horses, their only tangible possessions.

In recent years much attention has been directed to the nomads of East Africa, as it is believed that from these sprang the original individual peoples of Africa. Some of these nomads are pygmies.

It is probable that at one time they all spoke a distinct language and that many still preserve their own language, while using the language of the tribes among whom they reside. The pygmies of the upper Welle speak the Mbuba language in a manner markedly different from the Mbuba pronunciation, substituting for certain consonants a curious gasp or hiatus almost approximating to a click. The Sanya of northeast Kenya and certain of the Watta are also said to use clicks. The Sandawe (*q.v.*) of Tanganyika Territory, whose skulls

possess distinctly Hottentot characters, retain the typical Bushman clicks and gutturals. Rarely has the tribal name been ascertained, the different nomadic groups being called by the names bestowed on them by neighbouring tribes, but the persistence of some of these appellations is remarkable. Some form of the name Twa is widespread among the Bantu: thus the Bushmen of South Africa are known to their neighbours as Abatoa and Batwa is common throughout the Congo and Uganda. The word is said to mean "Bushdwellers," and is probably unconnected with the Watta of southern Abyssinia which is derived from an old Cushitic root meaning "Wanderers." Aka is a name given to geographically distinct groups of nomads.

In the mountainous forest country of southwest Uganda we find semi-pygmy hunters known as Batwa, and the name reappears on the upper slopes of mount Elgon at an altitude of from 9,000-11,000 ft., where they build earth-roofed huts and live principally on rats, other small mammals and honey.

The Sanya and Choni, hunting tribes living on the banks of the Sabaki and the Tana in Kenya, are also known as Watta to the Galla. They are similar to the Boni of Jubaland, and together with the Midgan and the Sandawe, who also practise circumcision, are the only nomad communities who practise clitoridectomy.

The Doko pygmies were first described in 1842 by Sir W. C. Harris and later by Borelli and Donaldson Smith, and Rigby also in 1842 reported from hearsay evidence the existence of some pygmies called Berikimo about six weeks inland from Mombasa. The latter are probably the pygmies near Lake Baringo, and the former may be the dwarf Dume who are found in the vicinity of Lake Stephanie. Another group of pygmy nomads exists on the slopes of Mt. Kilimanjaro known as Wapare.

Among the Turkana to the west of Lake Rudolf we find the Teuth, who live on roots and grubs and hunt the smaller mammals, and farther south the Ogiek, known to the Masai as Doroba from the Masai word for tsetse fly to which their arrows are likened, wander over a wide area of forest and bush country between Lake Victoria and the eastern lowlands, maintaining a livelihood by hunting and trapping. Among the Nandi the Ogiek are the hunters, but the Kunono fulfil this menial role for the Masai. The Embu speak of pre-Embu inhabitants of Kenya as "Agumba" or "Asi," pygmies, forest dwellers and hunters. The northern Watta of Lake Tana are fishers and skilled watermen, who use papyrus rafts, and on Lake Kwanya the Kenyi, a Bantuized type of nomad, live on the papyrus marshes and are completely aquatic without any interests on the land, being reminiscent culturally of the Batwa on Lake Bangweulu.

Wherever the nomads are found in East Africa they are treated as pariahs and are engaged in trades or occupations which are considered ignoble, such as hunting, fishing, metallurgy, leather tanning and pottery. Among the Kaffa and the Galla they provide the executioners. They are dispossessed rather than conquered, and though among the Kaffa they perform menial services like the collection of fuel, it is just among the Kaffa that their tribal organization is most developed under an independent chief.

They adopt the language of the tribes among whom they live, and in many cases their social organization, costume and even religion. Thus the Sanya have a clan organization based on Galla clans with Galla clan names, and have imitated the Galla initiations and system of age grades. The Somaliland nomads use Mohammedan invocations and celebrate the Mohammedan feasts in addition to their own pagan ritual. But, generally speaking, their religion is a vague ancestor worship. Except when, like the southern Watta, they build temporary villages they are monogamous, and the family wanders from place to place erecting no more than a rude shelter for the night. When anything more permanent is built the little huts are situated close to river banks and are roughly thatched with palm fronds. The northern Watta have portable cane huts which they carry with them in their wanderings. Caves are also used as dwellings and others build hiding places in trees. They possess no domesticated animals except dogs, and few practise agriculture, and that only of the most elementary kind. Their weapons are the bow and arrow with sometimes a spear in addition, and poison is applied to all weapons. The northern Watta, like the Ogiek, use a hunting spear with a detachable head, which carries the owner's distinctive mark enabling him to claim the kill. Game pits are used also.

Usually they are naked, but they may adopt some of the costume of their neighbours. Thus among the Kaffa the nomads have adopted the Kaffa headdress, a conical hat of monkey fur, and wear the large skin aprons worn by their Kaffa overlords. The Fuga, adjacent to the Watta, now clothe themselves with the typical Galla kilt. The Midgan women plait their hair after the Somali fashion, but long, plaited hair is an indigenous characteristic among several groups, particularly in the Bantu zone, as among the Amba Negrillos on the western flanks of Ruwenzori. The Ogiek plait their hair like the Nandi and wear a skullcap made from the stomach of a goat like their Kamasia neighbours.

Everywhere the nomads, despite their low status, are respected and feared, both for their knowledge of poisons and of sorcery in which they are thought to be most proficient. This attitude points to the probability that they were the original owners of the country, their conquerors recognizing their greater spiritual affinity with the soil together with its magical implications; and tends to discredit a Watta legend (of doubtful authenticity) that the Watta were banished from Egypt and on arrival at their present habitats were subjected by the Hamites who were already in possession of the country.

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NOME, an Alaskan town on the shore of Bering sea, 115 mi. from St. Michael; in 1900 the largest settlement in the territory. Pop. (1950) 1,852; (1939) 1,559. Gulch gold was found near Nome on Anvil creek in Sept. 1898, and diggings on the ocean beach were first worked in July 1899. The rush to Nome in 1900 was one of the most remarkable stampedes in U.S. mining history; the town soon had hotels, banks, stores, several newspapers and weekly mails from the United States; for part of the year there were, it was estimated, 20,000 inhabitants. By 1903 the population had greatly decreased, and in subsequent years the winter population averaged about 3,500, the summer population from 7,000 to 8,000. In 1905 the gold output of the Nome region amounted to about $2,500,000, nearly all from placers, though some quartz mining was done. At mid-century gold was still the principal industry, though greatly decreased in volume; native fur and ivory products were also made. The town is served by several air lines, and a narrow-gauge railway and several roads radiate into the tundra, to various mines and along the coast. Nome was first called Anvil City; the name "Nome" is derived from Cape Nome, first so called on a chart dated 1849, and said to have been a draftsman's mistake for the query "?Name" on the original chart.

NOMENOË or Nominoe (d. 851), duke of Brittany. To pacify Brittany, Louis the Debonair named him count of Vannes in 819 and governor or duke of Brittany in 826. Throughout the reign of Louis, Nomenoë maintained peace in Brittany. But in 841 he resolved to make himself independent of Charles the Bald. In 843 Charles made a vain attempt to subdue Brittany. In 844 Nomenoë invaded Maine, and in 845 the emperor was completely defeated at Ballon near Bain-de-Bretagne. In 846 Charles recognized the independence of Brittany. Having resolved to detach the duchy from the ecclesiastical province of Tours, Nomenoë accused the Frankish bishops of Vannes, Quimper, Dol and Léon of simony at the council of Coëtlouh in 848, replaced them by Bretons, and erected Dol into a metropolitan see. In 849 Nomenoë attacked the Frankish county of Anjou. Charles established a garrison at Rennes. Nomenoë seized Rennes, Nantes and Upper Brittany, and ravaged Maine. In 851 he seized Anjou and invaded Beauce. He died suddenly, leaving as his successor his son Erispoë.

See A. de la Borderie, *Histoire de Bretagne,* vol. ii (1898); R. Merlet, "Guerres d'indépendance de la Bretagne," in the *Revue de Bretagne, de Vendée et d'Anjou* (1891).

NOMINALISM, the name of one of the two main tendencies of mediaeval philosophy, the other being realism (from Lat. *nomen,* name). The controversy between nominalists and realists arose from a passage in Anicius Boëthius' translation of Porphyry's *Introduction to the Categories of Aristotle,* which propounded the problem of genera and species: (1) as to whether they subsist in themselves or only in the mind; (2) whether, if subsistent, they are corporeal or incorporeal; and (3) whether separated from sensible things or placed in them. The realists held that universals alone have substantial reality, existing *ante res;* the nominalists that universals are mere names invented to express the qualities of particular things and existing *post res;* while the conceptualists, mediating between the two extremes, held that universals are concepts which exist in our minds and express real similarities in things themselves. Though a strong realist tendency is evident in the system of Erigena (9th century), the controversy was not definitely started till the 11th century; it lasted till the middle of the 12th, when the first period of scholastic philosophy ends. Under an appearance of much vain subtlety the controversy about universals involved issues of the greatest speculative and practical importance: realism represented a spiritual, nominalism an anti-spiritual, view of the world; while realism was evidently favourable, and nominalism unfavourable, to the teaching of the Church on the dogmas of the Trinity and the Eucharist. Nominalism was a doctrine of sceptics and suspected heretics, such as Berengar of Tours and Roscellinus. Even Abe-

lard's mediating doctrine of conceptualism (*q.v.*) was sufficiently near to obnoxious ideas to involve him in lifelong persecution. The principles of the great orthodox philosophers of the later scholastic period which begins in the 13th century, Albertus Magnus and Thomas Aquinas, were those of moderate realism. When nominalism was revived in the 14th century by the English Franciscan William of Occam it gave evidence of a new tendency in thought, a distrust of abstractions and an impulse toward direct observation and inductive research, a tendency which had its fulfilment in the scientific movement of the Renaissance. Occam's dictum *Entia non sunt multiplicanda praeter necessitatem* was inspired by a spirit similar to that of Francis Bacon. Though nominalism is properly a mediaeval theory, the tendency has passed over into modern philosophy; the term nominalist is often applied to thinkers of the empirical, sensationalist school, of whom J. S. Mill may be taken as the chief representative.

(H. St.)

NOMOGRAPHY, the science of calculating charts. Its object is the general study of the representation, by means of diagrams called nomograms, of mathematical laws (Gr. *nomos*, "a law") which are expressed analytically by means of equations. Such graphical devices, once carefully drawn, yield the solutions of complicated problems with speed and with slight labour. They are especially helpful when many numerical problems of a similar sort are to be solved and when high accuracy is not required. They can be used by a person without special knowledge or experience and without the mastery of a difficult technique.

The use of graphic schemes for computation goes back to antiquity. The graphic solution of spherical triangles was in vogue in the time of Hipparchus, 150 B.C., and simple charts were designed by the mathematicians of the middle ages. The publication of René Descartes's *Discours de la méthode* in 1637, which introduced analytic geometry to the world, gave a powerful impetus to graphical methods and provided their analytical background. The theory of nomograms rests largely on analytic geometry.

Co-ordinate Papers.—The use of squared paper for the representation of relations between two quantities is familiar in many fields. A point on the paper is located by giving its distance X to the right of a vertical axis and its distance Y above a horizontal axis (distances to the left and downward being reckoned negative). X and Y are called co-ordinates. An equation $f(X, Y) = 0$ is pictured by plotting the points whose co-ordinates satisfy the equation. The resulting graph is a line or curve from which corresponding values of X and Y may be determined visually. The eye is guided by the vertical rulings along which X is constant and the horizontal rulings along which Y is constant. The values of X and Y are commonly written along the axes.

It is clear that nothing is essentially changed if the values which are marked on the axes are not proportional to the distances from the origin but more or less arbitrary scales are used. Points whose co-ordinates satisfy a given equation can be plotted as before and a curve be drawn from which corresponding values can be read. The form of the curve can be altered and in some cases simplified. These notions were developed by Léon Lalanne in his *Anamorphose logarithmique* in 1842 and further advances were made by J. Massau and Charles Lallemand in the '80s. A basic idea is to use such scales that the graphs of the equations under consideration become straight lines, which are easy to draw. The equation $af(x) + bg(y) + c = 0$, where a, b, c are constants, becomes the straight line $aX + bY + c = 0$ if the distances X and Y along the axes to the marks x and y are determined by the functions in the equation; namely, $X = f(x)$, $Y = g(y)$.

Well-known examples based on this principle are the commercial logarithmic and semilogarithmic papers. The former papers use the scales $X = \log x$, $Y = \log y$ and are convenient for plotting the graphs of relations of the form $y^m = ax^n$. Since this may be written $m \log y = n \log x + \log a$, the graph on this paper is the straight line $mY = nX + \log a$. The semilogarithmic papers have the scales $X = x$, $Y = \log y$.

Fig. 1 shows a paper made with the scales $X = x^2$, $Y = y^2$. Thus, the points marked 1, 2, 3, . . . on the axes are at distances

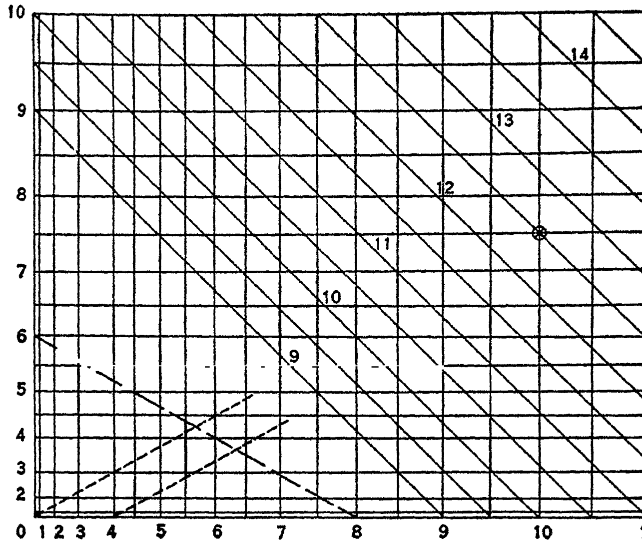


FIG. 1.—CO-ORDINATE PAPER WITH NONUNIFORM SCALES $X=x^2$, $Y=y^2$

1, 4, 9, . . . from the origin. The graph of the ellipse $\frac{x^2}{64} + \frac{y^2}{36} = 1$ is the broken line of the figure. The hyperbola $\frac{x^2}{16} - \frac{y^2}{9} = 1$ and its asymptotes $\frac{x^2}{16} - \frac{y^2}{9} = 0$ are the parallel lines made of short dashes. These simple graphs can be used for the usual purposes; for example, we read from the figure that the ellipse and hyperbola intersect at (6.3, 3.6).

An equation in three variables $F(X, Y, Z) = 0$ is represented in the cartesian system by a surface in three-dimensional space. To reduce the representation to a two-dimensional picture the use of contours is resorted to. Holding Z fixed, we have an equation in X and Y, whose graph is drawn. This is done for various values of Z and the values are written beside the curves. Other values of Z can be estimated visually. The resulting figure resembles a geographic map with contour lines upon it or a weather map showing isothermal lines or isobars.

We can sometimes reduce the contours to straight lines by a happy choice of scales on the axes. An equation of the form $p(z)f(x) + q(z)g(y) + r(z) = 0$ yields a straight line for each fixed z, say z_0, if we use the scales $X = f(x)$, $Y = g(y)$, since the equation now is linear in the variables: $p(z_0)X + q(z_0)Y + r(z_0) = 0$. For example, a chart for solving right triangles can be made from the equation $x^2 + y^2 = z^2$ by drawing contours across fig. 1. Giving z the values 9, 9.5, 10, etc., we get the heavy slanting lines of the figure. To find the hypotenuse of a right triangle whose sides are 10 and 7.5 we are led to the point marked in the figure, from which $z = 12.5$.

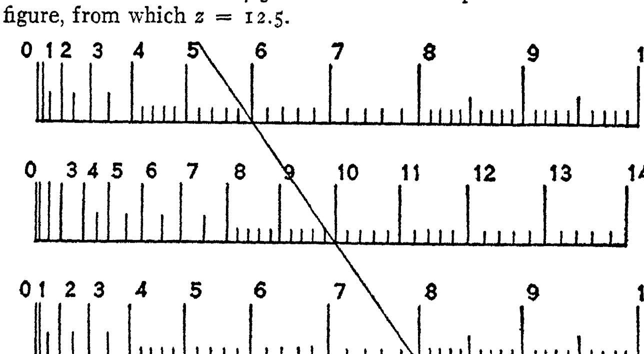


FIG. 2.—ALIGNMENT CHART FOR SOLVING $X^2+Y^2=Z^2$. FOR $X=6$, $Y=8$ THE LINE DRAWN SHOWS THAT $Z=10$

Alignment Charts.—The word nomogram is sometimes restricted to a special type of chart which is used by bringing the points of three scales into alignment. In fig. 2 is shown an alignment chart for the solution of $x^2 + y^2 = z^2$. On the upper and lower horizontal lines are laid off from a vertical axis the scales

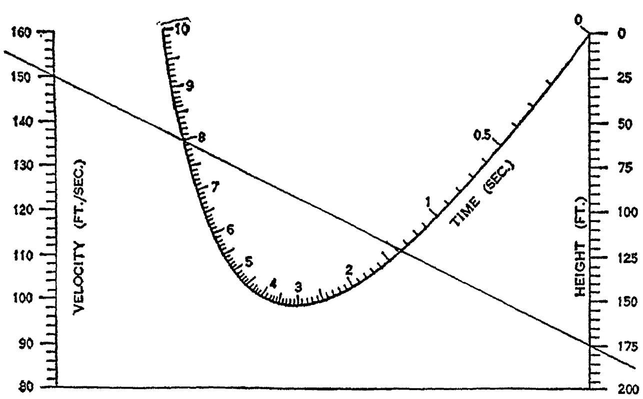
$X_1 = x^2$, $X_2 = y^2$ identical with those on the axes in fig. 1. Midway between is a line with a scale half as large, $X_3 = \frac{1}{2}z^2$. Now let a straight line be drawn across the figure cutting the scales at points marked x, y and z. It is seen from elementary geometry that $X_3 = \frac{1}{2}(X_1 + X_2)$, whence the equation $x^2 + y^2 = z^2$ is satisfied. The equation is solved for one of the variables by joining given values of the other two variables on the scales by a straight line and reading the solution where this line cuts the third scale.

A chart for solving any equation containing three variables can be made in a similar manner provided the variables can be segregated into three separate terms, $h(z) = f(x) + g(y)$. We have merely to plot the scales $X_1 = f(x)$, $X_2 = g(y)$ on the outside lines and $X_3 = \frac{1}{2}h(z)$ on the middle line. Thus, a scale for multiplication, $z = xy$, could be made after first writing the equation in the form $\log z = \log x + \log y$, the three plotted scales then being logarithmic.

This type of chart has certain obvious advantages. Only three scales need be drawn, and they are more easily used than a complicated diagram. Interpolation can be accurately done since the line cuts cleanly across the scale. As a practical matter the line across the chart should not be actually drawn since a few lines in pencil would mar the chart. A fine thread may be stretched across the chart. An excellent line may be made on a transparent ruler with the point of a knife, a little graphite being worked in to give it visibility, and this can be laid across the chart.

The principle of the alignment chart was first described in 1884 by Maurice d'Ocagne (1862–1938) of the École Polytechnique in Paris. He developed the subject in many papers and books and particularly in his treatise of 1899, *Traité de nomographie*, in which were brought together both the general theories and a multitude of practical applications. We may properly call D'Ocagne the creator of nomography.

In its more general forms the alignment chart for the solution of an equation in three variables may employ straight scales arranged in various ways, or one or more of the scales may be curved as in fig. 3. A curved scale may be constructed from parametric



$h = vt - 16t^2$

FIG. 3.—ALIGNMENT CHART FOR FINDING THE TIME AT WHICH A BODY THROWN UPWARD WITH A GIVEN VELOCITY ATTAINS A GIVEN HEIGHT (NEGLECTING FRICTION). THE LINE DRAWN SHOWS THAT FOR AN INITIAL VELOCITY OF 150 FT. PER SECOND THE BODY WILL BE 175 FT. HIGH IN 1.36 SEC. AND AGAIN (ON THE WAY DOWN) IN 8 SEC.

equations $X = f(t)$, $Y = g(t)$. A value of t gives a point (X, Y) on the curve. Points for suitably spaced values of t are marked and the value of t is attached. Thus, $X = \cos t$, $Y = \sin t$ gives a circular scale, since $X^2 + Y^2 = 1$. Whether the resulting scale is curved or straight depends upon the parametric equations.

Let us take two functions of a variable x, two functions of y and two functions of z. Let us use these to form three scales: an x scale $X_1 = F(x)$, $Y_1 = f(x)$; a y scale $X_2 = G(y)$, $Y_2 = g(y)$; and a z scale $X_3 = H(z)$, $Y_3 = h(z)$. Three points (X_1, Y_1), (X_2, Y_2) and (X_3, Y_3), corresponding to readings x, y and z, respectively, on the three scales lie on a line if the slope of the line joining the first two points is equal to the slope of the line joining the last two points; that is,

$$\frac{Y_2 - Y_1}{X_2 - X_1} = \frac{Y_3 - Y_2}{X_3 - X_2}$$

This condition may be put in the form

$$F(x)\,[g(y) - h(z)] + G(y)\,[h(z) - f(x)] + H(z)\,[f(x) - g(y)] = 0,$$

or as a determinant

$$\begin{vmatrix} F(x) & f(x) & 1 \\ H(z) & h(z) & 1 \\ G(y) & g(y) & 1 \end{vmatrix} = 0.$$

The chart will solve this equation for one of the variables when the other two are known. Conversely, an alignment chart can be made for any equation which can be written in this form.

If an equation can be solved by an alignment chart it can be solved by an infinitude of alignment charts. By applying a projective transformation

$$X' = \frac{a_1X + b_1Y + c_1}{a_3X + b_3Y + c_3}, \quad Y' = \frac{a_2X + b_2Y + c_2}{a_3X + b_3Y + c_3}$$

where the as, bs, cs are constants, to the plane of the chart we get another chart. The degree of a curve remains invariant, whence collinear points remain collinear and we still have an alignment chart for the equation. Because of the large number of constants at our disposal the chart can be thrown into a multitude of forms. Projective transformations are used to bring distant portions of a chart back on the page, to change the positions of scales so as to make the best use of the space on the page and to get convenient arrangements generally. The scales of fig. 3 consist of two parallel lines and a hyperbola. We could, for example, carry the linear scales into intersecting lines, or make the curved scale parabolic or circular, or greatly magnify some portion which we wish particularly to use. A useful result is that a convex quadrilateral covering any part of a chart can be carried into a rectangle of desired dimensions so that it will fit exactly on the page.

Nomograms have been widely used in engineering, in industry and in the physical and natural sciences. Equations in many variables are handled by using a sequence of scale alignments or by employing networks of scales, and a great diversity of problems can be solved.

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NONCONFORMITY, LAW RELATING TO. (*See* BAPTISTS; CONGREGATIONALISM; ENGLISH HISTORY; FRIENDS, SOCIETY OF; METHODISM; etc.; also OATH.) It is proposed here to note the matters in which the law as to nonconformists still differs from that applicable to members of the Church of England.

(1) *Judicial Notice.* Where the tenets and authorities of a nonconformist body come in question they must be proved by evidence. By Lord Lyndhurst's act, the Nonconformist Chapels act, 1844, where no particular religious doctrine or mode of worship has been prescribed by the deed or instrument of trust the usage of the congregation for 25 years is to be taken as conclusive evidence of the doctrine and worship which may be properly observed in such meetinghouses. (2) *Tribunal.* Matters arising in nonconformist bodies can be tried only by the ordinary secular courts and generally depend upon the question whether a minister has done any act which is not in accordance with the rules governing the particular body of which he is a minister. A nonconformist body is in law nothing more than a voluntary association whose members may enforce discipline by any tribunal assented to by them but must be subject in the last degree to the courts of the realm. (3) *Status of Ministers.* A nonconformist minister is not in holy orders, and his chapel is not a consecrated building. His status is, however, recognized to a limited extent. By the Toleration act, 1 Will. and Mar., c, 18, a minister, preacher or teacher of a nonconformist congregation is exempt from certain parochial offices, as that of churchwarden. He is also exempt from serving in the reserve forces or on a jury. These privileges attach only

where the place of worship of which he is a minister has been duly registered (the Places of Worship Registration Act, 1855), unless in the case of bodies subject to special legislation as Quakers. By the Municipal Corporations Act, 1882, s. 12, a nonconformist minister (as is a clerk in holy orders) is disqualified from being elected an alderman or councillor of a town council, but under the Local Government Act, 1888, a clerk in holy orders, or other minister of religion, may be a councillor or alderman of a county council, and, under the London Government Act, 1899, of a metropolitan borough. (4) *Marriage.* The first act of parliament relieving dissenters (other than Jews and Quakers) from restrictions was the Marriage Act of 1836. By that act the ceremony of marriage might be performed in a nonconformist place of worship, but it must be after due notice to the superintendent registrar and in his presence or in that of a registrar, and the building must be one that is duly certified for marriages. The Marriage Act, 1898, dispensed with the necessity of the attendance of a registrar at marriages celebrated at a nonconformist place of worship, substituting in place thereof a person duly authorized by the trustees of the place of worship, if the persons intending to be married so desire; but the parties may, if they wish, still require the presence of the registrar. Marriage by banns, licence or special licence cannot take place except in a church. (*See* MARRIAGE.) (5) *Burial.* By the Burial Laws Amendment Act, 1880, burial may take place in a churchyard without the rites of the Church of England. But in such a case notice must be given in a specified form, which is unnecessary where the burial service is conducted by a clergyman of the Church of England. (*See* BURIAL.) (6) *Parish Offices.* By 1 Will. and Mar., c. 18, s. 5, a dissenter chosen churchwarden and scrupling to take the oaths may execute his office by deputy. His acceptance of office is made optional by the act; there is nothing to prevent his discharging it if he see fit to do so. This seems to be still the law, although a declaration was substituted for the oath by the Statutory Declarations Act, 1835, s. 9. (*See* DISSENTER; JEWS; ROMAN CATHOLICS.)

NONFEASANCE, MISFEASANCE, MALFEASANCE. The expressions "nonfeasance" and "misfeasance," and occasionally "malfeasance," are used in English law with reference to the discharge of public obligations existing by common law, custom or statute. The rule of law laid down is that no action lies for nonfeasance, *i.e.*, for failure or refusal to perform such obligation, but that an action does lie for damage resulting from misfeasance or malfeasance, *i.e.*, for negligently and improperly performing the obligation. (*See* NEGLIGENCE.) At present the terms misfeasance and nonfeasance are most often used with reference to the conduct of municipal authorities with reference to the discharge of their statutory obligations. In the case of nonfeasance there is a remedy by indictment or *mandamus* or by the particular procedure prescribed by the statutes. This rule is fully established in the case of failure to repair public highways; but in other cases the courts are astute to find evidence of carelessness in the discharge of public duties, and on that basis to award damages to individuals who have suffered thereby. Misfeasance is also a term used with reference to the conduct of directors and officers of joint-stock companies.

NONIUS MARCELLUS, Latin grammarian and lexicographer, flourished at the end of the 3rd or the beginning of the 4th century A.D. He is the author of a sort of lexicon called *De compendiosa doctrina,* in 20 sections or chapters, the first twelve of which deal with language and grammar, the remaining eight with special subjects (navigation, costume, food, arms). It is valuable as preserving fragments from old dramatists, annalists, satirists and antiquarian writers. In the quotations from the authors cited Nonius always follows the same order, beginning with Plautus and ending with Varro and Cato. In the 5th century Julius Tryphonianus Sabinus brought out a revised and annotated edition.

Editions by L. Müller (1888); J. H. Onions, bks. i.–iii. (1895); W. M. Lindsay (1903).

NONJURORS, the name given to those beneficed clergy of the Church of England who refused to take the oaths of allegiance to William and Mary in 1689. They were about 400 in number, and included William Sancroft, archbishop of Canterbury, and four others of the "seven bishops": Thomas Ken of Bath and Wells, John Lake of Chichester, Thomas White of Peterborough and Francis Turner of Ely, together with the bishops of Gloucester, Worcester and Norwich. Other distinguished nonjurors were: William Sherlock, master of the Temple, Jeremy Collier, the ecclesiastical historian, George Hickes, dean of Worcester, Nathanael Spinckes, John Fitzwilliam, canon of Windsor, Henry Dodwell, Camden professor of history at Oxford, Henry Hyde, second earl of Clarendon, and Roger North, the lawyer. Afterwards their number was augmented by refusals to swear the oaths of allegiance to George I. Ken, the most eminent of the nonjurors, disapproved of their subsequent proceedings, and Sherlock and Dodwell afterwards took the required oaths, the former becoming dean of St. Paul's.

Believing in the doctrine of non-resistance to established authority, the nonjurors argued that James II. was still the rightful king, and likened the position of William to that of Cromwell. With the approval of William III., Gilbert Burnet, bishop of Salisbury, attempted to reconcile them to the new order; and it was only when the generous terms offered by Burnet had been refused, that, in Feb. 1690, they were deprived of their sees and other benefices. Although they had only a small following among the mass of the people, who were not required to take the oaths of allegiance, Sancroft and his colleagues claimed to represent the true Church of England, and requested James II. in his exile to nominate two new bishops to carry on the episcopal succession. James chose Hickes and Thomas Wagstaffe (1645–1712), who were consecrated in 1694 as bishops of Thetford and Ipswich respectively. A further consecration took place in 1713 when Collier, Spinckes and Samuel Hawes (d. 1722), were consecrated "bishops at large." In 1718 the introduction of a new communion office with some "usages" taken partly from primitive liturgies, and partly from the first prayer-book of Edward VI. caused a schism among the nonjurors, dividing them into "Usagers" and "Non-Usagers." The four "usages" were: The mixed chalice, prayers for the faithful departed, prayer for the descent of the Holy Ghost on the consecrated elements, and the Oblatory Prayer, offering the elements to the Father as symbols of His Son's Body and Blood. Accepting the "usages" the two bodies united in 1731, but other dissensions followed, although the episcopal succession was maintained until the death of a bishop named Charles Booth in 1805. The last nonjuror was probably James Yeowell, who died in 1875. Public worship was conducted in chapels or "oratories," and in private houses.

In Scotland the nonjurors included the greater part of the clergy of the Episcopal Church, which ceased to be the state church in 1689. The Scottish clergy maintained their opposition to the government until the death of Prince Charles Edward Stuart in 1788, when the bishops met at Aberdeen, and unanimously agreed to submit to the government of King George III. A large number of the Presbyterians in Scotland, principally found among the Cameronians, also refused to take the oaths of allegiance to William and Mary; but as their reasons for this refusal were quite different from those of the episcopalian nonjurors, they are not usually referred to by this name (*see* CAMERONIANS).

For the history of the nonjurors, *see* Macaulay, *History of England* vol. ii. (1895); T. Lathbury, *History of the Nonjurors* (1845); J. H. Overton, *The Nonjurors* (1902), a defence of the sect.

NONNUS (Egyptian for "saint"), Greek epic poet, a native of Panopolis (Akhmim) in the Egyptian Thebaid, probably lived at the end of the 4th or beginning of the 5th century A.D. His principal work is the *Dionysiaca,* an epic in 48 books, the main subject of which is the expedition of Dionysus to India and his return, a subject convenient at the time owing to the popular comparison of Alexander with Dionysus. In its luxuriance and preoccupation with action, it resembles the Indian epics. His chief merit consists in the systematic perfection to which he brought the Homeric hexameter, but this very quality tends to monotony. His influence on later poetic vocabulary was considerable.

We also possess under his name a paraphrase (*μεταβολή*) of the

Gospel of St. John, which is chiefly interesting as apparently indicating that Nonnus in his later years was a convert to Christianity. His style, in this content, produces an impression of extreme bombast and want of taste. According to an epigram in the Palatine Anthology (ix. 198), Nonnus was also the author of a *Battle of the Giants,* and four lines of the *Bassarica* (also on Dionysus) have been preserved in Stephanus of Byzantium.

Editio princeps (1569); H. Köchly ("Teubner" series, with critical introduction and full index of names, 1858); the most generally useful edition is that by the comte de Marcellus (1856), with notes and prolegomena, and a French prose translation. On the metre, *see* J. G. Hermann, *Orphica* (1805), p. 690; A. Ludwich, *Beiträge zur Kritik des Nonnus* (1873), critical, grammatical and metrical; C. Lehrs, *Quaestiones epicae* (1837), pp. 255–302, chiefly on metrical questions; on the sources, R. Köhler, *Über die Dionysiaka des Nonnus* (1853), a short and connected analysis of the poem, with a comparison of the earlier and later myths; *see* also I. Negrisoli, *Studio critico . . . Nonnus Panopolita,* with short bibliography (1903). The paraphrase on St. John (editio princeps, *c.* 1505) is edited by F. Passow (1834) and A. Scheindler (1881), with complete index.

NONPAREIL (*see* PRINTING; PRINTING TYPE), a size of type smaller than minion and larger than ruby. It is also known as 6-point. It is mainly used for footnotes. The following matter is printed in nonpareil:

In Europe, as late as the second half of the 14th century, every book and every public and private document was written by hand; all figures and pictures, even playing cards and images of saints, were drawn with the pen or painted with the brush.

NONPAREIL or **PAINTED BUNTING,** a small, brilliantly coloured finch (*Passerina ciris*) with blue head, green-yellow back, scarlet body and black wings and tail. After wintering in Central America, the painted bunting arrives in the southern states of the U.S.A. in April, and breeds north to Virginia, Ohio and Kansas. The "pin-tailed nonpareil" of Africa (*Erythrura prasina*) is blue in colour; the male has a long tail. It belongs to the *Ploceidae.* (*See* WEAVER-BIRD.)

NONPARTISAN LEAGUE, an American political and economic organization of farmers founded by Arthur C. Townley at Bismarck, N.D., in Feb. 1915. For years the farmers of the State had complained of exploitation by grain speculators, bankers and politicians. The 1915 session of the legislature, at which members of the Equity Society—a farm organization—received scant attention, fanned agrarian discontent into immediate flame. The Nonpartisan League, applying modern sales methods, rapidly organized the farmers into a cohesive political body, which captured control of the State Republican Party and elected its candidates for State offices and Congress. In 1916 the league began work outside North Dakota, and eventually established active organizations in 12 other Western and Middle Western States, where influence was exerted in behalf of sympathetic candidates with varying degrees of success. Though confining its own membership to farmers, the league regularly co-operated with urban labour in political action. During the World War the league was bitterly attacked on the ground of the socialist connection of some of its leaders and its advocacy of conscription of wealth to pay for the hostilities. In 1919 the league put its economic programme into effect in North Dakota. A State-owned bank, mill and terminal elevator, home-building association, and hail, fire and tornado insurance constituted the principal enterprises. All of these, except the home-building association, were still in operation in 1928. The league, as such, gradually disintegrated, though not before it had given birth to the Farmer-Labor Party in Minnesota and had stimulated many farmers to "non-partisan" voting.

BIBLIOGRAPHY.—Because of the bitter controversy over the league, little unbiased discussion exists. *See* H. E. Gaston, *The Nonpartisan League* (1920), and C. E. Russell, *Story of the Nonpartisan League* (1920) both sympathetic, while A. A. Bruce, *The Nonpartisan League* (1921) is hostile. The files of the *Nonpartisan Leader* (later the *National Leader*), which was published up to July 1923, give a running account of the league's work. (N. A. C.)

NON-SHATTERABLE GLASS: *see* GLASS, SAFETY.

NONSUIT, in law, the name given to a judgment whereby an issue is determined against the plaintiff. It was a term peculiar to the English common-law courts before the Judicature Acts, and was simply the expression of the opinion of the court that, apart from the merits, the plaintiff's case was incomplete. It did not in any way act as a bar to his bringing another action for the same cause. Although judgment of nonsuit still exists, it has, since the Judicature Acts, the same effect as a judgment on the merits, unless the court otherwise directs.

In the United States, litigants often take a "nonsuit" when a case has been settled out of court or they realize the futility of further proceedings.

NOODT, GERHARD (1647–1725), Dutch jurist, was born at Nijmegen in 1647. Educated at Leyden, Utrecht and Franeker, he became a professor of law at Leyden. As a writer on jurisprudence he acquired a wide reputation. His Latin style was modelled after the best writers, and his numerous works soon rose to the rank of standard authorities. Two of his political treatises were translated into French by Jean Barbeyrac, and appeared at Amsterdam in 1707 and 1714, under the respective titles of *Pouvoir des souverains* and *Liberté de conscience.*

The first edition of his collected works was published at Leyden in 1724 and the last in 1767. That of 1735 and those subsequent contain a life of the author by Barbeyrac.

NOON, midday, 12 o'clock. The O. Eng. *nón,* Nor. *non,* Dutch *noen,* are all from Lat. *nona* sc. *hora,* the ninth hour; *i.e.,* according to the Roman system, three o'clock P.M. The early uses of noon till the 13th and 14th centuries are either as translating the Latin, especially with reference to the Crucifixion, or as equivalent to the canonical hour of "Nones."

The ordinary word for 12 o'clock was *middaeg,* midday, also the equivalent of the canonical hour "Sext." Both the office and the meal taken about that time were shifted to an earlier hour, and by the 14th century the ordinary use of "noon" is that current today.

NORA, an ancient town of Sardinia, 22 mi. by road S.W. of Carales. It was founded, according to Pausanias, by the Iberians under Norax, son of Hermes, and was the most ancient town in the island. Discoveries made on the site, however, showed that it was of Phoenician origin. In Roman times, the milestones on the road from Nora to Bitia and even on that from Nora to Carales were reckoned from Nora (*Corp. inscr. Lat.,* x, 831; *Ephemeris epigraphica,* viii, 180). The sepulchral inscriptions found there, however, gave no information as to its juridical condition. The town occupied a characteristically Phoenician site, a small peninsula joined to the mainland by an isthmus, low, narrow and sandy. Excavations led to the discovery of Phoenician buildings, the foundations of a temple of Tanit, a road, quay walls at the water's edge and a watchtower on the extremity of the peninsula which rose to about 150 ft. above the sea. One cemetery which was found was of the 7th–6th century B.C. and consisted of tombs cut in the rock for inhumation. In another cemetery, going down to the 4th century B.C., cremation was the rule; there were ossuaries, or depositories for bones, placed in holes in the sand, with a sculptured stele over each. A quantity of small objects, gems, ivories, glass, vases, terra cottas, etc., were found; in some of them Egyptian, in others Greek, influence and importation were apparent. To the Roman period belong an aqueduct, which brought the water from the neighbouring hills, scanty remains of an amphitheatre, a theatre, considerable ruins of concrete foundations (perhaps of villas by the sea) and a watchtower on the promontory close to the Phoenician tower.

NORBA, an ancient town of Latium (*Adjectum*), It. It was 1 mi. N.W. of the modern Norma, 1,575 ft. above sea level, on the west edge of the Volscian mountains or Monti Lepini, above a precipitous cliff, with a splendid view over the Pomptine marshes. It was a member of the Latin league of 499 B.C., and became a Latin colony in 492 B.C., as an important fortress guarding the Pomptine marshes. It served in 199 as a place of detention for the Carthaginian hostages, and was captured and destroyed by Sulla's troops during the civil wars at the end of 82 B.C. Some revival in prosperity took place later.

NORBANUS, GAIUS, surnamed BULBUS or BALBUS, Roman politician, was a seditious and turbulent democrat. In 103 B.C., when tribune of the people, he accused Q. Servilius Caepio of having brought about the defeat of his army by the Cimbri through rashness and also of having plundered the temple

of Tolosa. Caepio was condemned and went into exile. About ten years later Norbanus himself was accused of treason because of the disturbances that had taken place at the trial of Caepio, but the eloquence of M. Antonius, grandfather of the triumvir, procured his acquittal. In 89 Norbanus as praetor successfully defended Sicily against the Italian socii. During the civil war between Marius and Sulla he sided with the former, but was defeated by Sulla at Mount Tifata near Capua and again by Metellus at Faventia in cisalpine Gaul (82). He fled to Rhodes, where he committed suicide while the Rhodians were debating whether to hand him over to Sulla.

NORD, the most northern department of France. Area 2,229 sq.mi. Pop. (1946) 1,917,452. Bounded for 21 mi. by the North sea, it has Belgian territory on the northeast and east. It lies below and parallel to the chalk scarp of Artois, famous for its defense in World War I. The coast is formed largely of sand dunes drained by canals. The department is crossed by the Scheldt (Escaut) with its tributaries and by the Sambre, the chief tributary of the Meuse. The climate of Nord is colder than that of France in general, the mean temperature being 49° or 50° F. Average annual rainfall is about 28 in.

In agricultural and industrial importance Nord is the first of French departments. In the southeast stock raising flourishes; in the central zone beetroot is characteristic, while mixed farming prevails in the northwest. Cereals (especially wheat and oats) and potatoes are grown in abundance, while flax, tobacco, chicory, colza and hops are minor crops. Market gardening and horticulture are practised in some localities. There are mineral springs, notably at St. Amand, where the mud baths are used in the treatment of rheumatism. The mineral wealth lies chiefly in coal mines forming part of the Valenciennes basin, the most important in France, which extends into Belgium and Pas-de-Calais. The textile industry centres in Lille, Roubaix and Tourcoing, which spin and weave cotton, linen and wool, as also around Fourmies. Other centres are Armentières (cloth weaving), Dunkirk (flax, jute and hemp spinning), Cambrai (batiste and other delicate fabrics; also chicory), Douai, Avesnes, le Cateau and Caudry. Other great industries are glass, brick, pottery and sugar manufacture, alcohol distilling, dyeing, iron founding and steel production. Branches of the metallurgical industry are at Denain, Hautmont, Maubeuge, Valenciennes, Douai, Raismes, etc. Dunkirk and Gravelines equip fleets for the cod and herring fisheries. Dunkirk is the chief port. Its system of inland navigation is highly developed, comprising a line of waterways from the Scheldt to the North sea at Dunkirk, with which the coal basin of Valenciennes is linked by the canalized Scheldt and the textile region of Lille by means of the Deûle canal and the canalized Lys.

The department is divided into six *arrondissements* (Avesnes, Cambrai, Douai, Dunkirk, Lille, Valenciennes) with 68 cantons and 665 communes. It forms the archiepiscopal diocese of Cambrai and part of the region of the 1st army corps (headquarters at Lille) and of the educational division of Lille. Its court of appeal is at Douai.

NORDAU (originally SÜDFELD), **MAX SIMON** (1848–1923), Jewish Hungarian author, was born at Budapest on July 29, 1849, and practised medicine in his native town. He made his name by his pseudo-philosophical *Entartung* (Eng. trans., *Degeneration,* 1895), which was translated into many languages, and had a great vogue. Other works were *The Conventional Lies of Society* (Eng. version, 1895) and *Biologie der Ethik* (1921). Nordau was an ardent Zionist, and took Theodor Herzl's side in wishing to accept the British government's offer of land for a Jewish settlement in East Africa.

In 1903 an attempt was made on his life by a Jew opposed to the scheme. He died on Jan. 22, 1923.

His works include novels and stories: *Gefühlskomödie* (1892), *Die Drohnenschlacht* (1897), *Morganatisch* (1904), etc.; dramas: *Das Recht zu lieben* (2nd ed., 1894), *Doktor Kohn* (1898) and others; some books of travel; and the critical works *Zeitgenössische Franzosen* (1901) and *Von Kunst und Künstlern* (Leipzig, 1905).

NORDENSKIÖLD, NILS ADOLF ERIK, BARON (1832–1901), geographer and arctic explorer, was born at Helsingfors, on Nov. 18, 1832. He was the son of Nils Gustav Nordenskiöld, a mineralogist and a traveller. Compelled to leave Russia for political reasons, he settled at Stockholm. He received an offer from Otto Torell, the geologist, to accompany him on an expedition to Spitsbergen. To the observations of Torell on glacial phenomena Nordenskiöld added the discovery at Bell sound of remains of Tertiary plants, and on his return became professor and curator of the mineralogical department of the Swedish State museum. In 1861 he took part in Torell's second Spitsbergen expedition. Of the further expedition to the same quarter promoted by the Swedish academy of science in 1864, Nordenskiöld was the leader. Four years later he headed an expedition in the iron steamer "Sofia," and reached the highest northern latitude (81° 42′) then attained in the eastern hemisphere. In 1870, with three young naturalists, he visited the vast inland ice sheet of Greenland. On his next expedition in 1872 the tenders were caught in the ice, and the crews of the three vessels were forced to winter in Spitsbergen. In 1875–76, however, a successful voyage eastward, including the ascent of the Yenisei, led him to attempt the discovery of the long-sought Northeast Passage. Starting from Karlskrona on June 22, 1878, in the "Vega," he doubled Cape Chelyuskin in the following August, and after being frozen in at the end of September near Bering strait, completed the voyage successfully in the following summer.

On his return to Sweden he received an enthusiastic welcome, and in April 1880 was made a baron and a commander of the Order of the Nordstjerna. In 1883 he again visited the east coast of Greenland, and succeeded in forcing through the great ice barrier, a feat attempted in vain during more than three centuries. He died at Stockholm on Aug. 12, 1901.

Baron Nordenskiöld also published *Facsimile Atlas* (1889) and *Periplus* (1897). The former contains reproductions of geographical documents printed during the 15th and 16th centuries, and the latter, a work of far greater research, deals with the history of early cartography and the sailing charts in use among mariners during the middle ages.

NORDENSKJÖLD, OTTO (1869–1928), Swedish explorer, was born in 1869; his father was a brother of Baron A. E. Nordenskiöld (*q.v.*). He specialized in geology in the University of Uppsala and after travels in Tierra del Fuego and Alaska, he led an expedition (Oct. 1901) to the South Polar regions. He landed at Snow Hill Island, off the east coast of Graham Land. Weather conditions made it impossible for the "Antarctic," which had continued her course to Tierra del Fuego, to relieve them in 1902–03, and she sank in the attempt. After several attempts at rescue had been made, they were eventually brought back by a vessel sent by the Argentine government in Nov. 1903. ("*Antarctic*" *Två år bland sydpolens isar,* 2 vol., Stockholm, 1904; Eng. trans., *Antarctica,* 1905). In 1920–21 Nordenskjöld explored the Peruvian and Chilean Andes. He died on June 3, 1928.

NORDERNEY (*i.e.,* "northern island"), the largest of the East Friesland group, Germany. Pop. (1933) 5,068. It is 8 mi. long and about 1½ mi. broad and is reached by steamer from Norddeich, Bremerhaven or Hamburg, and at low tide by road. The village is a popular resort. Norderney is associated with Heinrich Heine's *Nordseebilder.*

NORDHAUSEN, a town in the *Land* of Saxony, Germany. It is situated on the Zorge to the south of the Harz mountains, at the west end of the Goldene Aue (Golden Plain), a fruitful valley watered by the Helme. Pop. (1939) 42,267. Nordhausen possessed a royal palace in 874 and a convent was founded there in 962. It was destroyed by Henry the Lion in 1180, but was soon rebuilt and was made a free imperial town in 1253. In this and the following century several diets and other assemblies were held there. The protector (*Vogt*) of the town was the elector of Saxony and from 1702 to 1715 the elector of Brandenburg. Nordhausen accepted the reformed doctrines in 1522. It was annexed by Prussia in 1803 and again in 1815, having in the meantime belonged to the kingdom of Westphalia. The upper and lower parts of the town are connected by flights of steps. Among its churches the most noteworthy are the Roman Catholic cathedral, late Gothic with a Romanesque crypt, and the Protestant church of St. Blasius. Near the mediaeval town hall stands a Roland's

column, the ancient symbol of free commercial intercourse and civic liberty. The chief importance of the place arises from its distilling of "Korn Schnapps," a spirit somewhat akin to whisky.

NORDICA, LILLIAN (1859–1914), American operatic soprano, was born at Farmington (Me.), May 12, 1859, trained at Boston, and later at Milan, under Sangiovanni. She made her début at Brescia in 1879, sang at Covent Garden, London (1887–93), and at the Metropolitan Opera House, New York, after 1895. She died at Batavia, Java, May 10, 1914.

NÖRDLINGEN, German town in the Swabian province of Bavaria, on the Eger. Pop. (1939) 8,827. From 898, when first mentioned, to 1215 Nördlingen was subject to the bishops of Regensburg, but about 1215 it became a free city of the Empire. It was annexed to Bavaria in 1803. It is still surrounded with walls and towers. The church of St. George is a Gothic structure erected in the 15th century and restored in 1880. The Late Gothic town hall has a collection of pictures and antiquities.

Military Operations.—Nördlingen was the scene of two great battles in the Thirty Years' War (*q.v.*). In the first, which was fought on Sept. 5 and 6, 1634, the hitherto invincible Swedish army, commanded by Duke Bernhard of Saxe Weimar and Marshal Horn, was defeated with great loss by a somewhat superior army of Imperialists and Spaniards under Gen. Gallas, Horn being taken prisoner. In the second battle, fought 11 years later (Aug. 3, 1645), Condé (then duke of Enghien) and Turenne were the leaders on the one side, and Mercy and Johann von Weert, the dashing cavalry commander whose onset had decided the battle of 1634, on the other. The Germans were posted some 5m. to the east of Nördlingen, about Allerheim. In rear of the village the plain was occupied by Mercy's army in the customary two lines, foot in the centre, horse in the wings. The French army, similarly arrayed, was more heterogeneous than the German. After a cannonade in which it suffered more severely than its entrenched enemy, the French centre furiously attacked the village of Allerheim; the fighting here was very heavy, and on the whole in favour of the Germans, although Mercy was killed. The right wing of the French cavalry was swept off the field by Johann von Weert's charge, but the German troopers, intoxicated with success, dispersed to plunder. On the French left, meanwhile, Turenne saved the day. Fighting cautiously at first with his leading line to gain time for his second to come up, he then charged and broke up the hostile right wing of cavalry, while some battalions of infantry scaled the hill and captured the Bavarian guns. Unlike Weert the marshal kept his troops in hand, and swung round upon the Bavarian infantry behind Allerheim, who were at the same time cannonaded by their lost guns. A prolonged fight now ensued, in which the Bavarians had the worst of it, and Weert, returning at last to the field, dared not attempt to engage afresh. The armies faced one another all night with their sentries 50 paces apart, but in the morning the Bavarians were found to have retreated. Nothing was gained by the victors but the trophies and the field of battle, and the losses of both sides had been enormous. Nördlingen, therefore, is a classical instance of the unprofitable and costly *bataille rangée* of the 17th century.

See Beyschlag, *Geschichte der Stadt Nördlingen* (Nördlingen, 1851), and Mayer, *Die Stadt Nördlingen, ihr Leben und ihre Kunst im Lichte der Vorzeit* (Nördlingen, 1856).

NORE, THE, sandbank at the mouth of the river Thames, England, marked by buoys and a lightship, with revolving light. This ship lies 3 m. from the Kent coast, about the same from the Essex coast, and 47¾ m. below London Bridge. The first light was placed as an experiment by Mr. Hamblin, its patentee, in 1732.

NORFOLK, EARLS AND DUKES OF. The 1st earl of Norfolk was Ralph de Guader, a follower of William the Conqueror, who forfeited the earldom when he revolted against William in 1075; the 2nd was Hugh Bigod (d. 1177), one of Stephen's supporters, to whom the earldom was granted by this king before 1141. Hugh's grandson, Hugh (d. 1225), the 3rd earl of this line, married Matilda, daughter of William Marshal, earl of Pembroke, and from the Marshals their son Roger (d. 1270), the 4th earl, inherited the office of marshal of England. This powerful family of Bigod retained the earldom until Roger, the 5th earl, died childless in Dec. 1306.

The next earl of Norfolk was Thomas of Brotherton (1300–1338), a younger son of Edward I., to whom the earldom was granted in 1312 by his half-brother, Edward II. In addition to the estates which had formerly belonged to the Bigods Thomas received the office of marshal. He joined Queen Isabella when she landed in England in 1326, and was one of the group of nobles who brought about the deposition of Edward II. He died in August 1338, leaving no son. The survivor of his two daughters, Margaret (*c.* 1320–1400), who was countess of Norfolk in her own right, married John de Segrave, 3rd Lord Segrave (d. 1353), and their only child Elizabeth (d. *c.* 1375) became the wife of John de Mowbray, 4th Lord Mowbray (d. 1368), and the mother of two sons John and Thomas. In 1397 the countess Margaret was created duchess of Norfolk, and at the same time her grandson Thomas Mowbray was made duke of Norfolk.

On the death of John Mowbray, 4th duke of this creation, in 1476 the dukedom became extinct, but the earldom passed to his daughter Anne, wife of the young Richard, duke of York, who was murdered in the Tower with whom the earldom became extinct.

The dukedom was given in 1483 to John Howard whose mother, Margaret Mowbray, was a daughter of Thomas Mowbray the 1st duke. The dukedom has remained in the Howard line until the present day. (*See* Howard.)

NORFOLK, HENRY FITZALAN HOWARD, 15th Duke of (1847–1917), was born in London on Dec. 27, 1847, and succeeded his father, the 14th duke, in 1860. He was educated at the Oratory School, Edgbaston, and then spent some time with his uncle, Lord Lyons, in Constantinople. The duke was post-master-general from 1895 to 1900, first Lord Mayor of Sheffield in 1895, and served in the yeomanry in the South African War. His position as head of the English Roman Catholics and as premier duke and Earl Marshal made him for many years conspicuous in public life. He was throughout his life in close connection with the Vatican, and was sent by Queen Victoria in 1887 on a special mission to Leo XIII. He did not always agree with the policy of the Irish Catholic hierarchy, but he did much for Catholic education in Ireland. He was keenly interested in education generally; was one of the founders of Sheffield University, and its first vice-chancellor. The duke was concerned in the building of many Catholic churches in England, notably the church of St. John the Baptist at Norwich. He died in London on Feb. 11, 1917.

NORFOLK, JOHN HOWARD, 1st Duke of (of the Howard line) (*c.* 1430–1485), was the son of Sir Robert Howard by his wife Margaret, daughter of Thomas Mowbray, the first duke of that family. In 1455 John Howard was sent to parliament as member for Norfolk, although he "hadde no lyvelode in the shire"; in 1461 he was knighted; and in 1470, although he appears to have been a consistent Yorkist, he was created a baron by Henry VI. He was treasurer of the royal household from 1467 to 1474, and went to France with Edward IV. in 1475. After Edward's death, however, he supported Richard III., who created him duke of Norfolk and made him earl marshal of England in June 1483. He was killed at Bosworth whilst fighting for this king on Aug. 22, 1485, and the title thus suffered attainder.

NORFOLK, THOMAS HOWARD, 2nd Duke of (1443–1524), son of the preceding, shared his father's fortunes; he fought at Barnet for Edward IV. and was made steward of the royal household and created earl of Surrey in 1483. Taken prisoner at Bosworth he was attainted and remained in captivity until January 1489, when he was released and restored to his earldom but not to the dukedom of Norfolk. He was then entrusted with the maintenance of order in Yorkshire and with the defence of the Scottish borders; he was made lord treasurer and a privy councillor in 1501, and he helped to arrange the marriage between Margaret, the daughter of Henry VII., and James IV. of Scotland. Henry VIII., too, employed him on public business, but the earl grew jealous of Wolsey, and for a short time he absented himself from court. He commanded the army which defeated the Scots at Flodden in September 1513, and was created duke of Norfolk in February of the following year, with precedency as

of the creation of 1483. In his later years Norfolk worked more harmoniously with Wolsey. He was guardian of England during Henry's absence in France in 1520, and he acted as lord high steward at the trial of his friend Edward Stafford, duke of Buckingham, in 1521. Among his sons were William, 1st Lord Howard of Effingham (1510?–1573), and Sir Edward Howard (*c.* 1477–1513), lord high admiral, who defeated the French fleet off Brest in August 1512, and died during an engagement in April 1513.

NORFOLK, THOMAS HOWARD, 3RD DUKE OF (1473–1554), eldest son of the 2nd duke, married in 1495 Anne (1475–1512), daughter of Edward IV., thus becoming a brother-in-law of Henry VII., who had married Anne's sister Elizabeth. He became lord high admiral in 1513, and led the van of the English army at Flodden in September, being created earl of Surrey in February 1514. In 1513 he took for his second wife Elizabeth (d. 1558), daughter of Edward Stafford, duke of Buckingham. In 1520 Surrey went to Ireland as lord-deputy, but soon vacated this post to command the troops which sacked Morlaix and ravaged the neighbourhood of Boulogne in 1522; afterwards he raided and devastated the south of Scotland. He succeeded his father in May 1524, and as the most powerful nobleman in England he headed the party hostile to Cardinal Wolsey. He favoured the divorce of Henry VIII. from Catherine of Aragon, and the king's marriage with his niece Anne Boleyn. In 1529 he became president of the council, but in a few years his position was shaken by the fate of Anne Boleyn, at whose trial and execution he presided as lord high steward. But his military abilities rendered him almost indispensable to the king, and in 1536, just after the rising known as the Pilgrimage of Grace had broken out, he was despatched into the north of England; he temporized with the rebels until the danger was past, and then, as the first president of the council of the north, punished them with great severity. Sharing in the general hatred against Thomas Cromwell, Norfolk arrested the minister in June 1540. He led the English army into Scotland in 1542 and into France in 1544; but the execution of Catherine Howard, another of his nieces who had become the wife of the king, had weakened his position.

His son Henry Howard, earl of Surrey (*q.v.*), was arrested on a charge of treason; Norfolk himself suffered the same fate as accessory to the crime. In January 1547 Surrey was executed; his father was condemned to death by a bill of attainder, but owing to the death of the king the sentence was not carried out. Norfolk remained in prison throughout the reign of Edward VI., but in August 1553 he was released and restored to his dukedom. Again taking command of the English army he was sent to suppress the rebellion which had broken out under Sir Thomas Wyat, but his men fled before the enemy. He acted as lord high steward at the trial of John Dudley, duke of Northumberland; and he died on Aug. 25, 1554. Norfolk was a brutal and licentious man, but was a supporter of the Roman church, being, as he himself admits, "quick against the sacramentaries."

NORFOLK, THOMAS HOWARD, 4TH DUKE OF (1536–1572), son of Henry Howard, earl of Surrey, was born on March 10, 1536. His tutor was John Foxe, the martyrologist. Norfolk, who had already been married three times, was regarded as a suitable husband for Mary queen of Scots, who had just taken refuge in England. He presided over the commission appointed by Elizabeth to inquire into the relations between the Scottish queen and her subjects; and although he appears to have believed in Mary's guilt he was anxious to marry her. Among the Scots Maitland of Lethington favoured the proposed union; Mary herself consented to it; but Norfolk was unwilling to take up arms, and while he delayed, Elizabeth ordered his arrest and he was taken to prison in October 1569. In August 1570, after the suppression of the rising in the north of England, the duke was released; but he entered into communication with Philip II. of Spain regarding the proposed invasion of England by the Spaniards. After some hesitation Norfolk placed himself at the head of the conspirators; and in return for his services he asked the king of Spain "to approve of my own marriage with the Queen of Scots" But the plot failed; Norfolk's treachery was revealed to Lord Burghley, and in September 1571 he was arrested. He was beheaded on June 2, 1572. He always regarded himself as a Protestant. Norfolk's first wife, Mary (1540–1557), daughter and heiress of Henry Fitzalan, 12th earl of Arundel, bore him a son, Philip, who in consequence of his father's attainder was not allowed to succeed to the dukedom of Norfolk, but became 13th earl of Arundel in succession to his maternal grandfather in 1580. Norfolk left two other sons, Thomas Howard, created earl of Suffolk in 1603, and Lord William Howard (*q.v.*).

NORFOLK, THOMAS MOWBRAY, 1ST DUKE OF (*c.* 1366–1399), son of John de Mowbray, 4th Lord Mowbray, was created marshal of England for life in 1385. He was then Lord Mowbray and earl of Nottingham. In 1387 Nottingham began to act with Thomas of Woodstock, duke of Gloucester, his own brother-in-law, Richard Fitzalan, earl of Arundel, and the party of nobles who wished to deprive the king of his power. They routed the royal favourite Robert de Vere, earl of Oxford, at Radcot Bridge, and Richard was at their mercy. Owing partly to Nottingham's moderate counsels the suggestion to depose him was not carried out, but in the "merciless parliament" of 1388 his favourites were "appealed" of treason and were sentenced to death. For nearly two years the chief power was in the hands of the lords appellant, as Nottingham and his friends were called, but in 1389 the king regained his authority. He detached Nottingham from his colleagues and made him warden of the Scottish marches; later he became captain of Calais and the royal lieutenant in the north-east of France. Richard took him to Ireland in 1394 and soon afterwards sent him to arrange a peace with France and his marriage with Isabella, daughter of King Charles VI. But the earl's supreme service to the king was in 1397 when Richard took a tardy but severe vengeance upon three of the appellants. In their turn these lords were "appealed" of treason before the parliament, and as on the former occasion Nottingham was one of the accusers. He was present when Gloucester was arrested at Pleshey, and Froissart says that he actually beheaded Arundel himself. Gloucester was entrusted to his keeping at Calais, and in September 1397 he reported that his prisoner was dead. The duke had been murdered, and Nottingham was probably responsible, although the evidence against him is not conclusive. As a reward he received most of Arundel's lands in Surrey and Sussex, and was created duke of Norfolk. He now began to fear for his own safety, and took the duke of Hereford, afterwards King Henry IV., into his confidence. Hereford carried his words to the king, who summoned him to his presence, and at Oswestry Norfolk accused Hereford of speaking falsely. A court of chivalry decided that the dispute should be referred to the arbitrament of single combat at Coventry; but when everything was ready (Sept. 16, 1398) for the fight Richard interposed and ordered both combatants into banishment. Norfolk was deprived of his offices, but not of his titles; he left England for Dordrecht, and after passing some months in wanderings he reached Venice, where he died on Sept. 22 or 27, 1399. The concluding scene of the duke's life in England forms the staple material of act i. of Shakespeare's *Richard II.*

NORFOLK, an eastern county of England, bounded north and east by the North sea, south-east and south by Suffolk and west by Cambridgeshire and Lincolnshire. The area is 2,055 sq.mi., the county being the fourth in size in England.

Physical Features.—The county as a whole is low-lying, no point reaching up over 350 feet. In the extreme west we have the flat fens composed of recent alluvium, which is crossed by various dykes and ditches which help to drain the district; windmills used for this purpose are a conspicuous feature, though they are being replaced by pumping engines. To the east of the Ouse the land rises somewhat, where we have the north easterly extension of the chalk hills of England. These form the oldest rocks in the county, except for a few small patches of Kimeridge clay lying along their western side. The cretaceous rocks dip eastward under various glacial deposits such as boulder clay and gravel. The indeterminate nature of the drainage is due to glacial action. The heights also die away southward and eastward, and here the land is generally fertile and well wooded, with occasional expanses of heath. The rivers follow rather irregular courses, what

watershed there is lying across the centre of the county from south-east to north-west; the Cromer Morainic ridge forms a secondary parting at right-angles to the first. The largest rivers in the east of the county are the Yare and its tributaries the Bure and the Waveney, which forms a large part of the boundary with Suffolk. In the river valleys are large stretches of alluvial deposits.

Nearly two-thirds of the boundary of the county is formed by tidal water, but there are few bays or inlets. For the most part the coast-line is flat and low, and has been greatly encroached on by the sea, several villages having been engulfed since the Conquest. At certain points, however, blown sand is filling up some arms of the sea. From the mouth of the Yare to Happisburgh the shore is skirted by sandbanks. Thence for 20 m. it is formed of cliffs consisting of clay and masses of embedded rocks. These cliffs are succeeded by a low shingly or sandy coast stretching as far as St. Edmund's point. The shores of the Wash are formed of mudbanks, which are left dry at low water. At various points off the coast there are submarine forests, especially in Brancaster bay and in the neighbourhood of Cromer and Happisburgh.

Archaeology and History.—Palaeolithic implements have been found in the county in the valley of the Little Ouse and near Cromer. The county, because of the low rainfall and fairly strong winds, was never very heavily forested, and as such it offered a suitable home for Neolithic man, who has left extensive traces of his occupation on the chalk of the west and along the gravels in the east. A few miles north-east of Brandon there are extensive pits in the chalk dug by early man when quarrying for flint (Grimes' Graves), and in them were found numerous deer antlers used by him as picks. Bronze weapons are fairly numerous, and their distribution tallies generally with those of Neolithic artefacts. Evidence of probable contacts across the North sea is borne out by the fact that 11 beakers have been discovered in the county. Finds of the early Iron age are not numerous, but towards the end of the pre-Christian era and for some time after, Norfolk was part of the lands of the Iceni. This tribe accepted the suzerainty of the Romans at the Conquest, but at the death of their ruler, Prasutagus, and following the injustice of the Romans to his wife, Boudicca (Boadicea), and his daughters, they rebelled. Successful at first, they were finally completely defeated, and their territories ravaged by the victors. Of Roman remains in the county we have the settlement of Caister-by-Norwich, perhaps a small village at Caister-by-Yarmouth and a fort at Brancaster which guarded the Wash and the north coast, and which was the headquarters of the Count of the Saxon shore. A Roman road, known as the Peddar way, probably following a more ancient track, crosses the Little Ouse a few miles east of Thetford, and runs north-north-west across the country to near Hunstanton; another road from Colchester to Caister-by-Norwich enters the county by Scole. The eastward continuation of the pre-Roman Icknield way also crossed the county.

The district was invaded in the second half of the 5th century by Angle tribes from north Germany, who, having secured the coast districts, worked their way inland along the river valleys. East Anglia owned successively the supremacy of Kent, of Mercia and Northumbria, until in 827 the whole land was united under the rule of Egbert. In 867 the Danes under Inguar and Ubba defeated and killed King Edmund at Thetford, and Norfolk formed an integral part of the Danelaw. In the renewed Danish attacks of the 11th century Norwich and Thetford were destroyed. At the time of the Norman invasion Norfolk formed part of Harold's earldom.

Norfolk formed part of the diocese of East Anglia from its foundation in 630, and in 1075 the bishop's see was placed at Thetford, whence it was transferred to Norwich in 1093.

Architecture.—With a few exceptions, the majority of the churches are Decorated or Perpendicular, or a mixture of both styles. The churches of the marshes in the north-west are noteworthy, especially those of Tilney All Saints and Walpole St. Peter's, the finest Perpendicular edifice in Britain; the rich Norman church of Castle Rising should also be mentioned. At Northwold remains one of the rare Easter sepulchres. Apart from the churches in the towns, those of Worstead, Hingham, Cawston and Terrington St. Clement may be quoted as typical examples of the numerous fine later Gothic churches. Norfolk possessed an unusually large number of monastic foundations, but of these the remains are few and comparatively unimportant. The cathedral church of Norwich was originally connected with a very richly endowed Benedictine monastery. A foundation of almost equal importance was that of Augustinian canons at Walsingham, where there are remains of an Early English and Decorated church, a Decorated refectory and a Perpendicular gateway. The shrine of Our Lady of Walsingham was the resort of great numbers of pilgrims. Other monastic remains are Bromholm priory near North Walsham; slight Early English fragments of Beeston Augustinian priory, west of Cromer; good Norman and later remains at Binham (Benedictine) north-east of Walsingham; the Benedictine nunnery of Carrow near Norwich; the fine church (Norman and later) of the Benedictine priory at Wymondham; and the remains at Castle Acre and Thetford.

The shire-system was not definitely established in East Anglia before the Conquest, but the Domesday boundaries of Norfolk were practically those of the present day. The 36 Domesday hundreds were subdivided into leets, of which no trace remains, and the boroughs of Norwich and Thetford ranked as separate hundreds, while Yarmouth was the chief town of three hundreds. Norfolk and Suffolk were united under one sheriff until the reign of Elizabeth, the shire court for the former being held at Norwich.

In the war between John and his barons Roger Bigod garrisoned Norwich castle against the king. In the rising of 1381 Norwich was plundered by the insurgents, and in the rising of 1549 against enclosures Norwich was again captured by the rebels under Ket. In the Civil War of the 17th century Norfolk as a whole adhered to the parliamentary cause, forming one of the six counties of the Eastern Association. Lynn, however, was held for the king, and Norwich was one of the first cities to welcome back Charles II.

There are several old mansions of interest, such as the Jacobean brick building of Blickling hall, Barningham hall (1612), Hunstanton, the moated Oxburgh hall, and Cressingham manor, both of the 15th century. The larger mansions, however, such as Sandringham, are of modern date. Paston and Oxnead were successively the seats of the Paston family whose Letters are famous.

Politics and Agriculture.—Norfolk returned members to parliament in 1290, and in 1298 the county and the boroughs of Lynn, Norwich and Yarmouth returned each two members. Thetford acquired representation in 1529, and Castle Rising in 1558. Under the Reform Act of 1832 the county returned four members in two divisions, and Castle Rising was disfranchised. Under the act of 1868 the county returned six members in three divisions, and Thetford and Yarmouth were disfranchised.

At the time of the Domesday survey sheep-farming flourished almost throughout Norfolk, a flock of 1,300 being mentioned at Walton, and horses were extensively bred; numerous beehives, nearly 600 water-mills and valuable river fisheries are mentioned; and salt was made in the hundreds of Freebridge and East Flegg. There was also, after the Conquest, a well developed trade with Flanders in wool. The worsted trade was introduced by Flemish immigrants as early as the 12th century, and the woollen trade became especially prosperous in the hundreds adjoining the Wash. This immigration and those of religious refugees from the Continent in later times doubtless contributed to the county's having produced many notable men. Linen was manufactured at Aylsham in the 14th century. Fuller, writing in the 17th century, describes Norfolk as abounding in all good things, and especially rabbits, herrings and worsteds. The leather industry flourished in Norman times.

The great variety of the soils has helped to make Norfolk rich agriculturally, and where the land is not suitable for plowing it is usually good for pasture. It was at Holkham, in this county, that Thomas Coke, earl of Leicester, carried out experiments in the cultivation of wheat and began to improve the standard of livestock in Britain. In 1939 the total acreage under crops and grass was 974,246, of which 119,387 ac. were under wheat, 184,719 ac. under barley, while oats occupied less than half the acreage of wheat. Rye covered 1,978, beans and peas 11,338 acres.

The area of sugar beets was 89,391 ac., of potatoes 24,098 ac., and of turnips and swedes 21,698 ac. Clover and rotation grasses for hay occupied 82,633 ac., and orchards 9,664 ac. A feature in the cultivation of Norfolk has been the extensive planting of trees. The National Trust owned 6,538 ac. in 1942.

Industries, Communications, etc.—The weaving of silk and wool is still carried on at Norwich and also shawl weaving, although the staple trade of the town is now boots and shoes. Silk is also manufactured at Yarmouth, Wymondham and North Walsham. Flour-mills are numerous all over the county, and there are agricultural implement works at Norwich, Lynn, Thetford, East Harling, North Walsham, Walsingham and East Dereham. Lime-burning, brick-making, tanning, malting and brewing are carried on in various districts. There are extensive mustard and starch works at Norwich. The sea-coast is of a dangerous nature and there is a lack of harbours. A large trade, however, is carried on at Yarmouth, which is also famous for its herring fishery. The other principal port is Lynn, and there is a small trade at Wells.

The L.N.E. and the M. and Gt.N.Jt. railways serve the principal towns. The eastern rivers afford water communication with Great Yarmouth, while the Great and Little Ouse and some of the drainage cuts communicate with Lynn.

The area of the administrative county is 2,036 sq.mi., with a population (1938) of 501,660, though between Sept. 1939 and Feb. 1941 the population decreased 2% as a result of wartime evacuation. The municipal boroughs are—King's Lynn; Norwich, a city and county borough and the county town; Thetford; and Yarmouth, properly Great Yarmouth, a county borough. The county is in the south-eastern circuit, and assizes are held at Norwich. There are two courts of quarter sessions. Each of the four municipal boroughs has a separate court of quarter sessions. Norfolk is in the diocese of Norwich except for three rural deaneries in west Norfolk, which are in that of Ely. There are five parliamentary divisions—King's Lynn, South-Western, Northern, Eastern and Southern—as well as the parliamentary borough of Norwich (two members), and part of the parliamentary borough of Great Yarmouth (one member). Of the three boys' public schools in the county, two are in Norwich, viz., King Edward VI's school and the City of Norwich school. The third, Gresham's school, was founded at Holt, near Sheringham, in 1555, by Sir Thomas Gresham (*q.v.*).

Broads and Rivers.—The rivers and broads (lakes) of Norfolk, together with the few in Suffolk, form over 200 m. of navigable waterway. They are now, however, chiefly used by pleasure craft, though a diminishing number of trading wherries still carry coal and other goods between the large towns, such as Yarmouth, and the villages. The southern rivers are wider and deeper than the northern, and the Yare can be navigated by sea-going trading vessels as far as Norwich.

The formation of a broad may be due either to the widening of a river or to a sea-estuary becoming completely enclosed by sand-banks. The broads tend to become overgrown with reeds which, if they are not cut (they can be utilized to make a very durable thatch), rot and fall to the ground, and, aided by the general silting up, they may cause the broad to be replaced by dry land. Several of the broads have to be dredged to preserve a navigable channel, some of them (*e.g.*, Hickling broad) being extremely shallow.

Some of the broads are extremely beautiful; notably Wroxham, Salhouse and South Walsham (up the Bure), which are surrounded by wooded country; Barton broad (up the Ant); and Horsea mere (up the Thurne, not far from the sand dunes and near to Hickling broad), which is of quite a different character, being surrounded by reedy marshland, the haunt of hundreds of different species of wild birds. The bittern (*q.v.*) was saved from extinction at an island on Hickling broad, and now flourishes in considerable numbers. The bearded tit (*see* TITMOUSE) has also been saved from the same fate. The fishing is good, and wild duck are shot from a "Breydon duck-punt" which carries a heavy gun aimed by manoeuvring the boat itself.

See *Victoria County History; Norfolk;* F. Blomefield, *Essay towards a Topographical History of . . . Norfolk* (1739–75 and 1805–10); W. Rye, *History of Norfolk* (1885); P. H. Emerson, *Pictures of East Anglian Life* (1888); Rev. A. Jessopp, *Arcady* (1887), and other works by both; *Quarterly Review* (1897), where other literature is cited; G. C. Davies, *Norfolk Broads and Rivers* (Edinburgh, 1884); Christopher Marlowe, *People and Places in Marshland* (1927); "Land of Britain," *Land Utilisation Survey*, Part 70 (London, 1938).

NORFOLK, a city of Madison county, Neb., U.S., in the northeastern part of the state, on the Elkhorn river, at an altitude of 1,525 ft. It is on federal highways 81 and 275 and is served by the Chicago and North Western, the Chicago, St. Paul, Minneapolis and Omaha and the Union Pacific railways. Pop. (1950) 11,231; (1940) 10,490 by federal census. Food processing is its major industry. The city was founded in 1866, incorporated in 1881 and chartered in 1886.

NORFOLK, a seaport of Virginia, U.S., on the Hampton Roads. It is on federal highways 58, 60 and 460 and is served by the Atlantic Coast Line, the Chesapeake and Ohio, the Norfolk Southern, the Norfolk and Western, the Pennsylvania, the Seaboard Air Line, the Southern and the Virginian railways (all interconnected by an industrial belt line), and by interurban trolleys, motorbus and air lines, several ferries and about 60 steamship lines. Pop. 188,601 in 1950; it was 144,332 in 1940 and 129,710 in 1930 by federal census.

The city has 50 mi. of water front on Hampton Roads, Chesapeake bay, the Elizabeth river (which is a tidal estuary, not a river), and the Lafayette river (another estuary). Immediately opposite is the city of Portsmouth. The town of Berkley was annexed to Norfolk in 1906, and lying beyond it is the still independent town of South Norfolk.

The waters about Norfolk, Portsmouth and Newport News (officially known as the Port of Hampton Roads, and under the jurisdiction of the state port authority created in 1926) form one of the finest natural harbours of the world, where a thousand ships at a time have found berthing space or anchorage without taxing its capacity. The part known as Norfolk harbour (which includes the Portsmouth waters) is 15.5 mi. long, varies from ½ to 2 mi. in width and is connected with the bay by a 40-ft. channel. On the Norfolk water front there are 154 piers, largely owned by railroads, steamship lines and shipbuilding companies. The army supply base, north of the Lafayette river, established in 1917 and representing an investment of $30,000,000, was leased by the city from the United States in 1919, and beyond it a modern municipal terminal was constructed (at an expenditure of $6,000,000) including a grain elevator with a capacity of 800,000 bushels, a dock specially equipped for shipping garden and farm produce and a general merchandise pier 1,210 ft. long, with transit sheds and warehouses. The business section of the city is compactly built up with hotels, stores and office buildings that seem tall in proportion to the width of the streets.

Some beautiful antebellum homes and interesting old buildings remain, including St. Paul's church (1739), which has a British cannon ball embedded in its walls; the old Norfolk academy (built in 1840), now used temporarily by the juvenile and domestic relations court; and the colonnaded city hall (1850). There are public parks covering 500 ac., 30 playgrounds, 41 public-school buildings, 225 churches, two daily newspapers, a public library with seven branches, a municipal market built in 1923 at a cost of $500,000 and a picturesque municipal armoury.

Virginia beach, a popular resort on the Atlantic, 5 mi. below Cape Henry, is 20 mi. east of Norfolk, and there are many other recreation spots in the vicinity.

The water supply, sufficient for a much larger city, comes partly from works built in 1872–73, which for some time had been seriously inadequate, and partly from Lake Prince (20 mi. W.) through a new system constructed after 1920 at a cost of $6,000,000.

In 1919 the city adopted a council-manager form of government.

Norfolk is the centre of many activities of the federal government. The Norfolk navy yard is on the Portsmouth side of the Elizabeth river (*see* PORTSMOUTH), and the naval hospital is also in Portsmouth. In Norfolk (directly opposite the navy yard) is the St. Helena naval reservation, used as a naval air-landing

field. Within the city are also a U.S. public health service hospital, a branch of the U.S. hydrographic office, district headquarters of the coast guard, headquarters of the customs district of Virginia and various other offices. At Sewall point, on the northern edge of Norfolk, is the Hampton Roads naval operating base, where thousands of men were trained for the navy during World Wars I and II; a supply station with warehouse floor space of 55 ac. and the navy's principal fuel reserve depot; a naval air station and a submarine base.

Hampton Roads has become one of the important ports of the United States in respect to foreign trade, handling normally about 2% of the total of U.S. exports and imports. About 70% of the tobacco exported from the United States moves through Hampton Roads, and it is an important coal depot for coastwise and foreign trade and for bunkering purposes. It is also an important oil-bunkering port, with a storage capacity of 2,500,000 bbl. About two-thirds of the total tonnage of Hampton Roads moves through the Norfolk harbour.

Norfolk is surrounded by one of the finest truck-farming districts of the United States, and is the shipping point for immense quantities of potatoes, spinach, kale, beans, cauliflower, tomatoes and strawberries. Shipbuilding is perhaps the most important of Norfolk's industries. Among other products are fertilizers (1,000,000 tons a year), peanut and cottonseed oil, sea foods, textiles, automobiles, cement and lumber.

Norfolk was laid out in 1682 (on 50 ac. of land bought from Nicholas Wise, a carpenter, for 10,000 lb. of tobacco) to be a centre of trade, and was incorporated as a borough in 1736. On Jan. 1, 1776, it was furiously bombarded by the British under Lord Dunmore. Sailors set fire to the warehouses along the water front, and the town burned for three days, until all the buildings except St. Paul's church were destroyed. After the Revolution it was rebuilt, and grew rapidly until the Embargo act of 1807 ruined its commerce at a single stroke. In the War of 1812 Norfolk was attacked and successfully defended. It was chartered as a city in 1845.

In 1855 there was a disastrous epidemic of yellow fever, brought in by a man-of-war. At the outbreak of the Civil War Norfolk had a population of 14,620. The navy yard was burned and abandoned by the Federals in April 1861, and the city was held by the Confederates until May 10, 1862. Recovery after the war was gradual until 1880, when the population was 21,966. After that growth was more rapid, to 34,871 in 1890, 46,624 in 1900, and 67,452 in 1910. The Ter-Centennial exposition, celebrating the founding of Jamestown, was held here in 1907, on ground now within the city limits and occupied by the naval base.

During World Wars I and II Norfolk experienced accelerated prosperity, at first caused by heavy shipments of orders to the Allies, and in the later phases of both wars by the activities at the army supply base and the naval operating base and navy yard. Correspondingly severe was the postwar deflation following World War I, when the army base was closed down, the fleet transferred to the Pacific coast and the naval training station reduced to a skeleton organization; but in the following years substantial foundations were laid for a healthy commercial, civic and industrial development.

NORFOLK AND WESTERN RAILWAY COMPANY, THE, one of the world's greatest coal carriers, with total assets of $564,039,308.91 and a total capitalization of $163,482,800 on Dec. 31, 1939, employed 20,000 persons and operated 4,628.01 m. of track in six States in the United States, namely: Virginia, West Virginia, North Carolina, Maryland, Ohio and Kentucky. Its main line runs from Norfolk and Lambert Point, Va., the eastern terminus, on the Port of Hampton Roads, through agricultural, livestock and mineral sections of Virginia, through vast coal fields in West Virginia and thence into Ohio to Cincinnati and Columbus, the western terminals. A line from Roanoke, Va., to Hagerstown, Md., makes connections for the east and north; two lines into North Carolina, one from Roanoke, Va., to Winston-Salem and the other from Lynchburg, Va., to Durham, make connections with the south. One of the first railroads in the country to employ electric traction, the N. and W. greatly increased its operating efficiency by electrifying 210 m. of track on mountain grades in West Virginia. The coal traffic of the road has grown from 70,000 tons in 1883 to about 40,000,000 tons annually.

The road had its beginning in Virginia in 1838 as the City Point Railroad running between Petersburg and City Point, a distance of nine miles. The South Side (which purchased the City Point), Norfolk and Petersburg, and Virginia and Tennessee railroads, all in Virginia, and built between 1849 and 1858, running from Norfolk to the Tennessee line at Bristol, consolidated in 1870 as the Atlantic, Mississippi and Ohio R.R. Co., with a total trackage of 479 miles. This road was sold in 1881 and became the Norfolk and Western Railroad Company. Between 1881–91 it built three lines into the coal fields of Virginia and West Virginia extending beyond to Ohio and acquired by purchase two other roads, one running from near Ironton, Ohio to Columbus, and the other, from Roanoke to Hagerstown. In Sept. 1896, the railroad was reorganized as the Norfolk and Western Railway Co. Later in the year it purchased the two lines running from Virginia into North Carolina. In 1901 it bought a second line in Ohio, from Sciotoville to Cincinnati. Since that time the road has had a steady development, with double tracking, branch construction and the complete modernization of all its facilities. (W. J. J.)

NORFOLK ISLAND: *see* Pacific Islands.

NORICUM, a district south of the Danube, corresponding to part of Styria and Carinthia, Austria, Bavaria and Salzburg. The population was Illyrian afterwards subordinate to various Celtic tribes. The country is mountainous and the soil poor, but it was rich in iron, and the famous Noric steel was used for Roman weapons. The inhabitants were warlike and paid more attention to cattle-breeding than to agriculture. Gold and salt were found in considerable quantities; the wild nard grew in abundance, and was used as a perfume. Noricum was the southern outpost of the Celtic peoples and the starting-point of their attacks upon Italy. The cemeteries of Hallstatt (*q.v.*), less than 40m. from Noreia, contained weapons and ornaments from the bronze age up to the fully developed iron age. Prof. Ridgeway (*Early Age of Greece*, i. ch. v.), holds that here was the cradle of the Homeric Achaeans. For a long time the Noricans enjoyed independence under princes of their own, and carried on commerce with the Romans. In 16, having joined with the Pannonians in invading Histria, they were defeated by Publius Silius, proconsul of Illyricum. From this time Noricum was called a province, although not organized as such, but remaining a kingdom with the title *regnum Noricum*, under the control of an imperial procurator. In the reign of Marcus Antoninus the Legio II. Pia was stationed at Noricum, and the commander of the legion became governor.

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NORMAL SCHOOLS: *see* Teachers, Training of.

NORMAN, SIR HENRY WYLIE (1826–1904), field-marshal and colonial governor, was born on Dec. 2, 1826, and entered the Indian army at the age of seventeen. Norman served in numerous frontier campaigns between 1850 and 1854, and in the suppression of the Sonthal rebellion of 1855–56. In the Mutiny campaign he was constantly engaged, being present at the siege of Delhi, the relief of Lucknow and a number of other affairs. As adjutant-general of the Delhi Field Force, he was one of the leading spirits of the siege, and afterwards became its chief chronicler. Altogether he was mentioned twenty-five times in despatches. He held various important positions at Simla and at Whitehall until 1883. He was then governor of Jamaica (1883–88), governor of Queensland (1888–95), agent-general for Queensland, and in 1901 governor of the Royal Hospital, Chelsea. In 1902 he was made a field-marshal. He died on Oct. 26, 1904.

See Sir William Lee Warner, *Memoirs of Field-marshal Sir Henry Wylie Norman* (1908).

NORMAN, MONTAGU COLLET (1871–1950), British financier, was educated at Eton and King's college, Cambridge, and served in the South African War, 1900–01. He afterward be-

came connected with finance and his active association with the Bank of England began during World War I. In 1918 he was appointed deputy governor and in 1920 governor of the Bank of England. By 1926, when he was re-elected for the seventh time, he had held the post longer than any previous governor. He finally retired in April 1944 because of failing health and was succeeded as governor by Lord Catto. During his governorship the gold standard was restored (1925) and again abandoned (1931). In 1923 he was made a privy councillor and in 1933 he married Priscilla Worsthorae, granddaughter of the 7th Earl of Abingdon. He was created a baron in July 1944 and took the title Baron Norman St. Clere in the county of Kent. He died Feb. 4, 1950.

NORMAN, a city of central Oklahoma, U.S., 18 mi. S. of Oklahoma City, on a plateau 1,170 ft. above sea level, overlooking the valley of the South Canadian river; county seat of Cleveland county. It is on federal highway 77, and is served by the Santa Fe railway. The population was 27,006 in 1950 and 11,429 in 1940 by the federal census.

Norman was founded in 1889, when settlement in the Oklahoma territory began, and it was chartered as a city in 1902. Under the council-manager form of government adopted in 1919, the council members, who are directly elected for terms of two years, select the mayor. He can vote on all issues and also has full veto power. The city owns and operates a sewage treatment plant and a waterworks.

Hospitals in Norman are the Central State hospital for mental illness, established in 1895, the Ellison infirmary, on the University of Oklahoma campus, 1928, and the Norman Municipal hospital, 1946. There is the Norman Public library, which in 1950 had more than 18,000 volumes.

In 1892 the University of Oklahoma was opened in Norman after the people of the town and of Cleveland county, as required by the act of 1890 of the first legislature of the territory of Oklahoma, had provided 40 ac. for the university site and $10,000 for a building. In the first year, David Ross Boyd, the president, and three teachers began classes in a rented store, but by 1893 the first building was completed. A preparatory school, which was discontinued in 1911, was also established. By the 1950s the university had grown to include 11 schools and colleges with 12,000 students and a faculty of more than 800; the university library had more than 300,000 volumes.

Norman is primarily an agricultural community, and there are milk processing plants, cottonseed oil mills and cotton ginning plants. Other industries include mattress, broom and furniture factories and light manufacturing.

NORMAN, in architecture, the Romanesque style developed in Normandy and England during the 11th and 12th centuries, up to the time of the general adoption of Gothic architecture in both countries. Since it was only shortly before the Norman conquest of England that Normandy became settled and civilized enough to produce an architecture, the origin in both countries is the same, and early types extremely similar. This common early Norman differed from Romanesque in its love of geometric ornament such as zigzags, general crudeness in the scant figure and leaf carving, and a daring originality in construction ideas, possibly owing much to the fact that Lanfranc of Pavia (d. 1089) had introduced Lombard ideas into many Norman abbeys.

Although the English and French phases of the style were thus identical at the start, they soon became different. The French was characterized by careful, structural articulation (Abbaye-aux-Dames and Abbaye-aux-Hommes, Caen, both founded in 1062, but altered later), and elaboration of tower and spire (S. Michel de Vaucelles, Caen, 12th century). In England the chief characteristics are enormous length of church plan, the frequent use of great round columns for the nave arcade (Gloucester cathedral, 1089–1100; Tewkesbury abbey, 1123; and Durham cathedral, alternate piers, 1099–1128) and great decorative richness (Prior's door, Ely cathedral, late 12th century; S. Mary's chapel, Glastonbury abbey, 1186; the front of Iffley church, 12th century; and the Galilee porch at Durham, *c.* 1175). The general Norman structural genius is most markedly shown in the buttressing system and in the ribbed vault of Durham cathedral, whose date is much debated, being placed as early as 1133 and as late as the 13th century. (*See* BYZANTINE AND ROMANESQUE ARCHITECTURE.)

NORMANBY, CONSTANTINE HENRY PHIPPS, 1ST MARQUESS OF (1797–1863), British statesman and author, son of Henry, 1st earl of Mulgrave (1755–1831), was born on May 15, 1797. The 1st earl (who was created baron in 1794 and earl in 1812) was a distinguished soldier, and William Pitt's chief military adviser; and he held the offices of chancellor of the duchy of Lancaster (1804), secretary for foreign affairs (1805), first lord of the admiralty (1807–10) and master of the ordnance (1810–18). In 1792 he inherited the earlier Irish barony of Mulgrave—created in 1767 for his father, Constantine (1722–75), grandson of Sir Constantine Phipps (1656–1723), the lord chancellor of Ireland—from his elder brother, Constantine (1744–92), a naval captain.

His son, the 1st marquess, was governor of Jamaica (1830–35) and lord-lieutenant of Ireland (1835–39). He was created marquess of Normanby in 1838, and held successively the offices of colonial secretary and home secretary in the last years of Lord Melbourne's ministry. From 1846 to 1852 he was ambassador at Paris, and from 1854 to 1858 minister at Florence. The publication in 1857 of a journal kept in Paris during the stormy times of 1848 (*A Year of Revolution*), brought him into violent controversy with Louis Blanc, and he came into conflict with Viscount Palmerston and William Gladstone, on French and Italian policy. He died on July 28, 1863. He was succeeded as 2nd marquess by his son George (1819–90), a liberal statesman, who became governor of Queensland (1871–74), New Zealand (1874–79) and Victoria (1879–84).

NORMANDY, an ancient province of France, bounded on the northeast by the river Bresle, which falls into the English channel at Le Tréport and separates Normandy from Picardy, and then roughly by the Epte, which divides the Vexin into two parts. In 1791 the old duchy was divided approximately among the modern departments of Seine Inférieure, Eure, Orne, Calvados and Manche. Geographically, Normandy is characterized by its bordering on the sea, which encourages maritime life and explains the dampness of the climate; by the predominance of agriculture and stock raising; and, finally, by the importance of the Seine valley, which determined the situation of the capital city, Rouen, and attracted industry and trade, taking advantage of the neighbourhood of Paris.

History.—Till the 10th century A.D. Normandy retained certain Gallo-Roman features. The Germanic invasions and the conquest by Clovis before 506 little modified the features of the part of the old province of Lugdunensis Secunda, henceforth named Neustria; *civitas* and *pagi* subsisted. Christianity, introduced in the 4th century by St. Mello and St. Victricius, was extended under the protection of the Merovingians, benefactors of the abbeys of Fontenelle (modern Saint-Wandrille), Jumièges and Mont-Saint-Michel. The Norman settlement was established by the treaty of Saint-Clair-sur-Epte, concluded in 911 between King Charles the Simple of France and Rollo, chief of the Normans. The latter received territory comprising the town of Rouen and a few *pagi* situated on the coast; but afterward Rollo also received Bessin and Maine. This settlement put an end to plundering by the Normans, who, moreover, seem to have left intact much that they found. Rollo had been baptized; he and his successors maintained the great abbeys and kept the domanial system of farming almost unchanged. But since even today many proper names and place names of Scandinavian origin are found there, the newcomers must have been fairly numerous. Without losing the spirit of adventure which carried them in the 11th century to the conquest of England and southern Italy (on the pilgrims' road to Jerusalem), the Normans soon acquired the standards of the older population of France. They played their part in the troubles of the last Carolingian reigns and the feudal conflicts. Contact, if not rivalry, developed between the Norman duchy and the neighbouring county of Flanders, the counties of Maine and Anjou, the duchy of Brittany, the Capetian duchy (soon afterward kingdom) of France and, finally, England.

The first two dukes of Normandy, Rollo and his son William I

"Longsword", displayed a certain fidelity to the Carolingian dynasty, and in 936 William did homage to Louis IV d'Outremer of France. However, during the minority of William's successor, Richard I, Louis IV attempted to reconquer Normandy; but Richard was helped by King Harold of Denmark, and Louis was captured by the inhabitants of Rouen and handed over to Hugh the Great. William Longsword had been assassinated in 942 by Arnulf (Arnoul), count of Flanders, who was an ally of Louis IV; and Normans, Flemings and Robertian Frenchmen were rivals for the possession of Ponthieu.

The need for defense against common enemies brought together the Norman dukes and the Robertians and their heirs. In 958 Duke Richard I married Hugh the Great's daughter; and Richard's help facilitated the accession of his brother-in-law Hugh Capet to the French throne. Richard II (996–1026) had no need of external assistance to crush the peasant insurrection, of which William of Jumièges has given so horrifying an account; but his son Robert the Devil (1027–35), was clever enough to support Henry I of France against his brother Robert, who was laying claim to the throne; and in return for this service he received the Vexin-Français (1131). In turn, Henry I supported the young duke William II the Bastard (later William I the Conqueror of England), son of Robert the Devil and Arlette (daughter of a tanner of Falaise), and helped him defeat the rebellious Norman nobles at Val-aux-Dunes (1047). William in his turn supported the king against Geoffrey Martel, count of Anjou. There the exchange of good offices stopped.

A second phase of Norman history began with William's successes abroad. Normandy appeared as a dangerous rival of the Capetian monarchy. Henry I reconquered the Vexin-Français, supported Geoffrey Martel against William and encouraged the count of Eu and Montreuil in his claims to the duchy, but almost to no purpose. William conquered Maine, attacked Brittany and married Matilda, daughter of Baldwin V, count of Flanders; and the conquest of England doubled his power (1066). Normandy, however, was first administered by Matilda and then devolved not to William Rufus but to the Conqueror's eldest son, Robert Curthose, from whom his brother Henry Beauclerk (Henry I of England) finally wrested it, annexing it to England only in 1106.

Yet the duchy remained the geographic centre of the Anglo-Norman state, and its prospects were intimately linked with the feudal complications of the continent. Protected by the king of France, the son of Robert Curthose, William Clito, laid claim to Normandy, but defeat at Brémule (1119) destroyed his hopes. After the death of Henry I (1135) Normandy was once more disputed by his single heir Matilda (widow of the emperor Henry V and wife, by her second marriage, of Geoffrey Plantagenet, eldest son of Fulk V, count of Anjou); by Theobald II, count of Champagne, grandson of William the Conqueror, candidate of the Normans of Normandy; and on the other side by Stephen, count of Blois and Theobald's brother, whom the Normans of England supported. Geoffrey, with French and Flemish help, gradually subdued Normandy. In 1144 Theobald, whose position had been much weakened by loss of the castle of Rouen, gave up his rights to Henry Plantagenet, son and successor of Geoffrey. Bounded to Maine and Anjou, Normandy was, more than England and Aquitaine (brought in dowry), the main piece of the Angevin empire. Its wealth and the perfection of its administration by viscounts and then by *baillis* brought the prince both money and soldiers. The French kings, now fully conscious of the Angevin menace, struggled against it. The reign of Louis VII was occupied by the struggle against Henry II; and Philip Augustus pursued the same policy with tenacity and at last with success. Richard Coeur-de-Lion, however, was victorious at Fréteval and at Courcelles near Gisors and built Château-Gaillard to bar access into Normandy. On Richard's death at Châlus in 1199, Philip was in a position and was lucky enough to make peace by the treaty of Goulet (1200). But when the feudal condemnation of John Lackland, Richard's brother and successor, allowed Philip to confiscate his vassal's property, he invaded Normandy in June 1202 and besieged the castle of Arques, near Dieppe. Château-Gaillard was occupied after eight months' siege (Sept. 1203–April 1204), and the rest of Normandy was taken in the following months, Rouen surrendering in 1204 but obtaining a guarantee of the privileges allowed by Henry II (*Établissements de Rouen*). The French conquest of Normandy was not, however, recognized officially by the kings of England till the treaty of Paris (1259). The Capetians even modelled the institutions of their other estates after those of Normandy, which became prosperous. In 1329 the duchy was revived in favour of John, son and future successor of Philip VI. In his turn, John the Good gave Normandy as an appanage to the dauphin Charles (1350).

The Hundred Years' War opened a tragic and decisive period for Normandy. Its geographical position made the province a field of battle; the claims of the English kings to the French crown gave them a pretext for uniting the duchy with England. In 1346 Edward III invaded Normandy. Landing at Saint-Vaast-la-Hougue (July 12) and arriving at Caen on July 25, he laid waste to the country as far as Poissy. The treaty of London (1359) stipulated the cession of Normandy to England, but its provisions were modified by that of Brétigny (1360), and Normandy remained in the possession of France.

The most striking event of the war in Normandy during the reign of Charles V (1364–80) was the siege of Saint-Sauveur-le-Vicomte, which was occupied by the English and surrendered only after a siege of several years. At the death of Charles V, the English possessed only Cherbourg, which they evacuated in the last years of the 14th century. Still the war and taxes (*aides*) had so much overburdened the country that a revolt, the "Harelle," broke out in 1381 at Rouen, in punishment for which the town lost its privileges.

In 1415 the war with England was resumed. An English army of 60,000 men landed on Aug. 14 at the mouth of the Seine, took Harfleur on Sept. 16 and finally defeated the French king's army at Agincourt. During the following years the whole of Normandy was occupied, though Rouen held out for nearly six months (July 29, 1418–Jan. 13, 1419). Henry V of England entrusted the administration of Normandy to a special council. Under the government of the duke of Bedford, brother of Henry V and regent for the young Henry VI, Normandy profited from a policy of relative conciliation. But after the campaigns of Joan of Arc and her death at Rouen (May 30, 1431) there was an outbreak of patriotic feeling, which had been smouldering chiefly in the country districts. After the death of Bedford and the treaty of Arras, which deprived England of the Burgundian alliance, the position of the English in Normandy became insecure. The whole district of Caux revolted at the end of 1435, as did that of the Val-de-Vire in 1436. Mont-Saint-Michel had never been taken by the English, who built Granville to control it. But Normandy was not recovered by the French till after the sack of Fougères (1449). Cotentin was reconquered by the earl of Richmond, Arthur III (*q.v.*) of Brittany. Rouen surrendered on Oct. 29, 1449. An English army under Thomas Kyriel landed at Cherbourg and marched across Cotentin to Bayeux, but was met at Formigny (April 15, 1450) by the count of Clermont and routed. Caen and finally Cherbourg capitulated.

After the reconquest by the king of France, the history of Normandy is less eventful, but the province contributed its peculiar share to the life of France. Charles VII respected the local institutions—the provincial estates; the exchequer, which he transformed into a permanent court of justice (the *parlement* of Rouen); and the University of Caen (founded by the kings of England). The restored peace was to be troubled only in the 16th century during the wars of religion. The Reformation had most effect at the University of Caen, at Alençon and in the Pays-de-Caux. The Huguenots were helped by Queen Elizabeth, but the Catholic league established itself in Normandy, and Henry IV had to conquer it by force of arms, winning the victories of Arques and Ivry (though Rouen, defended by Alexander Farnese, duke of Parma, was surrendered only after Henry had abjured the Reformed religion). The weight of taxation gave rise in 1639 to the peasant insurrection of the *Va-nu-pieds*, but the Normans took little share in the Fronde, being temperamentally inclined to moderate courses.

The Normans combine the spirit of enterprise with prudence.

From the early 16th century their voyages to Newfoundland, Brazil and the Indies, on the initiative of Jean Ango of Dieppe and of the Florentine explorers Giovanni and Girolamo Verrazano, in the service of Francis I, enriched Rouen and the new port of Le Havre, founded in 1517. Jean Colbert recruited many Norman settlers for New France; and it was an inhabitant of Rouen, René Robert Cavelier, sieur de la Salle, who explored the valley of the Mississippi and founded Louisiana. In the 18th century Rouen inaugurated, with John Holker, the cotton manufactures which in the 19th century were to supersede the woollen. But the basic wealth of the province remains in agriculture and stock raising.

The architecture of Normandy is magnificent. Examples are the churches of flamboyant style, castles and also the urban residences of the merchants. Pierre Corneille may be regarded as typifying the balanced mind of the Normans; the economist Pierre le Pesant, sieur de Boisguilbert, their practical common sense.

Hostile to the dictatorship of men or parties, the Normans were for federalism against the Montagnards in 1793; Charlotte Corday, who killed Marat, was a native of Caen. Among the Norman middle class Louis-Philippe found his most faithful supporters and protectionism its most resolute partisans. In the politics of the third republic the bulk of the Norman population inclined to the moderate parties of the centre.

Spared in World War I, when it sheltered the exiled Belgian government, Normandy was devastated during World War II in June 1940 and more disastrously from June to August 1944, after the Allied landing (June 6) on the beaches of Calvados. Reconstruction began with the cessation of the fighting.

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NORMANS, the softened form of the word "Northman," applied first to the people of Scandinavia in general, and afterward specially to the people of Norway. In the form of "Norman" it is the name of those colonists from Scandinavia who settled in Gaul, founded Normandy, adopted the French tongue and French manners, and from their new home set forth on new errands of conquest, chiefly in the British islands and in southern Italy and Sicily. Normans and Northmen must be carefully distinguished. For these Normans began to adopt a new religion, a new language, a new system of law and society, new thoughts and feelings on all matters. To all outward appearance the Norman conquest of England was an event of an altogether different character from the Danish conquest. The one was a conquest by a people whose tongue and institutions were still palpably akin to those of the English. The other was a conquest by a people whose tongue and institutions were palpably different from those of the English. The Norman settlers in England felt no community with the earlier Danish settlers in England. In fact the Normans met with the steadiest resistance in a part of England which was largely Danish. But the effect of real, though unacknowledged, kindred had none the less an important practical effect. There can be no doubt that this hidden working of kindred between conquerors and conquered in England, as compared with the utter lack of all fellowship between conquerors and conquered in Sicily, was one cause which made so wide a difference between the Norman conquests of England and of Sicily.

Character of the Normans.—The English and the Sicilian settlements form the main Norman history of the 11th century. The new creed, the new speech, the new social system, had taken such deep root that the descendants of the Scandinavian settlers were better fitted to be the armed missionaries of all these things than the neighbours from whom they had borrowed their new possessions. With the zeal of new converts they set forth very much in the spirit of their heathen forefathers. The same spirit of enterprise which brought the Northmen into Gaul seems to carry the Normans out of Gaul into every corner of the world. Their character is well painted by a contemporary historian of their exploits, Geoffrey Malaterra. He sets the Normans before us as a race specially marked by cunning, despising their own inheritance in the hope of winning a greater, eager after both gain and dominion, given to imitation of all kinds, holding a certain mean between lavishness and greediness—*i.e.*, perhaps uniting, as they certainly did, these two seemingly opposite qualities. Their chief men, he adds, were specially lavish through their desire of good report. They were, moreover, a race skilful in flattery, given to the study of eloquence, so that the very boys were orators, a race altogether unbridled unless held firmly down by the yoke of justice. They were enduring of toil, hunger, and cold whenever fortune laid it on them, given to hunting and hawking, delighting in the pleasure of horses, and of all the weapons and garb of war. Love of imitation is marked. Little of original invention can be traced to any strictly Norman source; but no people were ever more eager to adopt from other nations, to take into their service and friendship from any quarter men of learning and skill and eminence of every kind. To this admirable quality is perhaps to be attributed the fact that a people who accomplished so much, who settled and conquered in so large a part of Europe, has practically vanished from the face of the earth.

Their Faculty of Adaptation.—But Geoffrey hardly did justice to the Normans if he meant to imply that they were simple imitators of others. Their position was very like that of the Saracens. In no department of science or art did any Saracen, strictly speaking, invent anything; but they learned much both from Constantinople and from Persia, and what they learned they largely developed and improved. The Normans did just the same. They adopted the French tongue, and were presently among the first to practise and spread abroad its literature. They adopted the growing feudal doctrines of France, and worked them, both in Normandy and in England, into a harmonious system. From northern Italy, as it would seem, they adopted a style of architecture which grew in their hands, both in Normandy and in England, into a marked and living form of art. Settled in Gaul, the Scandinavian from a seafaring man became a landsman. Even in land-warfare he cast aside the weapons of his forefathers; but he soon learned to handle the weapons of his new land with greater prowess than they had ever been handled before. He welcomed the lore of every stranger. Lanfranc brought law and discipline; Anselm brought theology and philosophy. The gifts of each were adopted and bore fruit on both sides of the Channel. And no people ever better knew how to be all things to all men. The Norman power in England was founded on full and speedy union with the one nation among whom they found themselves. The Norman power in Sicily was founded on a strong distinction between the ruling people and the many nations which they kept in peace and prosperity by not throwing in their lot with any one among them.

The quality which Geoffrey Malaterra expresses by the word "effrenatissima" is also clearly marked in Norman history. It is, in fact, the groundwork of the historic Norman character. It takes in one case the form of ceaseless enterprise, in another the form of that lawlessness which ever broke out, both in Normandy and in every other country settled by Normans, when the hand of a strong ruler was wanting. But it was balanced by another quality which Geoffrey does not speak of, one which is not really inconsistent with the other, one which is very prominent in the Norman character, and which is, no less than the other, a direct heritage from their Scandinavian forefathers. This is the excessive litigiousness, the fondness for law, legal forms, legal processes, which has ever been characteristic of the people. If the Norman was a born soldier, he was also a born lawyer. But nothing so well illustrates this formal side of the Norman character as the whole position of William the Conqueror himself. His claim to the crown of England is something without earlier precedent, something as far as possible removed from the open violence of aggressors who have no pretexts with which to disguise their aggression. It rested on a mass of legal assumptions and subtleties, fallacious indeed, but ingenious, and, as the result proved,

effective. His whole system of government, his confiscations, his grants, all that he did, was a logical deduction from one or two legal principles, arbitrary certainly in their conception, but strictly carried out to their results. Even Norman lawlessness in some sort took a legal shape. In the worst days of anarchy, in the minority of William or under the no-reign of Robert, the robber-baron could commonly give elaborate reasons for every act of wrong that he did.

The Normans were, therefore, crusaders before crusades were preached. Norman warriors had long before helped the Christians of Spain in their warfare with the Saracens of the Peninsula, and in Sicily it was from the same enemy that they won the great Mediterranean island. Others had done a kindred work in a more distant field as helpers of the Eastern emperors against the Turks of Asia. All these might pass for religious wars, and they might really be so; it needed greater ingenuity to set forth the invasion of England as a missionary enterprise designed for the spiritual good of the benighted islanders. The Norman, a strict observer of forms in all matters, attended to the forms of religion with special care. No people were more bountiful to ecclesiastical bodies on both sides of the Channel; the foundation of a Benedictine monastery in the 11th century, of a Cistercian monastery in the 12th seemed almost a matter of course on the part of a Norman baron. On the other hand, none were less inclined to submit to encroachments on the part of the ecclesiastical power, the Conquerer himself least of all.

Neither England nor Sicily has become a Norman land, and the tongue which the Norman brought with him into both has not for ages been spoken in either. Norman influence has been far stronger in England than in Sicily, and signs of Norman presence are far more easily recognized. But the Norman, as a distinct people, is as little to be seen in the one island as in the other, a result due to different and almost opposite causes. The whole circumstances of the conquest of England constrained the conquerors to become Englishmen in order to establish themselves in the conquered land. In William's theory, the forcible conquest of England by strangers was an untoward accident. The lawful heir of the English crown was driven against his will to win his rights by force from outside. But he none the less held his crown as an English king succeeding according to English law. Moreover, every Norman to whom he granted lands and offices held them by English law in a much truer sense than the king held his; he was deemed to step into the exact position of his English predecessor, whatever that might be. This legal theory worked together with other causes to wipe out all practical distinction between the conquerors and the conquered in a wonderfully short time. By the end of the 12th century the Normans in England might fairly pass as Englishmen, and they had largely adopted the use of the English language. The fashionable use of French for nearly two centuries longer was far more a French fashion than a Norman tradition. When the tradition of speaking French had all but died out, the practice was revived by fashion. Still the tradition had its effect. The fashion could hardly have taken root except in a land where the tradition had gone before it.

The Normans in England therefore became Englishmen, because there was an English nation into which they could be absorbed. The Normans in Sicily could hardly be said to become Sicilians, for there assuredly was no Sicilian nation for them to be absorbed into. While the Normans in England were lost among the people of the land, the Normans in Sicily were lost among their fellow-settlers in the land. The Normans who came into Sicily must have been much less purely Norman than the Normans who came into England. Indeed, we may doubt whether the Norman invaders of Sicily were Norman in much more than being commanded by Norman leaders. They were almost as little entitled to be called pure Scandinavians as the Saracens whom they found in the island were entitled to be called pure Arabs. The conquest of England was made directly from Normandy, by the reigning duke, in a comparatively short time, while the conquest of Sicily grew out of the earlier and far more gradual conquest of Apulia and Calabria by private men. The Norman settlements at Aversa and Capua were the work of adventurers, making their own fortunes and gathering round them followers from all quarters. They fought simply for their own lands, and took what they could by the right of the stronger. They started with no such claim as Duke William put forth to justify his invasion of England; their only show of legal right was the papal grant of conquests that were already made. The conquest of Apulia, won bit by bit in many years of what we can only call freebooting, was not a national Norman enterprise like the conquest of England, and the settlement to which it led could not be a national Norman settlement in the same sense. The Sicilian enterprise had in some respects another character. By the time it began the freebooters had grown into princes. Still there was a wide difference between the duke of the Normans and the duke of Apulia, between an hereditary prince of 150 years' standing and an adventurer who had carved out his duchy for himself.

The characteristic point of Norman rule in Sicily is that it is the rule of princes who were foreign to all the inhabitants of the island, but who were not more foreign to the inhabitants of the island than different classes of them were to one another. The Norman conqueror found in Sicily a Christian and Greek-speaking people and a Muslim and Arabic-speaking people. The relations between the two differed widely in different parts of the island, according to the way in which the Saracens had become possessed of different towns and districts. In one place the Christians were in utter bondage, in another they were simply tributary; still, everywhere the Muslim Saracen formed the ruling class, the Christian Greek formed the subject class. We speak of the Saracen very much as we speak of the Norman; for of the Muslim masters of Sicily very many must have been only artificial Arabs, Africans who had adopted the creed, language and manners of Arabia. In each case the Arab or the Norman was the kernel, the centre round which all other elements gathered and which gave its character to the whole. Besides these two main races, Greek and Saracen, others came in through the Norman invasion itself. There were the conquerors themselves; there were the Italians, in Sicily known as Lombards, who followed in their wake; there were also the Jews, whom they may have found in the island, or who may have followed the Norman into Sicily, as they certainly followed him into England. The special character of Norman rule in Sicily was that all these various races flourished, each in its own fashion, each keeping its own creed, tongue and manners, under the protection of a common sovereign, who belonged to none of them, but who did impartial justice to all. Such a state of things might seem degradation to the Muslim, but it was deliverance to the native Christian, while to settlers of every kind from outside it was an opening such as they could hardly find elsewhere. But the growth of a united Sicilian nation was impossible; the usual style to express the inhabitants of the island is "omnes" or "universi Siciliae populi." In the end something like a Sicilian nation did arise; but it arose rather by the dying out of several of the elements in the country, the Norman element among them, than by any such fusion as took place in England.

Normans in Scotland, Wales and Ireland.—From England, the Norman spread into Scotland, Wales and Ireland. In Scotland he was not a conqueror, but a mere visitor, and oddly enough he came as a visitor along with those whom he had himself overcome in England. Both Normans and English came to Scotland in crowds in the days of Margaret, Edgar and David, and Scottish national feeling sometimes rose up against them. In Scotland again the Norman settlers were lost in the mixed nationality of the country, but not till they had modified many things in the same way in which they modified things in England. They gave Scotland nobles and even kings; Bruce and Balliol were both of the truest Norman descent; the true Norman descent of Comyn might be doubted, but he was of the stock of the Francigenae of the Conquest. In Wales the Norman came as a conqueror, more strictly a conqueror than in England; he could not claim Welsh crowns or Welsh estates under any fiction of Welsh law. The Norman settler in Wales, therefore, did not to any perceptible extent become a Welshman. In Ireland the Norman was more purely a conqueror than anywhere else; but in Ireland his power of adaptation caused him to sink in a way in

which he sank nowhere else. While some of the Norman settlers in Ireland went to swell the mass of the English of the Pale, others threw in their lot with the native Irish, and became, in the well-known saying, *Hibernis ipsis Hiberniores* (see BOROUGH).

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(E. A. F.; F. M. S.)

NORMANTON: *see* CARPENTARIA, GULF OF.

NORMANTON, an urban district in the West Riding of Yorkshire, England, 3 mi. N.E. of Wakefield, on the L.M.S. and L.N.E. railways. Pop. (1938) 17,962. Area, 4.8 sq.mi. It is in the Calder valley, 1½ mi. from the right bank of the river, and is a railway junction for the line from Manchester to Leeds via Wakefield, and for the main line from the south via Chesterfield. A mound in the neighbourhood, called Haw hill, is believed to be a barrow. Traces remain of a moat surrounding the town, which is now a colliery district. Altofts, a neighbouring parish, was the home of Sir Martin Frobisher.

NORNS, in Northern mythology, the female divinities of fate, like the Gr. Μοῖραι generally represented as three in number, and said to spin, or weave, the destiny of men. They dwell beside the "Spring of fate," beneath the "world-tree," Yggdrasil's ash, which they water from the spring. Sometimes the Norns are indistinguishable from the Valkyries (*q.v.*). They appear as prophetesses (*völur*) at the birth of children. The most famous story is contained in the *Tháttr af Nornagesti.* (*See* TEUTONIC PEOPLES.)

NORRIS, FRANK (1870–1902), American novelist, was born in Chicago (Ill.), March 5, 1870. Believing that America ignored her own national epic, he devoted himself to his uncompleted trilogy of the wheat. *The Octopus* (1901) shows with a striking use of symbolism the raising of the wheat in California and the hold of the railway upon the ranchmen; *The Pit* (1903) is a powerful portrayal of the lure of board of trade gambling; the author's early death prevented completion of the third volume, dealing with consumption in Europe. Reared in Chicago (Ill.), educated at the San Francisco high school, the University of California, and Harvard, he studied art in Paris and served in South Africa as war correspondent for the San Francisco *Chronicle*. In 1896–97 he was associate editor of the San Francisco *Wave;* and in 1898 he was war correspondent in Cuba for *McClure's Magazine*. He died Oct. 25, 1902.

Besides the wheat trilogy, Norris's most important works are: *A Deal in Wheat, and Other Stories of the New and Old West* (1903); *The Third Circle* (1909), another collection of tales; *The Responsibilities of the Novelist, and Other Literary Essays* (1903); *Moran of the Lady Letty* (1898), a tale of adventure off the California coast; *Blix* (1899), a love story; *McTeague* (1899), a story of the San Francisco slums; and *Vandover and the Brute* (1914), a repulsive study of degeneration, issued with an introduction by Charles G. Norris. For a bibliography *see* F. T. Cooper's *Some American Story Tellers* (1911).

NORRIS, GEORGE WILLIAM (1861–1944), U.S. legislator, was born on a farm in Sandusky county, Ohio, on July 11, 1861. The death of his father and only brother while he was very young left the family in straitened circumstances, and Norris was required to work out among the farmers in the summer and attend school only in the winter. He afterwards taught school and studied law, and earned enough to finish his law course at Valparaiso university. He was admitted to the bar in 1883. In 1885 he moved to McCook, Neb., and began to practise. He was later elected prosecuting attorney of Furnas county, and in 1895 district judge of the 14th judicial district; re-elected in 1899, he was serving in this position when in 1902 he became a U.S. representative. He was re-elected for five successive terms and in 1910 was the leader of the insurgent group which successfully held out for a reform of house rules, and thus put an end to the autocratic control of the speaker. He also led the fight against secret committee meetings. Norris was elected to the senate in 1912 and served with that body until 1942, thus finishing 40 years in congress. He voted against the entrance of the U.S. into World War I, and denounced the Versailles Treaty. He fought for the direct election of senators, and for presidential primaries, and was the author of the 20th Amendment, which abolished "lame-duck" congresses. Norris favoured strict restrictions on private power interests; and the Norris bill for the retention by the government of the Muscle Shoals power development, the Tennessee Valley authority which he fathered and fought through congress, and the Norris dam are the result of his efforts to provide publicly produced electric power. He was a leader in the demand for farm relief legislation, and the leader of the independent group in congress. Though nominally a Republican, party ties rested lightly upon him, his dictum being that the people "ought to be independent of all parties." He backed the Roosevelt New Deal administration wholeheartedly because he believed it would carry out his own aims for governmental reform. His last fight was an unsuccessful attempt to pass anti-poll tax legislation. Senator Norris died Sept. 3, 1944, in McCook, Neb.

NORRIS, HENRY NORRIS or **NORREYS, BARON** (*c.* 1525–1601), belonged to an old Berkshire family, many members of which had held positions at the English court. His father, Henry Norris, was a grandson of Sir William Norris, who commanded the royal troops against Lambert Simnel at the battle of Stoke in 1487. Like his brother John (d. 1564), the elder Henry Norris obtained a post at the court of Henry VIII.; he gained the king's favour and was rewarded with many lucrative offices. He belonged to the party which favoured the elevation of Anne Boleyn; but in May 1536 he was arrested on the charge of intriguing with her, and though he was probably innocent of any serious offence, he was beheaded on May 17, 1536. His son Henry regained some of his father's lands and entered upon court life, being a member of parliament under Edward VI. During Mary's reign he was one of those who were entrusted with the custody of the princess Elizabeth, and when the princess became queen she amply repaid the kindness which Norris had shown to her when he was her guardian at Woodstock. In 1566 he was knighted and sent as ambassador to France, where he remained until 1570, and in 1572 he was created Baron Norris of Rycote. He died in June 1601.

The eldest of his six sons, Sir WILLIAM NORRIS, died in Ireland in Dec. 1579, leaving a son Francis (1579–1623), who succeeded to his grandfather's barony and also to the estates of his uncle Sir Edward Norris. In 1621 Francis was created earl of Berkshire. He left no sons and the earldom became extinct, but the barony descended to his daughter Elizabeth (d. 1645), the wife of Edward Wray (d. 1658). Their daughter Bridget (1627–57) married as his second wife Montagu Bertie, 2nd earl of Lindsey, and their son James Bertie (1654–99) became Baron Norris (or Norreys) in 1657, and was created earl of Abingdon in 1682. His descendants the Berties, earls of Abingdon, still hold this barony.

Sir EDWARD NORRIS (d. 1603), the 1st Lord Norris's third son, served with the English troops in the Netherlands from 1585 to 1588. He is chiefly remembered owing to his fierce quarrel with Philip, count of Hohenlohe (1550–1606), called Hollock by the English, in August 1586 at Gertruydenberg.

NORRIS, SIR JOHN (*c.* 1547–1597), English soldier, was the second son of Henry Norris, Baron Norris of Rycote, and gained his earliest military experience in the civil wars in France. In 1573 he went to Ulster with Walter Devereux, earl of Essex, winning fame by his conduct in the guerrilla wars against the Irish, and being responsible for the massacre on the island of Rathlin in July 1575. He was again in Ireland in 1584, but the greater part of these years was spent in service in the Netherlands. In 1588, when the Spanish Armada was expected, he was marshal of the camp at Tilbury; later in the same year he served the queen as ambassador to the Dutch states, and in 1589 he and Sir Francis

Drake led the fleet which ravaged the coasts of Spain and Portugal. In 1591, and again in 1593, he aided Henry IV. of France in his struggle with the League in Brittany; and in May 1595 he landed again in Ireland, where he was lord president of Munster. He was to assist the lord deputy, Sir William Russell, in subjugating Ulster. After fighting and negotiating with the O'Neills in Ulster, and warring in Connaught, he asked for his recall. This was not granted, but he was supplanted in his military command; and he retired to Munster and died at Mallow on July 3, 1597. His monument is in the church of Tattendon, Berkshire.

See J. L. Motley, *The United Netherlands,* vol. ii. (1904); and R. Bagwell, *Ireland under the Tudors,* vol. iii. (1890).

NORRIS, JOHN (1657–1711), English philosopher and divine, was born at Collingbourne-Kingston in Wiltshire. He was educated at Winchester and Exeter college, Oxford, being subsequently elected to a fellowship at All Souls'. His first original work was *An Idea of Happiness* (1683), in which, with Plato, he places the highest happiness or fruition of the soul in the contemplative love of God. He studied the works of Malebranche and of Descartes and his followers and opponents. Of English thinkers, More and Cudworth, the so-called Cambridge Platonists, had influenced him most; and in 1685 his study of their works led to a correspondence with More, published after his death by Norris as an appendix to his Platonically conceived essay on *The Theory and Regulation of Love* (1688). He also corresponded with Mrs. Astell (*q.v.*) and Lady Masham, the friend of Locke, to whom he addressed his *Reflections upon the Conduct of Human Life* (1689). In 1689 Norris was presented to the living of Newton St. Loe, in Somersetshire. In 1690 he published a volume of *Discourses upon the Beatitudes,* followed by three more volumes of *Practical Discourses* between 1690 and 1698. In an appendix to his *Discourses* he gave "Cursory Reflections" on Locke's *Essay on the Human Understanding* which anticipate many later criticisms of Locke's philosophy, though he was at one with Locke in dismissing the "grey-headed, venerable doctrine" of innate ideas. The last 20 years of Norris's life were spent at Bemerton, to the living of which he had been transferred in 1691. In 1691–1692 he was engaged in controversy with his old enemies the "Separatists," and with the Quakers, his Malebranchian theory of the divine illumination having been confounded by some with the Quaker doctrine of the light within. In 1697 he wrote *An Account of Reason and Faith,* one of the best of the many answers to Toland's *Christianity not Mysterious.* Reason, according to Norris, is nothing but the exact measure of truth, that is to say, divine reason, which differs from human reason only in degree, not in nature. In 1701 appeared his most important work, *An Essay towards the Theory of the Ideal or Intelligible World.* The first volume treats the intelligible world absolutely; the second, which appeared in 1704, considers it in relation to human understanding. It is a complete exposition of the system of Malebranche, in which Norris refutes the assertions of Locke and the sensualists. In 1708 Norris wrote *A Philosophical Discourse concerning the Natural Immortality of the Soul,* defending that doctrine against the assaults of Dodwell. He died at Bemerton, and a monument was erected to his memory in the church. He occupies a place in the succession of ecclesiastical and mystical thinkers of whom Coleridge is the last eminent example.

See Wood, *Athenae Oxonienses* (ed. Bliss), iv.; *Biographia Britannica;* Leslie Stephen in *Dictionary of National Biography;* J. Tulloch, *Rational Theology and Christian Philosophy in England in the 17th Century* (1874), who calls Norris "as striking and significant a figure in the history of English philosophy," as Berkeley, another idealist.

NORRIS, WILLIAM EDWARD (1847–1925), English novelist, was born on Nov. 18, 1847, the son of Sir W. Norris, chief justice of Ceylon. He was educated at Eton, and called to the bar at the Inner Temple in 1874. His first story, *Heaps of Money,* appeared in 1877, and was followed by *Mademoiselle de Mersac* (1880), *Matrimony* (1881), *No New Thing* (1883), *My Friend Jim* (1886), *The Despotic Lady* (1895), *Matthew Austin* (1895), *The Widower* (1898), *Pauline* (1908), *Not Guilty* (1910); *The Rt. Hon. Gentleman* (1913); *Barbara and Company* (1914); *The Triumphs of Sarah* (1920); *Sabine and Sabina* (1922); *Next of Kin* (1923) and *Trevalion* (1925). He died on Nov. 19, 1925.

NORRISTOWN, a borough of Pennsylvania, U.S., the county seat of Montgomery county; on the Schuylkill river, 17 mi. N.W. of the centre of Philadelphia. It is served by the Pennsylvania, Reading and Philadelphia & Western railways. Pop. 38,193 in 1950. Across the river is the borough of Bridgeport (pop. 5,823 in 1950). Norristown is a residential community; its principal industries are textiles, laminated plastics, mine products, beverages and machinery. The Norristown State hospital, an institution for mental cases, is there. Valley Forge (*q.v.*) is 6 mi. S.W. of the borough. The site of Norristown is part of a manorial estate purchased from William Penn in 1704 by Isaac Norris. The borough was incorporated in 1812.

NORRKÖPING, the fourth town of Sweden, in the district (*län*) of Östergötland, 113 m. S.W. of Stockholm by the Malmö railway. Pop. (1945) 78,255. A bull of Pope Lucius III shows that Norrköping existed in 1185. In the 17th century, Duke John of Östergötland introduced German craftsmen into Norrköping. Under Charles XII. the town suffered not only from war but from pestilence, 2,700 of its inhabitants perishing in 1710–1711. After the Russian invasion of 1719 the population was only 2,600. Norrköping occupies both banks of the Motala, the wide and rapid emissary of lake Vetter. Fires in 1719, 1812, 1822 and 1826 have caused rebuilding on modern lines. The falls in the river afford motive power to the cloth and cotton mills (spinning and weaving)—the staple industries —and to factories for sugar, paper, lithography, tobacco and carpets, joinery works and breweries. There are also shipbuilding yards and docks. Fine granite is quarried at Grafversfors, 7½ m. north. The inlet of Bråvik affords excellent harbour facilities for vessels up to 18½ ft. draught near the quay, and safe anchorage up to 30 ft. in the Pampas roads, 6 m. from the town.

NORSE LANGUAGE. The *Old Norwegian* language (till the Reformation) was not, like the modern language, confined to Norway and the Färoe islands, but was for some time spoken in parts of Ireland and the north of Scotland, the Isle of Man, the Hebrides, Shetland and Orkney (where it continued to the end of the 18th century), and also in certain parts of western Sweden.

The runic inscriptions in Old Norse are few in number (about 150) and of trifling philological importance, since they belong almost wholly to the period between 1050 and 1350, and are consequently not much earlier than the earliest literature. The whole literature preserved is written in the Latin alphabet. The earliest manuscripts are not much later than the oldest Old Icelandic ones and are of the greatest interest. The masses of charters which occur throughout the whole middle age of Norway from the beginning of the 13th century give information, especially of dialect.

In Old Norwegian the most primitive forms occur in old poems from times as remote as the days of Þorbiorn Hornklofi (end of the 9th century). The language at this epoch differed very little from other Scandinavian dialects. From the 13th century, Norwegian, owing to geographical and political circumstances, is considerably influenced by the eastern Scandinavian languages. The tendency in Norwegian to reduce the use of the so-called *u*-Umlaut has already appeared. There appears another kind of vowel-assimilation, almost unknown to Icelandic, the vowel in terminations being in some degree influenced by the vowel of the preceding syllable. Thus, for instance, we find in some manuscripts that the vowels *e, o, ø,* and long *a, æ,* are followed in terminations by *e, o; i, u, y* and short *a, æ,* on the other hand, by *i, u*—as in *bøner,* prayers, *konor,* women; but *tiðir,* times, *tungur,* tongues. The same fact occurs in certain Old Swedish manuscripts. When Norway had been united later with Sweden under one crown (1319) we meet pure Suecisms in the Norwegian literary language. In addition to this, the 14th century exhibits several differences from the old language: *rl, rn* are sometimes assimilated into *ll, nn*—as *kall* (elder *karl*), man, *konn* (*korn*), corn, *prestanner* (*prestarnir*), the priests; *i* passes into *y* before *r, l*—as *hyrðir* (*hirðir*), shepherd, *lykyl* (*lykill*), key; final *-r* after a consonant is changed into *-ar, -er, -ir, -or, -ur* or *œr,* sometimes only *-a, -e, œ*—as *hester* (*hestr*), horse, *bøker* (*bøkr*), books, the names Þolleifœr (Þorleifr), Guðlæifæe (Guðleifr). About the beginning of the 15th cen-

tury initial *kv* occurs for old *hv* (not, however, in pronouns, which take *kv* only in western Norway), as the local name *Quiteseið* (*hvitr*, white). During the 15th century, Norway being united with Denmark, and at intervals also with Sweden, a great many Danisms and a few Suecisms are imported into the language. Towards the end of the middle ages the Danish influence shows an immense increase, until at last Norwegian as a literary language is supplanted by Danish. Many Norse dialects developed in the 13th, 14th and 15th centuries. The language of western Norway resembles Icelandic, and the language of eastern Norway is still nearer to contemporary Old Swedish. The present dialectical division was in all essentials accomplished about the year 1600.

NORTH, BARONS. The English title of Lord North of Kirtling was created for Edward North (*c.* 1496–1564), son of Roger North, a London citizen, in 1554; he was a successful lawyer, clerk of the parliament (1531) and chancellor of the court of augmentations (1545). His second son was Sir Thomas North (*q.v.*), and he was succeeded as 2nd baron by his son Roger, a courtier and soldier of Queen Elizabeth's day, who married the daughter of Lord Chancellor Rich.

DUDLEY NORTH, 3rd Baron North (1581–1666), son of Sir John North and of Dorothy, daughter and heiress of Sir Valentine Dale, was born in 1581 and succeeded his grandfather, the 2nd Baron North, at the age of 19. He was educated at Cambridge, and married in 1599 Frances, daughter of Sir John Brockett of Brockett Hall, Hertfordshire. He travelled in Italy, took part in the campaign of 1602 in the Netherlands, and on his return became a conspicuous figure at court, excelling in athletic exercises as well as in poetry and music, and gaining the friendship of Prince Henry. In 1606, while returning from Eridge to London, he discovered the springs of Tunbridge Wells, which cured North himself of a complaint and quickly became famous. He also recommended the Epsom springs to the public. He supported and subscribed to the expedition to Guiana made by his brother Roger North (*c.* 1582–*c.* 1652) in 1619, and when Roger departed without leave Dudley was imprisoned for two days in the Fleet. In 1626 he attached himself to the party of Lord Saye and Sele in the Lords, who were in sympathy with the aims of the Commons; and when the civil war broke out he was on the side of the parliament. In 1641 he was a member of the Lords' committee on Religion, and served on the committee to consider Laud's attainder in 1644, finally voting for the ordinance in Jan. 1645. He was placed on the admiralty commission in 1645, and acted as lord lieutenant for Cambridgeshire. He was one of the small group of Lords who continued attendance in the House of Peers, and on Dec. 19, 1648, with three others, visited Fairfax, when they "cast down their honours at his Excellency's feet" and protested their desire not to retain any privileges prejudicial to the public interest. (Gardiner's *Civil War*, iv. 285.) He passed the rest of his life in retirement at Kirtling in Cambridgeshire, with his family, finding "employment with many airy entertainments as poetry, writing essays, building, making mottoes and inscriptions as well as in music." He wrote *A Forest of Varieties* (1645), a miscellany of essays and poems, another edition of which was published in 1659 under the title of *A Forest promiscuous of various Seasons' Productions.* He died on Jan. 16, 1666. North is described as "full of spirit and flame," of imperious temper but of well-balanced judgment, Lord Holland declaring that "he knew no man less swayed with passion and sooner carried with reason and justice." He left, besides one daughter, two sons, the elder of whom, Sir Dudley, succeeded him as 4th Baron North.

DUDLEY NORTH, 4th Baron North (1602–77), increased the family fortune by marrying the daughter of Sir Charles Montagu, brother of the 1st earl of Manchester. He was an accomplished man, of studious bent, and had 14 children, of whom the third son, Francis, became lord chancellor as Lord Guilford; the fourth was Sir Dudley North (*q.v.*), the economist; the fifth, John (1645–83), master of Trinity, Cambridge, and professor of Greek in the university; and the sixth, Roger (*q.v.*), the lawyer and historian.

The eldest son, Charles (d. 1691), was created Lord Grey of Rolleston during his father's life, and succeeded his father as 5th Baron North; and on the death of his son, William, 6th Lord North, without issue, in 1734, the barony of North went to a cousin, Francis North, 3rd baron, afterwards 1st earl of Guilford. The title of Lord North is that by which the 2nd earl of Guilford, prime minister from 1770–82, is best known in history. (*See* GUILFORD, BARONS AND EARLS OF.)

George Augustus, 3rd earl of Guilford (d. 1802), left three daughters, and the barony of North fell into abeyance till 1841 when it vested in Susan, Baroness North (1797–1884), wife of John Sidney Doyle, who took the name of North; at her death her son William Henry John North (b. 1836) succeeded as 11th baron, the title now being separate from that of Guilford.

NORTH, SIR DUDLEY (1641–1691), English economist, was 4th son of Dudley, 4th Lord North, who published *Passages relating to the Long Parliament,* of which he had himself been a member. He was born on May 16, 1641, and in his youth was carried off by gipsies and recovered with some difficulty by his family. He engaged in foreign trade, especially with Turkey, and spent many years at Constantinople and Smyrna. During the Tory reaction under Charles II. he was one of the sheriffs forced on the city of London with an express view to securing verdicts for the Crown in state trials. He was knighted, and was appointed a commissioner of customs, afterwards of the treasury, and again of the customs. Under James II., "he took," says Roger North, "the place of manager for the Crown in all matters of revenue." After the Revolution he was called to account for his alleged unconstitutional proceedings in his office of sheriff. He died on Dec. 31, 1691.

His tract entitled *Discourses upon Trade, principally directed to the cases of the interest, coinage, clipping and increase of money,* was published anonymously in 1691, and was edited in 1856 by J. R. M'Culloch in the *Select Collection of Early English Tracts on Commerce* printed by the Political Economy Club of London. In this emphatic assertion of the free-trade doctrine against the prevailing system of prohibitions, North shows that wealth may exist independently of gold or silver, its source being human industry, applied either to the cultivation of the soil or to manufactures. The export of money in the course of traffic, instead of diminishing, increases the national wealth, trade being only an exchange of superfluities. Nations are related to the world just in the same way as cities to the State or as families to the city. North emphasizes more than his predecessors the value of the home trade. With respect to the interest of capital, he maintains that it depends, like the price of any commodity, on the proportion of demand and supply, and that a low rate is a result of the relative increase of capital, and cannot be brought about by arbitrary regulations. In arguing the question of free trade, he urges that every advantage given to one interest over another is injurious to the public and that no trade is unprofitable to the public.

North, Locke and Petty are named by Wilhelm Roscher as the "great triumvirate" of English economists of the period.

NORTH, MARIANNE (1830–1890), English naturalist and flower-painter, was born at Hastings on Oct. 24, 1830, the eldest daughter of a Norfolk landowner, descended from Roger North (1653–1734). She trained as a vocalist under Madame Sainton Dolby, but her voice failed, and she then devoted herself to painting flowers. After the death of her parents she resolved to paint the flora of distant countries and with this objective she went to Canada, the United States and Jamaica, and spent a year in Brazil, where she did much of her work at a hut in the depths of a forest (1871–72). Later, she visited Teneriffe, California, Japan, Borneo, Java, Ceylon, Australia, New Zealand, South Africa, the Seychelles and Chile; and the scientific accuracy with which she represented plant life gives her work a permanent value. In 1882, her gallery at Kew Gardens was opened. It contains her paintings. She died at Alderly in Gloucestershire on Aug. 30, 1890.

NORTH, ROGER (1653–1734), English lawyer and biographer, was the sixth son of the 4th Baron North. He acquired a good practice at the bar, being helped by his elder brother Francis, who became lord chancellor and was created Baron Guil-

ford (*q.v.*), and in 1684 he became solicitor-general. But the Revolution stopped his advancement, and he retired to his estate of Rougham in Norfolk, and increased his fortune by marrying the daughter of Sir Robert Gayer. He collected books, and was constantly occupied in writing. He is best known for his *Lives of the Norths,* published after his death, together with his own autobiography (*see* the edition in Bohn's *Standard Library,* 1890, by Jessopp), a classic authority for the period. He died at Rougham on March 1, 1734.

He is to be distinguished from Roger North (1585–1652), brother of the 3rd baron, one of the captains who sailed with Raleigh in 1617, and who projected the plantation of Guiana.

NORTH, SIR THOMAS (1535?–1601?), English translator of *Plutarch,* second son of the 1st Baron North, was born about 1535. He is supposed to have been a student of Peterhouse, Cambridge, and was entered at Lincoln's Inn in 1557. In 1574 he accompanied his brother, Lord North, on a visit to the French court. He served as captain in the year of the Armada, and was knighted about three years later. He was a justice of the peace for Cambridge in 1592 and again in 1597, and he received a pension (£40 a year) from the queen in 1601. He translated, in 1557, Guevara's *Reloj de Principes* (commonly known as *Libro Aureo*) (*see* Guevara, Antoñio de) under the title of *Diall of Princes.* The English of this work is one of the earliest specimens of the ornate, copious and pointed style for which educated young Englishmen had acquired a taste in their continental travels and studies. With its mannerisms and constant use of antithesis, it set the fashion which was to culminate in Lyly's *Euphues.* His next work was *The Morall Philosophie of Doni* (1570), a translation of an Italian collection of eastern fables. The first edition of his translation of *Plutarch,* from the French of Jacques Amyot, appeared in 1579. The first edition was dedicated to Queen Elizabeth, and was followed by other editions in 1595 and 1603, containing in each case fresh *Lives.* The influence of North's vigorous English on contemporary writers was very great, and some critics have called him the first master of English prose. The book formed the source from which Shakespeare drew the materials for his *Julius Caesar, Coriolanus* and *Antony and Cleopatra.* It is in the last-named play that he follows the *Lives* most closely, whole speeches being taken direct from North.

See Plutarch's Lives of the Noble Grecians and Romans: English ed. by Sir T. North (in Tudor Translations, 1895); *Shakespeare's Plutarch* (a selection ed. C. F. T. Brooke, 1909); *The Diall of Princes* (reprinted 1921); F. Bushby, *Three Men of Tudor Times* (1911).

NORTH, THE, originally those of the English Colonies in America north of the Mason and Dixon line (*q.v.*), as distinguished from those south. They were New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey and Pennsylvania. With the extension of settlements across the Alleghenies, the Ohio river was considered as a continuation of the Mason and Dixon line to the Mississippi river. Missouri, west of the Mississippi, was before the Civil War, considered part of the South because it was a slave-holding State, but after the Civil War it became a part of the North in its political and economic life. West of Missouri the boundary between the two sections followed the southern boundary of Kansas (37° N. lat.) to the Great Plains. Beyond were the Western States which, because they supported the North, were usually considered part of it during the great struggle over slavery. The characteristic Northern life and settlement was broken, however, by the Great Plains which may, therefore, be considered to form the western boundary of the section.

The division between the North and the South was in no slight degree a natural one. In the North land and climate made small farms with diversified crops the only profitable type of agriculture. In the older sections the limited supply of farm land and the abundant amount of water-power stimulated manufacturing and the growth of town life. In the South, large plantations growing only cotton, or only tobacco, and dependent upon slave labour came into existence. As these economic systems with their attendant social differences grew in power and clashed in conflict over the virgin lands of the West, an intense struggle developed for supremacy, a struggle fought first, but vainly, in the halls of Congress, and later on the battlefields of the Civil War. The North through its victory gained undisputed political, economic and cultural supremacy. Politically, the North has always been the stronghold of the Republican Party which has fostered its industrial interests.

NORTH ADAMS, a city of Massachusetts, U.S., on the Hoosac river and at the west end of the Hoosac tunnel, served by the Boston and Albany and the Boston and Maine railways. Pop. (1950) 21,475; and by the census of 1940, 22,213.

The city has a beautiful situation, 700 ft. above sea level, in the foothills of the Berkshires, at the west end of the Mohawk trail. Within its limits is a natural bridge 50 to 60 ft. high, across Hudson brook. It is the seat of the Massachusetts State Teachers college (1897) and has extensive manufactures (chiefly cotton print, woollen goods, cotton cloth, boots and shoes, machinery and electric condensers). In the western part of the city are the ruins of Ft. Massachusetts, built in 1745 by the Massachusetts Bay colony as a frontier defense, and captured in 1746 by French and Indians under the Chevalier de Vaudreuil. North Adams was set off from Adams and incorporated as a town in 1878, and in 1895 it was chartered as a city.

NORTHALLERTON, an urban district, market town and administrative capital of the North Riding of Yorkshire, England, 30 mi. N.N.W. of York by the L.N.E. railway, on which it is an important junction. Pop. (est. 1938) 4,970. Area 5.7 sq.mi. It is on a slight eminence at the foot of the Cleveland and Hambleton Hills, 3 mi. from the bank of the Swale. It thus avoids the flood land of the Vale of York. Here the western scarp of the Wolds causes the Vale to narrow to a width of 10 mi. forming the Northallerton Gate.

Northallerton (Alvetune, Allerton) is believed to have been a Roman station, and the importance of the Gate is marked by two Roman roads, one running north from Catterick, the other from York. It was probably later a Saxon "burgh," and a Danish settlement, but nothing is known with certainty about it before the account given in the Domesday Survey, which shows that the Normans had destroyed the manor so utterly that it was still waste in 1086. In mediaeval times, the Gate was an obvious way south into England for the Scottish army. The Battle of the Standard was fought near the town in 1138 and the castle was destroyed in 1174. In 1317, the town was burned by the Scots under Robert Bruce. Soon after his accession, William Rufus gave Northallerton to the Bishop of Durham, whose successors continued to hold it until it was taken over by the ecclesiastical commissioners in 1865. There are now no traces of the fortified palace of the bishops. A priory was founded here in 1341, and a White Friars monastery in 1354, and all trace of these also has been lost. The Mount Grace priory, a Carthusian foundation of 1397, remains.

According to an inquisition taken in 1333, the town, markets and fairs were held by the burgesses who were governed by two reeves and the bishop's bailiff. This form of government continued until 1851, when a local board was formed, and this was superseded by an urban district council in 1894. As a borough by prescription, Northallerton returned two members to the parliament of 1298, but it was not represented again until 1640 when its earlier privileges were restored. From 1832 to 1885 it returned one member but is now in the Richmond division. The North Riding county library was opened in 1924 with headquarters at Northallerton. By 1943 it had 490 branches. The town has a considerable trade in dairy farming and has held a weekly market since 1205. There are flour mills, linoleum works, tanning and the manufacture of cart covers and tent cloths. A fair held on St. Bartholomew's day was famous for cattle in the 16th century, but it is no longer held. Northallerton is the railway focus of the Gate.

See C. J. D. Ingledew, *History and Antiquities of Northallerton in the County of York* (1858); J. L. Saywell, *History and Annals of Northallerton* (1885); *Victoria County History, Yorkshire.*

NORTH AMERICA. The continent of North America has a mean altitude of about 2,000 ft., and an area of about 9,000,000 sq.mi., 16% of the earth's land area and 4.5% of the earth's entire surface. Certain correspondences of its geological structure and history with those of the greater part of Europe and Asia, sym

metrically disposed, right and left, with respect to the Atlantic, support the view that Eurasia is a single continent: furthermore they controvert the idea that the new world of discovery is an old world geologically; and that the old world of history is geologically new. Both worlds are in part old, in part new; both share structures and changes of similar dates from the most ancient to the most modern periods.

PHYSICAL FEATURES

The Laurentian Region.—The general structural features of North America are (*see* map): the extensive area of ancient crystalline rocks, stretching from Labrador past Hudson bay and thence northwestward to the Arctic ocean, is of disordered structure; the surface now seen must have been originally buried at a considerable depth beneath a higher and mountainous surface; but that higher surface was reduced to low relief at a remote period. The Laurentian part of this great region has been described as the first emerged land area of North America, around which many later additions on the south and west built up the present continent; but a more modern interpretation shows that the worn-down Laurentian region is only part of a much larger land mass which in pre-Palaeozoic time extended more or less continuously as far as Texas and parts of the Rocky mountain region, and on which marine deposits were unconformably deposited as the land mass was progressively submerged beneath the Palaeozoic ocean. Hence the Laurentian region differs from other parts of North America more in having escaped later deformation than in being of earlier origin. In Pleistocene time, the Laurentian region became the centre from which ice sheets spread out on all sides. As a result the weathered soils were swept away, together with an unknown measure of unweathered rock, leaving scattered boulders and gravelly drift upon a rugged upland without mountains (except in Labrador) but diversified by innumerable knobs and hollows, and here and there covered by clay belts that are arable in spite of severe winter climate. The drainage of the region, which in pre-glacial times was probably accomplished by well-ordered rivers, was thus thrown into great disorder; large and small lakes abound, and some of the lakes have two outlets; the streams are repeatedly interrupted by rapids and not infrequently split into two channels, enclosing islands many miles in length. The region remains a forest wilderness, except at mining centres (several of which have produced large quantities of nickel, silver and gold), near pulp mills and on the sparsely settled clay belts.

The Appalachian Area.—This is a hilly and mountainous belt, stretching from Newfoundland to Alabama, with a western branch in Arkansas. It seems to have belonged in the earliest times to the great pre-Palaeozoic land mass, but it must be set aside from the undisturbed Laurentian region because of repeated movements of depression, deformation and elevation that it has suffered, generally along a northeast-southwest trend, causing alternations of heavy deposition and almost equally heavy degradation. These movements took place with generally decreasing intensity, through nearly the whole stretch of geological time covered by the fossiliferous record. The Appalachian mountains of today were formerly regarded as unconsumed residuals of greater mountains formed at the close of the Palaeozoic period; but it is now generally agreed that Mesozoic erosion reduced most of that ancient range to a lowland of moderate or small relief, leaving only isolated groups of subdued mountains in the areas of the most resistant rocks; and that the altitude and form of the mountains today, as well as of a belt of horizontal strata on the west, now known as the Allegheny plateau, are largely the result of Tertiary elevation and dissection of the previously worn-down mass; the additional height thus given to the subdued mountain groups made them the loftiest parts of the range today, as in the White mountains of New Hampshire (Mt. Washington, 6,293 ft.) and the Black mountains of North Carolina (Mt. Mitchell, 6,684 ft.). The Ozark plateau of Missouri and the Ouachita mountains of Arkansas and farther west are related to each other in much the same way as the Allegheny plateau and the middle and southern Appalachians. Numerous coal seams occupy discontinuous basins in the Appalachians from Nova Scotia to Pennsylvania, in the Allegheny plateau from Pennsylvania to Alabama, and in the extension of the same strata across the Ohio basin. The eastern coast of the continent has a rocky and irregular shore line from Greenland and Labrador to Massachusetts, with numerous submerged valleys forming bays and as many uplands and ridges outstanding in promontories and islands; this being the result of an increasing measure of depression to the north, where an archipelago now replaces what was probably once a corner of the continent.

A Coastal plain of gently inclined and imperfectly consolidated strata, which still borders the Gulf and part of the Atlantic coast of the United States, formerly extended northeast, probably at least as far as Nova Scotia; the same depression that has brought the ocean upon the older rocks from Massachusetts northward has diminished the breadth of the Coastal plain and embayed its shore line from North Carolina to the mouth of the Hudson, and has submerged it from the Hudson mouth, northeastward.

The Western Highlands.—The great complex of mountains in the Western highlands, sometimes styled the Cordilleras of North America (of which the Rocky mountains are eastern members in the United States and Canada), differs from the Eastern highlands in having suffered strong deformation in late geological periods. On the other hand, the transition from Palaeozoic to Mesozoic times, when mountain-making disturbances were so general in western Europe and eastern North America that earlier geologists thought them to be of world-wide extent, was here generally accomplished in relative quiet, so that in certain districts a conformable succession of stratified formations was accumulated in great thickness from Cambrian to late Mesozoic or early Tertiary time. Further, the Carboniferous period was marked by the deposition of marine limestones in the Cordilleran region. In contrast to the long quiescent Atlantic coast, the Pacific coast of North America is bordered for a good part of its length by mountains of late origin.

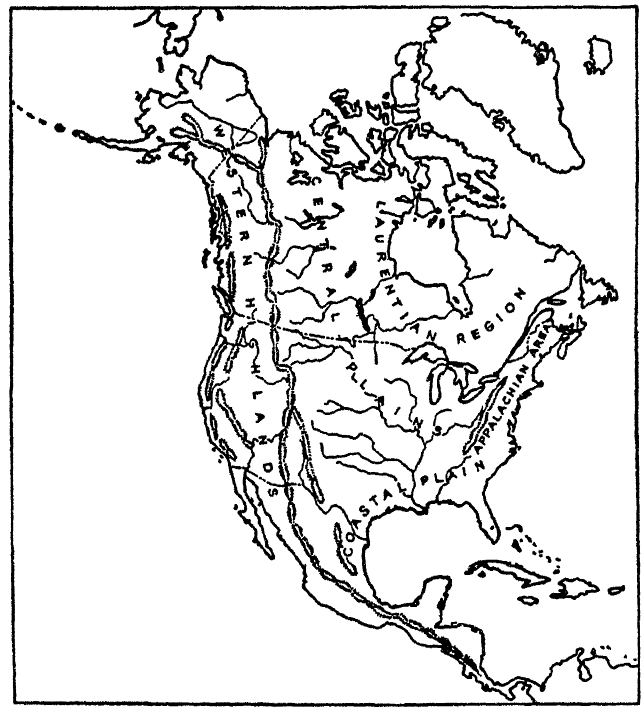
Volcanoes of commanding height here and there dominate the Western plateaus and mountains. Orizaba (18,314 ft.), Popocatepetl and their neighbours crown the southern portion of the Cordilleran system in Mexico; Mt. San Francisco rises over the desert plateau of Arizona and bears snow and Arctic plants; Shasta has small glaciers in northern California; Rainier, bearing large glaciers, surmounts the Cascade range in Washington; Wrangell is a lofty volcanic mass in Alaska. Vast lava floods have been poured out at various periods; those of the Snake and Columbia river basins in Washington, Oregon and Idaho are the most extensive. Similar lava-flows in British Columbia have been broadly uplifted and are now deeply dissected by Frazer river and its branches, leaving only disconnected highland patches.

As in all regions of great altitude, the erosion of valleys has progressed on a magnificent scale in the Cordilleran region. The plateaus of northern Arizona are traversed by the canyons of the Colorado river and its branches, at places over a mile in depth; yet upon the plateaus themselves, long and ragged cliffs of recession attest a vastly greater erosion before the uplift of the plateaus than is demanded by the canyons after uplift. Along the Pacific coast, as well as in the higher ranges of the northwest interior, intense glacial erosion during the Glacial period excavated huge cirques at the valley heads and deep troughs along the valley courses; on the coast these troughs are now occupied by sea water as fjords. Fitting complements to the deep erosion of the mountain masses are found in the great accumulations of mountain waste in various intermontane and piedmont basins, of which the so-called valley of California is the finest example. Similar basin deposits of Tertiary date abound in the Cordilleran region.

Central Plains.—Between the lower Eastern highlands and the higher Western highlands lies a great extension of medial plains, stretching in moderate altitude from the Arctic ocean to the Gulf of Mexico and having at their mid-length a breadth of 1,500 mi. They are composed throughout of nearly horizontal strata and mark a region long exempt from deformation. The eastern plains, best represented in the Ohio valley, are underlain by Palaeozoic strata, already mentioned as having been laid down

on the subsiding Archaean continent; the western plains are composed of Mesozoic and Tertiary strata. Both east and west large areas of the plains do not owe their present evenness to the preservation of their originally smooth surface, but to the degradation of that surface from the considerable altitude of its first uplift to low relief. The degraded surface has, however, been smoothed by veneers of till plains in the Ohio and upper Mississippi valleys, and by the addition of extensive piedmont detrital deposits in the central-western plains.

The Cordilleras of North and South America are not only far out of line with each other, but are separated by about 1,200 mi. in Central America, where, in association with the West Indies, an Antillean system of late geological deformation with east and west trends is believed to prevail, with abundant volcanic additions on the Pacific border and along the curved range of the Lesser Antilles, while in an intermediate space the calcareous lowlands of Yucatan resemble those of Florida in being the emerged parts of a larger area, much of which is still below the waters of the Gulf of Mexico. The warm waters that bathe the West Indies permit the growth of coral reefs in the Caribbean; the Bahamas are the slightly overtopping parts of broad platforms of calcareous deposits, of which the greater area constitutes extensive shallow banks which descend steeply to great depths.



PHYSIOGRAPHIC REGIONS OF NORTH AMERICA

Rivers.—The successive crustal movements by which North America has been developed have determined the growth of several great river systems. The broad upheavals which developed the medial plains had the effect of engrafting many rivers from the Eastern and Western highlands upon trunks of unusual dimensions. Thus the Mississippi system, some of whose eastern tributaries probably date from early Mesozoic times, received great reinforcement by the addition of many long western branches in late Tertiary time, roughly contemporaneous with the uplift of the southern Coastal plain, by which the lower trunk of the river was extended from its mid-length into the gulf. The present headwaters of that river-trunk to which the name Mississippi has been rather arbitrarily applied are of very modern date, as they are consequent upon the abundant glacial deposits of northern Minnesota; and relatively modern courses appear to have been taken by the earlier-born Ohio and Missouri around the margin of invading Canadian ice sheets, which displaced them from earlier courses. The evolution of the Mackenzie resembles that of the Mississippi in a general way, but it has presumably been much affected by glacial erosion and deposition, in consequence of which it, like the St. Lawrence, has many large lakes in its course. The regime of this great north-flowing river is strikingly unlike that of its south-flowing analogue on account of its course being from a warmer to a colder climate; hence while Mississippi floods have a free southward discharge, the floods of the Mackenzie have an obstructed northward discharge due to ice dams. Indeed, but for the complications that appear to be related to the outspread of Laurentian ice sheets, the areas drained by the Nelson and the St. Lawrence, now flowing to Hudson bay and St. Lawrence gulf, would be discharged by the Mackenzie and Mississippi. For a time, during the presence of the ice sheets, that simpler system was realized for the Mississippi, when it carried to the Gulf of Mexico much drainage now received by the St. Lawrence and Nelson; the flood plain of its lower trunk was probably given its great breadth at that time. Lake Superior is peculiar in apparently owing its great depth to a somewhat pronounced displacement of its basin floor, in addition to whatever deepening it gained by glacial erosion.

The chief rivers that discharge to the Pacific rank below those that discharge to the Atlantic; but the Yukon, flowing from farther Canada and inner Alaska, is one of the great rivers of the world. The Columbia, of hardly inferior rank, drains a large area of the Cordilleran system in Canada and the United States; it is peculiar in having one of its head branches rise at the eastern base of the Rocky mountains in Montana, so that its waters flow westward through all the Cordilleran ranges of its latitude. The Colorado discharges a muddy current into the Gulf of California.

Climate.—The climate of North America exhibits modifications of general conditions resulting from the globular form and eastward rotation of the earth. In January a mean temperature of zero or less invades the region northwest of Hudson bay, and extends as far south as the extreme central-northern United States, which thus resembles northeastern Asia in departing greatly from the more temperate mean prevailing in similar latitudes on the northern oceans. In July the great middle area of the continent becomes warmer than the oceans on the east and west, having a mean temperature ranging from 65° in the vicinity of the 50th parallel to above 80° south of the 35th parallel. Consequently the annual range between the means of January and July exceeds 40° for a large part of the continent, and exceeds 70° for much of the northern lands; the range of extreme temperatures is much greater. On corresponding northern oceanic areas, the temperature range is little more than 20°; and in the southern hemisphere it is probably less than 10°.

The several members of the planetary wind system, including therein the trades of a broadened torrid zone, the prevailing and westerlies of middle latitudes, and the irregular winds of the polar region, are well exemplified over North America; but they are better seen in the drift of clouds than in the movements of the surface winds. In consequence of the dominance of westerly winds, a great stretch of the Pacific coast, even as far north as Alaska, has a small annual temperature range (generally less than 20°); while a range more appropriate to continental interiors is experienced over most of the eastern coast of the continent in temperate latitudes; hence the extraordinary unlikeness between the climates of western Europe and eastern North America, where habitable Great Britain faces almost uninhabitable Labrador. The distribution of rainfall is likewise largely controlled by the general wind system. The West Indies, especially the mountainous islands, receive abundant precipitation from the passing trade winds. In Mexico and Guatemala the eastern slopes are for the most part better watered by the same winds (maximum, over 100 in.) than the western slopes. Farther north the reverse holds true; the Pacific coast north of latitude 40° has an abundant rainfall (maximum over 100 in.), and its mountains are clothed with dense forests; but there are large areas of deficient rainfall (less than 20 in.) in the interior where the intermontane and piedmont plains of the Cordilleras in middle latitudes are dry and treeless. Regions of heavy snowfall are chiefly in the far northwestern Cordilleras: in the northern interior and Greenland it is less heavy.

Fauna and Flora.—The fauna of North America (Nearctic)

is more closely related to that of Europe-Asia (Palaearctic) than to that of any other zoogeographical province; the two areas are united by many writers in one province (Holarctic). The reindeer (caribou), beaver and polar bear are found in both; the moose, wapiti, bison and grizzly bear of North America are closely related to the elk, red deer or stag, bison, and brown bear of Eurasia; and the following groups are well represented in both provinces: cats, lynxes, weasels, bears, wolves, foxes, seals, hares, squirrels, marmots, lemmings, sheep and deer. The following forms are characteristic of North America: (rodents) pouched rats or pocket gophers, musk-rat, prairie dog, Canada porcupine; (carnivores) raccoon and skunk; (ungulates) musk-ox, big-horn, Rocky mountain goat, prong-horn; (marsupial) opossum. Among birds, there is a close resemblance to those of Eurasia, with some admixture of South American forms, such as humming-birds. Characteristic forms are the Baltimore oriole, bobolink, cowbird, flycatchers, wood-warblers, California quail, tree grouse, sage grouse, wild turkey and turkey buzzard. Turtles are especially numerous; salamanders are varied and large; rattlesnakes are among the reptiles.

The floral area of North America, defined by form and climate, may be divided into five belts: the eastern forested area, the western forested area, the interior unforested area, the northern barren lands and the torrid coasts. The eastern forested area extends from the Laurentian highland in Canada southward to the Gulf and Atlantic coast east of the Mississippi; in the north and southward along the mountains the trees are largely conifers with a mixture of birches, poplars and maples; southward, especially in the interior and at low levels, the conifers almost disappear and oaks, hickories, plane-trees, tuliptrees, walnuts and other valuable deciduous trees are in abundance; the long-leaf pine characterizes the low coastal margin. The western forested area begins in the Rocky mountains and extends to the Pacific, but does not descend below the lower timber line into the dry intermontane basins of middle latitudes; northward in Canada, the forest is continuous from the upper timber line down into the valleys; it attains a luxurious and dense development along the rainy coast, where the redwood (*Sequoia*) of northern California and Oregon reaches a height of from 300 to 400 ft. The unforested area of the interior includes two dissimilar regions. On the east are the fertile prairies, spreading between the middle Ohio and the upper Great Lakes and extending beyond the Mississippi; here the native grasses and herbaceous vegetation are now largely replaced by agricultural crops. On the west under a drier climate vegetation is more scanty; but far north a wooded belt connects the eastern and western forests across the medial plains. Aridity and barrenness increase southwestward into California and southward into Mexico; on this broad desert few trees are found, although piñons grow on cliffs and ledges and cottonwoods are found along watercourses; and the mountains that rise above the desert carry forests. The desert vegetation consists of cactus, agaves, sage-brush (*Artemisia*) and other dry-climate plants in large variety. In the far north are the "barren lands," with their permanently frozen subsoil; the growing season here is short and trees cannot develop, although birches, poplars, willows and some other kinds that attain good size southward are here present as dwarfed shrubs.

The torrid coasts support a tropical vegetation; it is somewhat developed in Florida and becomes dominant in Mexico and Central America. (W. M. D.; P. H. O.)

POPULATION

In the accompanying table are given the best available data with respect to the number of people in the major political divisions of North America and the islands in the Caribbean sea generally regarded as belonging to the continent. For continental United States and the U.S. possessions and for Mexico, the Central American countries, Haiti and the Dominican Republic there are available the returns of the 1950 census; and for Canada and the remaining smaller areas there are estimates for 1950 or 1949. From the figures in the fourth column of the table, which gives the population per square mile, it may be seen that some of the smaller islands of the West Indies are very densely populated indeed. Among the larger areas, Puerto Rico, with 645.8 persons per square mile, is the most densely populated. This figure is even more significant when it is realized that much of the interior of this island is steep and mountainous and ill adapted to agriculture, which is Puerto Rico's dominant industry, so that the population per square mile of crop land would amount to around 1,400. In the last column of the table is presented the population of the several areas around 1881, or nearly 70 years earlier than the dates represented by the later figures. During this 70-year period the population of the continent increased from 72,991,815 to 214,488,216, or almost three times.

Urban and Rural.—In the U.S., 64.0% of the 1950 population lived in urban areas, which, under a new definition adopted for the census of that year, comprised all cities and other incorporated places having 2,500 inhabitants or more, together with the thickly settled suburban area, or "urban fringe," around the larger cities, and those unincorporated places which had 2,500 inhabitants or more. In Canada, according to the 1941 census, 54.3% of the population was classified as urban, leaving 45.7% as rural. In Canada, the urban classification included all incorporated cities, towns and villages without regard to size, though the population of places having fewer than 1,000 inhabitants formed only a small part of the urban total. In the 1940 census of Mexico, 35.1% of the population was classified as urban, the urban population comprising all persons living in places (*localidades*) having 2,500 inhabitants or more. In Puerto Rico 40.5% of the population was urban in 1950; in Cuba, according to the census of 1943, 51.6%. In Guatemala, in 1940, the urban population formed 27.6% of the total; in Honduras in 1945, 29.0%; and in Panamá in 1940, 37.2%. Mexico City and Havana are the only large cities in the southern part of the North American area.

Racial Composition.—The base of the population of Mexico and Central America is Indian. In Mexico, for example, the census of 1930 reported, in round numbers, 2,444,000 whites; 4,621,000 Indians; and 9,181,000 of mixed blood, almost all white and Indian. (The 1940 census of Mexico made no classification by race.) Thus less than 15% of the population is locally considered white, and the percentage of pure white stock is probably much smaller. What is true of Mexico is true also of the Central American republics. Furthermore, in these the Indians and mixed stocks are being still further mixed by a considerable immigration of West Indian Negroes. In the West Indies there are great differences between one area and another, but the predominant stock in many of these islands is Negro, very generally mixed with white and in some cases with Indian stock. Even in Puerto Rico, the percentage of the population returned as white in the census (76.6% in 1940) is without doubt an overstatement, though the proportion of the inhabitants of Puerto Rico who do not manifest any of the characteristics usually associated with either Negro or Indian blood is considerable. In the United States, certain racial lines are closely drawn. Of the total population in 1940, 89.8% were white and 10.2% nonwhite, all except about one-twentieth of the nonwhites being Negroes.

In Canada, in 1941, Indians and Eskimos formed only 1.1% of the population and Asiatics only 0.6% and Negroes about 0.2% of the population.

The important distinction in Canada, however, is that between the French-speaking and the non-French, the French constituting 29.2% of the total in 1941, and in the province of Quebec, about 82%.

Thus Canada, unlike most other countries in North America, has no real colour problem, but only a language problem.

(L. E. T.)

ETHNOLOGY

The Indians of North, as of South, America are believed to have had their origin in the eastern hemisphere. In the new world there are no unquestioned fossils of human ancestors or extinct human races of markedly distinct type, such as Europe, Africa, Asia and Oceania contain. Also, most American archaeological sites contain artifacts of Neolithic as well as Palaeolithic type, in

Population of the Countries of North America, 1949–50 and 1880–82, with Area and Population per Square Mile

Area	Population	Source and date	Land area (square miles)	Population per square mile	Population, 1880–82
Continental United States	150,697,361	Census, 1950	2,977,128	50 6	50,155,783
U.S. territories and possessions					
Alaska	128,643	Census, 1950	586,400	0 2	33,426
Panama Canal Zone	52,822	Census, 1950	362	145 9	..
Puerto Rico	2,210,703	Census, 1950	3,423	645.8	752,000
Virgin Islands of U.S.	26,665	Census, 1950	132	202 0	33,763
Canada	14,009,429	Census, 1951	3,609,116	3.9	4,504,319
British possessions					
British Honduras	66,000	Estimate, 1949	8,598	7.7	27,452
Bermuda	37,000	Estimate, 1949	19	1,947.4	14,888
Barbados	204,000	Estimate, 1949	166	1,228.9	171,860
Windward Islands					
Dominica	52,000	Estimate, 1949	304	171.1	..
Grenada	75,000	Estimate, 1949	133	563.9	42,403
St. Vincent	80,000	Estimate, 1949	150	533.3	40,548
St. Lucia	66,000	Estimate, 1949	233	283 3	38,511
Leeward Islands	109,000	Estimate, 1949	423	257.7	119,546*
Bahamas	78,000	Estimate, 1949	4,375	17.8	43,521
Jamaica	1,374,000	Estimate, 1949	4,470	307.4	580,804
Cayman Islands	7,000	Estimate, 1949	93	75 3	4,700
Turks and Caicos Islands	7,000	Estimate, 1949	202	34.7	4,732
French possessions					
Guadeloupe	286,000	Estimate, 1949	686	416.9	200,329
Martinique	270,000	Estimate, 1949	385	701.3	167,679
St. Pierre and Miquelon	5,000	Estimate, 1949	93	53.8	5,534
Danish possessions					
Greenland	23,000	Estimate, 1949	840,000	0.03	10,000
Mexico and Central America					
Costa Rica	800,875	Census, 1950	23,000	34.8	203,780
Guatemala	2,787,030	Census, 1950	42,353	65.8	1,224,606
Honduras	1,368,605	Census, 1950	43,277	31.6	350,000
Mexico	25,367,802	Census, 1950	758,061	33.5	10,447,974
Nicaragua	1,057,023	Census, 1950	53,668	19.7	275,815
Panamá	805,285	Census, 1950	28,575	28.2	285,000
Salvador	1,855,917	Census, 1950	13,176	140.9	613,273
West Indian republics					
Cuba	5,348,000	Estimate, 1950	44,217	120.9	1,521,684
Haiti	3,111,973	Census, 1950	10,695	291.0	872,000
Dominican Republic	2,121,083	Census, 1950	19,325	109.8	300,000
Total	214,488,216		9,073,238	23.8	72,991,815

*Including Dominica.

contrast with the thousands of pure Palaeolithic sites in the old world. Nevertheless, from about 1930, there were reported discoveries of chipped stone implements (Folsom type) in positive association with Pleistocene mammals now extinct (elephants, bison, horses, camels, sloths, etc.), with the result that man in America is now believed less recent than was the prevalent opinion formerly; some authorities allow him an age of 20,000 years, and most at least 10,000.

There is no reason to believe that the entry of man into America occurred as a single migration which was discontinued and never resumed. If one body of immigrants was able to find the way, it is almost certain that others would find it. The great speech diversification of America may have begun while the original speakers were still in the old world.

THE PEOPLING

It is practically certain that the peopling took place from Siberia via Bering strait, other land bridges to America being geologically too ancient to have served man. Bering strait is shallow, frozen over part of each year, less than 50 mi. wide, with the Diomede Islands near the middle. While probably never an insuperable obstacle even to primitive peoples, it never has been and is not now an easy means of communication, and the lands on both sides of it are inhospitable and capable of sustaining only a thin population.

The strait thus served much like a kinked tube. Man managed to filter through, and culture elements succeeded in being transmitted, but the flow of both was impeded.

There is no evidence that until the Russian occupation any advanced people ever occupied extreme northeastern Asia. Consequently, whatever accessions of inventions or other cultural materials reached the American Indians were of a type normally occurring among peoples of a relatively low level. Both in America and Asia the higher attainments of civilization occurred in latitudes not far from or below the Tropic of Cancer.

That the intercontinental connections occurred as just outlined is strongly suggested by ethnic conditions about Bering strait. The Eskimos on both sides of the strait are almost identical in physique, speech and customs; and farther back live Palaeo-Asiatic tribes (Chukchee, Koryak, Yukaghir) and American tribes (Dene, Tlingit, Haida) which resemble each other so definitely that some authorities have included the Palaeo-Asiatic ones with the Indians.

Race.—It follows that the racial origin of the American Indian has to be sought in Asia. The findings of anthropometry bear out the inference. The Indian belongs obviously to the Mongoloid division of the human species. He is brown skinned, with straight, stiff, black head hair, a minimum of beard and body hair, a definitely broad face (in popular parlance, high cheek bones) and moderate prognathism. These traits are constant among Indians, as among east Asiatics.

Minor peculiarities, such as shovel-shaped incisor teeth and bluish pigment spots in the sacral region during infancy, occur equally among the two populations.

The relations of the American Indian are, however, to the Mongoloid stock as a whole rather than to any one specific Mongolian people. They are probably closest to the east Siberians.

Although often called "red," the American Indians are so only when they paint themselves. Their general colour is a brown, little

if any darker than that of the Japanese. The tallest people are found in the centre of the continent in the Mississippi valley, and for some distance north and east. Along the Pacific coast and in Mexico, body heights are less. The Aztecs and Mayas were short peoples. Head form is about as variable as in the old world. In general, the cranial index is 79 or above (cephalic index 81+), except in six areas where it is less (longer heads): 1, the Eskimos of the Arctic coast; 2, 3, 4, in the east, from Cape Hatteras to St. Lawrence river; from the St. Lawrence north of the Great Lakes almost to the Rockies; an irregular tract in the Ohio and middle Mississippi valleys; 5, 6, on or near the Pacific coast, two intermittent tracts or chains of separated groups, between northern California and the tip of Baja California; from southern Arizona to central Mexico. In South America the long heads are almost all found in the eastern half of the continent, in or adjacent to Brazil. In both continents, ancient populations tend toward narrower heads than do modern populations.

The Eskimos (*q.v.*) are a well-marked sub-race. They are short, thick set, unusually long headed and broad faced, powerful jawed, narrow nosed, and with some tendency to the Mongolian eye. The remainder of the American race is difficult to sub-classify satisfactorily. Ales Hrdlicka distinguishes three types, of which he considers all existing populations in North and South America to be either representatives or mixtures. These are: 1, tall and broad headed; 2, long headed, mostly tall; 3, broad headed, stature moderate to short. The more advanced peoples from Mexico to Peru are assigned to this third type.

Language.—The outstanding characteristic of native American speech is its diversity. According to the older reckoning there were more stocks of languages in either North or South America than in the entire eastern hemisphere—about 75 on each continent. Recent researches have moved in the direction of uncovering similarities between some of these stocks, thereby reducing their number. There is little indication of borrowing between languages, except in South America.

The older view that American languages are overwhelmingly agglutinating, incorporating or polysynthetic, can no longer be maintained. There are languages as genuinely inflectional (Penutian) and isolating (Otomi, Zapotec) as in the old world. It is, however, true that the Indian languages tend to describe concretely and visually. Elements expressing the instrument or manner of action, the shape or position, and space relations, although by no means universal, are frequently well developed in the grammatical structure. It is also true that many of the idioms do not shrink from piling up structural elements into long words.

The most important linguistic stocks north of Costa Rica, in point of number of speakers or territory, are Eskimo, Athabascan, Algonkin, Iroquoian, Siouan, Muskogi, Caddoan, Uto-Aztecan, Salish, Sahaptin, Penutian, Hokan, Tarascan, Otomi, Zapotecan, Mixe-Zoque, Maya, Totonac. Of secondary rank are Tlingit and Haida (with Athabascan = Na-Dene?), Tsimshian, Wakashan (*see* KWAKIUTL and NUTKA), Chinook, Kootenay, three Pueblo stocks (Tanoan, Keres, Zuñi), Kiowa (with Tanoan?), Tonkawa, Natchez (probably with Muskogi), Yuchi, Beothuk (*see* also INDIAN, NORTH AMERICAN).

Culture.—The culture of the American Indians, like that of any large group, is so complex that a descriptive review is inadequate in proportion as it is compact. This culture is therefore perhaps best considered from the point of view of how its constituents classify as to origin—elements common to America and the old world, peculiar to America, important in the old world but lacking in the new, etc.

1. A series of simple culture traits are literally (or practically) universal among American tribes and of equally common occurrence in the old world, and may be assumed to have formed part of the culture stock with which the first immigrants came into the hemisphere. These traits include the use of fire and the ability to make fire with the drill; the dog as a domesticated or semi-domesticated animal; stone implements for piercing, cutting, scraping, chopping; the spear, the spear-thrower, and perhaps the harpoon and simple bow; cordage, netting and basketry; crisis rites and shamanistic beliefs and practices. These elements survive in the more remote and backward portions of the eastern hemisphere, and for the most part have their relative antiquity attested directly by archaeology, carrying back to the end of the Palaeolithic or beginning of the Neolithic period.

2. Equally well defined is a class of culture traits which are widespread in the eastern hemisphere, in fact practically universal in all parts possessing a sufficient development, but are totally lacking in both North and South America. These elements evidently originated in the old world subsequent to the movement which mainly populated America; they were not for some reason, perhaps chiefly because of the inhospitable conditions and backwardness of culture in the region of Bering sea, diffused into America. This class of traits includes all the important domesticated animals and plants of the old world excepting the dog, viz., cattle, sheep, the goat, pig, horse, ass, camel and even reindeer; wheat, barley, rice, etc.; the plough and the wheel; iron; stringed instruments; proverbs. Environment may be held responsible for the absence of some of these from the western hemisphere; it cannot account for the non-existence of the last four or five.

3. The higher civilizations of America were reared on an economic and technological foundation of their own, evidently evolved in and largely remaining confined to the region of "Middle America," namely the area from Mexico to Peru. The basis of this civilization was a form of agriculture limited to a series of indigenous plants. Fundamental among these plants was maize, whose wild ancestor, or hybridizing ancestors, and place of origin, remain a puzzle to botanists. Closely associated with maize were true beans (*Phaseolus*) and squashes. These plants were cultivated by nearly all Indians of both Americas as far as agriculture was practised by them at all, from the St. Lawrence to the La Plata. In the tropical region there were cultivated in addition other important plants—the potato, sweet potato, manioc, tomato, pineapple, chili pepper, tobacco, chocolate, etc. All this agriculture was practised without implements more complicated than a hoe or simple planting stick; it was strictly a hand culture. Domesticated animals were lacking, except for the llama and alpaca in Peru and the turkey in Mexico. Copper, gold, silver, tin and lead were smelted, cast, plated and alloyed in Middle America; in other words, metallurgy comparable to that of the old world prior to the iron age was known. Cotton, of another species than the cotton of the old world, had been domesticated in Middle America and was the basis of an elaborate textile art, operating, however, with simple apparatus; and clothing was of types based upon true fabrics instead of skins or bast fibres. Pottery shows a wide distribution almost identical with that of agriculture; archaeologically, it is generally associated with agricultural remains; and it may therefore be assumed to have originated in Middle America at about the same time as agriculture. Masonry had spread somewhat beyond the cultural nucleus of Middle America, as far as northwestern Argentina and southwestern United States.

Middle America was a region of towns, therefore of higher political organization, and in Mexico and Peru of considerable empires. In the same regions ritualistic religion, including altars, permanent edifices, sacrifices and symbolism, reached its most complex development. This development was evidently dependent upon the existence of a priesthood persisting through successive generations under stable social and political conditions. Finally, the intellectual achievements, probably also in large part due to priests, culminated in the mathematical and calendrical systems of the Maya, and in an incipient system of writing employed by them and the neighbouring Mexican nations. Attempts have been made to derive these products of learning from the old world; but analysis shows their principles, especially those of the calendar, to be unique. The Maya, for instance, had devised position numerals and a sign for zero; but their system of numeration was vigesimal, and they were probably using this system before any people in the old world had invented a sign for zero.

4. Other culture traits in America, not specially characteristic of higher civilization, do not occur regularly distributed in or around the Mexican-Peruvian area. Some of these traits may be presumed as due to local inventions independent of the Middle

American stimulus. Others may have originated earlier than the Middle American agriculture-metal-town-priesthood growth and have diffused irregularly, or perpetuated themselves only in certain tracts. Most elements peculiar to one or two culture areas fall into the present class; for instance, the carpentering, wood-carving and frame houses of the North Pacific coast; the special war customs of the eastern United States; the acorn food technique of California. Clan systems or exogamic institutions, usually with totemic manifestations, occur in North America in several areas: the southeast and northeast, the North Pacific coast, in a limited area in the plains, and in the southwestern United States.

5. A certain number of traits restricted to the northwestern half of North America show modern or recent analogues in the old world, usually in northern Asia and Europe, but do not appear to possess extreme antiquity. They may therefore be assumed as importations into America, mainly by diffusion rather than by migration, in the last few thousand years. For the most part these traits are distinguishable without difficulty from the universal and supposedly very ancient ones of class 1. Into the present group there may fall the sinew-backed bow (the American equivalent of the composite bow of Asia), the tepee or skin tent on poles, the snow-shoe and toboggan (equivalent of old world snow-shoe of ski type), birch bark canoes and vessels, the half-underground house roofed with earth, tailored or fitted clothing of sewn skins, and several myth episodes such as "Earth Diving" and the "Magic Flight." The distribution of most of these traits in America stops before it reaches the southwest and southeast United States. None of them had reached the advanced portions of Mexico.

Culture Types.—An attempt has been made by Americanists to organize the complex and irregular manifestations of native culture by classifying them into certain types characteristic of regions known as culture areas. These are to a certain degree environmental; the natural environment is thought to have acted as a stabilizing and perpetuating factor, once a certain type of culture had been achieved in an area. Essentially, however, this classification is one of culture types, and the concordant geographical areas largely represent empirical determinations of distribution. In this respect the culture area classification, as first formulated by Wissler and accepted with only minor modifications by practically all American students, differs from older attempts which proceeded from environment as the supposed determinative factor. The more important types of culture in these areas are outlined in separate articles. The areas are: 1, Mexican, north about as far as the Tropic of Cancer (*see* AZTEC, TOLTEC, ZAPOTEC); 2, Southwest (*i.e.*, of the United States, but including northern Mexico; *see* PUEBLO); 3, 4, Southeast and Northeast, perhaps to be joined and called Eastern woodland (*see* MUSKOGIAN INDIANS, MOUND-BUILDERS, IROQUOIS); 5, Plains (*q.v.*), in the untimbered centre of the continent; 6, Plateau, in the western intermountain region, an area relatively undifferentiated in culture, with actively entering influences from the adjacent areas (the Great Basin is sometimes separated from the upper Columbia and Frazer region and united with California); 7, California; 8, North Pacific coast (*q.v.*), from northern California to southern Alaska inclusive; 9, Mackenzie-Yukon (*see* ATHABASCAN); 10, Arctic (*see* ESKIMOS). The West Indies seem to belong culturally with South rather than with North America. The southern frontier of the Mexican area may be placed at southern Nicaragua—Costa Rica and Panamá forming part of the Chiboha or Colombian area of South America.

Qualitatively, these areal types are not equivalent but of quite different intensity and historic depth. The Southeast has been influenced by Mexico, and has in turn influenced the Northeast and Plains. The Southwest represents a second and largely distinct centre of derivation from Mexico. The North Pacific Coast has perhaps adopted more cultural material of Asiatic than of Mexican origin, and has reworked it all with considerable originality. On the technological side alone, the same may be said of the Eskimo. California, Plateau, Mackenzie-Yukon are intermediate areas of rather indifferent characterization.

Temperament.—This is notoriously difficult to dissociate from culture habits, but there appears to be a fairly general agreement as to a characteristic American type of mind and personality, though it might be arguable how far this is innate. Almost universally the American Indian is reserved, stoic, enduring and unresponsive, the antithesis of the Negro, and more similar to the Mongolian in behaviour than to the Caucasian. He is not without humour, but holds expressions of it in rigorous check, so that it becomes manifest chiefly in intimacy. He is patient but not quick; tough in adversity but unenterprising; stable but unimaginative; cruel when his inhibitions have been removed, but not given to brutality ordinarily. He prizes control as the highest virtue, and restraint and decorum as the essentials of manners, and therefore almost always impresses as imbued with unusual sense of respect of personality.

Population.—The original numbers of the American Indians are imperfectly known. The most complete and careful count, that by Mooney (*Smithsonian Misc. Coll.*, lxxx, 1928) arrives at a total of 1,150,000 souls north of Mexico at the time of first contact with Europeans. Inasmuch as several specialists have set a somewhat lower figure for the regions with which they were most familiar, Mooney's total is probably too large rather than too small, and one million in the United States and Canada was, perhaps, not far from the true number. In Mexico and in Central America population was much denser relatively and absolutely; it cannot well be put at less than three to four million, and has generally been estimated as several times greater than that. Similar conditions prevailed in South America: there may have been nearly as many natives under Inca rule as in the remainder of the continent.

In general, the race has declined after contact with Europeans. Some North American tribes have become completely extinct. Some have shrunk, lost their identity and merged. Some have more or less held their own, and a few, like the Navaho, have increased markedly. In the United States, most tribes began to increase again by 1910.

In many tribes there has been an infusion of white and sometimes of Negro blood. Except in the Southwest, it may be said that even those tribes that remain as numerous as originally, are so through the inclusion of alien blood. Socially the mixed bloods generally are Indians. Of this population of pure and mixed blood, there remains not quite half a million in the United States and Canada. Mexico is estimated to be about one-third pure Indian, and more than another third, part Indian. Guatemala is mostly Indian.

History.—There is no native documented history of the American Indian, except for the Mexicans and Maya. The great bulk of the tribes had neither time systems nor writing, and left only legendary traditions. These usually possess limited authenticity. In the main the history of the tribes is a history of their contacts with Caucasians. Often more can be gathered as to the movements or former fortunes of a stock, from its recent distribution and from the relations of its component languages, than from any directly historical source.

(*See* ATHABASCAN, UTO-AZTECAN FAMILY, ALGONKIN, SIOUAN INDIANS, MUSKOGIAN INDIANS, IROQUOIS.)

Native history resting on a documentary basis has been preserved only in the Mexican region. The Maya left both monuments with dated inscriptions and post-Spanish chronicles. The calendar (*q.v.*) in which the inscriptions are expressed is extremely accurate and is well understood, but its conversion into our chronology is still controversial. According to the correlation formerly accepted by most specialists, the Maya cities of the Great period, which have left the principal dated inscriptions, flourished from the 1st to the end of the 6th century after Christ. The present tendency is to construe the time as 260 years later: from the 4th to the 9th century. This calendar system involves long observation, some astronomical knowledge, considerable facility in computing, and is accompanied by hieroglyphic writing, fine sculpture, and advanced architecture. Beyond this was a formative period on which information is accumulating.

An Archaic period is well known from remains in and around

the valley of Mexico. This, however, was a culture already emerged from primitiveness, since the first of its several stages possessed agriculture and pottery. For this reason some now name it the Middle culture. Its beginnings seem coeval with the Maya formative period. The Archaic was succeeded by the more advanced culture of the Toltecs (Teotihuacan), and on this legendary data were preserved by the historic Aztecs, Mixtecs, etc. Some of these accounts are chronological and carry Toltec history back to about A.D. 600. The Toltec-Aztec calendar, however, while accurate within its cycles of 52 years, did not with certainty distinguish successive cycles, so that most Mexican dates must be accepted as only approximations.

In the southwestern U.S., Pueblo and pre-Pueblo culture has been unravelled by intensive archaeological work, until a series of seven stages is known, the first being without pottery and dated by dendrochronology (tree rings) to the 3rd century A.D. The Hohokam culture of S. Arizona is as old and may be older.

BIBLIOGRAPHY.—The most important general work of reference is the *Handbook of American Indians,* published by the Bureau of American Ethnology as Bulletin 30 in two parts (1907 and 1910). The basic work on linguistic classification is by Powell, *7th Report of the Bureau of American Ethnology* (1891). As regards culture, the points of view here adhered to were first outlined by Boas in a brief article, "The History of the American Race" (*N.Y. Acad. Sci.,* xxi, 1912); supplemented in the *Intern. Congr. Americanists,* xxi (Göteborg, 1925); and are most fully developed, with special emphasis on the culture areas and with attention also to racial and linguistic factors, in Wissler, *The American Indian* (1917; 3rd ed., 1938). Brief comprehensive works on special areas are Goddard, *Indians of the South-west, Indians of the North-west;* Wissler, *Indians of the Plains;* Spinden, *Ancient Civilizations of Mexico* (these four are *Handbooks* of the American Museum of Natural History) Kroeber, *Handbook of the Indians of California,* Bur. Amer. Ethn. Bull. 78; Kidder, *South-western Archaeology* (1924). Numerous monographs and special articles are cited in the bibliographies included in these general works. (A. L. K.; X.)

ARCHAEOLOGY

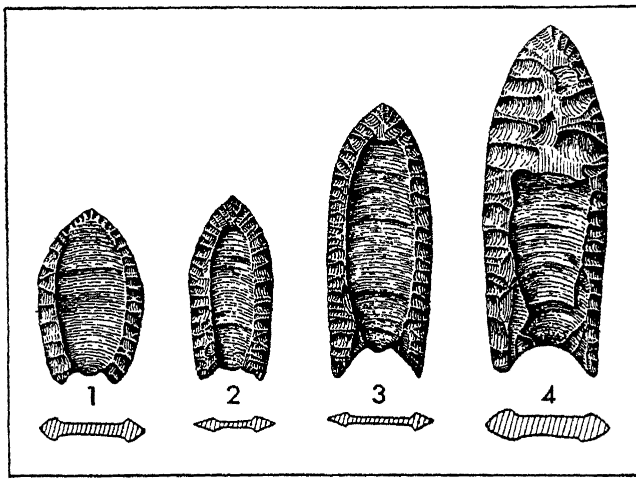
The discoveries of Palaeolithic man in Europe stimulated activities to discover similar evidence in the new world. Laymen and scientists expected to find comparable associations and closely related types of primitive man. During the close of the 19th century and the beginning of the 20th century a lack of sound criteria as well as over-enthusiasm on the part of many investigators created numerous erroneous conclusions. Many reputed discoveries of Palaeolithic man in America, when critically examined on a strictly scientific basis of direct association, did not satisfy the open-minded scientist.

Improved archaeological techniques, more careful observations and the accurate recording of information have provided the evidence of direct association between man-made objects, such as chipped arrow and spear points, gravers, knives and other tools, and the now extinct forms of mammoth, mastodon, bison, camel, horse and other animals.

The objects recovered by these more carefully controlled archaeological methods and the close co-operation between specialists of related sciences, such as Pleistocene geologists and palaeontologists, have produced the basic evidence required. This evidence consists of man-made stone tools and fire hearths in identifiable geologic strata, comparable tools in direct association with now extinct animals, camp site refuse on old land terraces and the shores of old beach lines.

The most generally accepted archaeological complex which has provided the evidence of ancient man in North America is known as the Folsom complex. The name "Folsom" has been given to this horizon because the first occurrence of extinct animals associated with finely chipped projectile points was discovered in a bone deposit on the upper sources of the Cimarron river near the town of Folsom, in eastern New Mexico. This bone deposit, consisting of articulated skeletons of extinct bison and a large deer-like animal, was discovered in 1925. During the next three years palaeontologists and archaeologists worked together in the excavation of the site and recovered numerous flint projectile points, characteristically chipped, in direct contact with the skeletons of the extinct forms of bison. In 1932 a similar characteristic Folsom point was found in conjunction with a few bones of a musk-ox-like animal eight feet beneath the surface of a cave deposit in the Guadalupe mountains in southeastern New Mexico. This association was several feet beneath a stratum of cultural material identified as a Basket Maker cultural-pattern, the oldest cultural level then known in the Pueblo area of the American Southwest. The three major sites producing specific Palaeo-Indian evidence are: (1) the original Folsom site; (2) along Black Water draw between Clovis and Portales in central-eastern New Mexico; (3) the Lindenmeier Ranch north of Fort Collins in the northeast corner of Colorado. There are other sporadic sites throughout the central plains east of the Rocky mountains, extending from Texas north into Canada, which have produced the association between these characteristic fluted points and mammoth or extinct bison bones.

There are two types of flint implements which are distinct and quite characteristic of this archaeological horizon: (1) a relatively small projectile point; (2) a larger knife-like specimen. Both of these forms have a longitudinal groove or channel on both faces extending from the base for two-thirds the length of the implement. In cross-section they have a biconcave appearance. The form is somewhat leaf-shaped with a concave base, and on the smaller points the tip is stubby. Along the edges of the blades and between them and the parallel ridges, formed by the removal of the central flake, is a fine marginal edge formed by the removal of small flakes. These points were extremely well made before the central flakes were removed, as indicated by the finding of the original lateral flakes which showed the primary flaking grooves. The exact purpose of the lateral grooves which characterize these specimens is not known. Such a form may have simplified the hafting of the point to the shaft of spear or arrow; it may have reduced the weight; enabled the shaft to be removed while the point remained in the animal to promote bleeding. The few perfect points that have been recovered represent some of the finest examples of aboriginal chipping techniques in North America.



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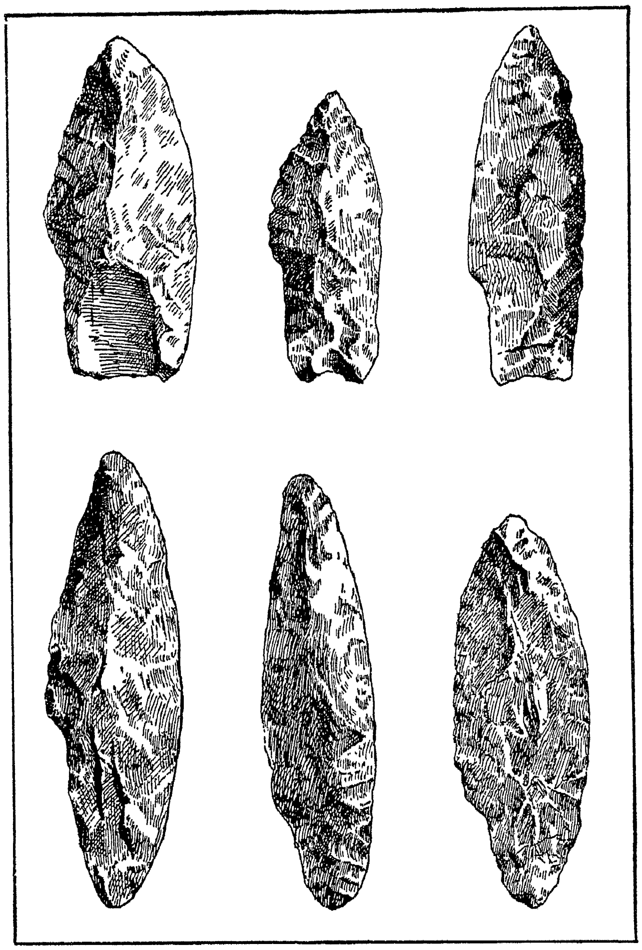
TYPES OF FOLSOM POINTS AND CROSS-SECTIONS ILLUSTRATING THE CHARACTERISTIC LONGITUDINAL GROOVE

In the stratified deposit of a cave high up in Las Huertas canyon in the north end of the Sandia mountains, east of Albuquerque, New Mexico, a group of artifacts was recovered beneath a Folsom deposit. This is the first and only site providing unquestionable proof of a period antedating the Folsom horizon. The archaeological results obtained at Sandia cave are of major importance. Three distinct cultural levels were recovered.

Pottery fragments comparable to those from pueblos inhabited prior to the Spanish explorations were found near the mouth of the cave. Under this more or less recent deposit extended a sheet of travertine representing roughly the end of the Pleistocene geological period in this section of North America. Beneath this hard crust classic Folsom points, large blades, gravers, scrapers, an ivory shaft and worked splinters of bone, together with fragmentary bones of the mammoth, bison, camel, horse and ground

sloth were recovered. Below this Folsom layer was found a sterile laminated stratum of yellow ochre. Under the yellow ochre the collection of Sandia material was found. This, the oldest level of



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CHARACTERISTIC PROJECTILE POINTS FROM THE LOWEST LEVEL IN THE SANDIA CAVF

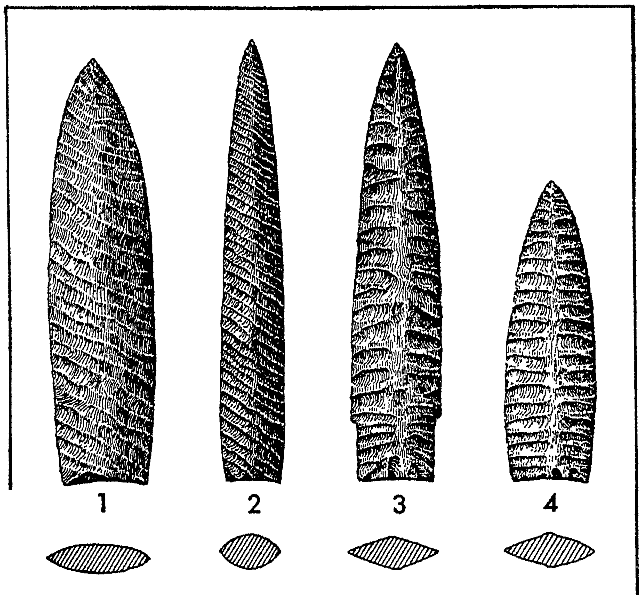
occupation, contained a distinctive type of chipped point which is larger than the Folsom type and not as well chipped. The points are characterized by a side shoulder or notch which is somewhat comparable to a Solutrian type. Some of the points are lanceolate in shape, others are straight shafted with paralleling sides. Snub-nosed and side scrapers, numerous flakes and bone points were also found in this layer. The animal bones identified are similar to those found in the Folsom stratum with the addition of bones from a mastodon. Evidence of ground sloth was found in the Folsom layer as well as in the most recent deposit, which would indicate the ground sloth to be one of the last survivors of the many large mammals belonging to the Pleistocene fauna.

In Yuma county, Colorado, relatively long, well-chipped spear points or knives were found associated with some Folsom points. These long slender blades, oval or diamond-shaped in cross-section, have been considered by some authorities as being contemporaneous with the Folsom remains. Others believe that they represent a later group of people although they have been found in association with some of the most recent Pleistocene mammals. They no doubt represent the work of nomadic hunters living on the North American continent at the very end of the glacial period and continuing after the Folsom horizon. The major concentration of this type of projectile seems to extend across the western plains from Alaska to Texas.

Except for the Sandia horizon there are many Folsom and Yuma sites throughout the central and western portions of the United States, ranging from sporadic discoveries on the surface to those providing direct association between the characteristically chipped points and now extinct animals. In none of the more important sites has there been any direct association between these projectiles and human skeletal material. Therefore, all conclusions have been based on the geological strata and the recurring fauna. On the basis of the geology and archaeology it is safe to assume that these sites represent the first and oldest evidence of man in the western hemisphere. Even though no direct association of human skeletal material has yet been recovered, most authorities agree that it represents an essentially modern type of American Indian arriving in the new world about 15,000 years ago with a stone culture somewhat comparable to the Early Neolithic in Europe. On the basis of this evidence a considerable hiatus exists between this Palaeo-Indian horizon and the oldest remains of the subsequent Indian tribes, whose earliest remains rarely precede the beginning of the Christian era. A broad interpretation of the factors governing such a long separation, of at least 10,000 years, is that the first migrants, after crossing Bering sea into Alaska, came down the eastern corridor shortly after the receding of the northern glaciers. Minor oscillation of subsequent ice sheets may have discouraged or prevented human migrations until a much later date. Other barriers may have prevented a continuous migration from the northern Asiatic mainland. A better understanding of the geology together with additional explorations may provide the necessary information relating to this most interesting problem of the Palaeo-Indian in America.

As indicated in the foregoing section, one of the most interesting problems for future research is a sound explanation of the hiatus of 10,000 years which now seems to exist between the remains of the Palaeo-Indian horizon and the basic cultures of the ancestors of the historically known American Indians. When written records were not left by the vanished peoples, as is the case in most of North America and in many other regions of the world, there must always be a considerable element of speculation regarding major archaeological monuments, though the basic facts may be ascertained with more or less clarity.

After 1930 modern archaeological techniques, the analysis of tree rings, as well as the concentration on historical problems, reduced the time elements formerly considered essential in the evolution and development of the prehistoric Indian cultures. Generally speaking, the ecology of various areas in the United States and the adjustments made by the aborigines to these local regions have played an important role in the various archaeological manifestations thus far recovered. For the sake of brevity and



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YUMA POINTS ILLUSTRATING OBLIQUE CHIPPING

clarity the various archaeological horizons will be considered in the following arbitrary areas: Alaska, Northwest Coast, Intermontane, the Southwest, the Mississippi Valley, the Great Plains and the North Atlantic.

ALASKA

In the Alaskan area, in contrast with some of the others to be considered, we are not confronted with the problem of major shifts in the population nor profound changes in culture caused by environmental factors. The local, somewhat limited, fauna is practically identical to that existing in prehistoric times. No other part of the continent presents such a clear picture of a modern culture derived from a prehistoric pattern as do some of the sites in Alaska and Greenland. Many important sites have been abandoned for centuries while others are still occupied by the descendants of the prehistoric Eskimos. On Little Diomede Island, halfway between Asia and America in the Bering strait, the modern Eskimo houses are built on top of the old midden and the present population continues to add evidence of their handiwork and discarded material to the mass of refuse that has been accumulating for the past 2,000 years.

The permanently frozen soil has preserved a remarkably full and detailed picture of life and the objects used by the aborigines. Implements, weapons, ornaments and utensils exist in large quantities and provide the archaeologist with the necessary data for reconstructing the life of these people.

Thus far the real origins of the Eskimo culture have not as yet been fully established. No trace of a pre-Eskimo population has been found. Nevertheless, Palaeo-Indian migrations must have used the Bering strait corridor in order to reach the new world. These original migrations developed no doubt as a result of following the herds of land mammals upon which ancient man depended for his livelihood.

Archaeological excavations in Alaska have disproved the theory that the more ancient the artifacts the more simple their design elements. The excavations within the Bering strait region have indicated a long series of cultural changes in the direction of simplification rather than progressively complex. From the point of view of decorative motifs the Old Bering Sea culture is much more advanced than that of the present-day Alaskan Eskimo. In southern Alaska, on the other hand, the oldest level at Kachemak bay is a more simple generalized Eskimo character in contrast with the more recent stages, largely the result of the influence of the northwest coast Indians.

Several archaeological horizons have been established in Alaska. Starting with the oldest remains, which have been dated around the beginning of the Christian era, there is the Old Bering Sea culture from excavated sites on St. Lawrence Island, the Diomede and Prince of Wales Island, and postulated for the region around Point Barrow. In southern Alaska a contemporaneous group has been called Kachemak Bay. In the central area and extending east as far as Greenland are cultures derived from ancient manifestations known as the Dorset culture.

The lack of concentrated archaeological excavations in northeastern Asia has been largely responsible for the lack of comparative material from such Asiatic coast sites. In 1939 and 1940 a site was discovered at Point Hope in northwest Alaska which has produced strange and highly conventionalized examples of carvings on ivory which do not resemble comparable material from other sites in the Eskimo region. This site consisted of hundreds of house ruins, none of which was superimposed, which would seem to indicate simultaneous occupancy by several thousand people. If this surmise is correct it would represent one of the most concentrated settlements in prehistoric times. Ipiutak, the name given to the site, produced a preponderance of chipped flint arrowpoints, knives and scrapers, and lacked many implements typical of the other prehistoric Eskimo cultures. They may have been an inland people, dependent on land mammals, who concentrated at such a coast site for a limited period in the spring for the hunting of such sea mammals as the walrus and seal. The 4,000 artifacts from this site are made from ivory, bone, antler and flint. One of the most striking differences between the collections from Ipiutak and other Eskimo sites is the lack of harpoon heads and the presence of many hundreds of arrowheads. There was also a group of 150 fantastic ivory objects whose use was impossible to classify immediately.

It would seem from the above description, and based on the tentative conclusion, that Ipiutak is the oldest of the Eskimo cultures; that the farther the past is penetrated the more complex are the ivory carvings. Future excavations in the Amur regions and other sections of northeastern Asia may produce comparable traits. Eskimo culture as it is known today may be an adaptation to the rigorous arctic coast by people from southern latitudes in eastern Asia.

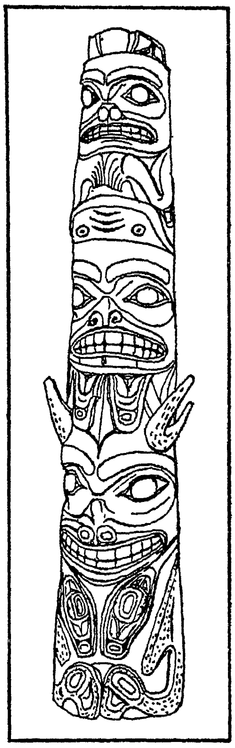
In southern Alaska, the Aleutian Islands, Kodiak Island and Cook inlet there is a more or less generalized Eskimo culture. In only a few cases are there any specific resemblances to the northern or Bering strait types. These few examples, however, would seem to indicate an ancient Eskimo stratum which became isolated and permitted the growth of a specialized form of culture in south Alaska. At a later period these people were subjected to strong Indian influences from the northwest coast.

The great number of kitchen middens or shell heaps, some attaining 20 ft. in height, throughout the Aleutian chain of islands is sufficient proof that these islands and the adjacent Alaskan coast line were as densely populated in prehistoric times as they were when explored by the Russians in the 18th century. The material culture from the sites in this general region consists of stone lamps, elaborate barbed bone points, compound fishhooks, awls, needle cases, needles, wedges, labrets, pendants, spoons, harpoon heads, foreshafts, drill points, chipped stone, rubbed slate knives and whetstones. Excavations on Kodiak Island produced skeletal evidence showing that the skulls from the lower levels are longer and higher (Eskimoid) as in contrast with the more modern Aleuts, which are extremely low and broad.

In the later stages of the culture, possibly in the 13th and 14th centuries, the Indian cultures farther south, along the northwest coast, greatly influenced this Eskimoid pattern by the introduction of such customs as disarticulated burials, the gathering of trophy heads, the use of human bones, and by the introduction of such specimens as the pestle, copper ornaments, elaborate stone lamps, nose pins, slate mirrors, stone clubs and the splitting adze. Environmental factors no doubt led to the adoption of many traits from the more highly developed social groups to the south.

NORTHWEST COAST

This comprises a coastal area ranging northward from Oregon to the Alaskan peninsula. The exceptional fauna and flora of this territory together with the peculiar geographical conditions influenced a specialized type of food-gathering culture. So far very little archaeological research has been made, and for this reason it is not possible to determine any contrast between the culture of the highly organized Indian tribes of the 18th century and their antecedents. Except for a few minor objects there seems to be very little influence from the Eskimo to the north. Certain traits, such as slat or rod armour, woven hats, grave monuments, bark beaters, and edged clubs are comparable to similar forms in southeastern Asia and parts of Oceania. Whether these objects reached the coast by direct contact or the accidental shipwreck caused by ocean currents has not been definitely determined. The similarities between the northwest coast and the Asiatic mainland west of the Aleutian Islands, as found among the Kamchadal-Koryak groups, may be the result of relatively recent contacts from east to west across the Aleutian Islands.



FROM A. L. KROEBER AND T. T. WATERMAN, "SOURCE BOOK IN ANTHROPOLOGY" (UNIVERSITY OF CALIFORNIA PRESS)

MODEL OF A TOTEM POLE FROM THE HAIDA INDIANS LIVING IN THE NORTHWEST COAST AREA

The material culture of the historic Indian tribes inhabiting this unusual coastal strip and the adjacent islands represents one of the outstanding aboriginal cultures on the American continent. This is especially noteworthy of a seminomadic group of people where agriculture was unknown. The ecological factors of the territory together with the aggressive and vigorous nature of the inhabitants are largely responsible for such a development. Because of the splendid forests the people developed great skill in the carving of wooden monuments, such as the totem poles, decorating their houses and implements, and in the manufacture of their world renowned dugout canoes from the giant cedar trees. Their aesthetic ability is also shown by their works of art in shell, ivory, stone, bone, horn and copper. The stone objects consisted of mauls, hammers, clubs, pipes, pestles and mortars, knives and chisels. The chipped stone objects are rare in the northern sections but more common to the south. Wooden, bone and horn vessels took the place of pottery. Even though copper occurs in easily mined surface deposits it is unknown as to whether this medium was used in prehistoric times. In historic times conventionalized copper plates served as important exchange items together with their beautifully woven goat hair blankets during their highly ceremonialized potlatch.

Many tribal variations are found based on the foregoing material culture. In the north were the Tlingit, Haida and Tsimshian; in the central area were the Kwakiutl and Bellacoola; in the south the Salish, Nootka, Chinook and some Athapascan tribes. The staple food

was that derived from fish and sea mammals and some hunting on the mainland, and there was dependence on the varieties of berries and plants. They cooked their food in the beautifully carved wooden boxes by heating the liquid with hot stones; lived in rectangular gabled houses of upright cedar planks, and travelled chiefly by water in their large artistically painted sea-going canoes. Their social organization consisted of matrilineal descent and was organized into a definite class system of chiefs, nobles, commoners and slaves. Their mythology was characterized by Raven legends.

THE INTERMONTANE

This area, sometimes referred to as the Great Basin, covers the southeastern part of Oregon, southern Idaho, Nevada, Utah and the eastern part of California. The natural environment at the close of the Pleistocene geological period became one vast desert with a rugged topography, all of which limited any horticultural activities except in a few restricted parts of the Colorado river valley and in the piedmont area of the Wasatch mountains. The deep valleys and high mountain ranges discouraged communication and infiltration from neighbouring culture areas. The scant vegetation restricted the survival of any herds of large animals. Mountain sheep and deer lived in the mountains, while a few antelope occurred in the valleys. Special techniques were required for the trapping of smaller mammals. Such limited natural resources formed a distinct barrier to a concentration of people. It is roughly estimated that from 30–35 sq.mi. of land was required to support one person.

Even though the Intermontane extends as far east as the Rocky mountains, the cultural remnants thus far recovered are associated with those from the west and south. The archaeological cultures reported from this area seem to cover a considerable period of antiquity, ranging from the close of the Pleistocene period at such sites as Gypsum cave in Nevada, remnants of early cultures along ancient stream and lake shores in southeastern California, through the Anasazi influences from northern New Mexico, Arizona and southern Colorado, to the historic Shoshonean Indian tribes.

During the close of the Pleistocene period or during the glacial age the Great Basin area was probably much more fertile than at the present time. Prehistoric man with his simple equipment would have found sufficient game to exist in considerable numbers. Except for those sporadic finds, such as at Gypsum cave and Lake Mohave to the south, no specific evidence has been found of glacial age man. After the continental glaciers receded the present semi-desert environment vastly changed the flora and fauna. The available natural food supply after the beginning of the Christian era consisted of seeds, rodents and fish in restricted localities. To exist under these limited conditions would require a culture possessing a basketry complex, the metate for the grinding of seeds and nuts, traps, nets, snares, the bow and arrow or spear for the limited hunting and fishing, and methods for transporting and storing water. During the development of the classical Basket Maker period in the archaeological area known as the Southwest, the fundamental traits required to maintain a livelihood in this semi-desert environment were developed and permitted population expansion and direct migration. Those traits of a Basket Maker origin which were carried into the Great Basin area were sandals, skin blankets of twisted animal fur, curved wooden clubs known as rabbit sticks, and the metate for pulverizing nuts. Other phases of the Basin culture may have spread from the west or north, such as the nets, snares, traps, bow and arrow. Many of these traits spread slowly within the Great Basin by the ancestors of the historic Shoshoneans. Before these ancestors spread this predominantly Basket culture to the eastern sections of the Basin a new and more highly developed Pueblo culture invaded the eastern sections. Evidence of this pottery-making culture spread throughout northern Utah and eastern Nevada. These pottery-making peoples did not remain for many years, and after their return to the Southwest the ancestral Shoshoneans expanded throughout the territory. After this settlement congealed the Shoshoneans borrowed salmon-fishing techniques from their northern neighbours, twined basketry from the west, pottery from the south and east, skin garments and moccasins and later the horse from the Plains Indians east of the Rocky mountains.

THE SOUTHWEST

This important archaeological area—where diverse prehistoric peoples overcame a rigorous semi-desert environment to become sedentary, establishing large apartment-like dwellings, with a communal society directed by native priests within an elaborate framework of ritualism —is located within the states of New Mexico, Arizona, southwestern Colorado, southern Utah, eastern Nevada and northern Chihuahua and Sonora. This area has been roughly divided into two distinct categories. The northern cultures have been grouped under a single term, "Anasazi," a Navaho word meaning "the ancient ones," while those cultures to the south, along the Gila and Salt rivers, have been designated by a word from the Pima tradition for those who departed long ago, "Hohokam." Archaeological investigations throughout the Southwest have been based on a true historical perspective by the use of the stratigraphic method. This method is comparable to that used by the geologists and palaeontologists in reconstructing the history of the earth and the animals that lived upon it. The seriation of European cultures from the Palaeolithic period to the beginning of historical records has been established through the same sound approach. In any undisturbed deposit of geological or human character formed over a considerable portion of time, the oldest material is found at the bottom of the deposit and the most recent material on the top, while those strata or layers in between the top and bottom are of an intermediate age.

The evidence obtained from pure stratigraphical studies gives a relative position for the early and late material. Due to conditions of an arid climate in the Southwest, many perishable objects such as wooden roof beams were preserved for many centuries. Such a climate with its radical wet and dry years influenced the growth of trees in a manner affecting the growth rings of the trees. To the archaeologist relative dating based on actual stratigraphy was vitally important, but to find a method whereby actual dates could be assigned to the Pueblo ruins and thereby determine the century or years within a century was even more acceptable. Such studies have now given dates to specific archaeological horizons extending back to A.D. 475, while unassociated timbers extend the dating back to A.D. 150. The following Pueblo ruins have been dated: Mesa Verde in southwestern Colorado, A.D. 1073–1272; in northwest New Mexico, Pueblo Bonito A.D. 919–1130; Aztec Ruin, A.D. 1110–1121, and many others with equal positiveness.

The Anasazi.—The Anasazi or Pueblo culture is located in what has been broadly characterized as a vast plateau ranging from 900–2,100 ft. above sea level. This terrain varies from vast open prairie to ragged mountains. Rivers and streams have eroded gorges and perpendicular canyons. The people lived for the most part on the intermediate levels where, even in this arid climate, they perfected agricultural methods to irrigate their soils for the growing of maize. This northern section contains the antecedents of all cultural horizons belonging to the division known as Anasazi. It is encompassed within an area drained by the San Juan, the Rio Grande, the Upper Gila and Salt, and the Little Colorado rivers, most of southern Utah and eastern Nevada. This Anasazi horizon has been divided, on the basis of the material culture and physical types, into two broad categories: the Basket Maker and the Pueblo groups. The earliest evidence of a semi-nomadic cave dwelling group is the Basket Maker. This has been divided into two divisions: Basket Maker and Modified Basket Maker. Here again as in other areas a hiatus of 10,000 years or more exists between the Folsom complex and earliest evidence of the Basket Maker, which may be dated approximately at the beginning of the Christian era.

The earliest evidence of the Basket Maker stage of development places them in a transitional state between a food-gathering mode of life and the very beginning of a food-producing style of existence in which agriculture played an important part. The growing of maize became the foundation for all ensuing cultures. The origin or method of diffusion of this very important cultural trait is unknown. The growing of maize imposed a more sedentary mode of life and necessitated a more permanent habitat. This factor as well as providing a stable supply of food encouraged the development of new arts and a subsequent broadening of the cultural pattern.

The artifacts left by these early Basket Makers are found in the lowest levels of human occupancy of dry caves and shelters. These shelters, however, served mostly as storage places for their food and seeds, which were stored in circular or oval stone-lined pits. Some of these pits were found to contain small, hard, yellow kernels of popcorn-like maize. Some of these pit granaries were also used for beds as well as places for the interment of their dead. From the skeletal material we know that they were a relatively long-headed people of short and slender stature. They were experts in the making of artistically twined woven bags and coiled baskets, sandals, fur-cloth robes, snares and nets for catching small mammals. In the planting of maize they used long, wooden, digging sticks and wooden scoops. Bone tools and curved sticks were used in dressing skins and making garments. They wore feathered headgear and comb-like ornaments as well as necklaces made from coloured stones, bones, shells and seeds. In these early levels no sign of the bow and arrow is found, but in its place is a long spear thrown with the aid of an atlatl, or spear thrower. The Basket Makers had no true fired pottery. However, near the end of this horizon a few unfired clay vessels have been found. Whether this important cultural element originated among these people as a result of lining their baskets with clay or the idea was diffused from other peoples to the south is still debatable. The clay used in the sun-dried forms was mixed with grass and cedar bark to allow for expansion and contraction. Some of the vessels which were molded in baskets extended above the sides by the addition of bands or coils of clay. Others were made without the support of baskets by the coiling process.

The most concentrated centre of this early period is found in what has been termed the Four Corners region, namely, northwestern New Mexico, southwestern Colorado, southeastern Utah and northeastern Arizona. On the basis of tree rings or dendrochronology, the Basket Makers used the caves in this region from about the 1st through the 6th centuries A.D. Elements somewhat comparable to those of the Basket Makers are found as far east as western Texas and south to Coahuila although no definite proof has been found that these cave cultures constitute a direct relationship. Other cultural lags have been identified in the Great Basin area to the north.

The Basket Maker horizon contributed one of the most important

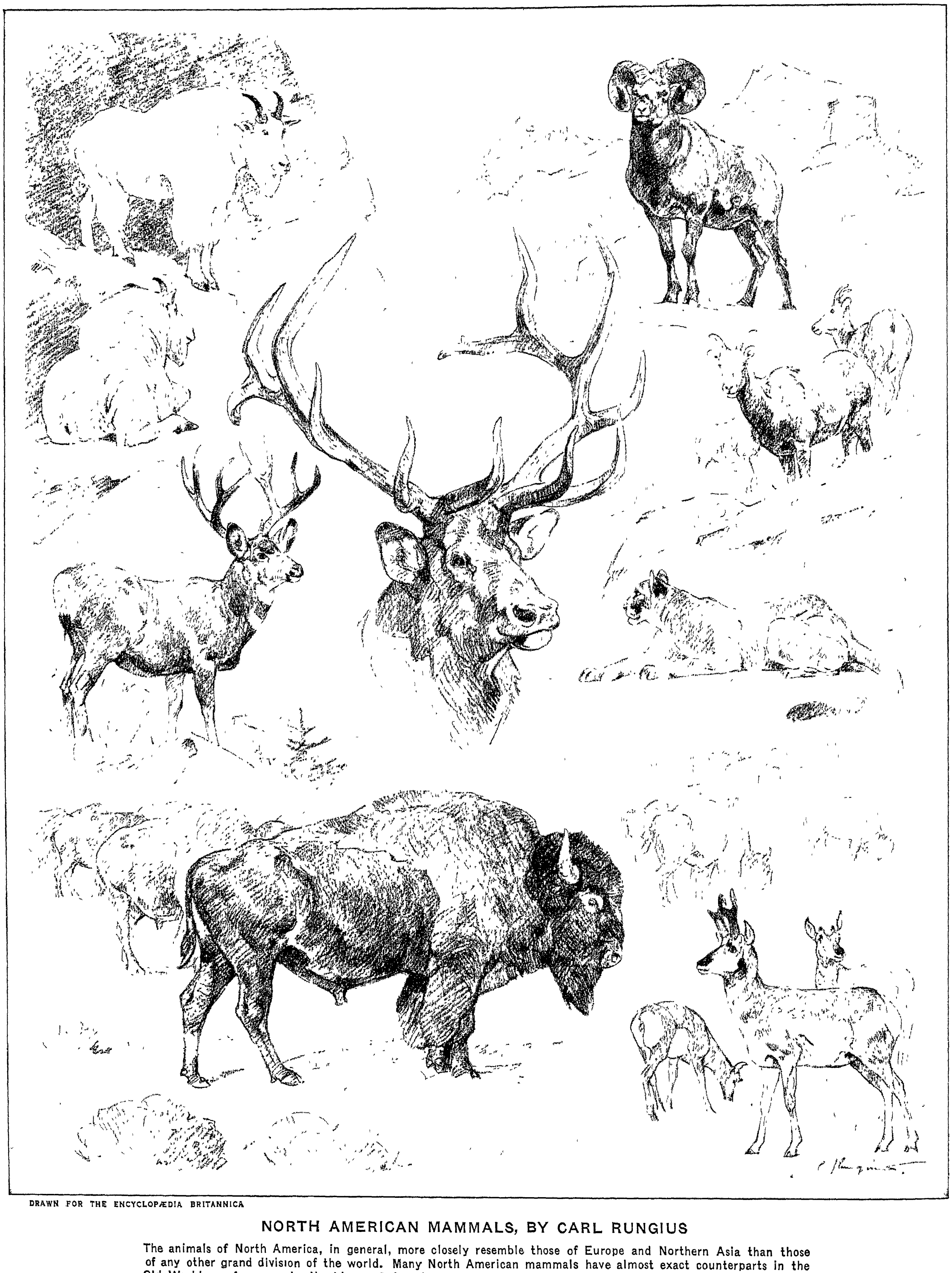
BY COURTESY OF CARL RUNGIUS

AMERICAN MOOSE AND ELK, BY CARL RUNGIUS

"After the Storm." Two bull moose (*Alces americana*) are passing through deep snow in a spruce forest in Alberta, Canada, in September, after a heavy storm. The brown leaves of the undergrowth form a contrast with the green of the spruces

"The Stampede." A stampede of American elk (Wapiti, *Cervus canadensis*) high in the Wind River mountains near Fremont Lake in western Wyoming, in September. The bull elk is leaping over a fallen spruce, with one cow, while other cows have gone ahead

NORTH AMERICA



DRAWN FOR THE ENCYCLOPÆDIA BRITANNICA

NORTH AMERICAN MAMMALS, BY CARL RUNGIUS

The animals of North America, in general, more closely resemble those of Europe and Northern Asia than those of any other grand division of the world. Many North American mammals have almost exact counterparts in the Old World, as, for example, the bison. A few, however, as the Rocky Mountain goat and the Pronghorn, shown in the illustration, are found only in North America

Rocky Mountain Goat (*Oreamnos montanus*), upper left

Bighorn or Mountain Sheep (*Ovis canadensis*), ram with ewes and lamb, upper right

Mule Deer (*Odocoileus hemionus*), left centre

American Elk or Wapiti (*Cervus canadensis*), head with antlers, centre

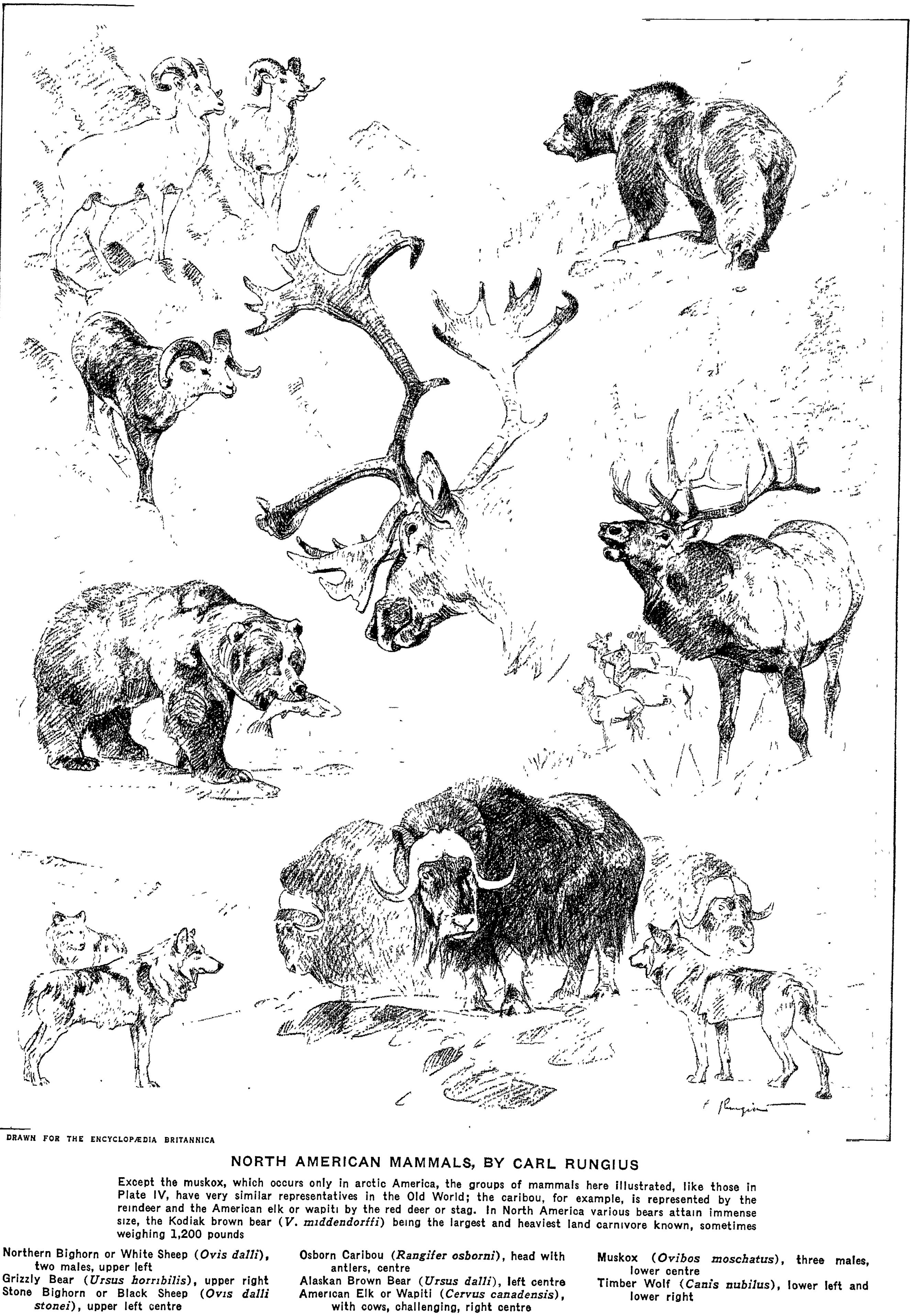
Puma, Cougar or Mountain Lion (*Felis concolor*), right centre

American Bison or Buffalo (*Bison americanus*), lower centre

Pronghorn or American Antelope (*Antilocapra americana*), a male and two females, lower right

NORTH AMERICA

PLATE III



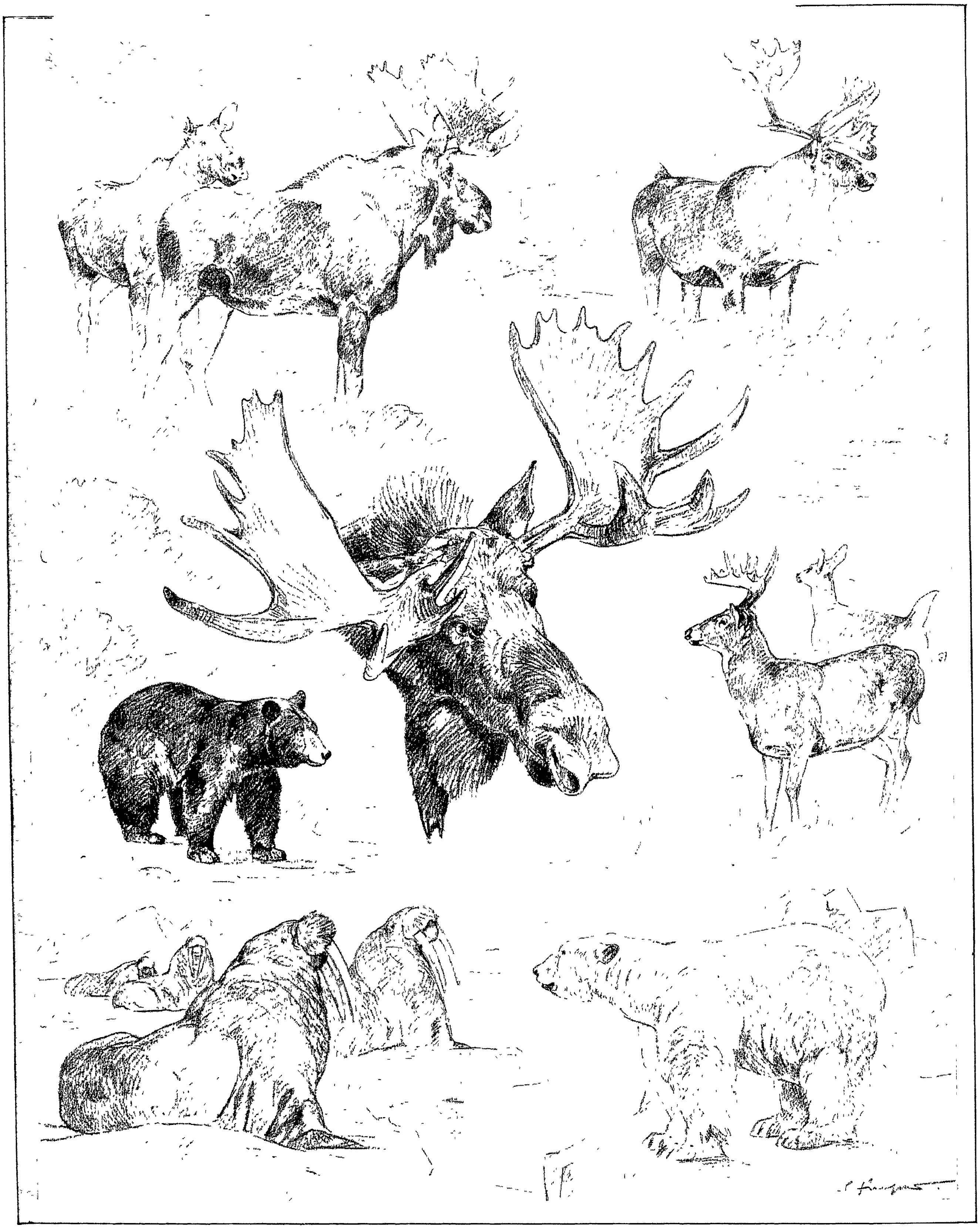
DRAWN FOR THE ENCYCLOPÆDIA BRITANNICA

NORTH AMERICAN MAMMALS, BY CARL RUNGIUS

Except the muskox, which occurs only in arctic America, the groups of mammals here illustrated, like those in Plate IV, have very similar representatives in the Old World; the caribou, for example, is represented by the reindeer and the American elk or wapiti by the red deer or stag. In North America various bears attain immense size, the Kodiak brown bear (*V. middendorffi*) being the largest and heaviest land carnivore known, sometimes weighing 1,200 pounds

Northern Bighorn or White Sheep (*Ovis dalli*), two males, upper left
Grizzly Bear (*Ursus horribilis*), upper right
Stone Bighorn or Black Sheep (*Ovis dalli stonei*), upper left centre
Osborn Caribou (*Rangifer osborni*), head with antlers, centre
Alaskan Brown Bear (*Ursus dalli*), left centre
American Elk or Wapiti (*Cervus canadensis*), with cows, challenging, right centre
Muskox (*Ovibos moschatus*), three males, lower centre
Timber Wolf (*Canis nubilus*), lower left and lower right

NORTH AMERICA



DRAWN FOR THE ENCYCLOPÆDIA BRITANNICA

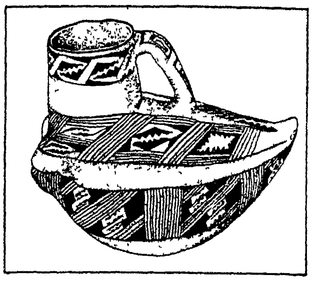
NORTH AMERICAN MAMMALS, BY CARL RUNGIUS

The American Moose (*Alces americanus*), which sometimes stands 6½ feet high at the shoulder, is closely allied to the Old World Elk (*A. alces*). The taller and blacker Alaskan Moose (*A. gigas*), sometimes attaining a height of 7½ feet, an antler spread of 6 feet and a weight of 1,800 pounds, is the largest known member of the deer family. For further details, *see* the articles on the animals illustrated

American Moose (*Alces americanus*), bull and cow, upper left
Woodland Caribou (*Rangifer caribou*), upper right
American Moose, head with antlers, centre
Black Bear (*Ursus americanus*), lower centre
Virginia Deer (*Odocoileus virginianus*), buck and doe, lower centre
Pacific Walrus (*Odobaenus obesus*), lower left
Polar Bear (*Thalarctos maritimus*), lower right

cultural elements to the subsequent Indian tribes, namely, the beginning of a food-producing economy. Their agricultural traits consisted of at least one variety of maize, pumpkin and beans. At the present time all evidence seems to point to Mexico and Central America for the original domestication of this indigenous wild plant. The necessary steps involved as well as the method of its diffusion have not been determined. Roughly estimated, this period ranges from the beginning of the Christian era to A.D. 500.

The next important period is known as the Modified Basket Maker, indicating a basic Basket Maker culture although somewhat changed in form. The most important changes which occurred during this period are: A few undeformed round-headed individuals in contrast to the earlier long-heads; sandals made with a scalloped instead of the square toe; degeneration in twined woven bags; the making of thin fired pottery vessels; the clustering of houses to form small villages and a better developed residential architecture; the appearance of the bow and arrow; grooved axes and mauls; the domestication of the wild turkey and the growing of additional varieties of maize or corn. This period extended from approximately A.D. 500–750.



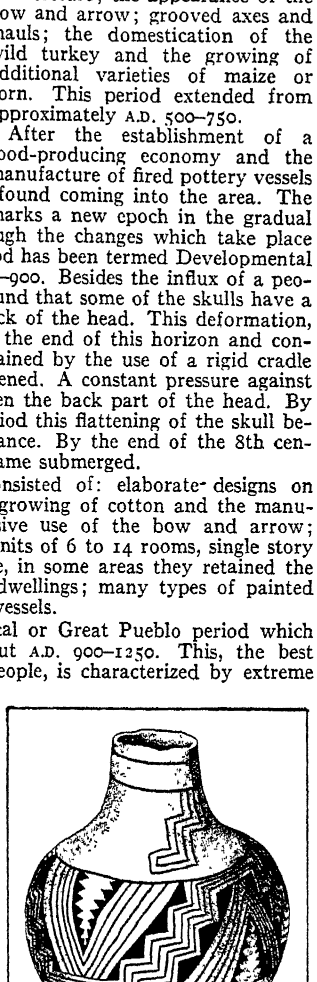
BY COURTESY OF SMITHSONIAN INSTITUTION. FROM "BULLETIN 126" OF THE BUREAU OF AMERICAN ETHNOLOGY

BIRD-SHAPED VESSEL WITH BLACK-ON-WHITE DESIGNS. DEVELOPMENTAL PUEBLO PERIOD

After the establishment of a food-producing economy and the manufacture of fired pottery vessels evidence of a new physical type is found coming into the area. The appearance of this new individual marks a new epoch in the gradual transition of this culture. Even though the changes which take place are in no sense radical, the next period has been termed Developmental Pueblo, which is dated from A.D. 750–900. Besides the influx of a people with round skulls, it has been found that some of the skulls have a definite artificial flattening at the back of the head. This deformation, which becomes more pronounced at the end of this horizon and continues in subsequent periods, is explained by the use of a rigid cradle to which the child was securely fastened. A constant pressure against the plastic skull would tend to flatten the back part of the head. By the close of the Modified Pueblo period this flattening of the skull became a standard of personal appearance. By the end of the 8th century all long-headed individuals became submerged.

Other changes in the culture consisted of: elaborate designs on the coiled rod and bundle baskets; growing of cotton and the manufacture of cotton cloth; the exclusive use of the bow and arrow; houses were built above ground in units of 6 to 14 rooms, single story in height made from stone or adobe, in some areas they retained the pole and mud and rectangular pit dwellings; many types of painted and corrugated fire-baked pottery vessels.

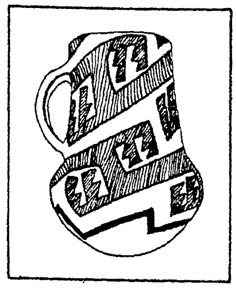
This now brings us to the classical or Great Pueblo period which ranges in point of time from about A.D. 900–1250. This, the best known epoch of these prehistoric people, is characterized by extreme development and local specialization in architecture and ceramics. One of the most important characteristics is the building of large multistoried apartment-like dwellings containing about 1,000 rooms, especially in Chaco canyon, the Kayenta district and at Mesa Verde. Here we find examples of the highest architectural achievements. Normally the great house is built around a court. These immense structures were usually rectangular or D-shaped and could serve as a fortress if necessary. The most distinctive type of walls consisted of very thin tabular blocks laid in horizontal bands, which provided an outside surface impervious to erosion. Those structures built in caves, such as the cliff-houses, were relatively thin and flimsy. Many theories exist as to the adoption of these large residences. At the end of the Developmental period the small unit houses were widely scattered near good farming lands. Some believe this connotes peace and freedom from attack. The arrival of foreign predatory raiders forced the Puebloans to gather in larger groups and to construct well defended communal houses; others believe that the development of the large apartment-like dwellings was a natural evolution and the product of an architectural vogue rather than fear of outside marauding groups. Within the central courts numerous types of ceremonial rooms were built. These semi-subterranean structures served as the centre for religious ceremonies. Both the small or common kiva as well as the large or great kiva are an outgrowth of similar ceremonial chambers developed in the Basket Maker period.



BY COURTESY OF SMITHSONIAN INSTITUTION FROM "BULLETIN 126" OF THE BUREAU OF AMERICAN ETHNOLOGY

CHARACTERISTICALLY DECORATED JAR OF THE DEVELOPMENTAL PUEBLO PERIOD

Except for the architectural and ceramic developments, very few new traits occur during this horizon. The growing of cotton and loom weaving were the only basic items which had been added to the previous lists. Nevertheless considerable improvements were made in the material culture.



BY COURTESY OF SMITHSONIAN INSTITUTION FROM "BULLETIN 100" OF THE BUREAU OF AMERICAN ETHNOLOGY

A PAINTED PITCHER FROM ONE OF THE CLASSICAL OR GREAT PUEBLO PERIOD SITES IN EASTERN ARIZONA

By the end of the Great Pueblo period various forces caused a general breakdown within the culture centres. This period is known as the Regressive Pueblo, extending from A.D. 1250–1400. There occurred a complete abandonment of the large pueblo structures and the population shifted to the south and southeast, those localities where the first Spanish explorers encountered them and in the general regions where the descendants now make their homes. The entire culture was in a state of flux. Whether this was due to recurring droughts or influenced by pressure of nomadic groups has not yet been determined. The most important settlements, during the transitional period, were made along the Rio Grande river in eastern New Mexico and the Little Colorado river in Arizona.

After the people became established in their new environments many of the older cultural traits with a strong social and religious organization became re-established. The people were tending toward a renaissance. This revival took place from about A.D. 1400–1700. The coming of the Spanish explorers and the subsequent conquest by the Europeans ended the further development of the aboriginal cultural pattern.

From A.D. 1700 to the present is known as the Historic Pueblo. Here we find both the deformed and undeformed crania; the use of moccasins in place of the sandal; baskets of wickerwork and plaited yucca leaves; cotton, wool and commercial textiles of European manufacture; bow and arrow, throwing clubs and European guns; villages of terraced houses and single units such as those of the modern Hopi towns, Acoma, Zuni and Taos.

The Hohokam.—Another important series of prehistoric cultural developments is termed the Hohokam. The evidence for the reconstruction of these people has been found in the general area bordered by the Colorado river on the west, the New Mexico state line on the east, and from Flagstaff, Arizona, on the north to the upper part of the state of Sonora in Mexico. The main centre is concentrated along the middle Gila basin.

The earliest evidence of these people would seem to indicate a sedentary type of subsistence, based on shaped metates for the grinding of maize. This early horizon is known as the Pioneer. The people lived in houses made from poles, brush and mud plaster, the roof supported by four posts, vestibule on one side, square in plan and about 40 ft. across. They made thin plain and red fired pottery vessels. Their crops were watered by means of flood water irrigation. The bodies of the deceased were cremated and the ashes buried in pits. During this period the houses became smaller and more rectangular in shape and the pottery instead of being plain had decorative designs painted on the surface.

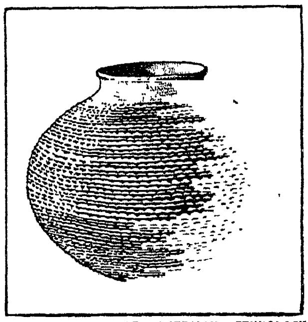
As this pattern of culture developed, other changes were made; new features were incorporated into the construction of their houses; the four posts supporting the roof were reduced to two near the ends of the rectangular houses, and these posts supported a ridge pole. The interiors were not plastered but lined with reeds. Each of the dwellings constituted a unit in the village which was scattered over the semi-arid valleys. Their food-producing fields were irrigated by ditches. The dead continued to be cremated. Ceramic and other industries advanced and became more and more standardized. This horizon is termed Colonial.

The stage known as the Sedentary is marked by new features: The villages were concentrated in smaller areas; two types of houses were constructed, a rectangular one over a shallow pit, with four roof supports, and a similar one built on the surface of the ground, with the framework covered with grass and daubed with mud; some of the villages were surrounded with a compound wall; the irrigation system was enlarged; the ashes of the dead were placed in pottery urns instead of a pit; the forms of pottery vessels were changed. During this Sedentary period and perhaps going back to the end of the Colonial a most unusual type of feature has been recovered, namely, ball courts, or at least structures very similar to those used in Middle America. This implies some connection with the Mexican area to the south. They are the only structures of this nature found north of the Mexican border.

The Classical period, which follows the Sedentary, is interesting because of the evidence showing an invasion of Anasazi people from the plateau country to the north. Even though the people lived side by side, each maintained its distinctive cultural patterns and the association was of such a short duration that no extensive borrowing or hybridization took place. Pueblo structures of stone and adobe were built within the Hohokam communities. The Hohokam cremated their dead while the Anasazi interred their deceased intact. Both Hohokam

and Anasazi types of pottery were used. The great irrigation systems along the Gila and Salt rivers were completed. After a span of about 100 years the Anasazi withdrew to the north while the Hohokam continued to live along their irrigated fields. Because of the seemingly peaceful invasion and on the basis of the Anasazi material culture, a tentative date for this phase in the Hohokam development has been given from about A.D. 1325–1425.

Little is known of the following period, termed Recent, except that the houses were possibly of pole, brush and clay, the dead continued to be cremated, and the pottery vessels were quite plain, resembling the ware of the modern Pima and Papago Indian tribes.



FROM BUREAU OF AMERICAN ETHNOLOGY "REPORT"

VASE FROM PUEBLO VIEJO, GILA VALLEY, ARIZONA

The Modern and last stage of the culture is represented by the Pima and Papago Indian tribes. Some believe that these modern Indians are the descendants of the older Hohokam. Others consider them a mixture of the Hohokam and more recent migrants from outside the area.

The Mogollon.—A third prehistoric pattern of semi-sedentary peoples is called the Mogollon. These inhabited an area centring in the San Francisco and Mimbres river valleys in southwestern New Mexico. Even though preponderantly dependent on agriculture, they supplemented their diet by the hunting of game.

As a whole the developmental stages represented by these people seem to compare with both the Anasazi to the north and the Hohokam to the west. The various phases have been designated as the Georgetown, San Francisco, Three Circle, Mimbres, and the most recent, Animas. The Georgetown period existed prior to the 9th century A.D. The first type of dwellings were deep pit-houses changing from round to rectangular pits with a pole, brush and plaster superstructure, the roof supported by a single post. Associated with the dwellings were ceremonial chambers analogous in type to the kiva structures among the Anasazi. Later houses had shallow pits and finally came the many-roomed, single-storied pueblo type of house. After this the territory was abandoned, the people migrating south to northern Chihuahua, Mexico. The subsequent inhabitants, in the Animas period, consisted of a pueblo-building group with a mixed cultural pattern. Disposal of the dead was usually by inhumation between the houses at first, and later burials were made beneath the floors of houses. Some bodies were cremated, as among the Hohokam. The skulls of the earlier people were low-vaulted, undeformed, round heads, while those buried under the pueblo type houses had high vaults, deformed, round heads. Pottery was made by the coiling process and then smoothed and rubbed. The greatest variations occur in the painted vessels. During the Mimbres period the pottery shows influences from the Hohokam and Anasazi cultures. Some of the earlier forms show some resemblance to pottery forms and decorative techniques comparable to vessels from the Mississippi valley. Certain developmental changes took place in their pipes, metates, mauls, bowls and other artifacts of stone, whereas numerous forms again show the influence from the Anasazi and Hohokam centres.

Besides the three more or less sedentary permanent house and village groups, the peripheral areas were occupied by semi-nomadic peoples. These are represented at least in modern times by the Navaho in central districts surrounding the Anasazi group, the Apache in the south, and the Shoshone along the western peripheries.

THE MISSISSIPPI VALLEY

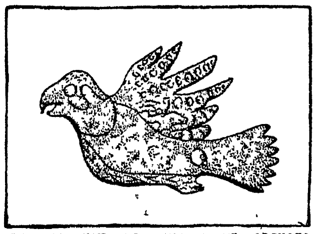
The prevalence of burying their dead in earth mounds, some of which, because of their size, were obvious to the early explorers and European settlers, caused the prehistoric cultures within the Mississippi valley to be given the general name of Mound-builders. Throughout the broad expanse of the Mississippi river drainage there are to be found prehistoric people adapting themselves to the ecological factors of the region. Here the rivers served as highways and the most prolific concentrations of prehistoric villages were located within the broad valleys of the numerous streams and rivers.

After the discovery of the distinctive type of Folsom projectile in association with extinct forms of animals, most of the museums throughout the Mississippi valley were amazed to find comparable types in their miscellaneous collections. A sufficient number have been found in Ohio, Virginia and other states to indicate the wide dispersal of this early horizon throughout the area. None of these points was found associated with any of the later archaeological complexes, but constituted arrowpoints collected from the surface.

As indicated in the other cultural centres, a considerable hiatus exists between this Folsom complex and the more sedentary type of prehistoric cultures. The following described cultures do not antedate A.D. 500. The centuries given for the various manifestations are purely relative. Thus far the dendrochronological studies have not advanced sufficiently to give actual years to the excavated sites. The environment, types of trees used, and method of interment do not preserve the wood to the same extent as in the semi-arid Southwest.

Many names have been assigned to the variety of archaeological remains recovered within the Mississippi valley. Those sites producing objects of European origin are considered protohistoric.

Hopewellian Phase.—Various phases have been determined for classification purposes and these have been subdivided in order to compare the archaeological specimens and determine their relationship. One of the most widespread archaeological manifestations throughout the northern and southern Mississippi valley is termed the Hopewellian phase. It represents one of the earliest of the sedentary groups. The most important diagnostic traits distinguishing it from other cultures found within the valley are: Realistically carved stone platform pipes, cut and hammered copper plates, modelling and painting miniature human figures in clay, intricate variety of woven textiles, conventionalized and realistic design patterns incised on pottery vessels. Much of the material used to portray their artistic talents as well as other artifacts in their culture came from widespread areas. Obsidian, a black volcanic glass, was brought into the Ohio valley from northwestern Wyoming, native copper from the Lake Superior region, barracuda jaws and conch shells from the Gulf of Mexico, mica, in large sheets, from North Carolina. These Ohio people also made good use of the pearls from the nearby freshwater molluscs, colourful flint from outcrops in southern Ohio, as well as the native pipestone for the carving of their animal and bird pipes. Thus far the excavations in southern Ohio, one of the most important centres of this culture, have been confined to the large burial mounds; therefore most of the analysis of the evidence is based on the objects buried with the dead. Burial consisted of a complex mortuary ritual. About 65% of the bodies were cremated and the ashes and unburned fragments of bones were placed in well prepared graves. The remaining 35% were buried extended in the flesh in similarly prepared graves. The bodies or ashes were usually surrounded with a rectangular cribbing of logs and covered with brush or bark, then covered with earth. A considerable number of these adjoining graves were in turn covered with a mound of earth extending 15 ft. or more in height and about 50–75 ft. in diameter. When two or more such mounds were built adjacent to each other they too would be covered with an additional mound, making a large single tumulus 25–30 ft. in height and from 200–300 ft. long and 100 ft. wide. Many smaller mounds were erected within a given area and these were surrounded by earth embankments. These embankments were designed as geometric patterns. On the basis of the evidence thus far produced, the construction of these large mounds, hundreds of small mounds and the surrounding earthworks must have required a relatively dense population and a well coordinated society which would also prescribe a relatively stable economy based on intensive horticulture. Hunting and fishing provided a varied diet. The society must have supported the sculptors and modellers, as evidenced by the number and excellence of the Hopewellian objects of art. To have obtained and transported the raw materials such as obsidian, copper, mica and gulf coast shells required time and encouraged explorations. The construction of the large mortuary tombs postulates a well developed ritual associated with considerable religious fervour. If these factors were due to a restricted ruling class, it must have dominated the greater portion of the central Mississippi valley. Even though no evidence has been found which can be identified with any of the higher culture centres in Mexico or Yucatan, the political organization may have been comparable to the autocratic forms in these areas. Such objects as copper head ornaments, coloured woven garments decorated with hundreds of fresh-water pearls and intricately cut mica, copper axes, black obsidian spear points, copper ear ornaments, and grizzly bear teeth necklaces would certainly clothe a person in a manner that would set him apart from one wearing only a breech cloth and copper ear spools.



BY COURTESY OF OHIO STATE ARCHAEOLOGICAL AND HISTORICAL SOCIETY

FLYING EAGLE, 12½ IN. LONG, MODELLED IN COPPER, FROM THE MOUND CITY GROUP OF OHIO

One of the most interesting problems associated with this manifestation is its origin and distribution. On the basis of pottery decoration, platform pipes, simple earth embankments, mound burial, and a few other traits, a somewhat related group inhabited east central Louisiana. Other elements of comparison to the southern Ohio centre have been found in northern Indiana, central Illinois, eastern Iowa, western Wisconsin, and as far west as Kansas City, Missouri.

Adena Phase.—Another prehistoric manifestation which recent excavations in Kentucky have shown to be somewhat related to the foregoing Hopewellian people has been called the Adena phase. The important burial traits consist of groups of two or more conical shaped burial mounds containing the remains of several individuals placed therein at different periods of time. However, they customarily consist of a central subfloor pit surrounded by wooden timbers. Numerous objects of copper, such as bracelets and finger rings, were worn at the time of burial. Pipes were usually made in the form of a simple tube. In one instance this tube was incorporated within a carved

full length human figure. Except for copper, very few objects were made from material foreign to the Ohio valley. Some of the incised designs on pottery from the Adena sites in Kentucky are comparable to those from Hopewellian sites in Louisiana. The use of tobacco, as evidenced from their pipes, the building of large mounds associated with specialized mortuary custom, together with other traits would imply a rather well organized society of a sedentary nature. To what extent the Adena phase may be related to the Hopewellian phase is undetermined; nevertheless their traits are more comparable to each other than to any of the later prehistoric groups. Here again it is impossible to give a specific period of time for the Adena culture. It is assumed, since no evidence of European trade objects has been recovered in their sites, that they lived along the drainage of the Ohio river before the 18th century and may have been contemporaneous with the Hopewellians.

BY COURTESY OF OHIO STATE ARCHAEOLOGICAL AND HISTORICAL SOCIETY

TUBULAR EFFIGY PIPE FROM AN ADENA MOUND IN OHIO

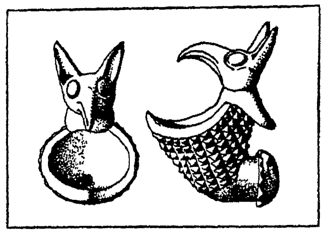
Mississippi Phases.—Herein are grouped a number of somewhat divergent and yet closely related archaeological manifestations. Their relationship to the preceding cultures is somewhat apparent in the southern portions of the Mississippi valley and quite dissimilar in the regions north of the Ohio and Arkansas rivers. At the present time the better known complexes are termed the Middle Mississippi and Upper Mississippi phases. As a whole these cultures are relatively recent, in most cases prehistoric yet later than the Hopewellian and Adena phases. Neither the Middle nor the Upper Mississippi phases existed much before A.D. 1400. The Middle Mississippi group centred between the mouth of the Arkansas northward to the Missouri and Ohio rivers. An eastward extension ranged along northern Mississippi, Alabama, into Georgia and Florida. The Ozark mountains seemed to confine its westward expansion; nevertheless important sites such as the famous Cahokia mounds in East St. Louis, Illinois, and the Angel and Kincaid sites in southern Illinois and Indiana were built by these people. The most important generalized traits consist of the use of earth mounds as foundation platforms on which their temples, chief's house and other ceremonial structures were built. These rectangular truncated pyramids reveal a series of superimposed floors and evidence of structures showing a distinct tendency of rebuilding at the same site.

FROM "PAPERS" OF THE PEABODY MUSEUM

CAHOKIA MOUND, IN ILLINOIS, LOOKING WEST; THE LARGEST PREHISTORIC EARTH-WORK IN AMERICA

These mounds, seldom used for mortuary purposes, are grouped around a plaza. The houses built on their summits were also rectangular in shape, consisting of a single room with walls of bent pole framework covered with cane-thatch or clay. The deceased were usually buried in cemeteries or around the village sites. They made large chipped stone implements for agricultural purposes as well as highly polished celts such as the monolithic ax. Circular discoidal stones were beautifully shaped and polished and used in one of their games. They also carved a few stone vessels and some human statues. Many objects used for fishing, preparation of skin and woven garments, and other utilitarian purposes were made of shell, bone and horn. The large conch shells were cut and carved to form ornaments suspended from the neck. Some of the designs carved on these shells are reminiscent of art forms from prehistoric sites in Mexico.

The pottery made by these people excels that of all other horizons both in the wide variety of forms and in painted decorations on their vessels. Pottery was also used for making pipes, figurines, rattles, ear ornaments, beads and disks. Their vessels consisted of plain type used for utility purposes and the polished ware, some engraved, others painted to produce a red ware, red and white, red, white, and black, and a lost colour technique. A heavy textile impressed pottery was used for the evaporation of liquids, sometimes called salt pans. Wherever stratigraphy has been established the Middle Mississippi overlies the other prehistoric cultures and just prior to those of an early European contact period such as the historic Choctaw, Caddo, Tunica and Natchez Indians This would establish a period ranging from about the 14th to 18th century A.D.



BY COURTESY OF MUSEUM OF THE AMERICAN INDIAN

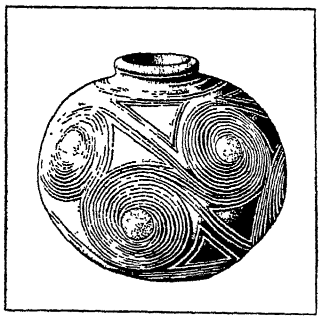
EARTHENWARE EFFIGY PIPE FROM THE NACOOCHEE MOUND, IN GEORGIA

The Upper Mississippi phase as in contrast to the Middle Mississippi phase extends north of the junctions of the Ohio and Missouri rivers with the Mississippi. The greatest concentrations have been found in the southern half of Ohio, southeastern Indiana, northeastern Ohio and western New York, eastern Iowa, Minnesota and central Wisconsin. Extensive village sites as well as mortuary mounds have produced the cultural traits for these late prehistoric people. In the Madisonville site in southern Ohio a few glass beads and iron axes were recovered, indicating a distant contact with early European explorers.

The thousands of small mounds as well as their village sites were used for the disposal of the dead. In contrast to the highly developed mortuary customs of the Hopewellians, among these Upper Mississippi people the deceased were buried in the flesh in the most convenient type of grave, soon after death, and forgotten. Some bodies were tightly flexed and placed in abandoned storage pits, while others were placed extended in rectangular graves. Subsequently storage pits were dug through these graves.

The material culture was largely of a utilitarian nature; very few examples of outstanding artistic merit have been recovered. Their stone objects consisted of small triangular flint projectile points, triangular knives, stone mortars and bell-shaped pestles, chipped and polished celts, and grooved club stones and hammers. Bone was used for every conceivable purpose—fishhooks, harpoons, needles, pins, awls, chisels, scrapers, tools for flaking arrowheads, animal shoulder blades were used for hoes, while other bones were made into whistles, flutes, beamers for preparing skin garments, etc. Shells from the native mussels were adapted for hoes, scrapers, neck ornaments and beads. The fired pottery vessels are quite distinct from the Middle Mississippi and preceding cultural groups. The clay was mixed with both powdered shells and fine grained sand to prevent cracking. Most of the vessels are jars with four or more strap handles. The decoration is primarily incised curvilinear or rectilinear patterns around the upper half of the vessel. The hundreds of cache pits which dotted their village sites were used for the storing of cultivated maize and beans. Here is found evidence of a domesticated dog, often buried with his master.

The above evidence indicates a rather large concentrated population widespread throughout this northern Mississippi watershed. Most of their artifacts were made from local materials. Their villages are located in most of the valleys previously occupied by the Hopewellians, and herein we find some evidence of definite superimposition or burials made in the tops of the large Hopewell mounds.



FROM BUREAU OF AMERICAN ETHNOLOGY "REPORT"

VASE WITH INCISED DESIGN FROM THE LOWER MISSISSIPPI VALLEY

Because a few objects made from European material were recovered from an important village of this group, various attempts have been made to identify the occupants or their descendants with some of the historic Indians visited or described by the first European explorers coming into the Ohio river region. Some believe the location of Mosopelia, as given on maps representing the area in the latter half of the 17th century, to correspond with the site at Madisonville, Ohio. If this hypothesis is correct it would identify the Upper Mississippi people as ancestors of the widely dispersed Siouan groups of historic times. Others imply from the archaeological evidence that the Upper Mississippi phase may represent the ancestors of the Algonquian linguistic stock.

Many of the archaeological manifestations to the west and north, especially those in the Great Plains, which will be described in the next section, seem to have had their original cultural stimulus emanating from the Mississippi river valley.

No attempt has been made to describe all of the cultural variations within the Mississippi valley. The following manifestations will summarize the various archaeological horizons: (1) Prepottery horizons, represented by the builders of extensive shell mounds along the Tennessee river in northern Alabama, Green river, Kentucky and along the falls of the Ohio river in southern Indiana. Along the middle Tennessee river drainage basin these shell mound cultures underlie all other archaeological manifestations. (2) The cave cultures in southern Ohio, Illinois and Kentucky as well as comparable remains in the Ozark mountains area of Arkansas. (3) Hopewellian, Copena and Adena phases. (4) Mississippi phase. (5) Historic period.

GREAT PLAINS

This area encompasses the states east of the Rocky mountains from the Canadian border to the mouth of the Arkansas river. The areas most densely inhabited by prehistoric Indians are those within the region drained by the Missouri and Arkansas rivers and their tributaries. Here as in the Mississippi valley the rivers and streams served as highways and their arable stream valleys provided the soil for the Indians' agricultural pursuits. The chief attraction to aboriginal man, however, were the vast herds of buffalo and other animals.

The variable climatic conditions ranging from the Missouri river to the high plains east of the Rocky mountains had a definite influence on the economy and cultural manifestations of the various archaeological groups. In historic times the Great Plains were inhabited by some 30 historic Indian tribes, such as the great buffalo hunting groups known as the Dakota, Arapaho, Cheyenne, Kiowa, Apache and Comanche. They are characterized by their complete dependence upon the buffalo, and by the skin tepee, dog and later the horse, specialized talent in working skins, numerous men's societies, the Sun Dance and scalp dances. As a result of the adoption of the horse they developed a nomadic food-gathering economy. Farther east, along the Missouri river, were the more sedentary Indian tribes belonging to the Caddoan and Siouan linguistic groups. They lived in grass, bark and earth houses, had pottery and raised maize, which gave them a more stable economy. Because of their large villages inhabited over long periods, more evidence is available for historical reconstructions.

Since the tribes inhabiting the Great Plains were in contact with whites for a considerable period of time during America's westward expansion, many opportunities are offered to complete the record between the last portion of the prehistoric era and the beginning of the historic period. It has not been possible, however, to link the antecedents of all the tribes inhabiting the area either as buffalo hunters or the food-producing sedentary groups. In the case of the Pawnee, excavations of historically documented sites have provided the material culture which has served as distinct indicators for the protohistoric sites, as well as the general antecedents of the Pawnee tribes. Similar studies have been advanced for the Omaha, Mandan and Cheyenne groups.

Within this area have been found sites producing the association of man made objects with now extinct forms of mammals. This has been described in the section on Folsom Man. The next dramatic act of prehistoric man shifts to the east of the high plains along the fertile river valleys, where man could develop a more sedentary form of life by growing maize and beans as well as hunting the bison. How many centuries elapsed between the nomadic Folsom hunters and the raising of domestic food plants is unknown. From the evidence recovered in the Southwest, and allowing ample time for the spread and adaptation of maize and bean cultivation, one may assume that this took place some time after A.D. 500.

The principal semi-sedentary prehistoric horizons within the Great Plains are distantly related to those manifestations east of the Mississippi river. The same temporal position of sequence of cultures occurs in the Great Plains as in the Mississippi valley. A so-called Woodland manifestation underlies all other prehistoric horizons. These sites are small, giving the impression of people from the upper Mississippi river and Great Lakes region pushing into what was to them an unknown land. The sites occur along old stream beds sometimes covered to a depth of 25 ft. The post hole patterns from their houses indicate a thatch type of structure comparable to eastern rather than western forms. Traces of squash and gourds have been found, but no direct evidence of maize cultivation. The stone work consists of roughly made knives and picks. Needles and bone awls were common. Their pottery comprised small to medium sized thin-walled jars with scalloped or incised decorations around the rims. Ceramic forms differ considerably in various sections. Lack of burials prevents a comparison of the physical types.

Some of the sites around Kansas City, Missouri, and extending as far west as Peru, Nebraska, have contained assemblages of cultural material comparable to some of the Hopewellian sites in eastern Iowa and western Wisconsin and Illinois. Although these do not contain all the elements described in the previous section on the Hopewellian phase, they nevertheless indicate a western dispersal of some of the characteristic elements.

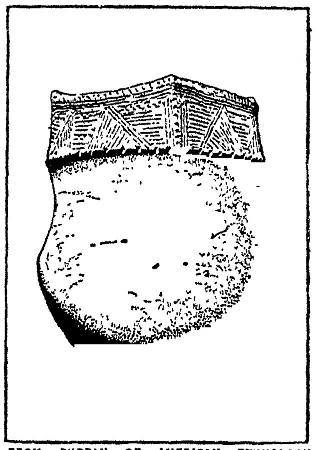
Following the Woodland and Hopewellian horizons, in point of time, are people of a more firmly established occupancy. Because of their wide distribution and prolonged tenure, several distinct variations developed. All of these widely dispersed groups had the following traits in common: A food-producing economy based on maize, beans and squash as the staple crops; a semi-permanent earth lodge subrectangular in shape; several such houses constituted a village, surrounded by their cultivated fields with no apparent attempt at concealment or fortification. This has led to the assumption that considerable freedom was enjoyed by these agriculturists of the Great Plains; the ceramic ware produced at this period differs in form and decoration from the Woodland peoples; the large assortment of implements made from bone, stone, shell and horn provides additional traits of similarity among themselves.

The following cultural divisions have been determined which formed the basic elements out of which the protohistoric and finally the well known historic groups of Indians developed: Upper Republican phase, ancestors of the Pawnee, Arikara and Mandan tribes; Nebraska and Plains-Mississippi phase, largely responsible for the sedentary Siouan groups; Mill Creek phase in the northern Great Plains, out of which developed the Assiniboine, Eastern Dakota, Chippewa and Cheyenne Indians.

The coming of European explorers ended one of the highest cultural attainments of the Great Plains village groups. It also ushered in a period of widespread unrest culminating in the rise and menace of nomadic groups. The adoption of the horse and firearms simplified their dependence on the vast bison herds to such an extent that the region became peopled largely by the roving bands of hunters, forcing the village tribes into small isolated groups along the eastern fringes of the Great Plains.

THE NORTH ATLANTIC AREA

This culture area, sometimes divided into two at the Delaware valley and sometimes into still lesser areas, may be regarded as extending from Newfoundland and the St. Lawrence valley in the north to Georgia in the south, and as including the maritime provinces of Canada, New England, New York, Pennsylvania, Maryland and large portions of Virginia, West Virginia, the Carolinas, the northern part of the territory extending inland indefinitely to the north and west, and its southern part extending westward to the Appalachian mountains. The tribes were chiefly those of the Algonkin, Iroquoian and Siouan stocks of historic times, and save for certain shiftings of boundaries and the extinction especially of most of the Algonkin and Siouan members, the archaeological and known linguistic areas may be regarded as practically coextensive. The forests and highlands afforded excellent hunting; the many rivers and bays, and the sea itself, offered an abundance of fish and shellfish, and while agriculture was practised, it was subordinate to fishing and the chase. Shellfish (oysters, clams, mussels, scallops, whelks, cockles) formed an important part of the diet, as shown by the almost numberless shell refuse heaps along the coast and the tidewater bays, rivers and inlets. One heap at Pope's creek on the Potomac in Maryland, consisting of oyster shells, covered about 30 acres.



FROM BUREAU OF AMERICAN ETHNOLOGY "REPORT"

AN IROQUOIS VASE, 13 IN. IN HEIGHT, FOUND IN A GRAVE IN NORTHERN PENNSYLVANIA

The dwellings of the ancient Indians of the North Atlantic area probably varied in no respect from those of early historic times. Stone as a building material was almost unknown, construction being of wattlework, bark and mats, and the Iroquois villages were often protected with stockades. Cache pits for storage were used in the central part of the area, centring in New Jersey. Some of the houses, as those of the Iroquois, the Mohican, and of Virginia and North Carolina tribes, were of the community type, those of the Iroquois (the well known "long-houses") being 50 to 100 ft. long and 16 to 18 ft. wide.

Burial customs varied more or less with locality, but interment was the usual practice; sometimes the corpse, fully clothed, was placed in the grave in a sitting posture. The custom of the Algonkin and Iroquois tribes from the St. Lawrence to the Delaware was to wrap the corpse and to bind the legs against the trunk, and sometimes, except among the early Algonkins who rarely practised the custom, the implements, utensils and ornaments of the departed were buried with his remains. Interment of dogs, sometimes with the human dead, was common. In the Iroquois area especially the bones of the dead were periodically gathered from their graves and deposited in ossuaries lined with furs and covered with brush and earth, but this was not an Algonkin custom. Among the Powhatan tribes of Virginia two methods of disposal were practised in prehistoric times as well as at the beginning of the Colonial period—the bodies of important men were wrapped and placed on platforms in the "temples," and probably afterward gathered and buried while those of ordinary people were at once inhumed.

In the lower Penobscot valley, in Maine, it was an ancient custom to place quantities of red hematite paint in the graves and to deposit with the dead certain exceptional stone objects only—long slender celts, gouge-adzes, and slate points of bayonet shape, resembling those of the Eskimo. In the abundant shell-heaps of the region such slate points are unknown, and the other implements are either scarce or entirely lacking, whereas bone and shell objects so common to the shell-heaps are not found in the graves. These conditions have given rise to the designation "Red-paint people" to distinguish the earlier from the later inhabitants, not alone because the graves of the ancients contain the hematite deposits, for a similar custom was practised elsewhere in New England as late as Colonial times. There are certain indications that point to relationship with the extinct Beothuk of Newfoundland, as well as with the Algonkin culture of New York

The ceramic art of the North Atlantic area was somewhat rudimentary in comparison with that of other cultures, yet the cooking utensils and the trumpet-like smoking pipes of the Iroquois display considerable taste, and the pipes especially were often elaborately decorated with modelled life forms of miniature jars. The typical Virginian pipe with long stem and upturned bowl, taken to England by early colonists along with the first tobacco, gave form to the clay pipe of the colonial times. The chief distinguishing features of the ancient earthenware vessels of the Iroquois of New York and Pennsylvania are a conical base, constricted neck, and flaring squarish collar usually embellished with an incised rectilinear pattern and sometimes with modelled heads and figures in relief. In the marginal regions—New York bay, Long Island, the lower Hudson valley, Connecticut and Rhode Island—the Algonkin pottery, otherwise usually plain in form and simply decorated by incising or with fabric or cord-marked impressions, often shows Iroquois influence.

Stone objects consisted of the pecked and polished celt-hatchet, grooved axe, chisel, pick, gouge-adze, mortar, long cylindrical pestle, knife and spearhead of slate, and hammer-stone; of these the gouge-adze is of exceptional excellence. Chipped stone implements of all the ordinary types (knives, projectile points, drills, etc.) were plentiful; objects of the same material used as ornaments or in ceremony were bannerstones, bird-shaped stones, "plummets," tubes, pierced gorgets, etc. Not all of these objects are found throughout the area, their distribution depending on the varying sub-cultures of the former tribes and their chronological sequence. Human effigies of stone are rare. Soapstone (steatite) abounds, and owing to its suitability and the ease with which it may be fashioned, it was extensively quarried with stone pickaxes and chisels for manufacturing cooking-pots, smoking pipes and ornaments. Objects of bone, especially in the Iroquois area, are rich in form and variety. Mica was mined in Virginia and North Carolina for use especially in making ornaments and mirrors, and it became an important medium of trade over a wide area, great quantities having been recovered from Ohio mounds. Argillite, jasper and rhyolite were quarried in New Jersey, Pennsylvania and New York, and quartz and quartzite boulder deposits in the District of Columbia and elsewhere for chipping into prodigious numbers of implements and weapons, especially arrowpoints and celt-hatchets (tomahawks). Engraved conch-shell gorgets of Virginia and the Carolinas suggest culture intrusion from the west. Water transportation was by dugout and bark canoes. Petroglyphs, or rock-writings, are rather common, the most noted being Dighton Rock in Taunton river, Massachusetts.

Bibliography.—The following list of references has necessarily been selected from the hundreds of publications covering the archaeological areas in North America. After the more generalized publications, which encompass several cultural areas, the publications have been grouped under the headings as used in the text. Most of the publications cited contain additional bibliographies which would provide more detailed accounts of the specific cultural complexes. The more generalized publications are: *Handbook of the American Indians*, Bull. 30, Bur. Amer. Ethnol. (1907–10); Cyrus Thomas, *Report on the Mound Explorations of the Bureau of Ethnology*, 12th Ann. Rep., Bur. Amer. Ethnol. (1894); various authors, *Essays in Historical Anthropology of North America*, Smithsonian Misc. Coll., vol. 100 (1940); various authors, *The Maya and Their Neighbors* (1940); Clark Wissler, *The American Indian*, 3rd ed. (1938); A. L. Kroeber, *Cultural and Natural Areas of Native North America* (1939).

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NORTHAMPTON, EARLS AND MARQUESSES OF. The Northampton title has been held in various English families. About 1080 Simon de Senlis (d. 1109), a Norman noble, and the builder of Northampton castle, was created earl of Northampton as well as earl of Huntingdon by William the Conqueror; his son Simon (d. 1153) was also recognized in the title about 1141, though his stepfather, David, king of Scotland (1084–1153), had meanwhile obtained the earldom in right of his wife. The second Simon died childless. In 1337 William de Bohun (*c.* 1310–60), a son of Humphrey de Bohun, 4th earl of Hereford and 3rd earl of Essex, was created earl of Northampton; and his son Humphrey, who succeeded, fell heir in 1361 to the earldoms of Hereford and Essex, which thus became united under that of Hereford. The titles, however, became extinct at his death in 1372.

In 1547 William Parr (1513–71), son of Sir Thomas Parr and brother of Catherine Parr, queen of Henry VIII., was created marquess of Northampton, and though attainted in 1553 was re-created marquess in 1559. He favoured the claim of Lady Jane Grey to the English throne. Although sentenced to death he was pardoned and released from prison at the end of 1553. North-

ampton died at Warwick on Oct. 28, 1571. He left no children and his marquessate became extinct. In 1604 Henry Howard (*see* below) was created earl of Northampton, his title dying with him. It next passed into the Compton family, where it has since remained. The 1st earl of Northampton in this line, William Compton (d. 1630), who received the title in 1618, was a great-grandson of the Sir William Compton (1482–1528) who was with Henry VIII. at the Field of the Cloth of Gold, and his son the 2nd earl is noticed below. The 9th earl, Charles Compton (1760–1828), was created a marquess in 1812, receiving at the same time the titles of Earl Compton and Baron Wilmington.

Henry Howard, earl of Northampton (1540–1614), was the second son of Henry Howard, earl of Surrey, the poet, and of Lady Frances Vere, daughter of the 15th earl of Oxford, and younger brother of Thomas Howard, 4th duke of Norfolk. After discovery of his brother's plot to marry Mary, Queen of Scots, and of his own correspondence with her, he was arrested more than once on suspicion of harbouring treasonable designs. In 1583 he published a work entitled *A Defensative against the Poyson of supposed Prophecies*, an ostensible attack upon astrology, which, being declared to contain heresies and treason, led to his imprisonment for a short time. After the accession of James I. he received many honours, and became Lord Privy Seal (1604) and a commissioner of the treasury (1612). He was one of the judges at the trials of Raleigh and Lord Cobham in 1603, of Guy Fawkes in 1605, and of Garnet in 1606, in each case pressing for a conviction. In 1604 he was one of the commissioners who composed the treaty of peace with Spain, and from that date he received from the Spanish Court a pension of £1,000. Northampton died on June 15, 1614. His title died with him. Northampton built Northumberland house in London and superintended the construction of the fine house of Audley End. He founded and planned several hospitals. Bacon included three of his sayings in his "Apophthegms," and chose him as "the learnedest councillor" in the kingdom to present to the king his *Advancement of Learning.*

Northampton's works are: a *Treatise of Natural and Moral Philosophy* (1569; ms. in the Bodleian library); a pamphlet supporting the union between Elizabeth and the duke of Anjou (1580; Harleian mss. 180); *A Defensative against the Poyson of supposed Prophecies* (1583); a reply to a pamphlet denouncing female government (1589; Harleian ms. 7021); *Duello Foiled*, printed in T. Hearne's *Collection of Curious Discourses* (1775), and ascribed there to Sir Edward Coke; *Translation of Charles V.'s Last Advice to Philip II.*, dedicated with a long epistle to the queen (Harl. 836, 1506 and elsewhere in Stowe 95, King's mss. 106); devotional writings (Arundel mss. 300); speeches at the trials of Guy Fawkes and Garnet in *State Trials*, vol. i. In Somers Tracts (ed. 1809), ii. 136, his opinions on the union between England and Scotland are recorded.

See the life in *Surrey's and Wyatt's Poems*, ed. by G. F. Nott (1815), and Sidney Lee's article in the *Dict. Nat. Biog.*

Spencer Compton, 2nd earl of Northampton in the Compton line (1601–43), was the son of William, 1st earl, lord president of the marches. On the outbreak of the Civil War he was entrusted with the execution of the commission of array in Warwickshire. After varying success and failure in the Midlands he fought at Edgehill, and after the king's return to Oxford was given, in November 1642, the military supervision of Banbury and the neighbouring country. He was attacked in Banbury by the parliamentary forces on Dec. 22, but relieved by Prince Rupert the next day. In March 1643 he marched from Banbury to relieve Lichfield, and having failed there proceeded to Stafford, which he occupied. Thence on March 19, accompanied by three of his sons, he marched out with his troops and engaged Sir John Gell and Sir William Brereton at Hopton Heath. In the moment of victory he was surrounded by the enemy, and, refusing quarter, was slain.

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NORTHAMPTON, county town of Northamptonshire, England, 66 mi. N.W. by N. from London by the London Midland Region railway. Pop. (1951) 104,429. Area 9.7 sq.mi.

British and Roman remains have been discovered near Northampton and it became the chief settlement of the Angle tribes early in the 6th century. It was occupied by the Danes in the reign of Edward the Elder. It is mentioned as a borough in Domesday. Henry II granted the incorporation charter in 1189. Tanning was an industry in the time of Edward I and in 1675 a law was made forbidding strangers to purchase hides in the town except on fair days. Boots and shoes were made here in the reigns of John and Edward I, and by the 17th century Northampton was one of the most noted places in England for their manufacture.

Northampton was the meeting place of several important councils and parliaments. In the wars between John and his barons the castle withstood a siege by the latter, but in 1264 it was occupied by the barons under the earl of Leicester. In the Wars of the Roses it was the scene of the battle in which Henry VI was defeated and taken prisoner in 1460. During the Civil Wars of the 17th century it was held for the parliament by Lord Brooke. In 1675, 600 houses were destroyed by fire.

The town is situated on the river Nene. The main roads converging upon the town meet near the centre in a market place. An important building scheme was the civic centre, which includes a fire station (1935), public baths (1936) and police buildings (1941). All Saints church was rebuilt after the fire of 1675, but retains its Decorated embattled tower. The church of St. Giles, a cruciform structure in the 12th century, has been greatly changed, and besides a Norman doorway contains Early English, Decorated and Perpendicular work. St. Peter's is supposed to be of the same date and its interior is Norman. St. Sepulchre's, one of the four round churches remaining in England, may have been built by the Knights Templars at the close of the 11th century.

Northampton is the seat of a Roman Catholic bishop, the cathedral being in Early Decorated style. Near the town there were a Cluniac priory of St. Andrew, a house (Delapré) for nuns of the same order, and one for Augustinian canons, but only of the last are there any remains. Some portions of the castle were re-erected on a new site after their destruction when the Castle station was built by the L.M.S. company. In Hardingstone, south of the town, is one of the original Eleanor crosses. The town and county school was founded in 1541. The charitable foundations include St. John's hospital (12th century). There is a race course north of the town. The staple trade is the manufacture of boots and shoes. There are also iron foundries, maltings, breweries and flour mills. The cattle market is extensive. The county borough returns one member to parliament.

NORTHAMPTON, a city of Massachusetts, U.S.A., the county seat of Hampshire county; on the Connecticut river and federal highways 5 and 10; 16 mi. N. of Springfield. It is served by the Boston and Maine and the New York, New Haven and Hartford railways, also by eight bus lines. Pop. (1950) 28,998; in 1940 it was 24,794. Venerable trees, an irregular plan and the grounds of its many institutions make the city very attractive. It is the home of Smith college (*q.v.*), two preparatory schools for girls, Northampton State hospital, U.S. Veterans' Administration hospital and the Clarke School for the Deaf (1867).

Mt. Holyoke, 954 ft., is 2 mi. S.E. of the city; Mt. Tom, 1,214 ft., is 6 mi. S. of the city. The city's industrial output includes silk stockings, brushes, cutlery, machine tools, ladies' hats and dresses.

Northampton was settled in 1654, became a separate town in 1656 and was incorporated as a city in 1883.

It was the birthplace of Caleb Strong, Joseph Hawley, Cornet Parsons and Timothy Dwight.

Jonathan Edwards was pastor there from 1727 to 1750. It was the home of Calvin Coolidge.

NORTHAMPTON, a borough of Northampton county, Pennsylvania, U.S., on the Lehigh river, 6 mi. N.W. of Allentown; served by the Jersey Central and the Northampton and Bath railroads. Population (1950) 9,359; (1940) 9,622 by the federal census. It is a cement-manufacturing centre, and there are textile mills.

It was settled about 1740 and incorporated in 1901.

NORTHAMPTON, ASSIZE OF, a short code of English laws issued in 1176, drawn up in the form of instructions to six committees of three judges each, who were to visit the six circuits into which England was divided for the purpose. Though purporting to be a reissue of the Assize of Clarendon (1166), it contains in fact many new provisions. As compared with the earlier assize it prescribes greater severity of punishment for criminal offences; arson and forgery were henceforth to be crimes about which the jurors were to enquire, and those who failed at the ordeal were to lose a hand as well as a foot. In what is perhaps the most important section we may probably see the origin of the possessory action of *mort d'ancestor,* an innovation scarcely less striking than the institution of the *novel disseisin* in the winter of 1166. The justices were also ordered to try proprietary actions commenced by the king's writ for the recovery of land held by the service of half a knight's fee or less. In their fiscal capacity they were to enquire into escheats, churches, lands, and women in the king's gift. The royal bailiffs were to answer at the exchequer for rents of assize and all the perquisites which they made in their offices, and apparently the duty of enforcing this provision was entrusted to the justices. As a result of the rebellion of 1173–74 it was provided that an oath of fealty should be taken by all, "to wit, barons, knights, freeholders, and even villeins (*rustici*)," and that any one who refused should be arrested as the king's enemy, and the justices were to see that the castles, the demolition of which had been ordered, were razed.

See Pollock and Maitland, *History of English Law* (1898); Stubbs, *Constitutional History of England* (1895). The text occurs in *Cronica Rogeri de Howden* (Rolls Series), ii. 89, and *Gesta Henrici Regis Secundi* (Rolls Series), i. 108. It has been reprinted from the latter by Stubbs in *Select Charters* (1913). (G. J. T.)

NORTHAMPTONSHIRE, an east midland county of England, bounded north by Lincolnshire, north-west by Rutland and Leicestershire, west by Warwickshire, south-west and south by Oxfordshire, south-east by Buckinghamshire, and east by Bedfordshire, Huntingdonshire and Cambridgeshire. The area of the geographical county is 998 sq.mi.

Geology and Physical Features.—The underlying structure of the county is very simple. It forms part of the Jurassic escarpment, here known as the Northampton uplands. All the rocks are of Jurassic age, the dip being in a general way to the south-east, and the strike from south-west to north-east. The oldest, and most westerly belt consists of Lias formations which cover a large surface in the south-west and centre, around Banbury, Daventry and Market Harborough, and they are also exposed along the rivers near Towcester, Northampton, Wellingborough and Kettering. The marlstones of the Middle Lias were formerly much used for building material; the Upper Lias is worked for bricks at Easton Neston (Towcester), Blisworth, Gayton, Heyford, Northampton, Wellingborough, Rushden, Irthlingborough, Kettering and Corby. Through the middle of the county, north-east to Northampton, Rockingham and Peterborough, is an elevated tract of Oolitic rocks, which formerly supplied stone, of which many of the villages are built, as well as lime and marl. The New Duston quarries have several varieties of good stone, the district around Northampton a limestone known as Pendle, and Weldon (Lincolnshire Oolite) a noted freestone; Barnack Rag (near Stamford) is no longer worked. The great Oolite limestone, though unsuitable for building material, owing to the ease with which it weathers, was largely used in the past, Culworth, Blisworth and Cosgrove quarries being famous. At the base of the Inferior Oolite, Northampton sands yield iron ore, which is worked at Duston, Culworth, Towcester and at numerous localities north-east of Northampton. Certain hard shelly beds in the Oolite rocks have been polished and used as marble.

On the south-east border of the county, a belt of Oxford clay occupies the surface, good exposures occurring in the brick fields about Peterborough. Boulder clay is widely distributed over the uplands and in the east of the county, and glacial and river gravels are also plentiful. The south-west portion of the county forms the principal watershed of the Midlands; the Cherwell, the Avon, the Leam, the Welland, the Nene have their sources in this region, and all form sections of county boundaries. The position of Daventry as a wireless station and a meeting place of roads is also related to this fact of centrality and elevation. The longitudinal river Nene flows in a north-easterly direction along the foot of the uplands, draining them to the Wash.

History and Early Settlement.—In primitive times the waters of the North sea reached almost to the foot of the Northamptonshire uplands. The immigrants of the end of the Stone age seem to have penetrated up from the coast, and Peterborough has yielded important finds of early pottery. Some Beaker pottery occurs, chiefly on the uplands. There are a few material objects of the La Tène I. culture and the La Tène III. culture. During the Iron age, the uplands offered defensible sites, and many hill camps were made, Hunsbury (1½ m. S.W. of Northampton), being one of the most famous. In Roman times, iron, stone and clay were worked, and Towcester was an important station on the Watling street route to the north-west. At some time in the 7th century the district suffered a simultaneous invasion (West Saxons from the south, Anglian tribes from the north), finds show a mingling of races, but West Saxon influence never spread farther north than a line from Daventry to Warwick, and with the extension of the Mercian kingdom under Penda and the conversion of the midland districts, ceased altogether. The abbey at Medehamstede (now Peterborough) was begun by Saxulf, a monk, and Penda's son, Peada, in 655. Foundations were also established at Peakirk, Weedon Beck, Castor and Oundle. In 870 the district was overrun by the Danes, and Northampton was one of the five Danish boroughs, until in 921 it was recovered by Edward the Elder, who fortified Towcester in that year.

In the 11th century Northamptonshire was included in Tostig's northern earldom; but in 1065, together with Huntingdonshire, it was detached from Northumbria and bestowed on Waltheof. The monastic foundation of Peterborough survived the Conquest. Norman castles existed at Rockingham, Barnwell, Lilbourne and Northampton. The shire is probably of Danish origin, representing in the 10th century the area which owed allegiance to Northampton as a political and administrative centre. In 921 this area extended to the Welland, and at the time of the Domesday survey the boundaries were approximately those of the present day. Northamptonshire is first mentioned by name in the *Historia Eliensis,* in connection with events which occurred at the close of the 10th century.

The Geld roll (William I.) and Domesday (1086) mention 28 hundreds in Northamptonshire, and part of Rutland is assessed under this county. By 1316 the divisions were changed, re-named and reduced to 20, and have remained practically unaltered. The names of the hundreds point to primitive meeting-places gradually superseded by villages and towns, and the court for Fawsley hundred met under a large beech tree in Fawsley park until the beginning of the 18th century, when it was transferred to Everdon. The shire-court originally met at Northampton.

Northamptonshire was originally included in the diocese of Lincoln. The archdeaconry of Northampton is mentioned in the 12th century, and in 1291 included the deaneries of Peterborough, Northampton, Brackley, Oundle, Higham, Daventry, Preston, Weldon, Rothwell and Haddon. The diocese of Peterborough was created in 1541, and in 1875 the archdeaconry of Oakham.

At the time of the Domesday survey the chief lay-tenant in Northamptonshire was Robert, earl of Mortain, whose fief escheated to the Crown in 1106. The estates of William Peverel, founder of the abbey of St. James at Northampton, also escheated to the Crown in the 12th century. Holdenby House was built by Sir Christopher Hatton, privy councillor to Queen Elizabeth, and Yardley Hastings was named from the Hastings, formerly earls of Pembroke. Higham Ferrers was the seat of the Ferrers family; Braybrook Castle was built by Robert de Braybrook, a favourite of King John; and Burghley House gave the title of baron to William Cecil. During the middle ages the Nene was a busy artery of trade, and many moated homesteads were built on its banks.

Northampton was a favourite meeting-place of the councils and parliaments of the Norman and Plantagenet kings. In 1215 John was besieged in Northampton castle by the barons, and in 1264

Henry III captured the castle from the younger Simon de Montfort. During the Wars of the Roses Henry VI was defeated at Northampton in 1460. In the Civil War of the 17th century the county declared almost unanimously for the parliament. A royalist garrison was placed at Towcester by Prince Rupert in 1644, but almost immediately withdrawn

In 1547 Brackley and Peterborough returned each two members, and in 1557 Higham Ferrers returned one member. Under the act of 1832 the county returned four members in two divisions, the above boroughs being merged in the county divisions. There are now four divisions with one member each, in addition to a member for the county borough of Northampton

Architecture.—Of monastic foundations, the abbey-church of Peterborough, afterwards the cathedral, is the only remaining one of importance. At Geddington, and also at Hardingstone, near Northampton, there is an Eleanor cross, erected by Edward I. The county is famous for its churches with beautiful broached spires. To the Saxon period belong the tower of Earls Barton church, on what is probably the mound of an old English strong-house; the tower, etc., at Brigstock; the ground plan, etc., at Wittering; the remarkable tower at Barnack; and Brixworth church, by some believed to include part of a Roman basilica. Of Norman work, excluding Peterborough cathedral, the finest examples are St. Peter's and St. Sepulchre's, Northampton, and the tower of Castor church. St. Mary's church, Higham Ferrers, formerly collegiate, Early English and Decorated, is one of the finest churches in the county; the churches at Irthlingborough and Lowick, with their lantern towers, Warmington, fine Early English work, Rushden, Finedon, Raunds and Fotheringhay should be mentioned.

A gateway at Rockingham, and earth-works at Higham Ferrers and Brackley are worthy of mention. Some castellated ruins remain of the castle at Fotheringhay, famous as the scene of the imprisonment, trial and execution of Mary, Queen of Scots. Barnwell castle, founded by William the Conqueror, is still a fine ruin, which includes four of the round towers and an imposing gateway. Holdenby manor house, where Sir Christopher Hatton (1540–1591) was born, and whence Charles I was carried away by Cornet Joyce, is largely restored. Among ancient mansions are Castle Ashby, the seat of the Comptons; Althorp, the seat of the Spencers; Drayton House; Burghley House, Stamford, founded by Lord Burleigh (1553); and Kirby Hall, a beautiful Elizabethan building once the residence of Sir Christopher Hatton.

Climate and Agriculture.—The climate of Northamptonshire is mild, and it is drier than many other inland districts owing to its low elevation (rarely more than 700 ft.). The mean annual rainfall at Wellingborough is 27·2 in. The soil is fertile, 84½% of the surface being under cultivation in 1939. The Lias clay belt gives rise to good grazing, and 303,889 ac., or about 46%, were under permanent pasture. Large numbers of cattle (152,024 in 1939) are fattened, droves from Scotland, Ireland, Wales, Hereford being sent for that purpose. The selling of fat cattle for Christmas markets, sets the population free in winter for hunting, giving rise in the 18th century to the making of whips at Daventry, while the long winter evenings encouraged the use of the tobacco-pipe, made almost exclusively from Northampton clays. Easy access to hides and to bark for tanning in the forests originated an industry in leather, which flourished in Norman times, and, in the middle of the 17th century Northampton began to specialize in the manufacture of boots and shoes, for which it has become famous. The difference in bulk between imported raw hides and exported finished boots and shoes creates an economic problem in connection with this trade. Good wheat can be grown on the boulder clay, and 11½% of the county was under grain in 1939, wheat accounting for 44,304 ac. Beans form an important crop; root-crops are also grown; sugar-beet is a fast developing industry (5,408 ac. in 1939, as against 1,077 ac. in 1926).

Sheep are kept in large numbers on the rich pastures, improved Leicesters for wool and Southdown for mutton. Wool was important in Norman times; in the 17th century the centre of weaving changed from Northampton to Kettering. Charcoal-burning was an early industry in the forests (Rockingham, etc.), mast from the oaks also feeding large numbers of pigs; these are still important. Paper-making, dependent on pure water, was introduced in the 18th century; early in the 19th, silk-weaving spread from Coventry.

Communications.—Two main lines of the L.M. and S. railway cross the county, linking London with the industrial northwest. The first is the Wolverton (Bucks) Blisworth, Rugby (Warwick) line, with an alternative route to Northampton, and branches northeast to Peterborough and north to Market Harborough (Leics.); with it are connected at Blisworth junction, branch lines through Towcester, west to Stratford-on-Avon (Warwick) and southwest to Banbury (Oxon). The second is the Wellingborough, Kettering, Market Harborough line with a branch to Oakham (Rutland). There are other branch lines. A main line of the L. and N.E. railway passing through the south of the county, connects with the G.W. railway at Banbury through Woodford. The Grand Junction canal, which is connected with the Oxford canal, enters the county at Braunston on the borders of Warwickshire, and passes by Daventry and Blisworth into Buckinghamshire, a branch connecting it with Northampton. The Grand Union canal unites with the Grand Junction near Daventry, and runs north until it joins the Leicester canal at Foxton, branches passing to Welford and Market Harborough.

Population and Administration.—The area of the administrative county is 905 sq.mi.; pop. (1951 census) 359,550. The soke of Peterborough, itself an administrative county, has an area of 84 sq.mi. and a population (1951 census) of 63,784, while the county borough of Northampton occupies 9.7 sq.mi. Wartime evacuation from the eastern counties of England and an increase in agriculture and industry caused a rise of 17% in the population of the geographical county between Sept. 1939 and Feb. 1941. In Domesday the county is mentioned as containing 30 hundreds, but it then included a considerable part of Rutland. These divisions were first reduced to 28, and in the reign of Henry II to 20, their present number. The administrative counties include four municipal boroughs, namely, Brackley, Daventry, Higham Ferrers and Kettering, in addition to Peterborough and Northampton. There are one court of quarter sessions and nine petty sessional divisions. The borough of Northampton and the liberty of the soke of Peterborough have each a separate court of quarter sessions and a separate commission of the peace. The total number of civil parishes in 1943 was 295, of which 25 were in the soke of Peterborough. The geographical county, including the soke of Peterborough, is in the diocese of Peterborough. The National Trust owned 31 ac. in Northamptonshire in 1942. For parliamentary purposes the county is divided into four divisions, Daventry, Kettering, Peterborough and Wellingborough. The parliamentary borough of Northampton returns one member.

See *Victoria County History, Northamptonshire;* John Norden, *Speculi Britanniae, pars altera,* or *A Delineation of Northamptonshire* (1720); John Bridges, *History and Antiquities of Northamptonshire,* compiled by Rev. Peter Whalley (2 vols., Oxford, 1791); Francis Whellan, *History, Topography and Directory of Northamptonshire* (2nd ed., London, 1874).

NORTH ANDOVER, a manufacturing town of Essex county, Massachusetts, U.S.A., on the Merrimack river, 2 mi. E. of Lawrence. The population was 8,485 in 1950; in 1940 it was 7,524. The town was settled about 1643, and a house built in 1667 by Simon Bradstreet, one of the founders, is still standing. His wife, Anne Dudley Bradstreet (1612–72), was the first woman in America to make a reputation as a poet. North Andover was set off from Andover and incorporated as a town in 1855.

NORTH BAY, a lumber, mining and railway city on the northeast shore of Lake Nipissing, northern Ontario, Canada, 227 mi. N. of Toronto, on the Canadian Pacific, Canadian National, and Ontario Northland railways and a port of call of the main Trans-Canada Air Lines. It is the base of supply for the mining districts of Cobalt, Gowganda and Porcupine, and is a summer resort. It is within 10 mi. of the home of the Dionne quintuplets. Pop. (1951) 17,899.

NORTH BERWICK, royal and small burgh, East Lothian, Scotland. Pop. (1951) 4,001. It is on the south shore of the entrance to the Firth of Forth, 22½ mi. E.N.E. of Edinburgh by the L.N.E.R., the terminus of a branch line from Drem Junc-

tion. Created a royal burgh by Robert III (d. 1406), it was once a port of some importance, but dwindled to a fishing hamlet. It is probably the most fashionable watering place in Scotland, frequented for bathing and golf. Here are the ruins of an abbey of Cistercian nuns founded by David I, and to the south rises the fine cone of North Berwick Law.

NORTH BRADDOCK, a borough of Allegheny county, Pennsylvania, U.S.A., 10 mi. S.E. of Pittsburgh, on the hills back of Braddock and Rankin. The population was 14,724 in 1950; in 1940 it was 15,679; and in 1930 it was 16,782 by the federal census. The three boroughs form one community and industrial centre, with large steelworks and other important manufactures. North Braddock is chiefly a residential section, but one of the largest steel plants is within its limits.

The first white man's cabin west of the Alleghenies was built there in 1742 by John Frazier.

On the ground now occupied by Braddock and North Braddock was fought (July 9, 1755) the battle in which Gen. Edward Braddock was defeated.

NORTHBRIDGE, a town of Worcester county, Massachusetts, U.S.A., on the Blackstone river, 13 mi. S.E. of Worcester; served by the New York, New Haven and Hartford railroad. Pop. (1950) 10,328; by the 1940 census it was 10,242. It is a manufacturing town, making principally textile machinery, textiles and paper.

Part of Uxbridge was established as the district of Northbridge in 1772, and in 1775 the district was made a town.

NORTHBROOK, THOMAS GEORGE BARING, 1ST EARL OF (1826–1904), English statesman, eldest son of the first baron (long known as Sir Francis Baring; *see* BARING), was born on Jan. 22, 1826, and educated at Christ Church, Oxford, where he graduated with honours in 1846. He was successively private secretary to Mr. Labouchere (Lord Taunton), Sir George Grey and Sir Charles Wood (Viscount Halifax). He was member of parliament for Penryn and Falmouth (1857–66). He was a lord of the admiralty in 1857–8; undersecretary for war, 1861; for India, 1861–4; for the home department, 1864–6; and secretary to the admiralty, 1866. In the Gladstone ministry of 1868 Northbrook was undersecretary for war (1868–72). He was then governor general of India, but resigned in 1876, because his policy of coming to an arrangement with Shere Ali, which might have prevented the Afghan War, was overruled by the duke of Argyll, then secretary of state. From 1880 to 1885 Northbrook, who had received an earldom, was first lord of the admiralty in Mr. Gladstone's second government. In Sept. 1884 Northbrook was sent to Egypt as special commissioner to enquire into its finances. He died on Nov. 15, 1904.

See B. Mallet, *Thomas George, Earl of Northbrook* (1908).

NORTH CAPE, a promontory on the island Magerö off the north coast of Norway in 71° 10′ 20″ N., 25° 45′ E., 78 mi. northeast of Hammerfest. Knivskjaerodden, an island a little to the west, is actually a little farther north than the North Cape, and Nordkyn, 45 mi. farther east, is the northern extremity of the mainland (71° 7′ N.). The desolate cape, rising abruptly over 1,000 ft. from the sea, is frequently visited during the summer period of the "midnight sun."

NORTH CAROLINA, popularly known as the "Tar Heel state," is one of the Atlantic coast states of the United States of America, situated between approximately 33° 52′ and 36° 34′ N., and between 75° 27′ and 84° 20′ W. It is bounded north by Virginia, east and southeast by the Atlantic ocean, south and southwest by South Carolina, south also by Georgia, and west and northwest by Tennessee. North Carolina has an extreme length from east to west of 503¼ mi., which is greater than that of any other state east of the Mississippi river. Its total area is 52,712 sq.mi., of which 3,615 sq.mi. are water surface.

Physical Features.—The state lies wholly within the three leading topographical regions of the eastern portion of the United States: the Coastal Plain region, which occupies approximately the eastern half, the Piedmont Plateau region, which occupies about 20,000 sq.mi. in the middle, and the Appalachian region, which occupies about 6,000 sq.mi. in the west. At the eastern extremity of the Coastal Plain region an outer coast line is formed by a chain of long narrow barrier beaches from which project capes Hatteras, Lookout and Fear, whose outlying shoals are known for their dangers to navigation. Between Hatteras and Lookout is Raleigh bay and between Lookout and Fear is Onslow bay; and between the chain of islands and the deeply indented mainland Currituck, Albemarle, Pamlico and other sounds form an extensive area, especially to the northward, of shallow, brackish and almost tideless water. Projecting into these sounds and between the estuaries of rivers flowing into them are extensive tracts of swamp land—the best known of these is Dismal Swamp, which lies mostly in Virginia and is about 30 mi. long and 10 mi. wide. Through most of the Coastal Plain region, which extends inland an average of 150 mi., the country continues very level or only slightly undulating, and rises to the westward at the rate of little more than one foot to the mile. The "Fall Line," the boundary between the Coastal Plain and the Piedmont Plateau, has a very irregular course across North Carolina, but lies in a general southwest direction from the Falls of Roanoke between Halifax and Northampton counties to Anson county on the South Carolina border and marks a rapid increase in elevation of about 200 feet. The Piedmont Plateau region extends from this line to the Blue Ridge Escarpment, toward which its mean elevation increases at the rate of about 3½ ft. to the mile. The southeast face of the Blue Ridge Escarpment, which rises precipitously 1,200–1,500 ft. or more above the Piedmont Plateau, forms the southeast border of North Carolina's Appalachian mountain region, which includes the high Unaka mountain range, segments of which are known by such local names as Iron mountains, Bald mountains and Great Smoky mountains. These ranges reach their culmination in this state, and with a series of more or less interrupted cross ranges constitute the greatest masses of mountains in the east half of the United States. Four peaks along the Blue Ridge have an elevation exceeding 5,000 ft., and 43 peaks in the Unakas and in the several cross ranges exceed 6,000 ft., the highest being Mt. Mitchell or Mitchell Dome (6,684 ft.), of the Black mountains, a short cross range extending north from the Blue Ridge through Yancey county. Another noteworthy peak is Hairy Bear (6,681 ft.), the next highest mountain. The valleys are usually narrow and deep, though few descend to less than 2,000 ft. above the sea.

From the Black mountains, the streams flow as from a ridge pole, some to the Atlantic, others to the Mississippi and finally to the Gulf of Mexico. West of Blue Ridge the Hiwassee, the Little Tennessee and the French Broad rivers flow west or northwest into Tennessee. Farther north are the headwaters of the New river, which finds its way to the Ohio. On the southeast slope of the Blue Ridge rise the Broad, the Catawba and the Yadkin, which first flow northeast, then finding a passage across one of the ridges of the Piedmont Plateau, turn to the south-southeast and across the boundary line into South Carolina, in which state their waters reach the Atlantic. In the northwest part of the Piedmont Plateau region rises the Dan, which in its northeast course crosses the boundary into Virginia, where it becomes a tributary of the Roanoke, in which its waters are returned to North Carolina near the "Fall Line." The other principal rivers—the Cape Fear, the Neuse and the Tar—rise in the northeast part of the Piedmont Plateau region, have their southeast courses wholly within the state, and, with the Roanoke, drain the Coastal Plain region. In the Mountain region and in the Piedmont Plateau region the rivers have numerous falls and rapids which afford a total hydroelectric capacity exceeded only by that in the states of California, New York and Washington, the largest being on the Yadkin, Roanoke and Catawba; and in crossing some of the mountains, especially the Unakas, the streams have carved deep narrow gorges that are much admired for their scenery. In contrast with the rivers of these regions those of the Coastal Plain are sluggish, and toward their mouths expand into wide estuaries.

Climate and Soil.—North Carolina has a climate which varies from that of the southeast corner, which approaches the subtropical, to that of the Mountain region, which is like the medium

continental type, except that the summers are cooler and the rainfall is greater. The mean annual temperature for the state (below an elevation of 4,000 ft.) is about 59° F. For the coastal plain region it is 62° F.; for the Piedmont plateau region, 60° F.; for the mountain region, 55° F.; for Southport, in the southeast corner of the state, 64° F.; and for Highlands, at an elevation of 3,817 ft. in the southwest corner, 50° F. Extremes have ranged from −19° F. at Highlands to 107° F. at Chapel Hill, Orange county. The average precipitation for the state is about 50 in. a year, nearly all of it in the form of rain. For the coastal plain region it is 48 in.; for the Piedmont plateau region 47 in.; and for the mountain region 54 in. On the east slope of some of the mountains the rainfall is exceedingly heavy. The winds are variable and seldom violent, except along the coast during the subtropical storms of late summer and early autumn.

On the coastal plain the soil is generally sandy, but in nearly all parts of this region more or less marl abounds; south of the Neuse river the soil is mostly a loose sand, north of it there is more loam on the uplands, and in the lowlands the soil is usually compact with clay, silt or peat; toward the western border of the region the sand becomes coarser and some gravel is mixed with it. The entire Piedmont region is underlain by crystalline rocks, such as granite and schists. The soils are, for the most part, red sandy loams and clay loams, gravelly and sandy in spots.

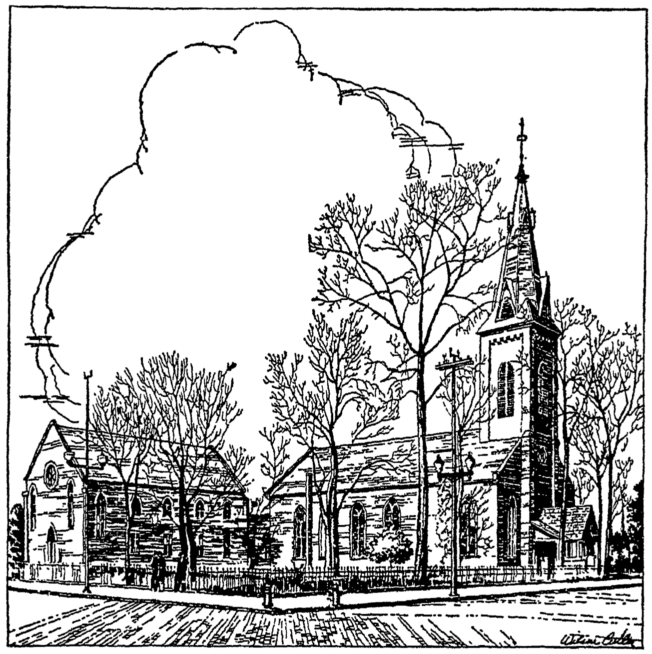
History.—The history of North Carolina may be divided into four main periods: the period of discovery and early colonization (1524–1663); the period of proprietary rule (1663–1729); the period of royal rule (1729–76); and the period of statehood (from 1776).

It is known that some of the early French and Spanish explorers visited the coast of North Carolina, but no serious attempt was made by Europeans to establish a settlement until near the close of the 16th century. After receiving from Queen Elizabeth a patent for colonization in the new world, Sir Walter Raleigh, in April 1584, sent Philip Amadas, or Amidas (1550–1618), and Arthur Barlowe (*c.* 1550–*c.* 1620) to discover a suitable site for a colony in the region bordering on Florida. They returned in September with a glowing account of what is now the coast of North Carolina, and on April 9, 1585, a colony of about 108 men under Ralph Lane (*c.* 1530–1603) sailed from Plymouth in a fleet of seven small vessels commanded by Sir Richard Grenville. The colony was established at the north end of Roanoke Island on Aug. 17 and about a week later Grenville returned to England. Threatened with famine and with destruction from hostile Indians, the entire colony left for England June 19, 1586, on Sir Francis Drake's fleet. Only a few days after their departure Sir Richard Grenville arrived with supplies and more colonists, 15 of whom remained when he sailed away. Although greatly disappointed at the return of the first colony, Raleigh dispatched another company, consisting of 121 persons under John White, with instructions to remove the plantation to the shore of Chesapeake bay. They arrived at Roanoke Island July 22, 1587, and were forced to remain there by the refusal of the sailors to carry them farther. Of the 15 persons left by Grenville not one was found alive. White's granddaughter, Virginia Dare (b. Aug. 18, 1587), was the first English child born in America.

White soon returned to England for supplies, and having been detained there until 1590 he found upon his return no trace of the colony except the word "Croatoan" carved on a tree; hence the colony was thought to have gone to friendly Indians of that name.

In 1663 Charles II granted the territory between the 31st and 36th parallel and extending from sea to sea, to the earl of Clarendon (1609–74), the duke of Albemarle (1608–70), and six other favourites. By a second charter issued in 1665 the limits were extended to 29° and 36° 30′. The first permanent English settlement in Carolina was on the Chowan river about 1653 by people from Virginia. In 1663 the settled region north of Albemarle sound was organized as Albemarle county. Settlers began to move into the Neuse-Pamlico region soon after 1700 and into the lower Cape Fear about 1725. The upper Cape Fear valley was settled largely by Scottish Highlanders; the piedmont region, by Scotch-Irish and Germans, following up the valleys from Pennsylvania. The colony grew rapidly and at the close of the colonial period (1776) the population numbered approximately 300,000, including about 40,000 Negroes. Economic advantages seem to have been the chief motives of colonization. The proprietary period (1663–1729) was one of slow growth and turbulence. Several governors or deputy governors were driven from office between 1674 and 1712, and there were two uprisings which have been deemed worthy of the term rebellion. A war with the Tuscarora Indians, in 1711–13, resulted in the defeat of the Indians and the removal of the greater part of the tribe to New York, where they became the sixth nation of the Iroquois confederacy. Albemarle as a colony ended in 1689 and in 1712 became the separate colony of North Carolina.

In 1729 an act was passed by parliament establishing an agreement with seven of the proprietors for the surrender of their claims to Carolina. They were allowed £17,500 for their rights and £5,000 for arrears of quit rents. Lord Carteret, afterward earl of Granville, the eighth proprietor, refused to sell, and a strip of land in North Carolina lying between lat. 35° 34′ and the Virginia line (36° 30′) known as the Granville district, was laid off as his one-eighth share of Carolina. The political history during the royal period (in which the colony developed rapidly) is, like that of other colonies, the story of a constant struggle between representatives of the people and the representatives of the crown. There were disputes over questions of government, of commerce, of finance and of religion. In 1765–66 armed patriots prevented the enforcement of the Stamp act in the colony. In the "back country" extortionate fees, excessive taxes, and the oppressive manner of collecting them brought about a popular uprising, known as the Regulation. Violence followed the refusal to pay taxes, and in Sept. 1768 Gov. William Tryon was forced to lead a military expedition against the Regulators. They, however, were not prepared to withstand the governor's forces and submitted without bloodshed. New outbreaks in the fall of 1770 provoked the second military expedition of the governor, and on May 16, 1771, with a force of about 1,000 men and officers, he met about twice that number of Regulators on the banks of the Alamance, where, after two years of fighting, with losses on each side nearly equal, the undisciplined Regulators were routed. About 15 were taken prisoners, and of these seven were executed.



BY COURTESY OF THE NEW BERN CHAMBER OF COMMERCE

CHRIST CHURCH, PROTESTANT EPISCOPAL, NEW BERN, N.C.

The first provincial congress met at New Bern Aug. 25, 1774, and elected delegates to the first Continental Congress. A second provincial congress met in April 1775, and in the next month

Gov. Josiah Martin sought safety in flight. A committee representing the militia companies of Mecklenburg county, on May 31, 1775, passed a series of resolutions which declared that the royal commissions in the several colonies were null and void, that the constitution of each colony was wholly suspended, and that the legislative and executive powers of each colony were vested in its provincial congress subject to the direction of the Continental Congress; and the resolutions requested the inhabitants of the county to form a military and civil organization independent of the crown of Great Britain which should operate until the provincial congress should otherwise provide or the British parliament should "resign its unjust and arbitrary pretensions with respect to America." The Mecklenburg declaration of independence, which it is alleged was passed on May 20 by the same committee, is of doubtful authenticity though the date appears on the state flag by legislative act. The patriot victory at Moore's Creek Feb. 27, 1776, thwarted Gov. Martin's effort to re-establish royal authority.

The first sanction of independence by any colony was the Halifax resolution adopted by the fourth provincial congress on April 12, 1776, and the same body immediately proceeded to the consideration of a new and permanent form of government. Their labours ended, however, in another provincial government by a council of safety, and the drafting of North Carolina's first state constitution was left to a constitutional convention which assembled on Nov. 12, at Halifax.

North Carolinians fought under George Washington at Brandywine and Monmouth and played a still more important part in the Southern campaigns of 1778–81. The state was twice invaded, in 1776 and in 1780–81. The two chief battles fought upon its soil were Moore's Creek, Feb. 27, 1776, and Guilford Court House, March 15, 1781.

North Carolina sent delegates to the Philadelphia constitutional convention of 1787, but the state convention, at Hillsboro, called to ratify the constitution for North Carolina, did not meet until July 21, 1788, when ten states had already ratified. The document was strongly opposed because it contained no bill of rights and on the ground that it would provide for such a strong central government that the state governments would ultimately be sacrificed. At the conclusion of the debate the convention by a vote of 184 to 84 declared itself unwilling to ratify the constitution until a bill of rights had been added and it had been amended in several other particulars so as to guarantee certain powers to the states. But a second convention met at Fayetteville in Nov. 1789 and the constitution was speedily ratified (on the 21st) by a vote of 194 to 77. Also in 1789 the University of North Carolina was chartered and the state ceded its western lands (Tennessee) to the United States.

The period from 1790 to 1835 was marked by a contest between the dominant eastern and the western counties. The west urged that equal county representation in the legislature be replaced by representation based on population. This was stubbornly resisted, and the west assumed a threatening attitude as the east opposed its projects for internal improvements for which the west had the greater need. In 1823 the west called an extralegal convention to meet at Raleigh, and delegates from 24 of the 28 western counties responded, but a lack of agreement over the counting of slaves as well as whites as a basis of representation caused little to be accomplished. Finally in Jan. 1835 the legislature passed a bill for submitting the question of calling a constitutional convention legally to all the voters of the state. When the popular vote was taken, in the following April, every eastern county gave a majority against the convention, but the west voted strongly for it and carried the election with a total majority in the state of 5,856 votes. In the convention, the east made some concessions: such as the popular election of the governor, the disfranchisement of free Negroes, the choosing of senators from districts according to public taxes, and the apportioning of commoners to counties according to population based on the federal ratio. The electorate gave its approval to the revision by a vote of 26,771 to 21,606, and with this the agitation over representation ceased.

The period 1835–60 was an age of progress in the state. After the constitutional reforms of 1835 broke the political dominance of the east, the new progressive Whig party controlled the state government from 1836 to 1850 and adopted the program of public education and internal improvements proposed by Archibald D. Murphey 20 years earlier. The Democratic party, generally dominated by the planter class, grew weary of successive defeats because of its negative program of opposition to Whig policies. It captured control of the state in 1850 because of its able young leaders, its advocacy of free suffrage and the weakening of the Whig party as a result of the slavery controversy and the failure of the Whigs to press forward with the progressive program which they had launched.

The Democratic party controlled the state from 1850 to 1860. Once in power it gradually adopted and extended the progressive program inaugurated by the Whigs. In the generation before 1860 the state government completed a new capitol (1840), gave millions of dollars of aid for building plank roads and a 900-mi. network of railroads, established (1839–40) and provided the major financial support for a state system of free public elementary schools for white children, established institutions for the care of the blind, deaf and insane, expanded the state system of taxation, and made some liberal changes in the criminal law and in the legal status of women. The state university grew rapidly; many private academies for women and men were founded as well as colleges for women; and the leading denominations established colleges for men. Newspapers increased in number and circulation. The period was characterized by economic development and prosperity. There were improvements in the methods of farming and increases in crop production (particularly cotton and tobacco) and significant beginnings of manufacturing. This age of progress was brought to an end by the Civil War.

The fundamental points of difference between North Carolina and South Carolina were exemplified in the slavery conflict. South Carolina led the extreme radical element in the South and was the first state to secede. North Carolina held back, worked for a compromise, sent delegates to the Washington peace convention in Feb. 1861, and did not secede until May 20, 1861, after President Lincoln's call for troops to preserve the union. Liberal support was given to the Confederacy, both in men and supplies, but Gov. Zebulon B. Vance, one of the ablest of the Southern war governors, engaged in acrimonious controversies with Pres. Jefferson Davis, contending that the general government of the Confederacy was encroaching upon the prerogatives of the separate states. The northwestern part of the state was captured by the Federals in 1862 and held throughout the war. Wilmington was captured in Feb. 1865; Gen. Sherman's army crossed the southern boundary in March; a battle was fought at Bentonville, March 19–21; Raleigh was entered on April 13; and the Confederates under Gen. Joseph E. Johnston surrendered near Durham station, in Durham county, on the 26th.

Reconstruction was a costly experience there as in other Southern states. Jonathan Worth (1802–69), elected governor under the presidential plan in 1865, was an honest and capable official, but the government established in accordance with the views of congress in 1868 was corrupt, inefficient and tyrannical. Carpetbaggers, Negroes and unscrupulous native whites, known as scalawags, were in control of affairs, while many people of wealth, refinement and education were disfranchised. They formed the Republican party, wrote and adopted the constitution of 1868, and captured control of the state government. Gov. William Woods Holden (1818–92; governor 1868–70) was so unpopular and tyrannical that he was impeached by the legislature in Dec. 1870. Under his successor, Tod R. Caldwell (1818–74), there was some improvement in the condition of affairs, and in 1875 a constitutional convention, in session at Raleigh, with the Democrats slightly in the majority, amended the constitution, their work being ratified by the people at the state election in 1875. The native white element completely regained possession of the government in the following year, when the Democrats came into office under Gov. Zebulon B. Vance. An interesting feature in the political history of the state was the rise and fall of the Peo-

ple's party. The hard times which followed the panic of 1893 enabled it, in alliance with the Republicans, to carry the state in 1894. The race question dominated the elections of 1898 and 1900, when the Democrats came again into power; and in 1900 a constitutional amendment virtually disfranchising Negroes was adopted.

With the accession of Gov. Charles B. Aycock in 1901, a new era of prosperity began which continued until the decade following the depression of 1929. The Democratic party was in continuous control of the state after 1901. Major activities of the government were in the fields of public education, public health, and highway construction. The state government extended tax relief to the counties by taking over almost the entire cost of road construction and maintenance in 1931 and of the public schools in 1933. In 1949 the state launched a $200,000,000-program for paving rural roads.

In the 1940s a vast medical care program was launched providing for a four-year medical school and hospital at the state university and hospitals throughout the state. After 1900 there was vast expansion in agriculture, particularly cotton and tobacco. Tobacco superseded cotton as the state's major crop in the 1920s; about two-thirds of the nation's crop of flue-cured tobacco is grown in the state.

Rapid industrialization, followed by urbanization, made manufacturing the chief source of the state's wealth and gave it pre-eminence in the nation in tobacco and high rank in textile and furniture manufacture. In national politics the state went Republican for the only time since Reconstruction when Herbert Hoover defeated Alfred E. Smith by a majority of 62,000 in the contest for president in 1928, but in 1932 the state returned to the ranks of the Democratic "solid south." (X.)

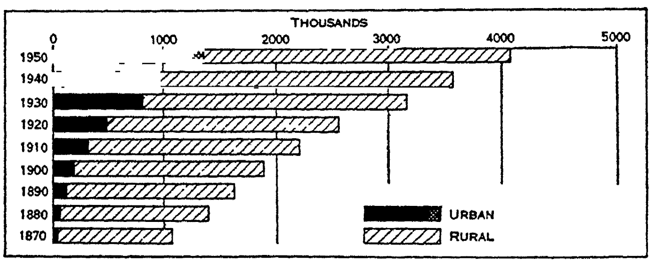
Government.—North Carolina has been governed under the charters of 1663 and 1665 (1663–1729), under commissions and instructions from the crown (1729–76), and under the state constitutions of Dec. 1776 and of April 1868, with numerous amendments. The present constitution, as amended, prescribes that no convention of the people of the state may be called by the legislature unless by the concurrence of two-thirds of all the members of each house, followed by an affirmative vote of a majority of the electors voting on the question; and that an amendment to the constitution may be adopted also by a three-fifths vote of each house, followed by an affirmative vote of the majority of electors voting on the question. The suffrage provisions containing the famous "grandfather clause" (in article vi, section 4), were adopted in the form of a constitutional amendment, ratified in Aug. 1900, and in effect July 1, 1902. Since Dec. 1, 1908, all new applicants otherwise qualified may place their names on the voting register, provided they can read and write any section of the constitution in the English language.

The governor has acquired extensive power over appointments and state fiscal policy. He is elected by popular vote for four years, and cannot succeed himself in office. His power is limited by a council of state, a relic of colonial days. This body is not, however, a special board, as in Maine, New Hampshire and Massachusetts, but a kind of administrative cabinet consisting of the secretary of state, the auditor, the treasurer, the superintendent of public instruction, the commissioner of labour, the commissioner of agriculture and the commissioner of insurance, advising the governor in the administration of his office. Judges and heads of the state departments are elected, and in most instances in which the governor appoints to office the confirmation of the senate is necessary. Furthermore, in North Carolina the governor has no veto power. In addition to the executive officials mentioned above there are a lieutenant governor and attorney general, each elected for a term of four years. Other executive officials are appointed by the governor.

Sessions of the general assembly are held biennially, beginning on the Wednesday after the first Monday in January in odd-numbered years. The senate is composed of 50 members elected biennially from 33 senatorial districts, and the house of representatives of 120, elected biennially and chosen by counties according to their population, each county having at least one representative, no matter how small its population. The pay for both senators and representatives is $600 for their term of office, but if an extra session is called they also receive $8 per day for a period not exceeding 20 days.

There is a supreme court consisting of a chief justice and six associates, elected by popular vote for eight years, and superior or circuit courts, composed of 21 judges elected by the people in each of 21 districts for a term of eight years. Minor civil and criminal cases are tried before a justice of the peace or municipal judge. The county officials are the sheriff, a coroner, a treasurer, a registrar of deeds, a surveyor and a board of commissioners, elected by the people; a clerk of the court elected for four years; a county board of education, elected by the legislature for two years; and a superintendent of schools and a superintendent of public welfare, appointed for a term of two years.

Population.—The population of North Carolina in 1790 was 393,751; in 1830 it was 737,987; in 1870, 1,071,361; in 1910,



BY COURTESY OF THE U S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF NORTH CAROLINA: 1870 TO 1950
The crosshatched part of the 1950 bar represents the population of the additional areas counted as urban under the new 1950 definition

2,206,287; in 1940, 3,571,623; and in 1950, 4,061,929. This last figure represented an increase of 13.7% over the population in 1940.

The population per square mile in 1950 was 82.7, as compared with 72.7 in 1940, and with 50.7 for the U.S. in 1950.

Of the 1950 population, 1,238,193, or 30.5%, lived in incorporated places of 2,500 or more, as compared with 27.3% in 1940 when these places constituted the urban area. The entire urban population, under a new definition set up for 1950, which included also the thickly settled suburban area, or "urban fringe," adjacent to the 5 cities which had 50,000 inhabitants or more in 1940, and 18 unincorporated places of 2,500 or more outside this fringe, amounted to 1,368,101, or 33.5% of the state total.

Area	Population			Per cent of increase	
	1950	1940	1930	1940–50	1930–40
The state.	4,061,929	3,571,623	3,170,276	13.7	12.7
Urban*	1,368,101	974,175	809,847	40.0	20.3
Rural*	2,693,828	2,597,448	2,360,429	3.8	10.0
Per cent urban	33.5	27.3	25 5	..	..
Principal cities:					
Charlotte	134,042	100,899	82,675	32.8	22 0
Winston-Salem	87,811	79,815	75,274	10.1	6.0
Greensboro	74,389	59,319	53,569	25.3	10 7
Durham	71,311	60,195	52,037	18.5	15.7
Raleigh	65,679	46,897	37,379	40.0	25.5
Asheville	53,000	51,310	50,193	3 3	2.2

*Final figures for 1950 based on *new* definition *See* comment in text.

The number of occupied dwelling units (or households) in 1950 was approximately 1,019,000, as compared with 790,000 in 1940. The average population per household had declined from 4.5 in 1940 to 4.0 in 1950.

The population of the state was distributed by colour and nativity in 1950 as follows: 73.0% native white; 0.4% foreign-born white; and 26.6% nonwhite, nearly all Negro. There were 99.8 males per 100 females in the native white population, and 95.4 in the Negro population; 5.6% of the population was 65 years old or over; and 55.0% of the population 14 years old and over was in the labour force. Of the total number of employed males, 31.1% was engaged in agriculture, 8.1% in construction, 26.5% in manufacturing and 18.0% in transportation and trade.

Finances.—North Carolina was one of the few states in the union in the 1940s that had no state tax on property. The total

of the state's general fund revenues for the fiscal year ending June 30, 1948, was $126,205,698; the principal sources being sales ($39,333,608), income ($59,583,846), franchise ($10,053,970), licence ($3,944,444), beverages ($6,471,703), intangibles ($591,572) and inheritance ($1,719,878) taxes. The average rate of county taxation in 1948 was about $10 per $1,000 of valuation on assessed property values of $3,705,712,198. The chief sources of revenue of the state highway fund were gasoline taxes ($40,699,063), automobile and truck licences ($12,415,110), and a contribution from the federal government ($11,020,720). General fund disbursements for the fiscal year ending June 30, 1948, were $92,018,238. Of this amount the chief disbursements were for public schools ($62,655,102), colleges ($5,789,044), general administration and governmental costs ($6,427,541), and maintenance of charitable and correctional institutions ($7,485,872). Of the special fund disbursements the greater were for the state highway and public works commission ($63,327,775), and interest and redemption of state bonds ($7,278,114). The total indebtedness of the state on June 30, 1948, was $79,359,500 in bonds. Of this bonded debt $36,306,000 was for highway construction, $38,803,500 for educational and charitable institution improvement, $1,750,000 for public school building bonds and $2,500,000 for World War I Veterans' Loan bonds. In 1949 the legislature and a popular referendum authorized the issue of $200,000,000 of bonds for the construction of rural roads, and $25,000,000 to aid the counties in the construction and repair of schoolhouses. In 1945 the legislature set aside from the surplus a sum adequate to retire all the general fund indebtedness at that time.

Education.—The public school system of North Carolina made remarkable and well-rounded progress after 1900. The total school expenditures increased from $1,248,157 in 1901 to $39,626,390 in 1929, or from $2.87 per capita of enrolment to $42.53. As a result of the depression, public school expenditures dropped to $19,239,000 in 1933 but rose to $84,255,969 in 1947–48. In 1901 there were 8,320 teachers and 435,184 enrolled pupils as compared with 26,618 teachers and 855,852 pupils in 1947–48. The high school enrolment increased from 63,499 in 1923–24 to 116,937 in 1929–30 and 164,432 in 1947–48. About three-fourths of the operating costs of the state-wide nine-month school system, excluding federal funds, was contributed by the state government. Of the total public school enrolment in 1947–48, 595,812 were white and 260,041 were Negroes. The length of school term and salary scale for teachers are identical for whites and Negroes. In fact the average Negro teacher's salary was higher because a larger percentage of Negro teachers held Class A certificates—90.5% of the Negroes as compared with 79.2% of the whites in 1948–49. The average annual salaries of high and elementary school teachers in 1947–48 were $2,029 and $2,000 respectively. From 1917, with the aid of federal funds, the state supported vocational education in the public schools. In 1947–48 there were 26,274 pupils taking instruction in agriculture and 27,738 studying home economics. In 1949 the state extended $50,000,000 aid to the counties for the construction and repair of public schools. The total value of public school property in 1947–48 was $166,067,207, and the state transported 348,100 pupils in buses to the consolidated public schools.

Chief among the state institutions of higher learning is the University of North Carolina at Chapel Hill, chartered in 1789 and opened in 1795, one of the oldest state universities in the country and the first to begin operation in the south. In 1949–50 it had an average enrolment of 6,965 students during the three quarters of the regular academic year. Other branches of the consolidated university are North Carolina State College of Agriculture and Engineering at Raleigh and Woman's College of the University of North Carolina at Greensboro. Other state schools are East Carolina Teachers college at Greenville, Western Carolina Teachers college at Cullowhee and the Appalachian State Teachers college at Boone. State-supported Negro institutions include the Negro Agricultural and Technical college at Greensboro, the Winston-Salem Teachers college at Winston-Salem, North Carolina College at Durham, and normal schools at Fayetteville and Elizabeth City. A school for the Cherokee Indians of Robeson county is located at Pembroke. Among the nonstate-supported institutions of higher education Duke university, formerly Trinity college, at Durham, is the greatest. It received from James B. Duke the sum of $6,000,000 for building and an endowment fund estimated to amount to anywhere from $80,000,000 to $100,000,000, one of the largest foundations for education and hospitalization in the world. Well-known sectarian schools are Wake Forest college at Wake Forest; Davidson college at Davidson; Greensboro college for women at Greensboro; Guilford college near Greensboro; Lenoir Rhyne college at Hickory; Catawba college at Salisbury; Meredith college at Raleigh; Belmont Abbey college at Belmont; Elon college at Elon; and Atlantic Christian college at Wilson. Institutions for Negroes include Shaw university at Raleigh, Johnson C. Smith university at Charlotte, Livingstone college at Salisbury and St. Augustine's college at Raleigh.

Charities and Corrections.—The chief state-supported institutions in 1950 consisted of hospitals for the white insane at Raleigh and Morganton and a hospital for Negro insane at Goldsboro, the Caswell Training school for mental defectives at Kinston, the North Carolina Orthopaedic hospital for crippled children at Gastonia, the North Carolina hospital for the treatment of spastic children, sanatoriums for the treatment of tuberculosis at Black Mountain, Sanatorium and Wilson; the Stonewall Jackson Training school for delinquent white boys at Concord, the Eastern Carolina Industrial Training school for delinquent white boys at Rocky Mount, the Morrison Training school for delinquent Negro boys at Hoffman, the Training School for Negro Girls at Rocky Mount, the North Carolina State Home and Industrial School for Girls and Women at Samarcand, and the state prison at Raleigh.

Agriculture.—North Carolina in 1947 ranked fourth among the states in the cash income from crops, the total cash income from crops being $624,310,000; from livestock and livestock products, $135,150,000; and from government payments, $8,056,000. The value of products for home consumption was $186,516,000. In that year the state ranked first in the production of tobacco (two-fifths of the nation's crop) and lespedeza seed, and third in peanuts. The principal crops in 1947, their acreage yields and values, were as follows: tobacco, 792,600 ac., 907,181,000 lb., $381,016,000; cotton, 654,000 ac., 452,000 bales, $73,653,400; Indian corn, 2,204,000 ac., 68,733,000 bu., $137,546,000; all hay, 1,258,000 ac., 1,250,000 tons, $35,500,000; sweet potatoes, 59,000 ac., 6,785,000 bu., $15,994,850; wheat, 508,000 ac., 8,194,000 bu., $19,583,660; potatoes, 68,000 ac., 8,840,000 bu., $13,855,600; oats, 508,000 ac., 11,387,000 bu., $11,728,600; rye, 145,000 ac., 336,000 bu., $7,560,000; barley, 53,000 ac., 1,204,000 bu., $1,938,440.

In the production of vegetables and fruits the state ranks high. In 1947 the orchards yielded 768,000 bu. of apples, 2,905,000 bu. of peaches and 127,000 bu. of pears. The vineyards of the state produced 5,600 tons of grapes. The approximate values of these crops in 1947 were: apples, $1,689,600; peaches, $4,212,250; pears, $190,500; grapes, $1,008,000.

The livestock on the farms of North Carolina in 1948 consisted of 677,000 cattle, of which 376,000 were for dairy purposes; 1,181,000 swine; 269,000 mules, 94,000 horses and 37,000 sheep. The production of milk was 177,790,700 gal., and egg production was 77,916,666 dozen.

The average size of farms in 1945 was 64.8 ac. as compared with 67.7 ac. in 1940, and the farm acreage was 18,617,932 as compared with 18,845,338. In the same period the number of farms increased from 278,276 to 287,412. Of the total number of farmers in 1945, 213,139 were whites and 74,273 were nonwhites, chiefly Negroes. The greater part of the nonwhite farmers (54,414) were tenants. The total number of tenants was 122,577 or 42.3% of the farmers as compared with 44.4% in 1940. In 1945 the total value of farm lands and buildings was $1,002,983,012, and the total farm population was 1,311,223 as compared with 1,623,481 in 1940.

Forests and Fisheries.—Woods and forests cover more than

half the area of North Carolina. In 1947, 4,588 active sawmills produced 1,539,656,000 bd.ft. of sawed lumber as compared with 1,042,122,000 bd.ft. in 1939. Of the 1947 production, which ranked fifth among the states, 1,173,562,000 bd.ft. were classified as softwood, chiefly yellow pine (1,118,053,000 bd.ft.), white pine (11,081,000 bd.ft.), cypress (25,778,000 bd.ft.), and hemlock (13,041,000 bd.ft.); and 366,094,000 bd.ft. as hardwood, principally oak (176,078,000 bd.ft.), tupelo (46,388,000 bd.ft.) and yellow poplar (70,449,000 bd.ft.). Other species of some importance were maple, cedar, red gum and ash. The early production of rosin, turpentine and tar from the long-leaf pine forests of the coastal plain caused North Carolina to be popularly called the "Tar Heel state." Forest resources were the basis for the manufacture of furniture and lumber and timber products.

In the sounds along the coast, in the lower courses of the rivers that flow into them, and along the outer shores, fishing is an important industry. In 1946–48 the total value of the food fish, shrimp, menhaden and shellfish taken in the waters of the state was $20,870,000.

Minerals.—During the first half of the 19th century North Carolina was a mining state of the first importance, but in the first half of the 20th century it ranked low (31st to 37th) among the states in mineral production. The total value of the mineral products in 1947 was $23,699,000. The principal minerals produced were stone ($7,561,167), clay products ($8,314,976), sand and gravel ($2,956,800), talc ($1,186,463), feldspar ($1,081,514) and mica ($928,361). North Carolina's annual production of crude feldspar is about one-third of the total quantity of that mineral produced in the United States. It is mined chiefly in Mitchell, Yancey and Avery counties. The state ranked first in the production of mica, found in the southwestern portion of the mountain region. Granite, suitable for building stones and paving blocks, is found in most parts of the state west of the fall line. Talc is found in Swain, Yancey, Mitchell and Avery counties.

Manufactures.—North Carolina in 1947 ranked second to Texas in the south and thirteenth among the states of the union in the total value of $1,646,673,000 added by its 5,322 establishments, employing 350,207 workers at total wages of $641,966,000. This industrial pre-eminence had been gained since 1880. Industrial leadership in the manufacture of cotton goods, tobacco products and furniture was achieved by an abundant supply of raw materials, favourable climate, a reliable supply of native labour and cheap hydroelectric power. The electric power production in 1948 was 9,353,600,000 kw.hr. The total value of the manufactured products of the state was $217,000,000 in 1910; $944,000,000 in 1920; $1,312,000,000 in 1930; $1,421,000,000 in 1939; and an estimated $3,091,000,000 in 1948. The value added by manufacture in 1939 was $544,181,000 as compared with $1,646,673,000 in 1947.

The following table shows the principal industries in 1947, the number of establishments, the average number of wage earners, and the value added by manufacture:

Industry	Number of establishments	Wage earners	Value added by manufacture
Textile mill products	939	200,880	$846,280,000
Yarn and thread, except wool	223	55,378	209,715,000
Cotton and rayon fabrics	149	83,423	405,821,000
Woollens and worsteds	13	5,398	23,212,000
Tobacco	69	29,428	257,986,000
Cigarettes	5	12,980	197,576,000
Furniture and fixtures	372	25,939	102,447,000
Household furniture	337	24,228	96,272,000
Lumber and lumber products	1,864	29,730	84,127,000
Food and kindred products	728	11,574	78,430,000
Chemicals and allied products	188	7,467	58,607,000
Paper and allied products	47	6,446	47,395,000
Apparel and related products	144	15,743	43,852,000
Printed and publishing	363	3,433	25,369,000

Gaston county, with the industry centred chiefly at Gastonia and Belmont, was the leading textile county, but Alamance, Guilford, Cabarrus and Mecklenburg were also important textile producers. Winston-Salem, followed by Durham, was the chief centre of tobacco manufacture, but the industry was important in Reidsville, Greensboro and Statesville. The chief centre of the furniture industry was High Point, but other important centres were Winston-Salem, Thomasville, Hickory, Lexington, Mount Airy, Salisbury and Lenoir. In value added by manufacture in 1947, Forsyth county led with $176,392,000, followed by Guilford, $125,140,000; Gaston, $120,211,000; and Cabarrus, $105,642,000.

Transportation.—Railway building was begun in the state in 1836, and the Raleigh and Gaston line opened in 1840. By 1860 nearly 900 mi. had been built with state aid. Great expansion occurred after 1880. The steam railway mileage in 1950 was 4,519 as compared with 4,596 in 1940. After 1920 great progress was made in developing a system of highways. The state highway and public works commission in 1950 maintained 11,534 mi. of state highways and 52,887 mi. of county roads, of which 17,875 mi. were hard-surfaced. There were in operation 870 mi. of city bus routes and 11,912 mi. of passenger bus routes in 1950. There were 526,749 telephones in use in the state. The total motor vehicle registration in 1950 exceeded 1,100,000. Wilmington, the deepwater port had imports of $16,000,000 and exports of $84,000,000 in 1944.

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NORTH CHICAGO, a manufacturing city of Lake county, Illinois, U.S.A., on Lake Michigan, 35 mi. N. by W. of Chicago, between Waukegan (on the north) and the Great Lakes naval

Training station. It is served by the Chicago and North Western, the Chicago, North Shore and Milwaukee, and the Elgin, Joliet and Eastern railways. Pop. 8,700 in 1950, 8,465 in 1940 and 8,466 in 1930 by federal census.

NORTHCLIFFE, ALFRED CHARLES WILLIAM HARMSWORTH (1865–1922), VISCOUNT, British newspaper proprietor, was born on July 15, 1865 at Chapelizod, Dublin, the eldest of a family of fourteen. His father, Alfred Harmsworth (1837–1889), descended from an old Hampshire family, was a barrister-at-law of the Middle Temple. His mother, Geraldine Mary, who died Aug. 29, 1925, a woman of remarkable intellect and strong character, was a daughter of William Maffett.

Of the seven sons, the two eldest, Alfred and Harold (1868–1940), became members of the house of lords as Lord Northcliffe and Lord Rothermere respectively; the third, Cecil Bisshopp (1869–1948), who in 1939 was made 1st Baron Harmsworth of Egham, became in 1915 under secretary for home affairs and in 1919 under secretary for foreign affairs, having sat in the house of commons as a Liberal from 1906 to 1922; the fourth, Robert Leicester (1870–1937), who was created a baronet in 1918, entered the house of commons in 1900 as Liberal M.P. for Caithness, a seat which he retained till 1922. The other three sons were Hildebrand Aubrey (1872–1929), from 1901 to 1904 editor of *The New Liberal Review;* St. John (b. 1876), the creator of the Perrier mineral water business; and Vyvyan George (b. 1881).

Early Journalism.—The Harmsworths moved to London in the year 1867, and at Henley House school, West Hampstead, the boy Harmsworth started in 1878 the first of his journalistic adventures, a school magazine. This was originally issued in ms. but was afterwards printed and sometimes set up by himself in his spare time. At 15 he did some work for Mr. Jealous, then editor of *The Hampstead and Highgate Express.* As secretary and companion to one of Lord Lilford's sons, he travelled extensively in Europe. On his return to London he became assistant editor of *Youth* and contributed articles to *The Morning Post,* and to the *St. James's Gazette.*

But his health temporarily broke down in 1884. Ordered to live out of London, he went to Coventry in 1885 and worked for the firm of Iliffe and Sons, owners of many publications. With them he remained till 1886, and he then went back to London and joined a general publishing business. Among other ventures he started on June 16, 1888 *Answers to Correspondents,* a weekly periodical intended to be a more popular form of *Notes and Queries.* As *Answers* it laid the foundation of what eventually became the largest periodical publishing business in the world, the Amalgamated Press. Alfred Harmsworth had already been joined by his second brother, Harold (*see* ROTHERMERE, HAROLD SIDNEY HARMSWORTH). The two brothers revolutionized the current methods of periodical journalism. The profits of the accumulated publications soon soared to £50,000 a year. In the next few years Alfred Harmsworth travelled much in Europe, India, Africa, Canada and the United States. On April 11, 1888, he had married Mary Elizabeth, daughter of Robert Milner, a West Indian merchant. On Aug. 31, 1894, he and his brother Harold acquired the London *Evening News,* in which the Conservative party had sunk some £300,000. It was then losing money heavily, but it was at once reorganized with such effect that the first working week yielded a profit of £7, and the first year one of £14,000. In the same year he fitted out an Arctic expedition under F. G. Jackson, which explored Franz Josef Land. In the general election of 1895 he stood unsuccessfully as a Conservative candidate for Parliament at Portsmouth.

The Daily Mail.—On May 4, 1896, a new halfpenny morning paper, *The Daily Mail,* was launched, "the busy man's newspaper," as he called it. It embodied many innovations, a very full service of cables, the employment of numerous famous writers, condensation of unimportant topics, and costly and daring enterprises of various kinds. A comparison of past files of the London Press shows how it revolutionized daily journalism. One of the three leading articles in the first number dealt with the then almost unknown motorcar, in the future of which Alfred Harmsworth had a firm belief, being himself already a qualified driver. *The Daily Mail* attained a sale of 600,000 copies a day in the Boer War, and acquired sound influence on national policy at home and abroad.

In 1903 he founded *The Daily Mirror;* it was at first a complete failure, losing £1,500 a week but after being transformed from a penny paper for women into a halfpenny illustrated morning journal, became as signal a success. In 1905 a Continental edition of *The Daily Mail* was established, with headquarters in France. In 1904 Alfred Harmsworth was created a baronet, and in 1905 he was raised to the peerage as Baron Northcliffe. In 1906 he and his brothers acquired for their companies about 3,000 sq.m. of forest land in Newfoundland, with lakes, rivers and water transport, for the manufacture of paper and wood pulp, the result being the formation of the Anglo-Newfoundland Development Co., a gigantic enterprise with its works at Grand Falls, and two lines of railway, a port and Atlantic and other steamers.

In 1908 Lord Northcliffe obtained control of *The Times,* to own which had always been one of the aims of his life. New machinery was installed, and the size of the paper greatly increased; in March, 1914, he reduced the price to one penny, with the result of a large increase in circulation, though the enormous rise of 600% in the cost of paper during the World War forced a subsequent increase in price. Meanwhile Lord Northcliffe had acquired *The Weekly Dispatch;* disposed of the Sunday *Observer,* which he for some time owned; and sold *The Daily Mirror* to his brother, Lord Rothermere. Among the reforms which Lord Northcliffe introduced into newspaper management were the five-day week for editors, sub-editors and reporters, a more generous payment of journalists and a system of profit-sharing by the chief members of his staffs.

From 1900 onwards, through his newspapers, he had exercised an ever-increasing influence on politics. He had at one time been anxious, like Edward VII. and Cecil Rhodes, to obtain a friendly understanding between England and Germany, but the Boer War caused him to abandon that idea as impracticable. His newspapers consistently pleaded the cause of a strong navy, and as consistently warned the nation for 20 years of the peril from Germany. From 1902 he sought to effect an entente with France, and also to promote agreements with Russia and the United States, whose sentiments and prejudices he had learnt in many visits. Through *The Daily Mail* he gave large prizes for airmanship, in which, from 1906 onwards, he took the warmest interest. His maiden speech in the House of Lords was devoted to the pressing claims of aircraft. He was a strong believer in the future of flying and a daily advocate of the value of aircraft in war. He was also interested from the first in submarines, in one of which craft he made an early and hazardous descent.

The World War.—In the World War he aimed at the vigorous conduct of the struggle, and was from the first of opinion that the War would be long and desperately contested. The chief newspaper campaigns which he carried out, always with the aims of victory and close union between the Allies, were: (1) for the organization of the munition supply and provision of high-explosive shells in April and May 1915, when he did not hesitate to lay the responsibility for the shortage of ammunition on Lord Kitchener in leading articles written by himself in *The Daily Mail* of May 19 and 21, the second of which was publicly burned on the London and other stock exchanges; (2) this campaign was one of the causes of the formation of the Coalition Ministry by Mr. Asquith; (3) throughout 1915 and early 1916, in the teeth of storms of abuse, he urged the necessity of introducing compulsory service; (4) he protested continuously against the excessive optimism of the Asquith Government and against official secretiveness; (5) he called for the strict enforcement of the blockade; (6) so far as the censorship would allow, he resisted the Dardanelles and Salonika campaigns, which absorbed so large a part of the national forces; (7) he continued his pre-War demand for the construction of aircraft—and "the right kind of aircraft"—on the largest possible scale; (8) he urged the necessity of creating a strong naval war staff and taking offensive measures against the enemy submarines; (9) he insisted on the need of compulsory food rationing. While always active with his pen and through

his Press, he went repeatedly to the various battle-fronts, British, French, Belgian, Italian and American, and kept in close touch with the various staffs. In Dec. 1916 he gave his support to Mr. Lloyd George in the political crisis which led to the fall of Mr. Asquith's Government, and dealt the final thrust which brought that Government down, though after the Armistice, by reason of his objection to the long-drawn-out after-war negotiations with the Germans, he became Mr. Lloyd George's most persistent critic. He was offered office but declined.

Work in New York.—Before the United States entered the War he was offered and declined the post of British ambassador at Washington. But he went to New York (June 2, 1917) as chairman of the much-needed British War Mission returning to London on Nov. 12, 1917, when he was created a viscount, as Viscount Northcliffe of St. Peter-in-Thanet, for his services. On Feb. 13, 1918, he became director of propaganda in enemy countries. To pave the way for operations among the nationalities subject to the Habsburgs, he secured an agreement between the Yugoslavs and the Italian Government, which played a big part in the defeat of the Austrian Army and was subsequently embodied, in substance, in the peace terms. An account of his work was given in Sir Campbell Stuart's *Secrets of Crewe House* (1920); Crewe House being the London headquarters of the organization.

Last Days.—During the Peace Conference Lord Northcliffe's Press and the *Continental Daily Mail* especially exerted a powerful influence on the British Government, extracting from Lloyd George a promise to fulfil election pledges and striving to maintain the closest and most cordial relations with France. In July 1921 he went for a prolonged tour of the world, as he was medically advised to take a rest cure. A complete breakdown followed, and after a long illness he died on Aug. 14, 1922, of ulcerative endocarditis. (H. W. W.)

See his *My Journey Round the World* (1923); L. Owen, *The Real Lord Northcliffe* (1922); M. Pemberton, *Lord Northcliffe* (1922).

NORTHCOTE, JAMES (1746–1831), English painter, was born at Plymouth on Oct. 22, 1746. He was apprenticed to his father, a poor watchmaker, but in 1769 left his father and set up as a portrait-painter. In 1773 he went to London and was admitted as a pupil into the studio and house of Reynolds. At the same time he attended the Academy schools. In 1775 he left Reynolds, and, about two years later went to study in Italy. On his return to England he settled in London, where Opie and Fuseli were his rivals. He was elected associate of the Academy in 1786, and full academician in the following spring. Northcote's works are said to number two thousand, and he made a fortune of £40,000. Apart from his painting he wrote lives of Reynolds (1813), and of Titian (1830), and two series of *Fables*. He died on July 13, 1831.

NORTHCOTE, STAFFORD HENRY, 1ST BARON (1846–1911), was educated at Eton and at Merton college, Oxford. He became a clerk in the foreign office in 1868, acted as private secretary to Lord Salisbury, and was attached to the embassy at Constantinople from 1876 to 1877. From 1877 to 1880 he was secretary to the chancellor of the exchequer, was financial secretary to the war office from 1885 to 1886, surveyor-general of ordnance, 1886 to 1887, and charity commissioner, 1891 to 1892. In 1887 he was created a baronet. In 1880 he was elected M.P. for Exeter as a Conservative, and retained the seat until 1899, when he was appointed governor of Bombay (1899–1903), being created a peer in 1900. Northcote was appointed governor-general of the Commonwealth of Australia in 1903, and held this post till 1908. He died on Sept. 29, 1911.

NORTH DAKOTA, the "Flickertail state," is one of the north-central group of the United States, and lies between approximately 45° 55′ and 49° N. and 96° 35′ and 104° 3′ W. It is bounded north by the provinces of Saskatchewan and Manitoba in Canada, east by Minnesota, from which it is separated by the Red river, south by South Dakota and west by Montana. Its extreme length east and west is 360 mi., its extreme width north and south is 210 mi. Its total area is 70,665 sq.mi. of which 608 sq.mi. are water surface. The original territory of Dakota was so called because of its being the home of the Dakota Indians, the word "Dakota" meaning "allied" in the language of these tribes.

Physical Features.—In crossing North Dakota from east to west three distinct plains are encountered, rising one above the other. The most easterly of these, from 790 to 965 ft. in elevation, is the remarkably level valley floor of the Red river extending from the west river bank 30 to 40 mi. westward. This valley was once the bed of a great glacial lake (Agassiz) formed when the huge ice sheet retreated northward. Its floor is covered with rich, silty lake deposits, coloured black by decayed vegetation, making it one of the most fertile and best agricultural areas in the United States.

West of this valley, between it and the Missouri plateau, is an intermediate plain, ranging from 1,300 to 1,650 ft. in elevation and known as the drift plain. Its east and west width varies from about 70 mi. at the south to more than 200 mi. along the Canadian boundary. The surface varies from gently undulating to rolling and hilly and is marked by irregular ridges or glacial moraines. Small salt or alkali lakes, many without outlets, are abundant. The largest of these is Devils lake, an irregular body of water 40 mi. long, forming a natural reservoir for a large area in the northeastern part of the drift plain. Rivers of importance, the Mouse, Sheyenne and James, all show narrow valleys and undisturbed glacial drift indicating a youthful land. In general, the soil is excellent for grain crops and supports a large farming population.

Bordering the drift plain on the west, approximately paralleling the Missouri river and 50 to 60 mi. east of the stream, is an escarpment or abrupt ridge 300 to 400 ft. high. This escarpment forms the eastern edge of the third plain, the Missouri plateau.

While the ice sheet extended from 40 to 60 mi. west of the Missouri river, it did not leave enough drift to affect the surface features appreciably; consequently, the Missouri plateau presents a marked contrast to the other two plains. Ranging in elevation from 1,800 ft. east of the Missouri river to 3,178 ft. in the southwest, the area presents an irregular surface formed largely by water erosion.

The plateau is well supplied with streams west of the Missouri river including the Little Missouri, Heart, Cannonball and the Knife, all of which have almost countless small tributaries, many of which are dry except in spring. The innumerable small streams, branching out in every direction and extending into all parts of the region, form a land surface of continuous slopes leading to some drainage course. A conspicuous feature is the large number of buttes rising 400 to 700 ft. above the general level which form prominent landmarks. There large herds of beef cattle and other livestock graze on grassy ranges both in summer and winter. The extreme western part of the plateau, from the southern border north to the Missouri river, is known as the "badlands." Horizontal strata of soft shales and sandstones coloured gray, yellow, black and every shade of red and brown have been sculptured into an infinite variety of weird fantastic formations by action of streams and rains. Viewed from commanding points, the "badlands" present an indescribable waste, of beautiful colour, with countless ridges, bluffs, points, domes and buttes. There too, are found protruding black seams of lignite coal, burning lignite coal mines, petrified forests and other fossils. In 1946 the U.S. congress established the Theodore Roosevelt National Memorial park in the "badlands." Although the steeper slopes are almost bare, many of the more gentle ones and the small valleys are covered with grass and support large herds of livestock.

Trees are natively found only in the Turtle mountains, a group of hills near the Canadian border, in the region around Devils lake and several smaller lakes, along streams and rivers and in a few other places sheltered from the wind and sun. Cottonwood trees predominate. Stunted cedars and junipers grow in the sheltered ravines of the "badlands." Hundreds of shelter belts and farm groves have been planted east of the Missouri river, and many farmers and ranchers have small groves of trees west of the river.

Climate.—Since there are no mountains, forests or large bodies of water to have a moderating effect, the climate is strikingly uniform over the state with the exception of the southwestern re-

gion during the winter. There temperatures average 16° warmer than in the northeast, partly because of chinook winds coming over the Rocky mountains from the Pacific ocean.

Great extremes in temperature are likely to occur in any part of the state. During the summer, temperatures near 100° are not uncommon, but the nights are cool, seldom being more than 70° and often going as low as 40°. In the winter, temperatures often reach −20° and occasionally go much lower. These temperature extremes are not as noticeable as in more humid regions because of the low relative humidity or dry air. The seasons are sharply demarked; both winter and summer come rapidly. The summers are short, but long hours of sunlight make vegetation grow rapidly. Killing frosts sometimes occur in May and return again in September. High winds are frequent, tornadoes are not uncommon, and hail storms are frequent in summer. Winds are usually light during the growing season; but late in summer occasional dry, hot winds from the south prove destructive to crops. The average annual rainfall is 18 in., decreasing from 22 in. in the east to 15 in. along the western boundary. Although this is low, 77% of the precipitation comes during the crop season. Snowfall is heavier in the east (35 to 40 in.) than in the southwest where it averages 20 to 30 in., which is less than in other states in the country having temperatures averaging below freezing from November to March. Blizzards come rapidly and often cause severe loss of livestock and occasionally human deaths.

History.—The first white men to visit North Dakota were members of an expedition from Ft. La Reine (Portage la Prairie, Can.) led by Pierre Gautier de Varennes, usually known as Verendrye. They reached a Mandan earth lodge village in 1738 (possibly the Menoken site, 13 mi. E. of modern Bismarck). From there Verendrye's sons were sent by him to another village on the Missouri river. The visit of this famous French fur trader to the Missouri river is marked by the Verendrye National monument established in 1917 by the federal government near the present city of Sanish. However, since investigations in 1936, the Menoken site is believed to have been the place visited by the Verendrye party.

Two sons of Verendrye crossed the Missouri near Sanish, 1742–43, and explored the country to the southwest in an attempt to carry out their father's dream of establishing an overland trade route to the Pacific. After reaching the rugged slopes of the Big Horn mountains they abandoned their search and recrossed the Missouri river at Old Crossing, as it was known thereafter.

After the English occupation of Canada in 1763, two famous fur companies, the Hudson's Bay company and the North West company, operating from Ft. Garry (Winnipeg, Can.), established trading posts on the Missouri river at the mouth of the Knife river where they were found by the Lewis and Clark expedition that wintered at Fort Mandan, 1804–05, before proceeding to the Pacific the following year. The purchase of Louisiana territory by the United States in 1803, and the success of the Lewis and Clark expedition, made St. Louis a rendezvous for American fur traders who exploited the fur resources of the upper Missouri. The American Fur company was the best known of these firms. It was the first to use steamboats on this river (1831). It built among others Ft. Clark (1826) and the best known of all, Ft. Union in 1831.

Two European travellers visited America at this time, George Catlin (1832) and Maximilian (1833), and their published narratives, with the accounts of many others, give a picture of this early fur trade and of Indian tribes living along the Missouri river.

The North West company early penetrated southward from Ft. Garry to occupy the Red river valley. Charles Chaboillez established the first post at Pembina, 1797, and Alexander Henry, Jr., built his first post near the mouth of Park river in 1800 and later located permanently at Pembina in 1801.

David Thompson, famous fur trader and surveyor, was connected first with the Hudson's Bay company and later, 1796, was employed by the North West company. His journal is a mine of information concerning the location of trading posts in the northwest. He visited the Five Villages of the Hidatsa and Mandan Indians at the mouth of the Knife in 1797, the Pembina post of Chaboillez in 1798 and the post built by Cadotte at the junction of the Red and Red Lake rivers at the well-known Minnesota Point, opposite Grand Forks.

The War of 1812 put an end to all British attempts to extend their Canadian frontiers southward by means of a number of well-placed fur trade salients and by the assistance of the North West company and their Indian allies. In conformity with their new policy of American alliances, England turned over to the U S. the entire Red river valley which had been in the possession of the Hudson's Bay company since 1670. By the treaty of Paris in 1818, the international boundary was fixed at the 49th parallel as far west as the Rocky mountains.

The first genuine settlement of homeseekers in North Dakota in this period was made by a band of settlers from Lord Selkirk's colony of Scottish Highlanders in Manitoba who migrated south of the boundary line and settled at Pembina in 1819. When Maj. Stephen H. Long, leading the first United States exploring expedition into the Red river valley in 1823, visited the place, the population numbered 350. Ft. Snelling (St. Paul) was established in 1823, and a brisk trade between this fort and Ft. Garry soon developed along both sides of the Red river. It was carried on principally by means of the well-known Red river carts and continued to be important until after the early '50s when the flatboats and later the steamboats replaced this primitive form of transportation. Ft. Abercrombie was built in 1858 and Ft. Pembina in 1863, and these forts became the rendezvous for commercial and military operations in the northwest, as well as a rallying point for settlers.

Between 1850 and 1870 there was considerable difficulty with the Dakota Indians, whose lands in Minnesota had been largely appropriated by the whites, and whose buffalo herds on the Dakota prairies were fast being depleted by the hunting activities of traders and half-breeds. The Minnesota outbreak of 1862 was followed by campaigns by Gen. Henry Sibley and Gen. Alfred Sully in 1863 and 1864 which finally drove the hostile Dakotas to the "badlands" west of the Missouri river. All eastern North Dakota was now open for occupation, and the completion of the first railroad to the eastern border in 1871 inaugurated the settlement period in earnest.

The following decade was a period of intensive development in the Red river valley, and by 1880 settlement was spreading out over the area of the drift plain, especially along the line of the Northern Pacific railway which in 1873 had reached the Missouri river at Bismarck.

West of the Missouri the country was made attractive to settlers by the survey and extension of the Northern Pacific railway from Bismarck westward. The completion of the Great Northern railway across the northern part of the state in 1887 opened that region to eager settlers.

The region forming North and South Dakota, which since 1861 had been known merely as Dakota Territory, was divided in 1889 into a northern and southern half. A convention met in North Dakota in July and framed a constitution which was accepted by the people in an election held on Oct. 1. Pres. Benjamin Harrison declared the state's admission to the union on Nov. 2, 1889.

The years 1890–1915 were years of constant growth in population and intensive railroad development. Competing railway lines strove to forestall each other in tapping promising grain territory. Once there they did their best to bring settlers into the newly opened region by conducting land excursions. Nearly 18,000 immigrants annually for this span of years made new homes in the state. Settlement of the drift plain was practically completed and homesteaders invaded the good land beyond the Missouri river. The inrush continued with little abatement until World War I, after which, because of the general depression in agriculture, it practically ceased.

In politics, North Dakota is normally Republican, but its farmers and other dissatisfied groups have shown a tendency to desert the party in times of agricultural distress to form separate party fractions that usually promised more direct and radical remedies. In 1915, a number of Republican party members, who were dissatisfied with the method of marketing grain, organized

the Nonpartisan league with A. C. Townley, a Socialist, as the head of the organization. By 1918, the league had elected a governor and a majority in both houses of the legislature. During the 1919 legislative session, the league passed laws creating the State Industrial commission to manage industrial enterprises of the state; the Bank of North Dakota; the North Dakota Mill and Elevator association; the Home Builders' association (later discontinued); and a number of less important laws relating to workmen's compensation, hail, fire and tornado insurance, and printing.

In 1920 the Nonpartisan league lost much of its prestige, and many influential people from all parties were opposed to its program. Forgetting party lines, this group formed the Independent Voters association known as the I.V.A., and became influential in government during the remainder of the decade. In 1932 the league again came into strong control with the election of William Langer as governor, and it remained a strong force in governmental affairs.

To combat the success of the league the Democratic party and conservative Republicans formed a coalition in 1938 and elected John Moses, a Democrat, governor; he served until the end of 1944. Conservative Republicans, attempting to develop a strong party in 1943, adopted the name of Republican Organizing committee (R.O.C.), and elected Fred. G. Aandahl governor for three terms and Norman Brunsdale in 1950. The R.O.C. maintained strong control in governmental branches after 1944

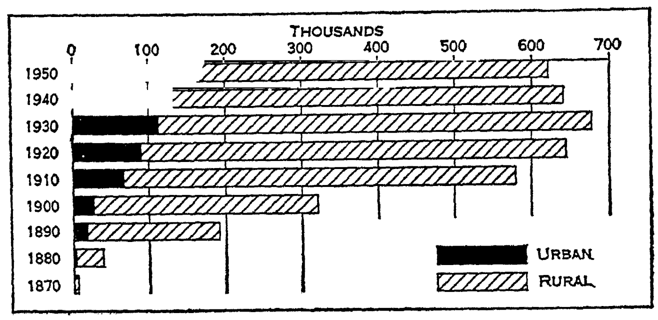
Government.—The state is governed under its constitution of 1889 as subsequently amended. Beginning in 1919, provisions were adopted for both the constitutional and the legislative ordinary initiative. The former permitted proposal of amendments by 20,000 qualified voters, and the latter the proposal of statutory law by 10,000 qualified voters. In all instances the direct ratification by the electorate is conclusive and applies to legislative proposals of amendment as well. The legislative or ordinary referendum, requiring 7,000 qualified petitioners, places a veto power over legislation in the hands of the electorate. The veto power of the governor does not extend to measures initiated or referred to the electors and thereupon passed, but does include the item veto on appropriation bills of the legislature. Amendment 33 gave the electors the power of recalling elective congressional, state, county, judicial or legislative officials, the recall petition to contain signatures of at least 33% of the voters voting for governor in the district of recall at the preceding election The legislative assembly is composed of a senate and a house of representatives with a membership respectively of 49 and 113 in 1949. Representatives are elected for two years and senators for staggered terms of four years. The assembly meets the first Tuesday after the first Monday in January in odd-numbered years.

Executive officers who are elected for two years are the governor, lieutenant governor, secretary of state, auditor, treasurer, attorney general, commissioner of insurance, commissioner of agriculture and labour, superintendent of public instruction, tax commissioner and three public service commissioners. The executive department includes about 50 boards and commissions whose members are partly elected officials serving with ex-officio duties, and partly officials appointed by the governor. Other appointments by the governor include adjutant general, state engineer, state mine inspector, state examiner, a three-member board of administration, a seven-member board of higher education, and members of many other professional examining boards. The industrial commission, composed of the governor, commissioner of agriculture and labour and the attorney general, is responsible for the management of all state-owned and -operated industries and enterprises.

The supreme court of the state is composed of five justices elected for ten years each. Terms are held on the first Tuesday of every month except July and August. There are six judicial districts in the state with justices elected for six-year terms. All counties have probate courts, and six counties provide county courts of increased jurisdiction superceding the district courts. Townships and villages have justices of the peace. Some cities are provided with police courts.

North Dakota has 53 counties, determined in number and size by the legislative assembly. The state relies in large measure upon the county for the local administration of most of the affairs in which it has a primary interest. The county thus constitutes the largest and most important unit in the administration of such basic activities as law enforcement, public health and welfare, highways, tax collection, recording, and election administration. Townships and school districts, however, share with the county in the administration of important functions. City forms of government in the state include mayor council, city commission and city manager.

Population.—The area which now forms North Dakota had 2,405 inhabitants in 1870 and 190,983 in 1890. The population of the state in 1910 was 577,056; in 1940, 641,935; and in 1950, 619,636, or 3.5% less than in 1940. The population per square mile in 1950 was 8.8, as compared with 9.2 in 1940, and with 50.7 for the U.S. in 1950.



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URBAN AND RURAL POPULATION OF NORTH DAKOTA: 1870 TO 1950

Of the 1950 population, 164,817, or 26.6%, lived in incorporated places of 2,500 or more, as compared with 20.6% in 1940. Since North Dakota had neither cities of 50,000 or more nor unincorporated places of 2,500 or more, these incorporated places constituted the urban area in 1950, the same as in 1940.

The number of households in 1950 was 162,184, as compared with 155,100 in 1940. The average population per household, based on the total number of inhabitants, had declined from 4.1 in 1940 to 3.8 in 1950.

TABLE I.—*Population of North Dakota and Its Principal Cities*

Area	Population			Per cent of increase	
	1950	1940	1930	1940–50	1930–40
The state	619,636	641,935	680,845	−3.5	−5.7
Urban	164,817	131,923	113,306	24.9	16.4
Rural	454,819	510,012	567,539	−10 8	−10.1
Per cent urban	26.6	20 6	16.6	..	..
Principal cities					
Fargo	38,256	32,580	28,619	17.4	13.8
Grand Forks	26,836	20,228	17,112	32.7	18.2
Minot	22,032	16,577	16,099	32.9	3.0
Bismarck	18,640	15,496	11,090	20.3	39.7

The population of the state was distributed by colour and nativity in 1950 as follows: 90.2% native white; 7.9% foreign-born white; and 1.7% nonwhite, practically all Indians. Of the 49,232 foreign-born white, 13,268 were born in Norway, 12,393 in Russia, 6,179 in Canada, and 4,195 in Germany. There were 107.8 males per 100 females in the native white population, and 122.3 in the foreign born; 7.9% of the population was 65 years old or over; and 53.1% of the population 14 years old and over was in the labour force. Of the total number of employed males, 52.1% was engaged in agriculture, 6.2% in construction, 3.0% in manufacturing, and 21.3% in transportation and trade.

Finance.—At the end of the 1950 fiscal year, total revenues were $65,045,182 ($105.26 per capita, as compared with $19.48 in 1932 and $28.13 in 1937). Payments were $88,378,862, leaving a balance of $57,446,693 on June 30, 1950. Although expenditures exceeded collections during the year, a balance of more than $80,000,000, carried over from 1949, offset the excess expenditure and left a large reserve.

The assessed valuation of property in 1950 was $1,119,294,450, with real estate valued at $724,905,532, personal property at $225,306,026 and public utilities at $169,082,892. Taxes are based on 50% of this total assessed valuation.

On June 30, 1950, there were 109 state banks with deposits of $301,657,657 and resources of $322,799,174; 41 national banks having $241,523,000 in deposits and $256,264,700 in resources; 10 state savings and loan associations with resources exceeding $27,000,000; 56 state credit unions having resources of more than $4,000,000; and a number of federal credit unions and savings and loan associations.

The inheritance tax was enacted into law in 1913, a motor vehicle licence tax in 1917, income, gasoline, and gross earnings taxes in 1919, a cigarette tax in 1925, a retail sales tax in 1935.

In addition to taxes raised by the state, the counties, cities, towns, villages, school districts, park districts and townships levy annual taxes which amounted to $31,523,000 in 1947.

Education.—Elementary and secondary schools are under the control of the state department of public instruction, with an elected superintendent, while the state institutions of higher learning are under the board of higher education appointed by the governor.

In 1948–49 there were 112,917 students enrolled in 2,263 school districts, 26,416 of whom were in secondary schools. The average daily attendance was 102,917 or 95.2%. School terms averaged 8.51 mo. with graded town schools averaging 9 mo. Transportation of 18,182 pupils indicated a growth in larger school districts. There were 6,349 teaching positions and the average salary for all teachers was $2,018. Total expenditures in 1948–49 amounted to $21,433,787—an average cost per pupil of $180. Schools are largely supported by local taxes, $13,023,525 coming from that source during 1948–49. Seven-twelfths of the state sales tax was distributed to school districts on the basis of need through the state equalization fund.

Public and private institutions of higher learning are numerous in the state when considered in relation to the population. There are two private schools, Jamestown college at Jamestown, with a 1950 enrolment of 347 and a staff of 32; and Wesley college at Grand Forks, with an enrolment of 214 and a staff of 10. A junior college at Bismarck enrolled 225 and one at Devils Lake enrolled 35 students. Below is a summary of public institutions:

TABLE II.—*State Institutions of Higher Learning*

Institution	Location	Year founded	Staff, 1950	Students, 1950	Education offered
University of North Dakota	Grand Forks	1883	178	2,294	4 years and graduate work
Agricultural college	Fargo	1889	164	1,960	4 years
Teachers college	Minot	1913	70	770	4 years
Teachers college	Valley City	1889	49	396	4 years
Teachers college	Mayville	1889	35	250	4 years
Normal school	Dickinson	1916	30	258	4 years
Normal and Industrial college	Ellendale	1889	22	147	4 years
School of Science	Wahpeton	1903	53	556	Junior college and trade training
School of Forestry	Bottineau	1897	12	85	Junior college

Corrections and Charities.—The state board of administration has general control over the major correctional and charitable institutions having a total appropriation of $7,418,369 for maintenance, improvements and operation in the biennium ending June 30, 1951. On June 30, 1950, the population at the hospital for the insane at Jamestown was 2,121; state training school for delinquent boys and girls at Mandan, 245; school for the deaf at Devils Lake, 90; school for the blind at Bathgate, 40; state penitentiary near Bismarck, including a state farm, 261; and a tuberculosis sanatorium at San Haven, Dunseith, 284. A soldiers' home at Lisbon is under a special board. The public welfare board, seven members appointed jointly by the governor, attorney general and commissioner of agriculture and labour, directs and controls such major phases of welfare as old-age assistance, aid to the blind, services for crippled children and child welfare services.

Agriculture and Livestock.—Probably no other state in the union depends so largely upon agriculture as does North Dakota. Of its total area 91%, or 41,001,158 ac., was classified as farm land in 1945. The 1949 estimated farm population was 285,000, considerably less than half of the total population as compared with 51.1% living on farms in 1935. Only 69,520 farms were in operation in 1945 compared with the high of 84,605 in 1935, even though the number of acres of farm land increased by 2,000,000 during the intervening period. Mechanization was largely responsible for increasing the size of farms from an average of 343 ac. in 1900 to 590 ac. in 1945. In addition to this large farm area and population, the many small towns comprising the major portion of the nonfarm population are almost entirely dependent upon farm trade. Total farm cash income in 1947 was $701,728,000, 28.4% of which was from livestock and products, 70.6% from crops and 1% from government payments. In 1948, buildings and land were valued at $26 per acre or $15,340 per farm.

North Dakota is divided into three farming belts. The black-earth belt occupies nearly all of the eastern half of the state. In this zone the soils are dark, moisture conditions are favourable, production is high, and the farms are smaller than in the other belts, averaging from 350–400 ac. West of the black-earth belt, extending a short distance west of the Missouri river, is the farming, grain and grazing belt. This belt, in general, presents a rougher topography, soils are somewhat lighter, production is lower, and the farms average from 500–600 ac. in size. In the southwestern quarter of the state is the grazing-forage crop belt. This region is hilly, the soils are residual in origin, and rainfall is less than in other parts of the state. Farms average from 700 to 1,000 ac. in size. Livestock and forage crops are important, but wheat and other small grains were produced in abundance after 1940.

Wheat is the main crop of the state; the 146,383,000 bu. produced in 1947 was valued at $319,974,000—46% of the cash farm income. Between 1919 and 1949 the average yield per acre varied from 5 bu. in drought years to 20 bu. in more favourable years. Wheat grown in North Dakota has a high protein content and commands a premium on the market. In 1947, 64,351,000 bu. of oats were harvested, valued at $21,837,000 and yielding 29 bu. per acre. In the same year barley amounted to 51,324,000 bu., with a cash value of $60,850,000 and an average yield of 21 bu. per acre; corn 24,374,000 bu., $2,195,000, 20 bu. per acre; rye 4,522,000 bu., $8,272,000, 14 bu. per acre; flax 12,112,000 bu., $54,703,000, 8 bu. per acre; potatoes 20,480,000 bu., $20,249,000, 160 bu. per acre; sugar beets 162,691 tons, 9.2 tons per acre; and tame and wild hay 3,184,000 tons valued at $1,913,000. Other crops include buckwheat, truck crops, fruits, alfalfa seed, sweet clover seed, soybeans, sorghums, forest products and nursery and greenhouse products. Potato production in the Red river valley increased by more than 15,000,000 bu. per year during the years 1919–49.

The production of livestock plays an important role in the farming industry of the state. Almost all farmers supplement the grain crop with livestock and poultry, although a small number of crop farms do not attempt to raise either. The greatest production of cattle in the first half of the 20th century was in 1944–45, with 1,915,000; sheep 164,000 in 1942; hogs 250,000 in 1943; chickens 50,696,000 in 1943; and turkeys 1,747,000 in 1941. In 1945 there were 951,000 cattle, and the number remained within 100,000 of that number in the next five years. Cattle accounted for 12% of the farm cash income in 1947, amounting to $93,561,000. The number of milk cows dropped to 392,000 in 1948 from a high of 640,000 in 1933. Average production of milk per cow, however, increased from 3,560 lb. in that year to 4,550 lb. in 1948. Dairy products were valued at $44,471,000 in 1948. Sheep production declined from the 1942 high to 380,000 in 1949. The greatest income from sheep in the period 1930–50 was $8,263,000 in 1946, and from wool $3,531,000 in 1943. Hog production reached a peak in 1944, totalling 1,101,000 valued at $38,742,000. The number of horses steadily declined, reaching a new low of 167,000 in 1949. In 1950 there were between 4,000,000 and 5,000,000 chickens and almost 1,000,000 turkeys.

Water Resources.—Ever since the retirement of the great glaciers northward the Missouri river, its tributaries and other lesser rivers of the state have been cutting their way across North

Dakota, removing topsoil, flooding lands, and dropping to extremely low levels in times of drought. After 1925, ground-water levels continued to sink, giving rise to many serious problems and speeding intensive study to devise means of controlling and developing remaining water resources. In 1943, Col. Lewis A. Pick of the U.S. army corps of engineers proposed an over-all plan for such control and development known as the "Pick plan." Basically, it called for six dams on the main stem of the Missouri river and 99 on its tributaries. The U.S. bureau of reclamation, at the same time, proposed the "Sloan plan" for irrigating thousands of acres of land around the Missouri river and of diverting water from the river through a series of canals, lakes and rivers to the eastern part of the state for additional irrigation and a stabilized water supply. In 1944, the two plans were co-ordinated and congress passed the Flood Control act.

On the Missouri river, 75 mi. N. of Bismarck, was begun the largest man-made lake in the world and the largest rolled-fill earth embankment ever constructed by man to 1950. As one of the key projects of the Pick-Sloan plan for control and development of the Missouri river basin, the dam and reservoir were to provide for flood control, power, irrigation, navigation, stream sanitation and, incidentally, recreation. The dam, with a maximum height of 210 ft., extends across the river valley for 12,000 ft. with a base 2,600 ft. wide. It is made up of 70,000,000 cu.yd. of earth, mostly taken from the dam site. The first earth was moved on Oct. 4, 1947. Behind this huge barrier, extending for 217 mi. northwest, was to be the man-made lake, with a maximum width of 14 mi., covering 390,000 ac., impounding 23,000,000 ac.ft. of water and having an elevation of 1,859 to 1,875 ft. above sea level. Three power units with a capacity of 80,000 kw. each were to be installed during initial construction, with space provided for two more units of the same capacity. The average dependable capacity of power output of all five generators would be 297,500 kw., with an average annual energy output of 1,712,000,000 kw.hr. Irrigated land would total 1,000,000 to 2,000,000 ac. after full development.

This mammoth project, spread over 500,000 ac. of land, necessitated the rerouting of 24 mi. of railroad, 108 mi. of highway and the moving of two towns (Sanish and Van Hook), the Fort Berthold Indian reservation and numerous telephone, telegraph and power lines. In order to house the necessary personnel for construction work, the government town of Riverdale was started in 1946 and by 1951 had grown to a city of more than 3,000. The total estimated cost of the project was $202,000,000.

Mining.—North Dakota possesses extensive lignite coal and clay deposits. Completion of a $750,000 federal lignite research laboratory at the University of North Dakota in 1950 was a big step forward in the development of almost unlimited supplies of this low grade of coal.

Lignite deposits of varying thickness underlie about 32,000 sq.mi. of surface in the state. The U.S. geological survey estimates that of the total lignite deposits of 965,902,000,000 tons in the United States, 633,329,000,000 are in North Dakota and about 500,000,000,000 are capable of being mined. Beds vary in thickness from a fraction of an inch to 35 ft., while 6- to 8-ft. veins are common. In places they are so close to the surface that the overlying soil can be stripped and the coal mined in open cuts; in other places the room and pillar method is used. In 1949–50 there were 104 licensed mines producing 3,212,534 tons valued at $7,875,799. Comparable figures were 416,580 tons in 1910 and 1,753,888 tons in 1940. Some companies briquette lignite.

Clay is found in a large number of varieties, ranging from common brick through tile to high grade art pottery clay. Deposits are especially large in the western part of the state where they are found near lignite beds which enhances the value of both.

Stone and gravel deposits in considerable abundance are found mainly in the ridges of glacial moraines.

Transportation.—The state is crossed east and west by two transcontinental railways, the Great Northern serving the northern part of the state and the Northern Pacific serving the southern part. Another transcontinental line, the Chicago, Milwaukee, St. Paul and Pacific, cuts across the southwestern corner, while the Minneapolis, St. Paul & Sault Ste. Marie runs from the southeast corner diagonally northwestward to make a transcontinental connection with the Canadian Pacific at the Canadian border. The Chicago and North Western railway and Midland Continental maintain short lines in the state. Railroad mileage increased from 4,201 in 1910 to 5,311 in 1920, but fell to 5,271 in 1940 and to 5,259 in 1950.

In 1950 there were 6,839 mi. of state highway, 95 mi. of which were concrete, 2,073 mi. other hard surfacing, 4,357 mi. gravel and 192 mi. graded. Rural roads totalled 107,593 mi., with .7 mi. concrete, 32 mi. other hard surface, 20,627 gravel, 20,392 mi. graded and the remaining mileage unimproved earth. Motor vehicle registration increased from 185,158 in 1940 to 281,044 in 1950.

Manufacturing and Industry.—Manufacturing did not have an important role in the state's economy at mid-century. Development of tremendous new power and water reserves, however, and new possibilities for the use of lignite coal would give impetus to manufacturing. All manufacturing and industry at mid-20th century were closely related to agriculture. Most important manufactured products were butter, cheese, ice cream, dried buttermilk, flour, feed and other grain products. After 1940 the manufacture of potato flour, potato chips, shoestring potatoes, building materials, brick, lignite briquettes, farm machinery, foundry products and road signs became increasingly important. Meat and poultry processing also developed considerably.

The estimated number of employees on June 30, 1949, was 130,699, an increase of 26% over 1940; and the estimated annual wage per worker in manufacturing was $2,650 in establishments of eight or more.

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NORTH DWINA AREA, a unit of the northeastern region of European Russia, bordered on the west and north by Archangel, on the east and north by the autonomous Komi (Zirian) area, on the southeast by Vyatka, on the south by Gorky, on the southwest by Kostroma and on the west by Vologda. It has an area of 40,971 sq.mi. and a population (1926) of 678,255, of whom 80% are Great Russians and 18% Zirians. Over 80% of the region is clad with coniferous forest, the cleared areas being mainly along the river banks.

The Dwina and its tributaries, the Sukhona, Yug, Vychegda and Luza, drain the area; the Sukhona is most used for navigation, since it connects via the Württemberg canal both with Leningrad and with the Volga river. There are no bridges except the railway bridge over the Luza river.

Cultivation is most dense in the south, and along the river banks, but, apart from the 80% forest, there is 12.8% of marsh land, so that less than 10% is available for the production of the winter rye, oats, barley, flax and potatoes grown there. There is some meadow and pasture land, and horses, cattle, dairy cattle and pigs are bred, the latter in large numbers. The income from hunting and fishing is small, though the salmon and sterlet of the Dwina river are noted for their quality. Linen is the most important industry and exceeds pre-1914 level, as does production of hemp and jute rope.

In addition to river communications, the railway from Vyatka

reaches Kotlas (*q.v.*), which has wharves and grain elevators, and from which the railway is to be continued to Soroka on the Gulf of Onega, thus providing a further outlet for Siberian grain. From Ustyug-Velikiy (*q.v.*), the administrative centre, at the junction of the Sukhona and Yug, post roads, impassable in spring and autumn, go to Vologda and Gorky, and the town has telegraphic links with the south and also as far north as Krasnoborsk. Electrification proceeds rather slowly, though the few town centres have production plants. The peat reserves in the region should prove an asset in the future. The area needs much more intensive colonization for its full development. Recently the north India area ceased to exist as an independent unit and was divided between the Vologda and Archangelsk regions.

See M. I. Ivanovskiy, *The North Eastern Area* (1926) (in Russian).

NORTHERN AUSTRALIA, a term indefinite but applied generally to that portion of the continent which lies north of the Tropic of Capricorn (*c.* 1,150,000 sq.mi. = 0.386 or about $\frac{5}{13}$ of the whole territory), comprises the northern portions of Western Australia (364,000 sq.mi. = 0.373 of the state), of the (former) Northern Territory (426,320 sq. miles = 0.814) and of Queensland (359,000 sq.mi. = 0.535). Except for a practically continuous belt of coastal lowlands—broader along and up the river valleys of the northwest and north and around the Gulf of Carpentaria (*q.v.*), narrow to the point of disappearance along the northeast—almost the whole of this area consists of tablelands of 500–1,500 ft. general elevation with but few small and isolated higher areas in the west, northwest, northeast and central south. (*See* AUSTRALIA: *Geomorphology*.) Climate is thus the dominant factor and characteristic in this respect are prevailingly high temperature levels, 85°–75° F. (*c.* 68° in the central interior) and summer (monsoonal) rainfall: *c.* 60 in. along the north, sinking to 20 in. at about 18° lat. and to 10 in. and less farther inland. Thus, apart from the mineral wealth, of which little new has been discovered in recent years, the chief economic possibilities would appear to be pastoral development in the drier and more invigorating interior, scattered agriculture in the more humid lowlands and fishing—including pearl-oyster, etc., fishing (*see* BARRIER REEF)—around the coasts. The ultimate commercial and strategic importance of certain parts of the coasts are probably also considerable.

The regional differentiation inherent in so vast an area will increasingly invalidate generalizations about it and the tropical portions of Queensland and Western Australia are best dealt with under those States (*qq.v.*). The area which was till recently called the Northern Territory is on a somewhat different basis, and as it also offers a fair average cross section of northern Australia, a brief account of it is given here.

The area in question extends from the Western Australian to the Queensland border (Longs. 129°–138° E.) and from the north coast—including adjacent islands, *e.g.*, Melville, Bathurst, Groote Eylandt—to the South Australian border (26° S. lat.) and covers 523,620 square miles in all. After a chequered history it was handed over by South Australia to the commonwealth in 1911, and, as a result of further and on the whole unsuccessful experience, it was subdivided—in March, 1927, under the northern Australia act of 1926—into North Australia and Central Australia, lying respectively north and south of lat. 20° S., to the administered, from Newcastle Waters and Alice Springs (*q.v.*) respectively, as commonwealth territories, each by a government resident assisted by an advisory council of four. In 1931 the two sections were again united under an administrator at Darwin.

North Australia (287,056 sq.mi.) consists mainly of rolling country which rises from the coastal lowlands and valleys to a general level of 500–1,000 ft. inland. In the north is the rather higher (sandstone) tableland of Arnhem Land and on the east and west the land rises gradually to the Barkly tableland and the Kimberley plateau respectively. In the south the swell of the land forms (17°–20° S. lat.) an almost imperceptible watershed between the coastward and inward flowing drainage. The coast is mostly low, sand beaches and mangrove mud swamps alternating with cliffy bluffs, but some fine natural harbours ("drowned" river mouths) exist (*e.g.*, Port Darwin). There are two seasons, the wet (Nov.–May) and the dry, and the average ann. rainfall ranges from *c.* 40 in. in the north (Darwin: 62 in.) to 14 in. in the south, Temperatures are high, but the range is greater, the heat is drier and more bearable, and the winters are cooler towards the south (Darwin, av. ann. temp., 85.7°–77.2° F.; Daly Waters [300 miles inland], 88.2°–68.6° F. [*cf.* Alice Springs *inf.*]). In the wet season the streams are mostly swollen, swift and liable to flood and wide areas in the valley bottoms are then under water while inland are lagoons and swamps (Lakes Woods, de Burgh, etc.). The Victoria, Daly, Roper and McArthur are considerable streams but are normally navigable only in the dry season for small craft (4 ft. 6 in. draught; cargo capacity 35 tons). The valleys are often timbered and open forests occur in parts, but the prevailing vegetation is of the savanna type—grass with scattered trees—merging inland into poorer scrub with soft spinifex in the sandy southwestern corner. From Camooweal (Queensland) to Newcastle Waters, in the upper Victoria river basin, and also southwestward toward Hall's Creek (Western Australia) are broad belts and patches ("many thousands of square miles") of open black soil (limestone and volcanic) plains bearing first class fodder grasses (Mitchell, Flinders, etc.) and edible scrubs and here are the principal cattle stations (*e.g.*, Alexandra, Anthony's Lagoon, etc., on the Barkly tableland; Wave Hill, etc., on the Victoria river). Surrounding these and occupying the bulk of the central belt are great expanses of more mixed country, fairly well grassed and watered and containing good patches. The sandy plateaux of the north and of the coastal margins have many well-grassed valleys and the swampy flats mentioned above. Lateritic and travertine incrustations, products of climatic and soil conditions, render considerable areas unproductive. Water is, generally speaking, available on the surface or in underground supplies and various minerals are found around Pine Creek. The chief economic potentialities have been indicated. Efforts towards development have not hitherto been conspicuously successful and a summary of the present (1927) economic and social position will suffice.

Population: Europeans, *c.* 3,306; non-Europeans (mainly Asiatics) 744; aboriginals, 15,000. *Land Tenure:* Of the total area *c.* 750 sq.mi. have been alienated, *c.* 8,000 sq mi. have been reserved for aboriginals and 1,025 for mission stations, while 160,850 sq.mi are leased for pastoral purposes, nearly one-half (or *c.* $\frac{1}{4}$ of the whole of North Australia) of which is held by six lessees. *Stock* (including Central Australia): cattle, 923,000; horses, 32,700; goats, 20,300; and sheep, donkeys, mules, camels, etc. (Cattle and horses do well; sheep do best on the Barkly tableland.

Products:—*Minerals:* output, gold £109,000, wolfram £78,277, mica £19,712, together with some tin and copper. *Fisheries:* pearl shell (179 tons) £14,350, besides small quantities of other products. *Nuts and Grains:* ground-nuts (peanuts), cotton and millet; coconuts are grown on a small scale. *Trade:* exports: cattle exported by land, 98,400 (Darwin exports £29,800, mainly cattle to Manila; this trade in cattle has since been discontinued). Imports £29,406. *Communications:* railways (3 ft. 6 in. gauge), from Darwin to Emungalan (199 miles), has been extended to Birdum, 316 miles from Darwin. Bush tracks: *c.* 3,500 miles. Telegraph and cables: Darwin overland line southwards (to Adelaide), also cables (3 lines) to Java, Singapore, etc. Wireless: Darwin and various cattle stations. Steamer: Darwin to eastern (Australian) states, monthly; to Western Australia, every two months. Inland mail services: 6-weekly (pack horse). After World War II was declared, a good motor road was made from Birdum to the railway at Alice Springs.

General Social and Economic Conditions.—Isolation, lack of communications, pioneering conditions, climatic influences have contributed to social and political unrest, lack of balance, and of continuity and stability. Wages have been high, labour scarce and exacting, much effort and expenditure has produced small results. The total cost of the Northern Territory to the commonwealth (1911–1926) was nearly £9,000,000, including deficits taken over from South Australia (*c.* £4,000,000). Climatic difficulties, though serious, do not appear insuperable, but more

attention must be devoted to hygiene (housing, ventilation, diet, etc.) and to economic adjustments and adaptations (*e.g.*, morning and evening hours of work).

Darwin (pop. 2,538 in 1947), at present the seat of the administration, is well built and well laid out with wide streets, has stone buildings and amenities (botanic gardens, etc.) and a natural harbour capable of improvement. The subtropical district around Darwin does not invite agricultural development. In the better grazing districts to the south the rainfall is not suited to most crops with which Australians are familiar, though some peanuts, millets and cotton may be possible in the distant future. It is significant that the first recommendations of the commission should be directed toward the improvement of communications—railways, particularly the linking of the Darwin-Daly Waters line with the Queensland system via Camooweal, motor roads, stock routes, ports, notably a port on the gulf coast at the Sir Edward Pellew Islands to serve the Barkly tableland and farther interior—besides increased telegraphic, wireless, aerial and coastal shipping services; toward improved water supply and hygienic and social facilities (*e.g.*, broadcasting), and toward the initiation of organized scientific research.

(*See* also CARPENTARIA, GULF OF.)

Central Australia (236,400 sq.mi.) is an oblong area lying between latitudes 20° S. and 26° S. and longitudes 129° E. and 138° E. The flat-lying sediments (sandstones, etc.) which were the floor of an ancient (Mesozoic) sea were subsequently elevated and denuded and now form a plateau, highest (*c.* 2,000 ft.) in the centre and sloping down gently eastwards and southeastwards to the Eyre-Diamantina basin in Queensland and South Australia. In the north an extension of the West Australian "platform" stretches eastwards. (*Cf.* Murchison and Davenport "ranges," *c.* 1,000 ft.) Across the centre lie the Macdonnell ranges (Mount Heughlin, 4,800 ft.), a series of parallel ridges and troughs composed partly of hard folded (Palaeozoic) rocks, the uptilted edges of the above-mentioned plateau. The main drainage lines originate amidst, and north of, the Macdonnell range and run southeast (Finke, Todd, etc.) towards Lake Eyre. These streams, during a former rainier epoch, incised their courses to keep pace with the uplift (*v. sup.*) and have sawn through the hard ridges remarkable transverse gorges valuable because of the facilities they offer for routeways and for the impounding of water. Today the beds contain streams only after rains, the lower courses being normally long tree-lined tracks of water-bearing sand and gravel. The climate is transitional between that of northern and southern Australia and shows continental extremes (Alice Springs [alt. 2,000 ft.]: av. ann. temps. 84°–52.5° F with cool and bracing winters; rainfall occurs throughout the year with summer maximum and variations from 28.5 in. to 5 in.). Mainly steppe country with sparse scrub (mulga, etc.), low scattered growths, and grass in good seasons, the earth lies bare and dust-swept in times of drought except where stream courses, soaks, and waterholes afford a little moisture. Clay and stone desert patches occur and in the little-known northwest and southwest, and again in the east, are areas of sandridge, spinifex, saline flats (Lake Amadeus), and some scrub. In the more humid northwest are areas of seasonal swamp. (*Cf.* North Australia.) After rains the country is transformed as by magic; flowery grasslands spread like seas to the horizon, streams and pools sparkle, life awakens and flourishes for a space. Apart from a little agriculture for home needs—some of it possibly by irrigation—the economic future seems to lie mostly in the direction of pastoralism and mining. Minerals—gold (*e.g.*, Arltunga), mica, nitrates—a recent discovery—exist, the mica crystals are large and rather valuable. Erratic rainfall, rabbits and dingoes are the bane of the pastoralist and little stability can be obtained until water resources—superficial and underground—have been tested and supplies assured. Some 76,000 sq.mi. have been let under pastoral leases or grazing licences but as in North Australia the conditions of land tenure seem to need revision. Given water—horses, sheep, cattle, and live stock generally thrive, as do also human beings, in the climate. (Live stock: *c.* 117,000 head—including 85,000 cattle, 15,000 horses.) But costs of all necessities—including fencing and mining machinery—have been prohibitive. Transport has been by camel, horse or mule train, but motor traction is possible and is increasing. The overland telegraph line traverses the heart of the area and along it—with its government wells—lies the chief route for stock and men. Apart, too, from a few mining, cattle, and mission stations and blacks' encampments, practically all the population (whites: *c.* 410; aboriginals: *c.* 4,000) lives in telegraph stations along this route. The railway line (3-ft. 6-in. gauge) from Oodnadatta (South Australia) was built by 1929, and this extension brings Alice Springs (*q.v.*) within 60 hours (*c.* 1,000 miles) of Adelaide. Another line may ultimately be built from Alice Springs to the proposed port at the Sir Edward Pellew Islands (Carpentaria, Gulf of, *q.v.*) thus giving the area a northern outlet as well. Except near Alice Springs most of Central Australia has not been found worth occupying. But with improved conditions of water supply, transport, fencing (against dingoes, etc.), its stock holding capacity, though it will never be high, will probably improve somewhat in the future. In particular new sheep areas await development here and facilities for movement (railways, stock routes, etc.) will help to combat drought. Much of the southwest portion has been made into an aboriginal reserve.

NORTHERN IRELAND: *see* IRELAND, NORTHERN.

NORTHERN PACIFIC RAILWAY. The main line of the Northern Pacific railway extends from Ashland, Wis., United States, through the states of Minnesota, North Dakota, Montana, Idaho, Washington and Oregon, to Seattle and Tacoma in Washington and to Portland, Oregon. Its main terminals in the east are St. Paul, Minneapolis, Duluth and Superior; in the west, Seattle, Portland and Tacoma. It was constructed under an act of congress approved by President Lincoln on July 2, 1864. With its completion in 1883 the vast territory adjacent to it was first made accessible to settlers, and the government's long-cherished aim of opening to the north Pacific coast a route following, roughly, that taken by the explorers Lewis and Clark in their expedition of 1804–06, was at length realized.

The Northern Pacific system consisted in 1939 of about 6,720 mi. of operated railroad. It owned also nearly one-half of the stock of the Chicago, Burlington and Quincy Railroad company, and exactly one-half of the stock and bonds of the Spokane, Portland and Seattle Railway company, operating together 11,000 mi. additional. A large part of the tonnage which it carries consists of the products of agriculture and of the forest; but its traffic is well diversified and its earnings, under normal conditions, are comparatively stable. It has outstanding 2,480,000 shares of stock of a par value of $100 each. Its bonded indebtedness in 1939 was $316,000,000. (C. E. DE.)

NORTHFIELD, a city of Rice county, Minnesota, U.S.A., on the Cannon river 35 mi. S. of St. Paul. It is on federal highway 65, and is served by the Chicago Great Western, the Chicago, Milwaukee, St. Paul and Pacific, the Minneapolis, Northfield and Southern, and the Rock Island railways, and by motorbus lines. Population (1950) 7,487 by the federal census. It is the seat of St. Olaf college (Norwegian Lutheran, 1874) and of Carleton college (1866). The former is the home of the St. Olaf Lutheran choir, and a centre of Norse culture. Carleton is known for the work of its science departments and strong liberal arts faculty. Northfield is surrounded by a rich farming and dairying region, where the breeding of Holstein cattle is an important specialty. It was settled by New Englanders in 1856; named after John W. North, who platted it, and chartered as a city in 1875.

NORTHFLEET, an urban district in the Gravesend parliamentary division of Kent, Eng., on the River Thames, 20 mi. E.S.E. of London bridge and 2 mi. W. of Gravesend by road. Pop. (1951) 18,803. Area 5.9 sq.mi. The town is an industrial centre with printing works and factories for cement, paper, electric cables, etc. The church of St. Botolph is of Norman foundation, the nave is Decorated and the chancel Perpendicular, and the tower was rebuilt in 1628. Swanscombe (pop., 1951, 8,295) adjoins Northfleet on the southwest. Its name is said to be derived from a camp formed there by the Danish king Sweyn, and tradition fixes at that spot the meeting between William the Conqueror and the men of

Kent, to whom was confirmed the possession of all their ancient privileges.

NORTH HOLLAND, a Netherlands province, lying between the North sea and the Zuider Zee (IJsselmeer) and bounded southward by the provinces of South Holland and Utrecht. The present area, including the islands of Texel, Vlieland and Terschelling, in the West Frisian group, and Marken and Urk in Zuider Zee, the isle of Wieringen having been incorporated with the mainland, as starting point of the Afsluitdijk (closing dike) which drains the Zuider Zee and connects the provinces of North Holland and Friesland, is 1,065 sq.mi., with pop. (1950) 1,847,272, showing an increase during the 20th century from 905 per square mile to 1,808 per square mile. Three natural divisions can be recognized: (1) foreshore and sand dunes, (2) inner dunes and the *geest* grounds, (3) low fens and clay lands. The dunes form a long, smooth, unbroken protection for the other regions, and the absence of deep inlets explains the absence of commercial towns. Ijmuiden is a small town, and its recent creation was solely dependent on its position at the exit of the artificial North sea canal from Amsterdam. Nevertheless, the broad, gently sloping, sandy beach is admirable for sea bathing and permits the beaching of the characteristic flat-bottomed fishing boats used at Zandvoort and at smaller fishing villages. Bergen aan Zee, Egmond aan Zee and Wijk aan Zee are gay little unconventional resorts. In the second zone, behind recently planted woods, especially along the margin of the *geest* grounds, from about 5 mi. N. of Haarlem to 10 mi. S., hyacinths, tulips, narcissi and crocuses, in exact squares of brilliant and varied colours, attract numerous tourists each springtime, while market gardens provide valuable and continuous products for home and foreign trade.

This part of North Holland was early inhabited and contains many old towns and villages. Some of the most interesting are Haarlem (pop. 161,980), the seat of government of the old counts of Holland and the scene of the great resistance of 1573—one of the most glorious failures in history. Near to Haarlem are the extensive red brick ruins of Brederode castle, the seat of an old and illustrious family. Nearer to the south border is Bennebroek, the site of a 10th-century nunnery. Alkmaar (*i.e.*, all water) (pop. 31,774), though originally belonging to the lowland zone, also has important historical associations, including its personal success against the Spaniards in the Eighty Years' War. Near Alkmaar are Schoorl, a village in the 9th century; Bergen, also of considerable antiquity; Heiloo, stated to be the site of a church built by St. Willibrord in the 8th century; and the villages of Beverwijk and Velsen. Other possessions of the same apostle still remain, while Egmond, near by, was famed for its great abbey. Nearer Helder (pop. 37,113) is Schagen, a flourishing village in the 12th century, a lordship in the 15th, but of no special importance today.

The third division comprises much the largest area, that lying at or below sea level. Considerable land reclamation has been effected. To the north of the former Y (or IJ) the famous Purmer and Beemster lakes were drained in the beginning of the 17th century; but several sea polders to the north of these were added to the mainland only in the first half of the 19th century. This region is traversed by the 46-mi. North Holland canal (1819–25), between Amsterdam and Helder. The Y, formerly an inlet of the Zuider Zee, was drained, and the direct east-to-west 15-mi. North sea ship canal was cut in its stead (1865–76); in the south, Haarlem lake (72 sq.mi.) was drained between 1840 and 1853. The landscape in this lowland division is more typically Dutch than elsewhere. The province is very poor in minerals. Consequently cattle rearing and cheese manufacture (chiefly Edam) are the main industries, but agriculture and even market gardening are also practised in the heavier clay lands of the polders. Purmerend, the natural focus of the Purmer, Wormer and Beemster polders, with street and canals too narrow to contain the present market-day produce; Alkmaar, the great cheese town with a famous weigh house; and Enkhuizen, one of the "dead cities" of the Zuider Zee, are the chief market centres. The security offered by the Zuider Zee for trade and fishing was the prime factor in the commercial development of North Holland, and the cities of Medemblik, Enkhuizen, Hoorn, Edam and Monnikendam, though now of little more than local importance, possessed a large foreign commerce in the 16th and 17th centuries. This prosperity later concentrated itself upon the Y (that is, upon Amsterdam; *q.v.*) and upon the series of industrial settlements situated on its offshoot, the Zaan, of which Zaandam (pop. 43,218, with oil, saw, corn, cement and paper mills) is the most important.

Of the islands, Marken is rapidly learning how to commercialize its own quaintness, though it is not yet entirely spoiled. Microscopic Urk has a population (about 3,000) largely dependent on the North sea fishery. Texel is noted for sheep and their products, wool and green cheese, and also for sea birds' eggs, which are exported to Amsterdam. Vlieland and Terschelling are but slightly populated and relatively unimportant.

NORTHINGTON, ROBERT HENLEY, 1ST EARL OF (*c.* 1708–1772), lord chancellor of England, was the second son of Anthony Henley, a Whig member of parliament and a well-known wit and writer. Robert was educated at Westminster school and St. John's college, Oxford, and was called to the bar in 1732. In 1747 he was elected member of parliament for Bath, of which he became recorder in 1751. He acquired a lucrative practice at the bar and in 1756 was appointed attorney general. In the following year he was promoted to the office of lord keeper of the great seal, being the last person so designated. For three years he presided over the house of lords as a commoner, having incurred the hostility of George II. He was given the title of Baron Henley in 1760 so that he could preside at the trial of Earl Ferrers for murder.

On the accession of George III the office of lord chancellor was conferred on Henley, and in 1764 he was created earl of Northington. In 1765 he presided at the trial of Lord Byron for killing William Chaworth in a duel. Northington, who was a member of the group known as "the king's friends," was instrumental in procuring the dismissal of the marquess of Rockingham and the recall of Pitt to office in 1766, and he himself joined the government as lord president of the council, Lord Camden becoming chancellor. He resigned office in 1767 and died at his residence in Hampshire on Jan. 14, 1772.

See Lord Henley, *Memoir of Robert Henley, Earl of Northington* (1831); Campbell's *Lives of the Chancellors;* Foss's *Judges of England;* Horace Walpole's *Memoirs.*

NORTH LITTLE ROCK, a city of Pulaski county, Ark., U.S., on the Arkansas river, opposite Little Rock; served by the Missouri Pacific, the Rock Island and the St. Louis Southwestern railways. Pop. (1950) 44,097 by federal census. It is an industrial and distribution centre, with extensive railroad shops and miscellaneous types of manufacturing industries.

NORTH PACIFIC COAST INDIANS. The Indians of the coast of southern Alaska, British Columbia, Washington, Oregon and northern California formed an areal grouping of tribes with a common cultural foundation. The principal tribes and stocks comprised are the Tlingit, Haida, Tsimshian, Kwakiutl, Nutka, Bella Coola and other Coast Salish, Chimakun, Makah, Chinook, Yakonan, Kus, Takelma, Yurok, Wiyot, Karok and the Hupa and other Athabascan groups. Linguistically there was considerable diversity among these groups; otherwise their similarities exceeded their differences. Generic cultural features extending over the entire area were: dependence primarily on fish, especially salmon; coastal maritime navigation; development of woodworking, including the carver's art; wealth accumulation, with an elaborate system of economic exchange and property law; the organization of society on the basis of hereditary rank dependent on economic status; religious cults heavily influenced by proprietary rights. Particular traits exemplifying these trends were: deep-sea fishing; whale hunting; large dugout canoes with plank lashings for higher freeboard; mat sails; clothing largely of mats, with basketry hats; twined basketry with overlay decoration; villages of large, all-frame houses facing the beach or river; totem poles and wooden grave monuments; boxes for cooking, storage, etc.; clubs, spoons and most utensils, also rattles, masks, etc., elaborately carved or painted in a peculiar totemic-symbolic art style; dentalium shells, plates of native copper, boxes, etc.,

serving as standardized mediums of exchange, often with high fictitious credit values; potlatches or competitive socioreligious festivals with wealth distribution for prestige; loans with high rate of interest; division of society into rich nobles with titles, crests and privileges, commoners and slaves; marriage by purchase; secret religious societies with elaborate ranks and masks. The greatest concentration and elaboration of this distinctive combination of traits occurred among the Haida, Tsimshian and Kwakiutl. In several respects, however, the classic manifestations of the complex among these tribes were late and short lived. Thus, woodworking and potlatching were greatly stimulated through access to iron tools and external sources of wealth subsequent to 1800, but both practices were on the decline well before the end of the 19th century.

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NORTH PLATTE, a city of Nebraska, U.S., 280 mi. W. of Omaha. It is on the Lincoln highway, a main transcontinental airway and the main line of the Union Pacific railroad. The population by the federal census of 1950 was 15,433; (1940) 12,429. The city has one of the largest icing plants in the country. The irrigated region raises sugar beets and hay. There is a station of the U.S. weather bureau and a state agricultural experiment station 4 mi. S. "Scouts Rest," the ranch of Col. W. F. Cody ("Buffalo Bill") is 3 mi. N.W. North Platte was incorporated in 1871.

NORTHROP, JOHN HOWARD (1891–), U.S. biochemist, winner of the 1946 Nobel prize in chemistry with W. M. Stanley and J. B. Sumner, pioneer in crystallization of enzymes and related substances, was born July 5, 1891, at Yonkers, N.Y.

Columbia trained, he received his doctor's degree in 1915 and later studied with Jacques Loeb at the Rockefeller Institute for Medical Research on theories of life duration. He became a member of the institute in 1924. In 1949 he was named research professor of bacteriology at the University of California, Berkeley. Early work on fermentation to produce acetone and ethyl alcohol led to the study of enzymes essential for digestion, respiration and general life processes. He showed that enzymes obey chemical laws. In 1930 Northrop prepared pepsin in pure crystalline form. With M. Kunitz he succeeded in crystallizing the enzymes trypsin and chymotrypsin as well as their precursors trypsinogen and chymotrypsinogen. With Roger M. Herriott he isolated crystalline pepsinogen. He studied proteins of meat, viruses and antibodies. From the intestines of mammals, Northrop isolated a bacteriophage, a virus which destroys bacteria. He also made studies on starch, the kinetics of bacteriophage, agglutination of bacteria and temperature effect on insects. In 1941 he purified diphtheria antitoxin. In 1939 he published *Crystalline Enzymes* and assumed the editorship of the *Journal of Physiology* of the Rockefeller institute. He served in the chemical warfare service in World War I as captain, and in World War II he was consultant to the National Defense Research committee. (V. Bw.)

NORTH SEA, a sea occupying a shallow basin between Great Britain and continental Europe. It extends southward from the edge of the continental shelf north of the Shetland Islands to the Straits of Dover, covering an area of about 222,100 sq.mi. Its bed slopes gently down from south to north as a rule. The southern areas are very shallow, with many low ridges of sand barely covered at low tide. Off the Holderness coast the Silver Pits and other east-west trenches show depths of more than 50 fathoms in places. The Dogger bank, a submerged plateau, rises abruptly to the north of these depressions and occupies about one-third of the width of the sea. Depths over the bank vary from 8 to 20 fathoms and are less than 10 fathoms over 250 sq.mi. of its area. The nets of trawlers fishing on the Dogger have brought up masses of peat, sometimes containing teeth and bones of prehistoric land animals, showing it to have been a wooded area after the close of the Ice Age. To the north the bed slopes very gently, though cut by several depressions, until the continental edge is reached. In the northeast the Norway deep or Gut is a remarkable feature. It begins off Alesund as a break in the edge of the continental shelf and extends southeastward as a narrow trench, parallel to the Norwegian coast, into the Skagerrak as far as Oslo. Its depth increases toward its head, depths of more than 400 fathoms being recorded in Skagerrak. Its edge rises very steeply on the Norwegian side but much more gently on the west.

History.—The North sea basin was formed by slow submergence during Tertiary times. Toward the close of the Pliocene period its southern margin lay along the northern edge of the Dogger bank and the north Yorkshire moors, a long estuary penetrating far to the south between them. This was probably the outlet of an ancestral Rhine to which the early Thames and other rivers of eastern England flowed over a marshy plain. During the glacial period most of the basin was repeatedly covered by ice sheets, and thick deposits of drift were laid down over the former plain. At the close of that epoch the Dogger bank, Holderness and a wide coastal plain beyond the present shores were all exposed. On these surfaces woodlands and peat swamps developed whose remains form the forest beds exposed at low tide at many points along the present coasts. It was on this land surface that the river systems of today were developed. A later rise of sea level led to the covering of this surface and brought about the formation of the Wash and the Humber and many of the minor estuaries on the English and continental shores. The present coastal limits, in their broad outlines at least, were finally determined in the period extending from Middle Stone Age to Bronze Age times. The Straits of Dover were probably first opened during the Ice Age.

Coasts.—The North sea coasts of Norway and Scotland are usually cliffed except along the more penetrating inlets. That these have been cut so often in highly resistant rocks is an indication of the long period during which wave action has continued at or about their present position. South of Berwick and the Skagerrak the coasts are composed of softer rocks, and cliffs, where present, might be of relatively recent formation even when, as in northeastern England, they are of considerable height. On the English side of the North sea, south of Flamborough head, low cliffs, often of boulder clay and fronted by sandy beaches, are characteristic. The continental shores are usually low and flat and backed by wide marshes, sometimes protected by coastal sand dunes and sometimes by artificial dikes. A slow but persistent down-warping seems to be taking place over all the southern areas of the sea and causing a relatively rapid shift of the coast line except where it is protected. Such floods as those of Jan. and Feb. 1953 are almost certainly indicative of this transgression of the sea upon the land.

Temperature and Salinity.—Thanks to the great influx of land water from the Baltic and from the many rivers which enter the North sea directly, its waters are less saline (34.5 *pro mille* on the average) than those of the Atlantic. Baltic water entering it has a salinity of less than 30 *pro mille*. Coastal waters are fresher than those of the central areas where tidal turbulence produces thorough mixing. Because of snow melt and higher winter rain, salinity is lowest in winter and spring. In summer and autumn, warmer Atlantic water of more than 35 *pro mille* salinity enters the basin from the north and through the Straits of Dover. These movements affect the migrations and spawning dates of fish. Sea temperatures are always high enough to prevent freezing.

Tides.—Tides from the ocean enter the North sea in three main streams: (1) around the north of Scotland and advancing southward along the east coast of Britain; (2) from the English channel and moving along the Dutch and German shores; (3) along the Norwegian coasts toward the Skagerrak. A counterclockwise circulation, though with several minor eddies, is thus produced. The flood tide of the Scottish system reaches the Thames estuary at the same time as the next succeeding high tide coming up-channel, and the interference of the two waves produces local complications. Thus the range of tidal levels off the Thames is increased and the range between Yarmouth and the Helder decreased by their interaction. Tidal ranges on the British coasts are about double those on the Dutch and German and nearly four times those on the Norwegian coasts.

Fisheries.—The waters of the North sea are extremely rich

in many forms of marine life. Especially are they so in the microscopic forms of plant and animal life, known collectively as plankton, on which either directly or ultimately all fish depend for their food. The amazing abundance of this food supply is attributed to many factors—the mingling of Atlantic waters with local waters differing from them in temperature; the plentiful supplies of food substances derived from the land; the turbulence of the sea because of storms, and tidal and other currents, all contributing to its aeration; and the shallowness permitting the penetration of sunlight to the sea bed. In consequence, few other seas rival the North sea in the quantities of food fishes it supports. The chief varieties are herring, cod, haddock, plaice, sole and turbot. Herrings are found off the British coasts between June and November when they gather in great shoals in the surface waters. Mackerel appear in the same waters earlier in the year. Cod are caught mainly on the Dogger bank (*dogger* in Dutch signifies cod) and in the colder northern waters. The flat fish prefer the shallower seas except in winter when they move to such deeper waters as those of the Silver Pits. At other times they are found mainly in the southern and eastern regions from the Thames estuary to Denmark.

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NORTH SHIELDS, seaport, Northumberland, England, within the borough of Tynemouth (*q.v.*, for history, etc.), which adjoins it on the east. It lies immediately above the mouth of the Tyne, opposite to South Shields, 7½ mi. E. of Newcastle by a branch of the North-Eastern Region railway. It is a town of modern growth. Coal and coke are largely exported, and corn, timber and esparto grass are imported. There is an extensive fish quay. There are marine engineering (engines, chain cables, anchors), salt, rope, earthenware and stained glass works and some shipbuilding is carried on.

The town was specially affected by the depression of the 1930s, more than 27% of the insured population being unemployed in June 1934.

NORTH TONAWANDA, a city and a port of entry of Niagara county, N.Y., U.S., on the Niagara river, at the western terminus of the State Barge canal (opposite Tonawanda), 14 mi. N. of Buffalo.

It is on the boulevards connecting Buffalo and Niagara Falls, and is served by the Erie, the Lehigh Valley, and the New York Central railways and by motor-bus lines. The population of North Tonawanda was 24,731 in 1950; in 1940 it was 20,254; and in 1930, 19,019 by the federal census.

Though separately incorporated, the two Tonawandas are practically one community. Electric power rates are among the lowest in the United States.

The cities have a great diversification of industry, and manufacture, among other things, musical instruments, office equipment, nuts and bolts, bakelite, chains and hoists, paper products, steam pipes, silk products, skis, wagons and sleds, furniture, chemicals and roofing supplies.

North Tonawanda was settled in 1809, incorporated as a village in 1865 and chartered as a city in 1897.

NORTHUMBERLAND, EARLS AND DUKES OF. The earldom, and later the dukedom, of Northumberland, are famous in English history by their connection with the house of Percy (*q.v.*).

In the year 1377 Henry de Percy, 4th Baron Percy, officiated as marshal of England at the coronation of Richard II and was created earl of Northumberland. With his son Sir Henry Percy, the celebrated "Hotspur," the earl played a leading part in the history of the period, especially in bringing about the deposition of Richard II and the accession of Henry IV. The quarrel of Northumberland and his son with King Henry over the ransom of their Scottish prisoners taken at Homildon Hill on Sept. 14, 1402 has been immortalized by Shakespeare; and in consequence of their rebellion all the earl's honours were forfeited in 1406. He was not himself present at the battle of Shrewsbury in July 1403, when Hotspur was killed, but he was slain, heading a fresh rebellion, at Bramham Moor on Feb. 19, 1408.

The 1st earl of Northumberland was succeeded by his grandson, Hotspur's son, HENRY (*c.* 1394–1455), who was restored to the earldom and the estates of the Percies in 1414 and was killed at the battle of St. Albans in May 1455. The title then descended in the male line till the death of the 6th earl in 1537. During the Wars of the Roses the Percies took the Lancastrian side, which led to the attainder of Henry the 3rd earl (1421–1461) during the time of the Yorkist triumph, his forfeited title being conferred in 1464 by Edward IV. on John Neville, Lord Montagu (*see* the separate article, p. 538), by a patent which was cancelled a few years later. The earldom, together with the barony of Poynings which his father had obtained by marriage, was restored in 1473 to Henry Percy, son of the 3rd earl, who attached himself to Edward IV., acquiesced in the accession of Richard III., and submitted to Henry VII., by whom he was received into favour. His grandson Henry, the 6th earl (*c.* 1502–1537), left no direct heir, and the latter's nephew, Thomas Percy, was debarred from the succession by an attainder passed on his father for his participation in the Pilgrimage of Grace. In 1549, however, Thomas was restored in blood, and in 1557 he became by a new creation earl of Northumberland, 7th of his line. Meantime, in 1551, John Dudley, earl of Warwick, was created duke of Northumberland (*see* NORTHUMBERLAND, JOHN DUDLEY), his title being, however, forfeited by attainder in 1553.

The earldom restored to the house of Percy by the creation of 1557 continued without interruption in the male line till 1670. The 7th earl was beheaded in 1572 for sharing in a conspiracy in which he was joined by the earl of Westmorland with the object of securing the release of Mary Queen of Scots and the free exercise of the Catholic religion. By the earl's attainder the baronies of Percy and of Poynings and the earldom of Northumberland of the older creation were forfeited, but owing to a clause in the patent the newer earldom of Northumberland and the other honours conferred in 1557 passed to his brother Henry (*c.* 1532–1585), who is usually known as the 8th and not the 2nd earl.

Henry's grandson, ALGERNON PERCY, 10th earl of Northumberland (1602–1668), son of Henry the 9th earl (1564–1632), became a peer in his father's lifetime as Baron Percy in 1626. Northumberland played a distinguished part in the Civil War. He was a friend of Strafford, and gave evidence at his trial which, though favourable on the important point of bringing the Irish army to England, was on the whole damaging; and he afterwards leaned more and more towards the popular party, of which he soon became leader in the House of Lords. He was a member of the committee of safety, and later of the committee of both kingdoms; and he took an active part in the attempts to come to terms with the king, whom he visited at Oxford for that purpose in 1643 and at Uxbridge two years later. Northumberland helped to organize the new model army; and in 1646 he was entrusted by parliament with the charge of the king's younger children. He led the opposition in the House of Lords to the proposal to bring Charles I. to trial, and during the Commonwealth he took no part in public affairs. At the Restoration he was called to the privy council by Charles II., and with his habitual moderation deprecated harsh proceedings against the regicides. His second wife, Elizabeth (d. 1705) daughter of Theophilus Howard, 2nd earl of Suffolk, brought him Northumberland House in the Strand, London, which was demolished in 1874 to make room for Northumberland avenue. On the death of his son Joceline, the 11th earl, in 1670, the male line became extinct.

George Fitzroy (1665–1716), third son of Barbara, duchess of Cleveland, the wife of Roger Palmer, earl of Castlemaine, by King Charles II., was created by his father earl of Northumberland in 1674, and duke in 1683. This second dukedom of Northumberland became extinct on his death at Epsom on July 3, 1716.

Meanwhile Elizabeth Percy, daughter of Joceline, the 11th earl, had married Charles Seymour, 6th duke of Somerset; and her son Algernon, the 7th duke, was in 1749 created Baron Warkworth and earl of Northumberland, with remainder to

his son-in-law, Sir Hugh Smithson, Bart., son of Langdale Smithson of Langdale, Yorkshire. Sir Hugh Smithson (*c.* 1714–1786) took the name and arms of Percy on inheriting the earldom in 1750; in 1766 he was created Earl Percy and duke of Northumberland; and in 1784 he was further created Baron Lovaine of Alnwick, with special remainder to his second son, Lord Algernon Percy. He took a prominent part in politics as a follower of Lord Bute, and was one of George III.'s confidential advisers, holding the office of lord-lieutenant of Ireland from 1763 to 1765, and that of master of the horse from 1778 to 1780. He was a man of cultivated tastes, and spent much money in repairing and improving Alnwick castle and his other residences. His wife, Elizabeth (1716–1776), inherited in her own right her father's barony of Percy. The duke was succeeded by his eldest son Hugh; and his second son Algernon, Lord Lovaine, was created earl of Beverley in 1790.

Hugh, 2nd duke of this line (1742–1817), first inherited his mother's barony of Percy. He was present at the battle of Minden, and although in parliament, where he was member for Westminster from 1763 to 1776, he had opposed the policy that led to the American war, he proceeded to Boston in 1774 as colonel commanding the 5th Fusiliers, a regiment that has since then been known as the Northumberland Fusiliers. He succeeded to the dukedom in 1786, and became general in 1793. His son Hugh, 3rd duke (1785–1847), was lord-lieutenant of Ireland in 1829–1830, when the Catholic Emancipation Act was passed, and was pronounced by Sir Robert Peel "the best chief governor that ever presided over the affairs of Ireland." Both he and his brother Algernon, 4th duke (1792–1865), who was created Baron Prudhoe in 1816, died without issue; the barony of Percy devolved on their great-nephew, the duke of Atholl, and the dukedom passed to George (1778–1867), eldest son of Algernon, 1st earl of Beverley, and so to his son, the 6th duke (1810–1899), and grandson, the 7th duke (1846–1918).

See Edward Barrington de Fonblanque, *The House of Percy* (2 vols., 1887); G. E. C(okayne), *Complete Peerage,* vol. vi. (1895).

NORTHUMBERLAND, ALAN IAN PERCY, 8TH DUKE OF (1880–1930), was born on April 17, 1880, a son of the 7th duke. He succeeded to the title in 1918. As one of the largest coal-owners in the north of England, he was summoned to appear as a witness before the Sankey Coal Commission (1919) and came much into public notice owing to his prolonged controversy with Robert Smillie, the leader of the miners, and subsequently to his anti-Communist campaign. In 1924 the duke acquired an interest in *The Morning Post* newspaper, sold by Lady Bathurst. He died Aug. 23, 1930.

NORTHUMBERLAND, JOHN DUDLEY, VISCOUNT LISLE, EARL OF WARWICK, and DUKE OF (*c.* 1502–1553), was the eldest son of Henry VII.'s minister, Edmund Dudley (*q.v.*), by his second wife Elizabeth, daughter of Edward Grey, Viscount Lisle, and co-heiress of her brother John, Viscount Lisle. He was probably descended from the old baronial house of Sutton *alias* Dudley; but his father's attainder and execution in 1509 clouded his prospects. His mother, however, married as her second husband in 1511 Arthur Plantagenet, the illegitimate son of Edward IV., who in 1523 was created Viscount Lisle in his wife's right; and Lisle's rise in Henry VIII.'s favour brought young Dudley into prominence. In 1512 he was restored in blood, and in 1538 he was made deputy to his step-father, who was governor of Calais, and he does not appear to have suffered by Lisle's temporary disgrace and imprisonment in the Tower. Lisle died early in 1542, and Dudley was created Viscount Lisle on March 12 and was made warden of the Scottish marches in November, and lord high admiral of England in 1543 in succession to his future rival, Edward Seymour, earl of Hertford. He was also created a knight of the garter and sworn of the privy council. In 1544 he accompanied Hertford to the capture and burning of Edinburgh. On the capture of Boulogne in September Lisle was given command of the town and of the Boulonnais; in 1545 he directed the operations of the fleet in the Solent which foiled the French attack on Portsmouth and the Isle of Wight; and he was sent to Paris to ratify the peace concluded in 1546.

Lisle had thrown in his lot with the reforming party, and he took an active share in the struggle at Henry VIII.'s court for control of affairs when Henry should die. Hertford and he were described by the Spanish ambassador as holding the highest places in Henry VIII.'s affections and as being the only noblemen of fit age and ability to carry on the government. The Howards were infuriated by the prospect, and Surrey's hasty temper ruined their prospects. Lisle quarrelled bitterly with Bishop Gardiner, served as commissioner at Surrey's trial, and was nominated one of the body of executors to Henry's will from which Norfolk and Gardiner were excluded. On Henry's death Lisle was raised to the earldom of Warwick and promoted to be lord great chamberlain of England, again in succession to Hertford, who became duke of Somerset and Protector. He accompanied Somerset on his Pinkie campaign, and materially contributed to the winning of that victory. Nor did he exhibit any sympathy with the intrigues of the Protector's brother, Thomas Seymour, the lord high admiral; his subtler policy was to exasperate the brothers and thus weaken the influence of the house of Seymour. He helped to bring the admiral to the block in March 1549; and then used the Protector's social policy to bring about his deposition. Warwick detested Somerset's ideas of liberty and his championship of the peasantry against the inclosure movement; one of his own parks was ploughed up as a result of a commission of enquiry which Somerset appointed; and when the peasants rebelled under Kett, Warwick gladly took the command against them. His victory at Dussindale made him the hero of the landed gentry, and as soon as he had returned to London in Sept. 1549, he organized the general discontent with the Protector's policy into a conspiracy. He played upon the prejudices of Protestants and Catholics alike, holding out to one the prospect of more vigorous reform and to the other hopes of a Catholic restoration, and to all gentry the promise of revenge upon the peasants.

The coalition thus created effected Somerset's deposition and imprisonment in Oct. 1549; and the parliament which met in November carried measures of political coercion and social reaction. But the coalition split upon the religious question. Warwick threw over the Catholics and expelled them from office and from the privy council, and the hopes they entertained were rudely dashed to the ground. But it was difficult to combine coercion of the Catholics with the proscription of Somerset; the duke was therefore released early in 1550 and restored to the privy council; and his daughter was married to Warwick's son. Warwick himself assumed no position of superiority over his colleagues, and he was never made protector. But he gradually packed the council with his supporters, and excluded his enemies from office and from access to the king. His plan was to dominate Edward's mind, and then release him from the trammels of royal minority. He abandoned the Tudor designs on Scotland, and made a peace with France in 1550 by which it recovered Boulogne and was left free to pursue its advantage in Scotland. Nor did the betrothal of Edward to Henry's daughter Elizabeth prevent the French king from intriguing to undermine English influence in Ireland. In domestic affairs Warwick pushed on the Reformation with none of the moderation shown by Somerset; and the difference between the two policies is illustrated by the change effected between the first and second Books of Common Prayer. Warwick, however, was widely distrusted; and the more arbitrary his government grew, the more dangerous became Somerset's rivalry. A parliamentary movement had early been started for Somerset's restoration. Warwick therefore kept parliament from meeting, and the consequent lack of supplies drove him into the seizure of church plate, sale of chantry lands, and other violent financial expedients. At length he resolved to get rid of his opponent; his opposition was magnified into conspiracy, and in Oct. 1551, after Warwick had made himself duke of Northumberland and his ally Dorset, duke of Suffolk, and had scattered other rewards among his humbler followers, Somerset was arrested, condemned by the peers on a charge of felony, and executed (Jan. 22, 1552).

Parliament was permitted to meet on the following day, but for the next 18 months Northumberland grew more and more unpopular. He saw that his life was safe only so long as he con-

trolled the Government and prevented the administration of justice. But Edward VI. was slowly dying, and Northumberland's plot to alter the succession was his last desperate bid for life and power. Its folly was almost delirious. Edward had no legal authority to exclude Mary, and the nation was at least nine-tenths in her favour. Northumberland bullied the council and overawed London for a few days; but the rest of England was in an uproar, and as he rode out to take the field against Mary, not a soul cried "God speed." A few days later he returned as Mary's prisoner. He was tried for treason, professed himself a Catholic in the delusive hope of pardon, and was executed on Aug. 22. He was a competent soldier and one of the subtlest intriguers in English history; but he had no principles. The violence of his pretended Protestantism was largely responsible for the reaction of Mary's reign. His best-known son was Robert Dudley, earl of Leicester, Queen Elizabeth's favourite.

See *Letters and Papers of Henry VIII.; State Papers, Domestic and Foreign, Edward VI. and Mary;* ms. 15,888, *Bibliothèque Nationale de France;* G. E. C(okayne), *Complete Peerage;* A. F. Pollard, *England under Somerset* (1900), *Life of Cranmer* (1904) and vol. vi. of the *Political History of England* (1910).

NORTHUMBERLAND, JOHN NEVILLE, Earl of (*c.* 1430–1471), English soldier, was the third son of Richard Neville, earl of Salisbury, and a brother of Richard Neville, earl of Warwick, the "king-maker." In 1459–61 he was twice a prisoner of the Lancastrians and in 1463 as warden of the east marches towards Scotland, he was responsible for the Yorkist victories at Hedgeley Moor and at Hexham in April and May 1464. In this year (1464) he was created earl of Northumberland, the Percies being now crushed, and their head, Henry Percy, being in prison. Northumberland did not at first join his brother Warwick and the other Nevilles when they revolted against Edward IV., but neither did he help the king. Edward, doubtless suspecting him, restored the earldom of Northumberland and its vast estates to Henry Percy, while John Neville's only recompense was the barren title of marquess of Montagu. At Pontefract in 1470 he and his men declared for Henry VI., a proceeding which compelled Edward IV. to fly from England, and under the restored king he regained his position as warden, but not the earldom of Northumberland. He did not attempt to resist Edward IV. when this king landed in Yorkshire in March 1471, but he fought under Warwick at Barnet, where he was slain on April 14, 1471.

NORTHUMBERLAND, the northernmost county of England. The area, included in the North of England basin, is 2,018.7 sq.mi. The higher land, including the north Pennines and the Cheviots, lies in the west and north. The Cheviot hills, rising to 2,676 ft., are formed by the intrusion of an igneous dome in Tertiary times, and between them and the northern Pennines we have the lower line of the Tyne Gap, giving an important way for routes from west to east. The larger rivers generally flow eastward, the chief exception being the Till which flows northward, to join the Tweed, along a bed of shales less resistant than the remainder of the region.

The number of weapons of Neolithic age which have been found in the county show that it was occupied by man in those times. Most implements have been found along a broad band of country north-eastward from Hexham to Alnwick, that is, along the lower levels of the limestone lands. In later times, the evidence of beaker-pottery shows that Northumberland was probably invaded from across the North sea at the dawn of the Metal age. The evidence for the pre-Roman Iron age is not great and the Bronze age may have continued far longer than in the south of England. The county was occupied by the Romans some time after A.D. 80 and about 124. Hadrian built his wall from the Tyne to the Solway to defend his northern frontier, but the region as a whole was not thoroughly Romanized like the south-eastern parts of Britain. Hadrian's wall marked the frontier south of which the Romans never retreated until they finally left Britain, but they often advanced farther north which northern region was crossed by military roads. The wall ran across the county a few miles north of the Tyne from near Haltwhistle to Wallsend. On the wall there was the fort of Magnae, near Haltwhistle, where the road from Kirkby Thore along the south Tyne abutted on the wall. There was a settlement at Corbridge where the main road from the south crossed the Tyne and a fort near Halton where the road met the wall. At the eastern end of the wall there was a fort and another at Newcastle guarding a route across the Tyne. Within the wall, from Halton to Magnae through the Tyne Gap, ran another road.

History.—The first English settlement in the kingdom of Bernicia, which included what is now Northumberland, was effected in 547 by Ida, who pushed through the narrow strip of territory between the Cheviots and the sea, and set up a fortress at Bamburgh, which became the royal seat of the Saxon kings. About the end of the 6th century Bernicia was first united with the rival kingdom of Deira under the rule of Aethelfrith, and the district between the Humber and the Forth became known as the kingdom of Northumbria. In 634 Cadwalla was defeated at Hefenfeld (the site of which lies in the modern parish of St. John Lee) by Oswald, under whom Christianity was definitely established in Northumbria, and the bishop's see fixed at Hexham, where Bishop Wilfrid erected the famous Saxon church. Oswald also erected a church of stone at Tynemouth, which was destroyed in 865 in an incursion of the Danes. The Danes later overran the region, but in Northumberland, the English princes continued to reign at Bamburgh as vassals of the Danes, and not a single place-name with the Danish suffix "by" or "thorpe" is found north of the Tyne. The English names are, however, often associated with those of Gaelic or Cymric origin. In 938 Aethelstan annexed Northumberland to his dominions, and the Danish authority was annulled until its re-establishment by Canute in 1013. The vigorous resistance of Northumbria to the Conqueror was punished by ruthless harrying. The Normans rebuilt the Saxon monasteries of Lindisfarne, Hexham and Tynemouth; Eustace Fitz John founded Alnwick abbey, and other Norman abbeys were Brinkburn, Hulne, the first Carmelite monastery in England, Blanchland and Newminster. Castles were set up at Alnwick, Warkworth, Prudhoe, Dunstanborough, Morpeth, Ford, Chillingham, Langley, Newcastle, Bamburgh, Wark and Norham, a stronghold of the palatine bishops of Durham.

The term Northumberland is first used in its contracted modern sense in 1065 in an entry in the Saxon Chronicle relating to the northern rebellion. The county is not mentioned in the Domesday Survey, but the account of the issues of the county is entered in the Great Roll of the Exchequer for 1131. In the reign of Edward I. the county of Northumberland comprised the whole district between the Tees and the Tweed, and included liberties belonging to the bishop of Durham, archbishop of York, the king of Scotland, the earl of Lancaster and the earl of Angus. These franchises were all held exempt from the ordinary jurisdiction of the shire. By statute of 1495–96 the lordship of Tynedale was annexed to Northumberland on account of flagrant abuses of the liberties of the franchise; that of Hexham in 1572; Norhamshire, Islandshire and Bedlingtonshire continued to form detached portions of Durham until 1844, when they were incorporated with Northumberland. The division into wards existed at least as early as 1295, the Hundred Roll of that year giving the wards of Coquetdale, Bamburgh, Glendale and Tynedale.

The shire-court for Northumberland was held at different times at Newcastle, Alnwick and Morpeth, until by statute of 1549 it was ordered that the court should thenceforth be held in the town and castle of Alnwick. The assizes were held at Newcastle, and the itinerant justices, on their approach to the county, were met by the king of Scotland, the archbishop of York, the bishop of Durham and the prior of Tynemouth, who pleaded their liberties either at a well called Chille near Gateshead, if the justices were proceeding from York, or, if from Cumberland, at Fourstanes. In these franchises the king's writ did not run, and their owners performed the office of sheriff and coroner. The burgesses of Newcastle claimed return of writs in their borough and the town was made a county by itself by Henry IV. in 1400, and has jurisdiction in admiralty cases. The county was in the diocese of Durham, but in 1882 Northumberland was formed into a separate diocese with its see at Newcastle. Northumberland was the scene of perpetual inroads by the Scots, and the churches were

often so built as to form refuges against the invaders. Norham, Alnwick and Wark were captured by David of Scotland in the wars of Stephen's reign, and in 1290 it was at Norham castle that Edward I. decided the Scottish succession in favour of John Baliol.

In 1295 Robert de Ros and the earls of Athol and Menteith ravaged Redesdale, Coquetdale and Tynedale. In 1314 the county was ravaged by Robert Bruce, and in 1382 by special enactment the earl of Northumberland was ordered to remain on his estates in order to protect the county from the Scots. In 1388 Henry Percy was taken prisoner and 1,500 of his men slain at the battle of Otterburn. Alnwick, Bamburgh and Dunstanborough were garrisoned for the Lancastrian cause in 1462, but after the Yorkist victories of Hexham and Hedgley Moor in 1464, Alnwick and Dunstanborough surrendered, and Bamburgh was taken by storm. In 1513 the king of Scotland was slain in the battle of Flodden Field on Branxton moor. During the Civil War of the 17th century Newcastle was garrisoned for the king by the earl of Newcastle, but in 1644 it was captured by the Scots under the earl of Leven, and in 1646 Charles was led there a captive under the charge of David Leslie. The county of Northumberland was represented by two members in the parliament in 1290, and in 1295 Bamburgh, Corbridge and Newcastle-upon-Tyne each returned two members. Today, the parliamentary divisions of the county are Berwick-upon-Tweed, Hexham and Wansbeck, each returning one member; while the parliamentary borough of Newcastle-upon-Tyne returns four members, and Morpeth, Wallsend and Tynemouth one each.

Industries and Agriculture.—The early industrial development of Northumberland was much impeded by the constant ravages of internal and border warfare. Again Aeneas Sylvius Piccolomini (Pope Pius II.) who passed through the county disguised as a merchant in 1436, leaves a picture of its barbarous and desolate condition, and as late as the 17th century, Camden, the antiquary, describes the lands as rough and unfit for cultivation. The mineral resources, however, appear to have been exploited to some extent from remote times. It is certain that coal was used by the Romans in Northumberland. In a 13th-century grant to Newminster abbey a road for the conveyance of seacoal from the shore about Blyth is mentioned, and the Blyth coal-field was worked throughout the 14th and 15th centuries. The coal trade on the Tyne did not exist to any extent before the 13th century, but from that period it developed rapidly, and Newcastle acquired the monopoly of the river shipping and coal trade. The building of ships to carry the coal laid the foundations of the great modern shipbuilding industries. Lead was exported from Newcastle in the 12th century, probably from Hexhamshire, the lead mines of which were very prosperous throughout the 16th and 17th centuries. In a charter from Richard I to Bishop Puiset creating him earl of Northumberland, mines of silver and iron are mentioned, and in 1240 the monks of Newminster had an iron forge at Stretton. A saltpan is mentioned at Warkworth in the 12th century; in the 13th century the salt industry flourished at the mouth of the river Blyth, and in the 15th century formed the principal occupation of North and South Shields.

In the reign of Elizabeth glasshouses were set up at Newcastle by foreign refugees, and the industry spread rapidly along the Tyne. Tanning, both of leather and of nets, was largely practised in the 13th century, and the salmon fisheries in the Tyne were famous in the reign of Henry I. The height of the land and the composition of the soil together prevent the county from being rich agriculturally. In 1939 the total area under crops and grass was 640,153 ac., of which 133,771 ac. were arable land. As would be expected in a northern county, the chief grain crops are oats (27,720 ac. in 1939) and barley (9,929 ac.), though turnips and swedes occupied 15,681 ac. Potatoes covered nearly 5,000 ac., and the area under clovers and rotation grasses for hay was 30,921 ac. The number of cattle is fairly large, but the great acreage of hill-land makes it pre-eminently a sheep country, these animals numbering 1,147,383 in 1939. Manufactories centre on the Tyne, which is a region of ironworks, blast furnaces, shipbuilding yards, ropeworks, coke ovens, chemical works and manufactories of glass, electrical apparatus, pottery and firebricks, from above Newcastle to the sea. Machines, appliances, conveyances and tools are the principal articles of manufacture in metal. The National Trust owned 339 ac. in the county in 1942, besides the Wallington estate of 13,000 ac. presented by Sir Charles Trevelyan in that year. Communications are provided almost wholly by the L.N.E. Ry. The area of the administrative county is 1,994.1 sq.mi., with a population (1938) of 405,900. The population of the county was reduced 5% between Sept. 1939 and Feb. 1941 owing to wartime movements. Normally it is especially dense in the southeast portion, where the mining district and the Tyneside industrial area are situated. The latter area was particularly affected by the depression of the 1930s and was included in the "Special Area" over which a commissioner was appointed under the act of 1934. There are two county boroughs, Newcastle-upon-Tyne (a city) and Tynemouth; four municipal boroughs, Berwick-upon-Tweed (a county of itself), Blyth, Morpeth and Wallsend; and 12 urban districts. The county is in the northern circuit, and assizes are held at Newcastle. There is one court of quarter sessions for the county and one for Berwick and there are 13 petty sessional divisions.

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NORTHUMBERLAND, a manufacturing borough of Northumberland county, Pennsylvania, U.S.A., immediately north of Sunbury, at the confluence of the east and west branches of the Susquehanna river. It is served by the Lackawanna, the Pennsylvania and the Reading railways.

Pop. (1950) 4,176; (1940) 4,469 by federal census. Northumberland was the home of Joseph Priestley, the English chemist, from 1794 until his death (1804), and his dwelling has been preserved as a memorial.

NORTHUMBRIA, one of the most important of the Anglo-Saxon kingdoms, extended from the Humber to the Forth (*regnum Northanhymbrorum*). Originally it comprised two independent kingdoms, Bernicia and Deira (*q.v.*), each of which had a dynasty of its own. The first known king of the former was Ida, who, according to tradition, acquired the throne in 547 and reigned twelve years. To him the foundation of Bamburgh is attributed Four of Ida's sons successively occupied his throne: Glappa 559–560, Adda 560–568, Aethelric 568–572 and Theodoric 572–579. Of the first three nothing is known, but Theodoric is said (*Historia Brittonum*) to have been besieged by the Welsh under Urien in Lindisfarne. Theodoric was succeeded by Frithuwald 579–585/6 and Hussa 586–592/3. Then Aethelfrith (*q.v.*), son of Aethelric, came to the throne. He greatly extended his territories at the expense of the Welsh, and eventually provoked an invasion of Aidan, king of the Scots, whom he defeated at a place called Daegsastan (603). The first king of Deira of whom we know was Ella, or Aelle, who, according to Bede, was still reigning when Augustine arrived in 597. Aethelfrith eventually acquired possession of Deira, expelling Aelle's son Edwin (*q.v.*). Thenceforward, with rare intervals, the two kingdoms remained united.

Aethelfrith became involved in war with the Welsh towards the end of his reign and captured Chester, probably about 613. Shortly afterwards, in 616, he was slain in battle on the river Idle by Edwin, who was assisted by the East Anglian king Raedwald. Edwin now became king over both Northumbrian provinces. By his time the kingdom must have reached the west coast, as he is said to have conquered the islands of Anglesea and Man. Under Edwin the Northumbrian kingdom became the chief power in the country. At his death in 633 the kingdom was again divided, Deira falling to his nephew Osric, while Bernicia was occupied by Eanfrith son of Aethelfrith. Both these kings were slain by Cadwallon in the following year, but shortly afterwards the Welsh king was overthrown by Oswald (*q.v.*), brother of Eanfrith, who reunited the whole of Northumbria under his sway and acquired a supremacy analogous to that previously held by Edwin. After Oswald's defeat and death at the hands of Penda in 642 Bernicia fell to his brother Oswio, while Oswine son of Osric became king in Deira, though probably subject to Oswio. Oswine's death was compassed by Oswio in 651, and the throne of Deira was then obtained by Aethelwald son of Oswald. He is not mentioned, however, after

655, so it is probable that Deira was incorporated in the Bernician kingdom not long afterwards. After Oswio's victory over Penda in 654–655 he acquired a supremacy over the rest of England similar to that held by his predecessors. The Mercians, however, recovered their independence in 658, and from this time onward Northumbria played little part in the history of southern England. But Oswio and his son Ecgfrith greatly extended their territories towards the north and north-west, making themselves masters of the kingdoms of Strathclyde and Dalriada, as well as of a large part of the Pictish kingdom. Ecgfrith (*see* EGFRITH), who succeeded on Oswio's death in 671, expelled the Mercians from Lindsey early in his reign, but was in turn defeated by them in 679, his brother Aelfwine being slain. From this time onwards the Humber formed the boundary between the two kingdoms. In 684 we hear of the first English invasion of Ireland, but in the following year Ecgfrith was slain, and his army totally destroyed by the Picts at a place called Nechtansmere (probably Dunnichen Moss in Forfarshire). The Picts and Britons now recovered their independence; for Aldfrith, apparently an illegitimate son of Oswio, who succeeded, made no attempt to reconquer them. He was a learned man, and during his reign the Northumbrian kingdom partially recovered its prosperity. He was succeeded in 705 by his son Osred, and under him and his successors Northumbria began rapidly to decline through the vices of its kings. Osred was slain in 716. He was succeeded by Coenred 716–718, and Coenred by Osric 718–729. The next king was Ceolwulf, to whom Bede dedicated his *Historia Ecclesiastica* in 731. In the same year he was deposed and forced to become a monk, but was soon restored to the throne. In 737 he voluntarily retired to a monastery and left the kingdom to his cousin Eadberht. The latter appears to have been a vigorous ruler; in the year 740 we hear of his being involved in war with the Picts. Aethelbald of Mercia seems to have taken advantage of this campaign to ravage Northumbria. In 750 Eadberht is said to have annexed a large part of Ayrshire to his kingdom. Finally in 756, having now allied himself with Oengus king of the Picts, he successfully attacked Dumbarton (Alcluith), the chief town of the Britons of Strathclyde. Eadberht showed considerable independence in his dealings with the church, and his brother Ecgberht was from 734 to 766 archbishop of York. In 758 Eadberht resigned the kingdom to his son Oswulf, and became a monk.

Oswulf was slain by his household at a place called Mechil Wongtun in 759. Moll Aethelwald, who may have been a brother of Eadberht, succeeded, and after a victory over a certain Oswine, who fell in the battle, abdicated and became a monk probably under compulsion in 765. His successor Alchred sent an embassy to Charlemagne in 768 and was deposed in 774, whereupon he fled to Bamburgh and afterwards to the Picts. His deposition has been ascribed to a formal act of the Witan, but this seems an antedating of constitutional methods and the circumstances point to a palace revolution. The successor of Alchred was Aethelred son of Moll Aethelwald. In 778 three high-reeves were slain at the instigation of the king. Aethelred was expelled during the next year, perhaps in consequence of this event, and Aelfwald son of Oswulf became king. Aelfwald was murdered by Sicga in 789, whereupon Osred his nephew the son of Alchred succeeded. In 790 the banished Aethelred returned to the throne and drove out Osred, whom he put to death in 792. Aethelred, who had married Aelflaed the daughter of Offa, also killed Aelf and Aelfwine, the sons of Aelfwald and was murdered himself at Corbridge in 796. Oswald, who is called *patricius* by Simeon of Durham, succeeded, but reigned only twenty-seven days, when he was expelled and eventually became a monk. Eardwulf *dux*, who had apparently fled abroad to escape the wrath of Aethelred, was now recalled and held the crown until 807 or 808. Aelfwald then became king but Eardwulf was restored in 808 or 809 after appealing to the emperor and the pope. Eanred, son of Eardwulf, probably came to the throne in 809 and reigned until 841. It was during his reign in 827 that Northumbria acknowledged the supremacy of Ecgberht, king of Wessex. Eanred was succeeded by his son Aethelred, who was slain in 850, when Osberht came to the throne and reigned until 863. On the expulsion of Osberht, Ella or Aelle, succeeded. The chroniclers emphasize the fact that this king was not of royal descent. He is said to have slain Ragnarr Loðbrok. In the year 866 Loðbrok's sons Ingwaere (Ivarr, *q.v.*), Healfdene, Ubba and others brought a vast army to England to avenge the death of their father. In the following year they obtained possession of York. Ella seems now to have made peace with the exiled king Osberht, and their united forces succeeded in recovering the city. In the great battle which ensued the Northumbrian army was annihilated and both kings were slain (the death of Ella, according to Irish tradition, being due to the treachery of one of his followers). The southern part of Northumbria now passed entirely into the hands of the invaders, but they allowed a certain Ecgberht to reign over the portion of the kingdom north of the Tyne. Ecgberht was expelled in 872 and died in the course of the following year. His successor Ricsig died in 876 and was followed by Ecgberht II., who reigned until 878. He was the last English king who reigned in Northumbria. After him the chief power north of the Tyne came into the hands of a certain Eadulf of Bamburgh, who did not take the kingly title, but accepted the overlordship of Alfred the Great perhaps in 886. In the winter of 874–75 Healfdene returned to Northumbria, which he partitioned next year among his followers. After an interregnum of a few years a certain Guthred became king in 883. He is said to have been a slave and to have been appointed king at the command of St. Cuthbert who appeared to Eadred the abbot of Carlisle in a dream. There is some reason for the conjecture that he belonged to the family of Loðbrok. He died in 894, after which date little is known of Northumbrian history for some years.

About 919 the country was invaded by vikings from Ireland under Ragnall, grandson of Ivarr, who seized York and occupied the lands of St. Cuthbert. Aldred, the son of Eadulf, who now ruled north of the Tyne, appealed to Constantine II., king of the Scots, for help, but the Scottish and Northumbrian armies were defeated at Corbridge. Shortly after this, however, all the northern princes submitted to Edward the Elder. Ragnall was succeeded by Sihtric, who married Aethelstan's sister. He died in 926, and his brother and successor Guthfrith was soon afterwards expelled by Aethelstan and fled to Eugenius, king of Strathclyde. The Welsh and Scottish kings, however, both submitted to Aethelstan, and Guthfrith was again driven into exile. He died in 934, leaving a son Anlaf (Olafr) Godfredsson or Godfreyson. In 934 Aethelstan invaded Scotland as far as the Tay. In 937 a great fleet and army were brought together by Constantine and Anlaf Godfreyson from Ireland. Aethelstan, however, won a complete victory over them at a place called Brunanburh. Anlaf Godfreyson escaped to Ireland but returned to England after Aethelstan's death, occupied York and compelled Edmund to cede to him all Danish Mercia north of Wattling street. He died in 941, and a series of obscure Scandinavian kings of York followed him until 954 when Northumbria was conquered by Edred king of Wessex. Eadred placed Northumbria in the hands of a certain Osulf, who is called high-reeve at Bamburgh. In the reign of Edgar, Oslac was appointed earl of southern Northumbria, but he was banished at the beginning of the following reign. The next earl was Waltheof and after him Uhtred, who defeated Malcolm II., king of the Scots, in 1006. Twelve years later, however, the Northumbrians were completely defeated at Carhan, and Lothian was annexed by the Scots (*see* LOTHIAN). Uhtred was slain by the orders of Canute, who gave the province to Eric (Eirikr) earl of Lade. Shortly afterwards, however, part of it at least came into the hands first of Eadulf and then of Aldred and another Eadulf, the brother and sons respectively of Uhtred. The younger Eadulf was slain by Siward, probably in the reign of Harltacuut. Siward held the earldom till his death in 1055, when it was given to Tostig, son of earl Godwine, and after his banishment to Morkere, son of Aelfgar, earl of Mercia. Tostig's banishment led to the invasion of Harold Hardrada, king of Norway, and the battle of Stamford Bridge, in which both perished.

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series), ed. T Arnold (1882); J C. H R. Steenstrup, *Normannerne* (Copenhagen, 1876–82). (F. G. M. B.)

NORTHWESTERN UNIVERSITY, an institution of higher learning, privately controlled, coeducational, was established in 1851 through a charter from the Illinois general assembly. The founders planned an institution that would "meet adequately the growing want in the Northwest for a university of the highest grade, adapted to the country." No particular religious faith is required of students or faculty, although a majority of members of the board of trustees must be members of the Methodist Church.

The university maintains two campuses, both of which are located on the shores of Lake Michigan: one in the residential suburb of Evanston, 12 mi. N. of Chicago's central business district, and the other on Chicago's near north side at Lake Shore drive and Chicago avenue.

The undergraduate programs are confined to the Evanston campus. The professional schools are located on the Chicago campus. There the school of law is close to the law courts, to large business organizations and to the various departments and agencies of the city, state and federal governments; and the schools of medicine and dentistry have at hand an abundant supply of clinical material for their programs of teaching and research.

Among the founders of the university was John Evans, for whom the city of Evanston was named. In 1853 he, with Orrington Lunt, selected as the site for the new university a wooded 379-ac. tract of land on the shore of Lake Michigan. The city of Evanston grew up around the university.

The first building of the university, Old College, was erected and the first class was held in Nov. 1855. The trustees provided an endowment consisting of 678 ac. of Evanston land, which was tax-exempt by an amendment to the university's charter. This land was subdivided and sold as lots.

The original school of the university was the college of liberal arts. Other schools, offering training for the various professions, were added in the years that followed: medicine (1859), law (1859), speech (1878), dentistry (1891), music (1895), commerce (1908), graduate (1910), summer session (1920), journalism (1921), education (1926), university college (1933) and the technological institute (1939).

The growth of the university after 1920 was striking. The faculty increased from 553 to more than 1,000 members at mid-century; full-time students from 4,653 to about 9,000; part-time students from 4,265 to more than 16,000; bound volumes in the libraries from 197,999 to more than 1,000,000; and assets from $11,960,000 to more than $100,000,000. Endowments at mid-century exceeded $70,000,000.

The Chicago campus was dedicated in 1926 and at mid-century comprised eight large buildings: Montgomery Ward Memorial building (1926), the home of the medical and dental schools and the university college; Wieboldt hall (1926), housing the evening divisions of the schools of commerce and journalism; Levy Mayer hall (1926), home of the school of law; Elbert H. Gary Law Library building (1926); the Floyd D. Patterson Memorial building, housing the Passavant Memorial hospital (1929); Thorne hall (1931); Abbott Hall (1940), an 18-story dormitory; and Wesley Memorial hospital (1941).

The technological institute building was completed in the fall of 1941 at a cost, including equipment, of $6,000,000, made possible by a gift from Walter P. Murphy, railway-supply manufacturer.

Upon his death in 1942 Murphy bequeathed to the university more than $25,000,000 to endow the program of the institute. The institute has curriculums in mechanical, chemical, civil, electrical and industrial engineering. It is operated on the co-operative plan under which a student alternates a quarter of classroom study with a quarter of work in industry. During the five-year program the student completes 12 quarters of academic work and 6 quarters in industry.

In 1947 the university established the Institute for the Study of Rheumatic Fever, the first of its kind to be established in any school of medicine in the United States.

Another development in medical research was the Institute of Human Nutrition for the study of nutritional diseases. The institute is housed in a nine-story building near the Chicago campus.

The university observed its centennial in 1951 with a year-long series of academic conferences, convocations and other special events. (E. H. SG.)

NORTH-WEST FRONTIER PROVINCE, the most northerly province of Pakistan, created during British rule in India. Roughly it may be defined as the tract of country north of Baluchistan, lying between the Indus and Afghanistan. More exactly it consists of (1) the cis-Indus district of Hazara; (2) the comparatively narrow strip between the Indus and the hills constituting the settled districts of Peshawar, Kohat, Bannu and Dera Ismail Khan; and (3) the rugged mountainous region between these districts and the borders of Afghanistan, which is inhabited by independent tribes. This last region is divided into five agencies: Dir, Swat and Chitral with headquarters at Malakand, Khyber, Kurram, Tochi and Wana.

The province lies between lat. 31° 4′ and 36° 57′ N. and long. 69° 16′ and 74° 7′ E. The approximate area is 39,186 sq.mi.

Physiography.—The mountains of the Hindu Kush, running from east to west, form the northern boundary of the province and are met at the northeastern corner of Chitral by the continuation of an outer chain of the Himalayas after it crosses the Indus above the Kagan valley. From this chain, minor ranges run in a southwesterly direction the whole length of Bajour and Swat, till they merge into the Mohmand hills and connect the mid-Himalayas with the Safed Koh. The Suliman system lies south of the Gomal unconnected with the northern hills. To the east the Safed Koh extends its spurs into the Kohat district. The Salt range crosses the Indus in the Mianwali *tahsil* of the Punjab and forms the boundary between Bannu and Dera Ismail Khan, merging eventually in the Waziri hills.

The Dera Ismail Khan district is one of the hottest areas in the Indian subcontinent, while over the mountain region to the north the weather is temperate in summer and intensely cold in winter.

There are two seasons of rainfall over the province; the monsoon season, when supplies of moisture are brought up by the ocean winds from the Arabian sea and the Bay of Bengal, and the winter season, when storms advancing eastward from Iran and the Caspian districts cause winds, widespread rain and snowfall. Both sources are precarious and instances are not infrequent of the almost entire failure of either the winter or the summer rainfall.

History.—The origin of the Pathans is obscure. It is clear, however, that many tribes of foreign origin were early gathered around the nucleus of the true Pathans, with whom they became blended. In the 15th century they began to descend from the hills to the plains. Their spirit of independence soon brought them into collision with the Mogul empire. In the 17th century the settlers in the plains wrested terms from Aurangzeb which left them almost as independent as their brothers in the hills. The invasion in 1738 of Nadir Shah, who traversed the province from Peshawar to Dera Ismail Khan, is a landmark in the history of the frontier. From his death to the rise of Ranjit Singh, the frontier districts remained an appendage of the Durrani empire. Little control was exercised by Kabul, and the country was administered by local chiefs or Afghan sirdars very much as they pleased. The Sikh invasions began in 1818. After the Second Sikh War, by the proclamation of March 29, 1849, the frontier districts were annexed by the British government. Then the settled districts were taken into the Punjab, while the independent tribes were controlled at different times by the Punjab government and the government of India. Their turbulence still continued, and they were the object of more than 50 punitive expeditions after 1849. The proposal to make the frontier districts into a separate province dates back to Lord Lytton's minute of April 22, 1877, as a result of which a frontier commissionership, including Sind, was sanctioned by the home government. The outbreak of

the Second Afghan War caused the project to be postponed, but it was eventually brought to completion, on Oct. 25, 1901, by Lord Curzon, whose scheme was more modest than Lord Lytton's It omitted Sind altogether and, with the exception of the cis-Indus tract of Hazara, confined the new province to the Pathan trans-Indus districts north of the Gomal. (*See* INDIA: *History*.)

Population.—The census of 1941 gave the population of the administered area as 3,038,067, that of the tribal as 2,500,000. The first census of Pakistan (1951) gave the administered area 3,239,000, the tribal 2,460,000. The province is mainly agricultural. The towns, except Peshawar and Dera Ismail Khan, are either expansions of large agricultural villages or bazaars which grew up around the many cantonments of the province. The great majority of the population are Pathan (*q.v.*) by race and Mohammedan by religion. The chief tribes, in addition to Chitralis and Bajouris, are the Utman Khel, Yusafzais, Hassanzais, Mohmands, Afridis, Jowakis, Mullagoris, Orakzais, Zaimuks, Chamkannis, Khattaks, Bangash, Turis, Bhittannis, Darwesh Khel Waziris and Sheranis. The predominant language is Pushtu.

Agriculture.—The limit of profitable cultivation had, by the middle of the 20th century, almost been reached. The Pathan, however, is a slovenly cultivator and slow to adopt new methods. The principal crops are maize and *bajra* in the cold weather; wheat, barley and gram in the spring. Rice and sugar cane are largely grown on the irrigated lands of Hazara, Peshawar and Bannu districts, and the well- and canal-irrigated tracts of Peshawar district produce fine crops of cotton and tobacco. In the transborder agencies the valleys of the Swat, Kurram and Tochi yield much rice.

Canals are the main source of irrigation in the province, and fall under three heads: (1) private canals in the various districts, the property of the people and managed on their behalf; (2) the Michni Dilazak and Shabkadar branch in Peshawar, constructed by the district board, which receives water rates; and (3) the Swat and Kabul river canals, which were constructed by and are the property of government and are managed by the irrigation department.

See C. C. Davies, *Problem of the North-West Frontier* (Cambridge, 1932). (T. H. H.; X.)

NORTHWEST TERRITORIES, official name of the portion of Canada lying outside the provinces and to the north of them, but excluding the Yukon Territory (*q.v.*). The territories extend from their apex at the north pole to the 60th parallel of north latitude. The boundary of the territories, beginning at the north pole, follows the 141st meridian to the mainland, thence along the coast to a point about 136° 30′ W., south to the 67th parallel, east to about 134° and thence along the divide separating the watersheds of the Peel and the Yukon from the Mackenzie to the 60th parallel; thence along that parallel to Hudson bay and thence through Hudson strait to the open sea; down the straits and channels separating Greenland from the arctic archipelago and along the 60th meridian of west longitude to the apex of Canada at the north pole. The offshore islands in Hudson and James bays and the arctic archipelago are included in the territories. The territories were divided into the districts of Mackenzie and Keewatin, on the mainland, respectively east and west of the meridian 102° W., and the district of Franklin, covering the arctic archipelago. The divisions were made merely for administrative convenience. Total area, 1,304,903 sq.mi.

History.—The territories represent in origin, though not in boundaries, the area handed over to the jurisdiction of the Hudson's Bay company under its charter of 1670. This area included all the land drained by rivers flowing to Hudson bay and the Arctic ocean—roughly speaking, all of Canada from the Rocky mountains to the St. Lawrence watershed. The term Rupert's Land was the original official name of the whole area, but the name Hudson's Bay Territory early began to replace it in common speech. The name Northwest Territory was used to mean the western half and Rupert's Land the east.

These were names current at the time of the confederation in 1867 and were adopted by the British North America act in providing for their inclusion in the dominion. But the area now known as the territories was quite unknown and unexplored except for the coast of Hudson bay, for a century after the charter of 1670. The company traded by way of the Hudson bay, but their posts were established on the Churchill, Nelson, Red, Saskatchewan and other rivers, at points entirely within Manitoba and Saskatchewan. Further exploration began with the journeys of Samuel Hearne, a company employee, northwestward from Fort Churchill across the barren lands. In his third journey (1770–72) he discovered the Coppermine river, reached the arctic coast and brought home a 4-lb. lump of copper. His explorations were followed by those of Sir Alexander Mackenzie, in the service of the Northwest company. Mackenzie discovered and descended the river named after him and reached the Beaufort sea (1789). A journey over the Rocky mountains took him to the Pacific (1792–93).

British interest in the will-o'-the-wisp of the Northwest passage brought Sir John Ross (1818) and Sir William Edward Parry (1820) to the Arctic archipelago and led to the discovery by Ross's nephew, Sir James Ross (1831) of the magnetic pole on the Boothia peninsula, and prompted the overland journeys of Sir John Franklin to the Coppermine river and Coronation gulf (1819–22) and to Great Bear lake and the arctic coast (1825–27). Franklin's ill-starred expedition by sea (1845–48), his disappearance and the loss of his ships, with all his men, occasioned the famous search (1848–59) which incidentally added much to the knowledge of the arctic coast. Meanwhile John Rae, in the service of the Hudson's Bay company, carried on numerous inland journeys (1846–54) and learned much of the Eskimos and of how to live in the north. These explorations had led to the establishment of trading posts by Alexander Mackenzie at Fort Chipewyan on Lake Athabasca (1792), at Edmonton (1795), Fort Resolution on Great Slave lake, Fort Providence on the Mackenzie below, Fort Simpson at the mouth of the Liard, and Fort Good Hope almost on the Arctic circle. The entire area of the territories remained under the jurisdiction of the company till the transfer of 1869, when it became part of Canada, the company retaining only a commercial footing.

The province of Manitoba was created out of the Northwest Territory in 1870, the rest of which, with Rupert's Land, passed under federal control. The North West Mounted Police (later renamed Royal Canadian Mounted Police) was established in 1873. The rapid immigration and land settlement under the Homestead act (1874) necessitated new government. The Northwest Territories Act of 1875 set up a lieutenant governor and council. In 1882 the area below parallel 60° was divided into the provisional districts of Assiniboia, Saskatchewan, Athabasca and Alberta. An act of 1887 gave representation to the territories at Ottawa, and an act of 1888 set up an elected territorial legislature at Regina. The gold discoveries on the Klondike (1896) led to the separation of the Yukon Territory in 1898. In 1905 the situation was entirely changed by the creation of the provinces of Alberta and Saskatchewan. The Boundaries Extension Act of 1912 carried Manitoba to Hudson bay and gave to Ontario and Quebec the rest of the southern and the eastern coast of the bay and what was left of Rupert's Land, thus reducing the territories to their present boundaries.

Government.—The territories are largely under federal control (the department of resources and development), with the seat of government at Ottawa, Ont. The Northwest Territories act (142. R.S.C. 1927) provided for a territorial government composed of the commissioner of the Northwest Territories, the deputy commissioner and five councillors, all appointed by the governor-general in council, but in 1951 this act was amended to provide for three additional elected councillors (total of eight). The commissioner was given power to make ordinances under instructions from the governor-general in council or the minister of resources and development, respecting direct taxation and establishment of territorial offices, prisons, municipal institutions, solemnization of marriage, property and civil rights, administration of justice and in general all local matters. The 1947 redistribution act created a federal electoral division called Yukon-Mackenzie River, and thus after the 1949 election the Mackenzie

river port of the Northwest Territories was represented jointly with the Yukon Territory in the house of commons. Appointment of a superintendent for the eastern arctic and one for the Mackenzie district was provided. An agent stationed at Fort Smith, the point of entry from Alberta, was also given duties as superintendent of the Wood-Buffalo National park, as land and crown timber agent, mining recorder and magistrate and sheriff.

The territories were divided into medical districts with appointed officers in charge at Forts Smith, Simpson, Resolution and Norman, and at Aklavik, Yellowknife, Chesterfield and Pangnirtung. The medical officers act also as coroners and have jurisdiction over hospitals, schools and industrial homes (Chesterfield and Pangnirtung). Public hospitals were opened, under government subsidy, by the Anglican and Roman Catholic missions at Forts Smith, Resolution and Simpson, and at Hay River, Aklavik (both denominations), Rae, Chesterfield and Pangnirtung. An Indian affairs hospital was established at Coppermine.

The Royal Canadian Mounted Police maintain law and order. Detachments stationed at various points in the territories carry out patrols by dogsled, boat, aeroplane, motorcar and on foot. Police are responsible for enforcing the criminal law, customs, game laws and fur-trade regulations. The R.C.M.P. schooner "St. Roch" is used as a floating detachment in the far north and as a supply ship to isolated detachments.

Physical Geography.—Apart from division by latitude and longitude, the territories are physically divided into distinct areas. There is first the broad northeastern stretch formerly called the barren lands or the subarctics, often described as the arctic prairies. This is a treeless country, flat or of low, rolling elevation, of barren slate and rock partly covered with thin soil, over which shallow, rapid rivers, expanding into considerable lakes, run northeast (the Thelon, Dubawnt and Kazan) to the Chesterfield inlet on Hudson bay, or north to form the Back and the Coppermine rivers to the arctic. The arctic prairies are in part covered with vegetation that includes more than 750 species of flowering plants and forms thus a rich grazing ground for caribou and musk oxen. A few stunted willows grow in sunken or sheltered spots. The line of delimitation between the arctic prairies and the line of real forest runs irregularly from Fort Churchill to the Mackenzie delta, the trees advancing northward in favoured places. A midway division, named on official maps the Northern Transition section, in the territories about 100 mi. wide, may be distinguished between the arctic prairies proper and the line of real forest that runs from the eastern end of Lake Athabasca and Great Slave lake to the western end of Great Bear lake. This wooded section covers all the basin of the Mackenzie and its great tributaries, but in the territories is narrower on the west bank where it passes into plains of grass and then changes to the forests of the Rockies. The trees of the Mackenzie basin are chiefly spruce, balsam, white birch, poplar and jack pine.

The Arctic Archipelago.—Among the islands of this archipelago are some of the largest in the world. Baffin Island covers 197,754 sq.mi., and Victoria Island 80,340 sq.mi. Until recently the total white population consisted of about 50 on Baffin Island and perhaps 20 more scattered through adjacent islands. With the advent of air services and the extension of meteorological and radio research this number was considerably increased. A notable event was the Canadian military expedition ("Exercise Musk-ox") early in 1946, in which a group of army men travelled by tractors from Churchill to Cambridge bay on Victoria Island, returning via Coppermine and Norman Wells. Of great interest also were the voyages of the "St. Roch," which twice traversed the Northwest passage. In 1941 and 1942 it made the journey from Cambridge bay to Pond inlet in Baffin Island, wintering near the magnetic pole. In 1944 Sgt. Henry Larsen made the return journey, and traversed the difficult portion of the journey—from Pond inlet to the Beaufort sea—in 18 days. He found the narrow Prince of Wales strait (north of Victoria Island) practically free of ice, and so was able to accomplish this feat of navigation in record time. The "St. Roch" was the only vessel to traverse the historic passage both ways.

Most of the large islands belong to a large geological basin and exhibit the same topography. They are plateaus, built up for the most part of Palaeozoic rocks, though Triassic rocks form the uppermost saucer of the basin in Sverdrup Islands. However, the northern portion of Ellesmere Island has been much affected by past mountain building, and there are rugged peaks, said to be as much as 10,000 ft. high. There are large ice caps on the higher portions of the plateaus in Ellesmere and Baffin Islands. The most northerly post is that at Bache peninsula, about halfway up the east coast of Ellesmere Island.

An expedition in 1947 investigated the site of the north magnetic pole. Survey by the aeroplane "Aries" seemed to show that it had moved north from Boothia peninsula by perhaps as much as 300 mi. About that time the United States co-operated with Canada in establishing weather and loran (long range radar aid to air navigation) stations on various islands of the archipelago, including such locations as Eureka sound, Winter harbour, Cambridge Bay, and on Resolution and Nottingham islands.

Climate.—The line of the Arctic circle (lat. 66° 32′ N) runs through the north mainland of the territories across the upper corner of Great Bear lake, thus leaving the Mackenzie delta (Aklavik, Fort Macpherson) and the centre coastal region in the arctic winter night. The greatest range of temperature in the continent is found in the region to the east of Great Slave lake, where the difference between January and July temperatures amounts to more than 85 degrees. But the outstanding feature of the climate is the warmth of the Mackenzie basin in midsummer. The isotherm of 57° F. in July forms a hot loop which includes the big river and the districts around Great Slave and Athabasca lakes. All this huge region is therefore as warm in midsummer as is most of Newfoundland. This is particularly significant, since this isotherm represents the northern limit of some agriculture, and where the soils are suitable a hay-potato economy may spread down the Mackenzie valley to the circle.

Midwinter shows a January average of −20° F. from the Yukon down to Lake Athabasca (Fort Churchill −25°). The Great Bear lake average is −30°; the coast at the delta about −25°. Lowest average annual figures are −55° to −60°, in the Mackenzie valley. The summer months are June, July and August; in parts of the territories summer temperatures may rise to 90° in the shade and average 70° in the daytime. Great Bear lake in midwinter freezes over with ice 7 to 8 ft. thick but is open for navigation from mid-July till the end of September. Great Slave lake also freezes over completely each winter, the ice having an average thickness of from 2½ to 4 ft., depending on the snowfall during the early part of the winter. The shore waters begin to freeze about the middle of October, and freight trucks and tractors are able to cross the lake early in January. Navigation opens about June 10.

The rainfall is low throughout the territories, with a minimum below 10 in. in Boothia and Melville peninsulas. Along the Mackenzie river the rainfall increases to 11 in., and the Liard basin receives about 14 in. Some of this falls as snow, but as the region is one of summer rainfall the snow cover is never very thick.

Population.—The population of the territories, made up of officials, police, missionaries and transport and company workers, was placed by the census of 1931 at 9,723 and by the census of 1951 at 16,004. The territories experienced a rapid increase of population by the influx into the Yellowknife gold mining district, and into the Great Bear lake uranium area, in the 1939–51 period. The Eskimo population of the territories was estimated at 8,437 in 1950. Various tribes of Athabascan Indians (the main stock of northwest Canada) are grouped along the Mackenzie river systems in the wooded country. All of the Indians of the territories (3,816 in 1944) were placed under treaty arrangements guaranteeing certain rights (annual subsidy, free schools, hunting rights, etc.) and imposing certain disabilities as to liquor, right to vote, etc.

Entirely separate in life and culture, though distantly related by race to the Indians, are the Eskimos. They occupy the arctic coast from the Mackenzie river mouth to Hudson bay along the Baker-Lake Chesterfield inlet. Most of the 8,437 live in the

territories proper, but about 1,600 live on the Ungava coast, on the south shore of Hudson strait, formerly a part of the territories but later joined to Quebec. A few bands of Eskimos in the territories left the coast to live inland, depending on caribou for both food and clothing. Only a handful of Eskimos live on the Yukon coast and on that of Manitoba.

The majority of the Indians and Eskimos are, at least nominally, Christians, the Indians mostly Roman Catholic as the result of early missions, the Eskimos Anglican by British contact by sea. The belief and practices of both are much affected by their earlier spirit doctrines. Roman Catholic missions began with the Abbé Thibault in 1845. The Church of England created a bishopric of the Mackenzie as early as 1884, but the first wintering Anglican missionary in the arctic was the famous I. O. Stringer (Hershel Is. 1892–1902, Bishop of Yukon, 1905).

Resources.—The natural resources of the territories are undoubtedly great but until after World War II were only scantily explored and little exploited. Apart from the seals and salt water fish of the arctic and the Hudson bay, the fish of Great Bear lake (12,000 sq.mi.) and Great Slave lake (11,170 sq.mi.) and apart from the forest and grazing grounds, there is undoubtedly great wealth to develop in oil and minerals. Oil and natural gas had been known to underlie the Mackenzie valley ever since Alexander Mackenzie saw flaming coal seams on his journey of 1789. Prospecting for oil began in 1914 and a strike was made in 1920 near Fort Norman, below the mouth of the Great Bear river. There was a stampede to stake claims, but it was soon found that the heavy cost of transport prevented oil development. The radium discoveries on Great Bear lake and the opening of the Yellowknife gold fields created a market and put the oil wells at Fort Norman into active operation. Production reached a peak of 1,223,675 bbl. for 1944, but by 1949 had fallen off to 155,528 bbl.

During World War II much attention was given to the Norman Wells oil field, and two large settlements were established on the Mackenzie river about 40 mi. N. of Norman. On the east bank and in the small islands in the river many wells were drilled, and in 23 oil was obtained at about 1,500 ft. The field is about 3 mi. wide and 5 mi. long, and the oil was pumped across the 4-mi. wide river to "Canol." There another group of engineers was concerned with pumping the oil through a 4-in. pipe for about 600 mi. to the refinery at Whitehorse, Yukon. During 1944 and 1945 there were daily planes flying from Edmonton to this outlying oil field; but the project was abandoned to a large extent after peace was declared.

A striking feature among the resources of the territories is the radium of Great Bear lake. Silver-pitchblende at the east end of the lake was discovered in 1930, and a milling and mining plant was established. Silver, copper, cobalt and lead, as well as radium and uranium, are recovered from the ores. The radium and uranium products are sent for treatment to a refinery at Port Hope, Ont. Canadian production of radium had cut the price of radium 62% by 1938. Radium and uranium shipped in 1939 were valued at $1,121,553. In 1944 supervision and control of Canadian radium and uranium production was entrusted to Crown-owned Eldorado Mining and Refining limited, and production statistics thereafter became confidential.

Following reports from the Geological survey (1935), active prospecting for gold began on the north side of Great Slave lake. The resulting discoveries opened up rich mines at Yellowknife on the north arm of the lake in 1938 and created a boom town. Production by the four chief mines had a total value of $6,389,748 in 1949.

A stock of 2,370 reindeer was driven in from Alaska in 1935 and established on a reserve near the Mackenzie delta. This main herd had increased to 5,000 head by 1942, and 3,000 other deer were in minor herds near the Anderson and Horton rivers. Surplus reindeer, about 200 head, were slaughtered each year, and about one-half of the carcasses were given to the local mission stations. The Wood-Buffalo park (17,300 sq.mi., and largest in the world), overlapping the provincial border at Fort Smith, was set aside for the protection of buffalo. The Thelon game sanctuary east of Great Slave lake was created to protect all game, especially musk oxen which may not be killed anywhere in the territories. In 1940 an area of about 14,000 sq.mi. around the Mackenzie delta was declared a beaver sanctuary in which all trapping was forbidden.

Land fit for agriculture is very limited and is found only in the immediate Mackenzie basin. Common garden vegetables—potatoes, cabbages, peas, lettuce, etc.—are raised at all posts, the long daylight counteracting the short summer season. The greater part of the Mackenzie valley carries a forest, as described, which supplies both timber and firewood.

Water Power.—The Mackenzie river itself, without rapids, offers no water power. But there is extensive water power in the territories which by 1951 was neither accurately estimated nor much developed. Official statistics of 1949 showed water power (1,000–100,000 h.p. in each location) on the Great Bear river, on the inland feeders of Great Bear lake, in various rapids of the Dubawnt and above all (at least 200,000 h.p.) in the Great Slave river, and even more at the gathering of waters at Clinton Colden and Aylmer lakes. By 1951 power to the extent of 4,200 h.p. was developed on the Yellowknife river and transmitted to the mines; waterpower was supplemented in 1948 by the opening of the federal government controlled hydroelectric project on the Snare river, 94 mi. from Yellowknife.

Communications.—There were no railways in the territories at mid-20th century. Communication was by water, sled and aeroplane. The Mackenzie river, which from its sources in the provinces is in all 2,635 mi. in length—the longest river in Canada—affords an admirable central artery. It offers an unimpeded water course for steamers, motorboats and barges, extending 1,292 mi. from Fort Smith on the Slave river to Aklavik on the arctic. From the refrigerator cars at the railhead waterways (Alberta), refrigerator barges, chemically chilled, carry fresh frozen meats, vegetables and even ice cream into the arctic as far as Great Bear river during the open season, and carry out fish. Communication with Great Bear lake is difficult, since the Great Bear river (75 mi. long) is shallow and swift with abrupt banks and is broken in mid-course by many miles of rapids, around which a portage road for trucks was constructed. The coming of the aeroplane and communication by radio ended the isolation of the arctic.

The department of transport operates meteorological stations at Chesterfield and Coppermine on the mainland, in addition to those on islands of the archipelago. The Alaska highway, constructed as a military measure in 1942 from Dawson Creek, B.C., to Fairbanks, Alsk., cut past the southwest corner of the territories and afforded a new means of access. A winter tractor road following the course of the Hay river connected Grimshaw (Alta.) with Great Slave lake. (S. Lea.; G. Tr.; C. Cy.)

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NORTHWEST TERRITORY, the name given by congress in 1787 to that portion of the then United States west of the Allegheny mountains and north of the Ohio river. Previous to 1763 it belonged to France; by the treaty of peace at the close of the Revolutionary War, this vast area of more than 250,000 sq.mi. became part of the United States. Its ownership was claimed by various states, but by 1786 all but the Western Reserve (*see* Ohio), which was retained by Connecticut, was ceded to the federal government. In the ordinance of 1787 passed by congress for the government of the territory, provisions were made which long played a prominent part in U.S. history, espe-

cially that by which slavery was forever prohibited within it. Out of this territory, Indiana, Illinois, Wisconsin, Michigan, Ohio and part of Minnesota were subsequently carved.

NORTHWICH, a market town and urban district of Cheshire, Eng., 171 mi. N.W. of London, on the London Midland Region railway route. Pop. (1951) 17,480. Area, 3.3 sq.mi. It lies at the junction of the Weaver and Dane rivers and is located in Great Britain's most important salt-producing area. In the narrow and irregular streets of Northwich many of the houses have sunk and are at fantastic angles (being strongly bolted to keep them secure) because of subsidences resulting from the pumping of brine. This latter method of salt production has largely replaced the mining of rock salt. The salt is conveyed to the Mersey ports for export, by the Weaver river, which is connected by a hydraulic elevator with the Trent and Mersey canal on higher level.

NORTON, CAROLINE ELIZABETH SARAH (1808–1877), afterward Lady Stirling-Maxwell, English writer, was born in London in 1808. One of the three beautiful granddaughters of Richard Brinsley Sheridan, daughters of his son Thomas, the "three Graces" of London society in the reign of George IV, she began to write before she was out of her teens. Her two sisters Helen and Georgina became respectively Lady Dufferin and duchess of Somerset. At the age of 17, Caroline published a merry satire, *The Dandies' Rout,* illustrated by herself; this was followed by *The Sorrows of Rosalie* (1829) and *The Undying One* (1830), a version of the legend of the Wandering Jew. She married in 1827 the Hon. George Norton, brother of Lord Grantley. The husband's persecutions culminated in 1836 in an action brought against Lord Melbourne for seduction of his wife, which the jury decided against Norton without leaving the box. The case against Lord Melbourne was so weak that it was suggested that Norton was urged to make the accusation by Melbourne's political enemies, in the hope that the scandal would prevent him from being premier when the princess Victoria should succeed William IV. In 1853 legal proceedings between Mrs. Norton and her husband were again entered on, because he not only failed to pay her allowance but demanded the proceeds of her books. Mrs. Norton made her own experience a plea for addressing to the queen in 1855 an eloquent letter on the divorce laws, and her writings did much to ripen opinion for changes in the legal status of married women. George Meredith, in *Diana of the Crossways,* used her as the model for his "Diana." Mrs. Norton was not a mere writer of elegant trifles; her *Voice from the Factories* (1836) was a most eloquent and rousing condemnation of child labour. *The Dream, and other Poems* appeared in 1840. *Aunt Carry's Ballads* (1847), dedicated to her nephews and nieces, are written with charming tenderness and grace. Later in life she produced three novels. She wrote a preface to *The Rose of Jericho,* a translation from a German fable by her mother, Mrs. Sheridan. She died on June 15, 1877. Her husband died in 1875; and Mrs. Norton in the last year of her life married Sir W. Stirling-Maxwell.

See Jane G. Perkins, *The Life of Mrs. Norton* (1909).

NORTON, CHARLES ELIOT (1827–1908), U.S. scholar and man of letters, was born at Cambridge, Mass., on Nov. 16, 1827. The descendant of a long line of clergymen and of Anne Bradstreet, the Puritans' "tenth muse," in his idealism, restraint and dignity he was a member of the New England group already passing into its decline. Yet in him there was, too, an alien strain that made him, after graduation from Harvard in 1846, take employment with an oriental trading firm, for which as supercargo he travelled out to India. The leisurely trip through Europe on his return and his early contact with the culture of an older civilization made him feel sharply what he had been losing in life—"pleasure, opportunities, happiness, indeed, of a sort that nothing else can supply." He felt himself to be "half starved" in the U.S., yet he knew that in the old world he would be "half starved for this strange new one." Thenceforth his work was largely that of torchbearer and interpreter. As lecturer on and first professor of the history of art at Harvard (fom 1874 to 1898 when he became emeritus), he was long considered the "oracle of the humanities." From his first publication of church hymns (1852), he turned to *Notes of Travel and Study in Italy* (1860), and to his later *Historical Studies of Church Building in the Middle Ages* (1880). A translator of *The New Life of Dante Alighieri* as early as 1859, he did what was probably his best literary work in his prose translation of the *Divine Comedy* (1891–92). He helped to develop the creative abilities of his own countrymen in his editorship (1864–68) with James Russell Lowell of the *North American Review.* For long years with unfailing grace and tact he edited the literary remains of many of his friends. *The Correspondence of Thomas Carlyle and Ralph Waldo Emerson* (1883), *Letters of John Ruskin to Charles Eliot Norton* (1904)—records of a rare friendship mutually profitable—the *Orations and Addresses of George William Curtis* (1894), *Henry Wadsworth Longfellow; a Sketch of his Life, together with Longfellow's Chief Biographical Poems* (1907), the *Letters of James Russell Lowell* (1894) all bear testimony to the variety of his friendships in England and the U.S. and to his editorial discrimination. In allusion to this phase of his life, he suggested to Lowell as an inscription over his grave, "He had good friends, whom he loved." Yet his was never too exclusive a disposition. A lover of the beautiful in art, he was also a worker for the beautiful in life. Between 1846 and 1849 when he was still in the countinghouse, he opened a night school for men and boys in Cambridge; he was a director of the movement for model lodginghouses in Boston; he was a zealous worker for the Union cause, especially through his editorial labours for the New England Loyal Publication society. When he died (Oct. 21, 1908) at "Shady Hill," the gracious house in which he had been born, he left the memory of a serene and well-ordered life.

Bibliography.—The best record of his life is afforded by his *Letters,* which were edited with biographical comment by his daughter Sara Norton and M. A. De Wolfe Howe (1913). Tributes to his work and personality may be found in *The Harvard Graduates' Magazine* (vol. 16, Dec. 1907; vol. 17, Dec. 1908) and in T. W. Higginson, *Carlyle's Laugh* (1909).

NORTON, JOHN PITKIN (1822–1852), U.S. agricultural chemist and educator, was born in Albany, N.Y., on July 19, 1822. Norton worked on the farm of his father, John Treadwell Norton, during the summers, and he studied under leading teachers in Boston, Mass., New Haven, Conn., and New York city. He attended Yale university, New Haven, where he studied chemistry, and was a student of James F. W. Johnston at Edinburgh and Gerardus J. Mulder at Utrecht. After Norton was named professor of agricultural chemistry at Yale university in 1846, he played an important part in organizing the department which later became the Sheffield scientific school. His scientific papers include "On the Analysis of the Oat," *Transactions of the Highland Agricultural Society of Scotland* (July 1846), and "The Potato Disease," *American Journal of Science and Arts* (Nov. 1846; July 1847). Norton died at Farmington, Conn., Sept. 5, 1852.

NORTON, THOMAS (1532–1584), English lawyer, politician and writer of verse, was born in London in 1532. He was educated at Cambridge, and early became a secretary to the protector Edward, duke of Somerset. In 1555 he was admitted a student at the Inner Temple, and married Margery Cranmer, the daughter of the archbishop. From his 18th year Norton had begun to compose verse. He contributed sonnets to *Tottel's Miscellany,* and in 1560 he composed, in company with Thomas Sackville, the earliest English tragedy, *Gorboduc,* performed before Queen Elizabeth I in the Inner Temple on Jan. 18, 1561. In 1562 Norton, who had served in an earlier parliament as the representative of Gatton, became member of parliament for Berwick, and entered with great activity into politics, especially religious politics, and was employed on official business in the Channel Islands and at Rome. Toward the end of his life he was a fanatical anti-Catholic. His punishment of the Catholics, as their official censor from 1581 onward, led to his being nicknamed "rackmaster-general." At last he was deprived of his office and thrown into the Tower. Sir Francis Walsingham presently released him, but he died on March 10, 1584.

The *Tragedie of Gorboduc* was first published, very corruptly, in 1565 and, in better form, as *The Tragedie of Feerex and Porrex,* in 1570.

His numerous anti-Catholic pamphlets included those on the

rebellion of Northumberland and the projected marriage of Mary Queen of Scots to the duke of Norfolk. Norton also translated John Calvin's *Institutes* (1561) and Alexander Nowell's *Catechism* (1570).

For *Gorboduc see* SACKVILLE, THOMAS. The best account of Norton, and his place in literary history, is that of Sidney Lee in his *Dictionary of National Biography*. (E. G.)

NORWALK, a city of Fairfield county, Connecticut, U.S., 42 mi. N.E. of New York city, on Long Island sound at the mouth of the Norwalk river. It is on federal highway 1, and on the Merritt parkway, is served by the New York, New Haven and Hartford railroad. Pop. (1950) 49,460; (1940) 39,849; (1930) 36,019 (24% foreign-born white). The city's area of 24.7 sq.mi. embraces districts of very diversified character: the port and manufacturing centres, summer resorts along the sound and residential sections old and new. Churches and colonial houses surround the historic green. There are four parks and a municipal bathing beach. The city has 200 industries manufacturing a variety of products. Valuable oyster fisheries are also found in Norwalk. It is there that steam was first used in the oyster industry and there, too, the first derby hat in the U.S. was made. The site of Norwalk was purchased from the Indians in 1640 by Roger Ludlow and Daniel Patrick. The first settlement was made in 1649 by a small company from Hartford, and the town was incorporated in 1651. The city was formed by its consolidation in 1913 with the city of South Norwalk (chartered 1870). It was from Norwalk that Nathan Hale, disguised as a Dutch school teacher, started on his fatal errand to Long Island in Sept. 1776.

The village was burned by the British under Gov. William Tryon on July 12, 1779, and a chair is preserved in which (the story goes) Tryon sat and watched the flames from Grumman's hill.

NORWALK, a city of northern Ohio, U.S., on federal highways 18 and 20; the county seat of Huron county. It is served by the N.Y. Central and Wheeling and Lake Erie railways and by many truck lines. Population was 9,775 in 1950 and was 8,211 in the census of 1940. Century-old maple trees line most of the streets, and the manufacturing industries include food products, woodworking, rubber and printing plants. Norwalk was settled in 1817 by colonists from Norwalk, Connecticut. It was incorporated as a town in 1829 and chartered as a city in 1881. It lay within the "Fire Lands" grant made in 1792 by the state of Connecticut to the people of eight Connecticut towns, to indemnify them for losses by fire during the British expeditions under Gov. William Tryon in 1779 and Benedict Arnold in 1781.

NORWAY (NORGE), a kingdom of northern Europe, occupying the western and smaller part of the Scandinavian peninsula. Its eastern frontier marches with that of Sweden, except in the extreme north, where Norway abuts on Finland and the Soviet Union. On the north, northwest and west, the boundaries are the Arctic ocean, Norwegian sea (Atlantic ocean) and North sea respectively. The Skagerrak washes it on the south and southeast. The southern extremity of the country is the island of Kråga near Mandal in 57° 57′ N., the northern is the island of Cape Knivskjell (71° 11′ N.), west of the North cape on the island of Mageröy. Of the mainland, the northernmost promontory is Nordkyn, in 71° 8′ N., the southernmost, Lindesnes in 57° 59′ N. The most western island, Steinsöy, lies off the mouth of the Sogne fjord (4° 30′ E.), and the easternmost point is Hornöy (31° 10′ E.) near Vardö. The direct length of Norway (southwest to northeast) is about 1,100 mi. The extreme breadth (about 61° N.) is 267 mi.; the average is about 60 mi., but the Swedish frontier approaches within 5 mi. of a head branch of Ofoten fjord, and the Finland frontier within 22 mi. of Lyngs fjord. The length of the coastline is difficult to estimate; disregarding indentations it is about 1,647 mi., but including the fjords and greater islands it is probably 12,000 mi. The total area is 125,000 sq.mi. Including Spitsbergen (Svalbard) and Bear Island (Björnöya), the state territory of Norway amounts to about 150,000 sq.mi.

The Spitsbergen group of islands, with Bear Island, Kvitöya, King Karl's Land and Hopen, constitute Svalbard (24,294 sq.mi.), lying between lat. 74° and 81° N. and long. 10° and 35° E. Svalbard is part of the kingdom of Norway; administratively it is an independent unit under a governor. There are about 2,000 Norwegians there, mostly coal miners. Small islands under Norwegian dominion are Jan Mayen in the arctic and Bouvet and Peter I in the antarctic. Queen Maud Land, on the antarctic continental coast between 20° W. and 45° E., is also under Norwegian sovereignty.

Physical Features.—The main highland mass of the whole Scandinavian peninsula is a much eroded plateau which, probably because of its forming, in the main, the watershed between the rapid western rivers and the normally longer and slower eastern rivers of Sweden, has received the name of Kjölen (the Keel). Although the plateau as a structural feature may be considered to extend from southwestern Norway to North cape and even beyond into Spitsbergen, its ridgelike character is most marked where it coincides most closely with the Swedish boundary; *i.e.*, north of 63° N. The high plateau consists of early Palaeozoic rocks which represent one of the oldest structural elements in Europe. An Archaean zone stretches along the west coast from Bergen to Hammerfest, interrupted toward the north by overlying patches of Palaeozoic deposits. Gneiss predominates, but other crystalline rocks occur subordinately. The Lofoten Islands consist chiefly of eruptive granite, syenite and gabbro. South of a line drawn from the head of the Hardanger fjord to Lake Mjösa is another great Archaean area.

A line drawn from the Nase to the North cape coincides roughly with a marked change in the character and structure of the Palaeozoic rocks. East of this line even the Cambrian beds are free from overfolding, overthrusting and regional metamorphism. They lie flat upon the Archaean floor, or have been faulted into it in strips, and they are little altered except in the neighbourhood of igneous intrusions. West of the line the rocks have been folded and metamorphosed to such an extent that it is often difficult to distinguish the Palaeozoic rocks from the Archaean. They form in fact a folded mountain chain of ancient date which has subsequently been worn down and then faulted up. No volcanic rocks of recent date are known in Norway. This faulting largely accounts for the almost unique character of the river and coastal topography of Norway. Differential erosion, partly glacial, has caused many of the highland masses to form prominent mountain summits not only on such islands as the Lofoten chain, but on the plateau itself. The average height of Norway is probably about 1,600 ft. and may be compared with approximately 1,000 ft. for Europe as a whole. This high figure for Norway is achieved not so much from the height of individual summits as from the absence of extensive lowlands; southeastern Norway is the lowest part and even this is of a hilly nature. In the area northwest of the Norway-Finland boundary a few peaks reach slightly more than 4,000 ft., but immediately south of the junction of the three countries the general height increases considerably, though the most lofty summits are entirely Norwegian only in the extreme north of this area. (*See* SWEDEN.) Here Jaggevarre (6,053 ft.) lies between Lyngs and Ulls fjords, and Kistefjell (5,361 ft.) provides right-bank water for the Barduelv, which runs westward north of Torneträsk. Sulitjelma (6,279 ft.) lies actually on the frontier. Nearer the coast and centred approximately on the Arctic circle is the great ice field of Svartisen (*see* GLACIERS), through which projects Snetind peak (5,246 ft.). The only important peaks immediately south of this are Okstindene (5,922 ft.) and the rather better known Börgefjell (5,502 ft.). At about lat. 63½° N. is the southern limit—Trondheim fjord—of a remarkable depression which runs for more than 200 mi. southwest to northeast dividing the narrowest part of Norway into almost equal eastern and western strips. Its exit is at Salt fjord (near Bodö) and it is characterized by numerous rivers, some draining north, others south; the depression is of the greatest importance for internal communication, including railway routes. Due east of Trondheim fjord the plateau is lowest and narrowest, again offering a relatively easy communication route already utilized by a railway. Also from this fjord southward is a valley line and a railway route to the upper Glomma valley and down this to Oslo. South of the Trondheim "narrowing" the plateau swings westward, becoming higher, wider and more definitely Nor-

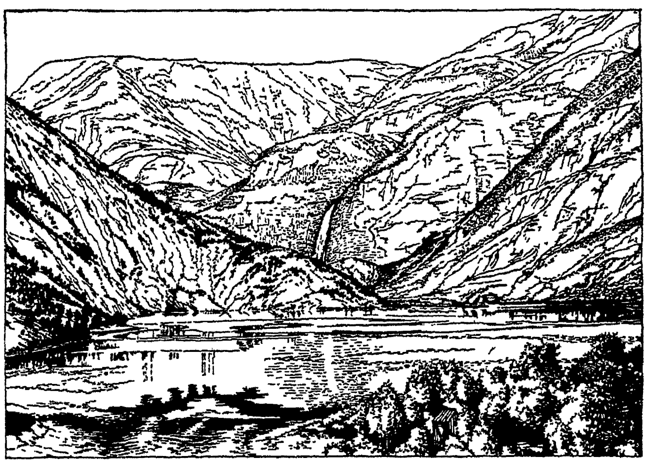
wegian. The Sogne fjord (61° N.) and its branches reach out toward a giant horseshoe of the highest ridges in Norway; northward are the Jostedalsbre; the Jotunheim lies north and northeast; the Hardangervidda is southeast and Vossevangen (Voss) lies south. Northeast of the Jotunheim beyond the deep cleft of Gudbrandsdal and its northwestern counterpart Romsdal, is Dovrefjell, and southeast of this Rondanefjell. South of the Hardangerfjell, beyond Hardanger fjord, is the lake-sprinkled Hardangervidda, the most expansive tract of open high plateau in Europe; southeastward this plateau merges into the lower hummocky Telemark mountains which are drained south and southeast to the Skagerrak. The most lofty summits occur in the Jotunheim with Galdhöpiggen (8,097 ft.) as the highest Norwegian mountain, though if the 100 ft. or so of snow on the top of Glittertind is included, then this reaches to 8,140 ft.; nearly 30 peaks in all exceed 6,500 ft. in the Jotunheim mass. The other mountain areas are lower, though the Dovrefjell and the Rondanefjell have Snöhetta (7,500 ft.) and Rondvaasbu (7,162 ft.) as their respective summit masses.

Glaciers.—The relatively insignificant Norwegian glaciers of today have unimportant effects compared with the glaciation consequent on the presence of the enormous ice fields in the last Ice Age. To these latter glaciers is owed much of the smoothing of islands and the fjord character of the coast. The rounded nakedness of the mountains, the U-shaped valleys, the shelflike ledges over which the rivers plunge to produce the "white coal" of Norway and the pockets of finely divided fertile soils in rock basins are all direct legacies. The level terraces and raised beaches which exist on some of the coasts and prove such desirable sites for settlement are mainly composed of glacial debris once deposited below sea level but now elevated by land oscillation. Today Norway still contains the largest European ice field—the Jostedalsbre. This is about 500 sq.mi. in extent: from it glaciers run to within 150–200 ft. of sea level. Jotunheim, though glaciated, has the icecap broken by deep valleys, also as it lies farther east the precipitation is lower and the summer temperatures higher—two factors seriously affecting the size of icecaps. Between Hardanger fjord and its branch Sör fjord is Folgefonn—110 sq.mi.—and the most southerly considerable area in Norway. Second in point of size to the Jostedalsbre but not inferior in interest is Svartisen—280 sq.mi. in area, from which glaciers descend almost to sea level. In about lat. 70° a small glacier, the Engabre, actually enters the sea in Jokul fjord (a branch of Kvaenangen fjord) and gives birth to miniature icebergs. The Seiland glacier (46 sq.mi.), on the island of the same name south of Hammerfest, is the most northerly Norwegian example. The snow line in Norway varies in height with aspect and amount of precipitation, but it is everywhere fairly low—ranging from below 3,000 ft. in Seiland to slightly above 5,000 ft. in southern Norway.

Coast.—The Norwegian mountains fall abruptly to the sea, and the coastline almost throughout is cliffbound. The land features are continued as numerous islands, estimated at 150,000, which fringe the mainland. This island fringe, occurring also in a modified form along the Swedish coast, is, in Norway, termed the Skjaergård (skerry fence). This fringe and the fjord coast are most fully developed from Stavanger nearly as far as the North cape, but only between Stavanger and Flekkefjord can the coast be considered smooth and moderately free from islands. Here, particularly north of Egersund, a narrow lowland, abundant in peat bogs, is fringed by a flat, open coast, dangerous to shipping. The channels within the island line are of incalculable value to a people largely dependent on coastwise navigation. In fact, the voyage northward from Stavanger may be made in quiet waters almost throughout. Only at rare intervals, as off the port of Haugesund, or when crossing the mouth of some large fjord, need the open sea be encountered. At some points large steamers follow the carefully marked deep water channel, between cliff edges which seem to overhang the vessel on either side. Small vessels, fishing or trading between the fjordside villages, navigate narrow ramifying "leads" (*leder*) where the sole danger is the tidal current, often exceedingly strong. The largest island is Hinnöy (Lofoten and Vesterålen group), about 850 sq.mi. in area.

Many islands, chiefly northern, are of great elevation; thus the jagged granite peaks characteristic of the Lofotens reach about 4,000 ft. Other interesting islands are Hornelen, near the mouth of Nord fjord, rising nearly sheer for 3,000 ft. above the sea; the well-named Torghatten ("the market hat"), north of Namsos, completely pierced, 400 ft. above the sea, by a vast natural tunnel, which on occasion reaches upward of 200 ft. in height and 80 ft. in width; the quaintly shaped small Hestmannöy ("horseman island"), intersected by the Arctic circle, justly named from its form. Bare rock is the dominant feature of the coast and islands, save where a few green fields surrounding a farmstead occupy a miniature level terrace. The oscillation of the land relative to sea level is illustrated by marine terraces, 600 ft. above the present sea level, near Trondheim, and by the numerous former beachlines of north Norway, which are occasionally in pairs at different heights. Nevertheless, at some points (as on the Jaeren coast) glaciated "giants' kettles" may be observed even below the level of high tide thus indicating the greater level of the land toward the close of the glacial epoch.

Fjords.—Oslo fjord, opening from the north angle of the Kattegat and Skagerrak, differs from the great fjords of the west. Its shores are neither high nor precipitous. It is shallower and wider and is surrounded by the most extensive lowland in Norway. It is studded with numerous small islands. Thence, past Lindesnes, to Bokn fjord there are many small fjords, 300 fathoms in extreme depth, but even the intermittent inner lead which can be traced to Flekke fjord ceases to exist beyond. Bokn fjord is broad and island-studded, but throws off several inner arms, of which Lyse fjord, due east of Stavanger, is 25 mi. long and half a mile wide, with precipitous walls. It is the most beautiful and mysterious fjord in southwestern Norway. Hardanger fjord (355 ft. extreme depth) penetrates the land for 105 mi. and is frequently visited, for it lies near to shipping routes which converge on Bergen, but its beauty is exceeded by that of Sogne fjord and Nord fjord farther north. Sogne is the largest and deepest fjord of all; its head is more than 124 mi. from the sea; its maximum width scarcely exceeds 2 mi., and the main channel is 500–660 fathoms deep. Some of the northern arms intersect the snow-clad



THE LISTER FJORD, A NARROW ARM OF WATER CREEPING INLAND TOWARD THE GLACIERS OF THE JOTUNHEIM, IN NORWAY

Jostedalsbre and their dark blue waters have a surface layer showing a milky tinge imparted by glacier-fed streams. Nord fjord (340 ft. in extreme depth) touches the northern side of the Jostedalsbre and is popular with tourists. Stor fjord opens inland from Aalesund; it is more than 70 mi. long and is wild and imposing. Trondheim fjord (300 ft. in extreme depth), the next great fjord northward, broadens inland from a narrow entrance, but lacks grandeur as the elevation of the land is reduced at the Trondheim "narrowing." Immediately north of Trondheim the fjords, though long, are not so extensive and the coastline loses its grandeur, but north of Salt fjord, which lies beyond the great Svartisen ice field, the scenery is unsurpassed. Salt fjord is connected with Skjerstad fjord by three narrow channels where the water, at ebb and flow, forms powerful rapids. The Lofoten Is-

lands and Vesteraalen are separated from the mainland by the Vest fjord (340 ft. deep), which is continued inland by Ofoten fjord, on which is situated Narvik, the railhead town for the line from Sweden.

The main fjords north of Vesterålen have a general northerly direction; among them is Lyngs fjord near Tromsö, with high flanking cliffs. The softer and looser schists are more prevalent in the north, hence the fjords are wider, branched and interlaced, particularly in Finnmark. The Alta fjord (225 ft. extreme depth) is remarkable for the vegetation on its shores. From Lofoten north there is a chain of larger islands: Senja, Kvalöy, Ringvassöy, Söröy, Seiland and Mageröy, thus extending to the most northerly point, but hereafter the Skjaergård ends abruptly. The coast to the east is of widely different character; flat mountain wastes descend precipitously to a sea destitute of islands, save Vardö, with two low islets at the eastern extremity of Norway. The chief fjords are Porsanger and Tana, opening north, and Varanger opening east. North of the last fjord the land is low and the landscape monotonous; on the south of it a few islands and branch fjords break the smoothness of the coastline.

Lakes and Rivers.—Both in respect of rivers and of lakes Norway is well supplied. As a rule, the rivers are short and have a small basin; and the lakes are long, of little area, but of great depth, for many give soundings showing their beds to be well below the present sea level. In this connection, Mjösa, the largest Norwegian lake, 141 sq.mi. in area at an altitude of 397 ft., has a maximum depth of 1,453 ft. (nearly 1,100 ft. below sea level); Tyrifjord (alt. 207 ft., area 51 sq.mi.) has its maximum depth 700 ft. below sea level; Tinnsjö (alt. 605 ft., area 38 sq.mi.) with its bed more than 800 ft. below sea level; but the most remarkable case is Hornindalsvatnet, 6 mi. beyond the head of Nord fjord—20 sq.mi. in area, 180 ft. in altitude; its maximum depth is 1,414 ft. below sea level. Many of the high-level lakes are also of great depth; *e.g.*, Bygdin—area 18 sq.mi., alt. 3,484 ft., greatest depth 705 ft. The total number of lakes, tarns and pools is very high: in all they probably cover nearly 5,000 sq.mi. (4% of the entire country). In many cases the low-lying lake near the head of a fjord is separated from sea water by a narrow but steep-sided neck of land which on further land subsidence would resemble the submerged sill which is so characteristic of the underwater topography of the fjords. The majority of the river-valley lakes resemble mere expansions of the width of the river and possess strong currents; hence they are valuable for internal transport less as routes for water-borne traffic than as providing through lines for land communication in the difficult mountainous sections of the country. Store Le on the frontier in the southeast is somewhat exceptional, for it provides a water-transport link between a Norwegian canal system and a Swedish. The majority of the rivers run swiftly between steeply sloping valley walls, particularly in their upper and middle courses, where they are of little or no value for any form of navigation though they are extremely useful as gigantic flumes for the gravity carriage of timber. They are utilized as waterheads for hydroelectric schemes by which more than 2,000,000 kw. had been developed by 1951.

The unexploited sources were still enormous at mid-century (more than 8,000,000 kw. by the early 1950s). The development of this source of natural wealth is facilitated by the numerous rapids and falls on the rivers. As Norway fully realizes the financial value of its remarkable scenery and of its anglers' haunts, the mode of utilizing this smokeless power in the industrialization of any area is always a matter for careful consideration. A limiting factor in the "white coal" schemes is the seasonal character of many Norwegian streams which run low in winter on the freezing of their upper courses and rise rapidly during the period of maximum rainfall—here the lakes are of supreme value as safety valves controlling spring thaw water and autumnal rain water. Nevertheless, disastrous floods are not unknown. The lakes themselves in the north and interior freeze for varying periods each year, but in the south, where the majority of the large lakes are situated, it is only during very severe winters that these reservoirs become icebound.

The principal river of Norway is the Glomma, about 365 mi. long, which rises about 2,300 ft. above sea level in the highlands south of Trondheim fjord. It is a swift stream with numerous falls, and even within eight miles of its mouth, in Oslo fjord, there is a series of seven falls of which Sarpsfoss (74 ft. high and 120 ft. wide) is the best known. The river, which runs mainly north to south, drains about 16,000 sq mi., pierces the richest timber area and provides an important railway route from Oslo to Trondheim. Above Öyeren (35 sq.mi.), the largest lake of the numerous ones in its course, the Glomma makes a remarkable bend (at Kongsvinger). Here, in postglacial times, the river which formerly ran due south to Vänern lake (Sweden) make a sudden swing to the west capturing the upper waters of the Lågen, formerly an independent stream. (The old bed still carries occasional floodwater from Glomma to the lake.) The Lågen, more than 200 mi. long, has, for a Norwegian river, a large upper basin receiving water from the Jotunheim and the Dovrefjell. Its sources lie near Romsdals fjord, and a direct railway runs from Oslo along its lower course (Vormen river), past the shores of Lake Mjösa, up the Gudbrandsdal, over the watershed and down through Romsdal (another railway line links Trondheim with the head of Gudbrandsdal). Other important streams entering Oslo fjord are the Tistedalselv and the Drammenselv. The Tistedalselv reaches the eastern seaboard after draining through a series of long, narrow lakes connected by rapids. The Drammenselv, a large river with a considerable basin extending into Hemsdalsfjell, Valdres and Filefjell, enters on the western seaboard. Its upper tributaries, the Randselv and the Ådalselv (plunging over Hönefoss), unite to form the Storelv which expands into the Tyrifjord lake. Below this the real Drammenselv begins and receives, on the right bank, the Hallingsdalelv which flows through Lake Kröderen—all these valleyways afford important but not easy routes, and though the rivers are not navigable for any long stretches yet steamers are employed on the lakes. Numerous streams drain southward from the plateau and lake district of Hardangervidda, one of these, the Lågen is noted for its falls (*e.g.*, Hammerfoss and Labrofoss), and for its wealth in salmon. From the Telemark district runs the Skienelv (152 mi.) flowing through the very deep Tinnsjö and the slightly larger, deep Norsjö; the former lake receives the river Måne, on which is the famous Rjukanfoss (460 ft. high). The most notable falls occur in the courses of the shorter and more rapid western streams. Some of the most striking, in order from the south, are: Vöringfoss (597 ft.) on the Bjoreia and Skjeggedalsfoss (525) on the Tysso—these two are in the Hardanger fjord area. Around Sogne fjord are several, of which Vettisfoss (853 ft.) on the Mörkedola is probably the most interesting. The famous Seven Sisters falls are in a branch of the Stor fjord, while the Namsenelv (116 mi.), a popular salmon river entering Namsen fjord, has Fiskumfoss (138 ft.) and several others. The Arctic ocean rivers have gentle gradients, occasional rapids but no important waterfalls. Two longer ones are the Altaelv (124 mi.), which drains into the Alta fjord, though unfortunately its valley affords no route of importance; and the Tanaelv (205 mi. long—third longest river in Norway), which drains a considerable area in Norway and Finland, though the absence of lakes results in summer floods increased by the presence of ice dams. The lower river is wide (about 2,000 yd.) and tidal for six or seven miles and is ascended by small vessels. River boats are used along certain river stretches below and above the Storfoss rapids which occur about 45 mi. from the mouth of the river and have a fall that averages 23 ft. in 1,000 yd.

Climate.—The striking and unique feature of the climate of Norway is the presence of the largest positive temperature anomaly on the surface of the globe, which results in such unusual conditions as average temperatures within the Arctic circle which are higher than those of places farther east and 20° of latitude farther south. Again, Hammerfest, a thriving settlement of more than 3,000 inhabitants, is actually north of King William Land, which witnessed the tragedy of the Sir John Franklin polar exploration party. This temperature anomaly is consequent on the warm water and air drift across the Atlantic ocean onto the shores of Norway. January is the coldest month, and southeastern Norway then has a mean temperature of below 32° F. (Oslo 24.6°), but

the coldest parts in this area are the Glomma valley, between Tynset and Röros (near the Swedish border). At the latter place (altitude 2,067 ft.) the January mean is 13.1° and an absolute minimum of approximately 90° F. of frost has been recorded. Even this intense cold has been exceeded at stations near the Norway-Sweden boundary in Lapland. Along the coast of western and northern Norway winter temperatures are higher, the January mean being 35° in Bergen, 30° in Bodö and 23° in Vardö.

In these coastal districts February is on the average rather colder than January. The number of days on which frost occurs varies between 45 at Ona and 240 in certain parts of Finnmark; North cape has about 190. The fjords are not penetrated by the cold water from the open ocean and are always ice-free except for patches along shallow coastal stretches during unusually severe winters. Summer temperatures range between slightly below 50° in the extreme north (Tromsö 52.5° F. July average), and 62.5° at Oslo in July. Röros, with much greater altitude, has 52.5° average in the same month. The southeast of Norway is the warmest part in summer. At Bergen the warmest month is also July (57.5° average). Absolute maxima are high, and the following have been recorded: Skudenes, 84°; Bergen 86°; Oslo 94.4°; and even Karasjok, in Lapland, has recorded 88°. The annual range increases from west to east generally and from south to north along the coast.

Though the southwest wind is usually prevalent over Norway and very marked in summer, yet the winter high-pressure area causes outflowing winds—northeast on the Skagerrak, south and southeast on the western coast and southwest on the northern. Gales are frequent on the western coast, averaging three to four per month in winter and about one to two per month in summer. In the interior and east, gales are comparatively rare. Gales from the southwest bringing rain are the most common; next in frequency are gales from the northwest bringing snow. Calm weather is rare on the western coast but frequent in the interior. December and January are the stormiest months. Hailstones and thunderstorms are not of frequent occurrence in any part of Norway.

The number of days on which rain or snow falls is greatest on the northwestern and northern coasts, least in the southeastern districts and the interior of Finnmark. In the former area, precipitation occurs on 150–200 days in the year. On Dovrefjell and the southeastern coast the average is about 100 days. Snowfall occurs least frequently in the south (*e.g.*, at Mandal, 25 snowy days out of 116 on which precipitation occurs), increasing to 50 at Oslo and Dovrefjell, to 90 at Vardö and to 100 at the North cape. Hence in the north and in the upland tracts snow occurs at least as frequently as rain. Snow may fall in any month on the coast as far south as the Lofotens. The amount of precipitation exceeds 100 in. per annum in the mountains a few miles from the coast north and south of Sogne fjord. On the outer islands there is a slight decrease; inland the decrease is rapid and great. In the extreme south of the country the average is about 39 in. There is a diminution eastward along the northern coast and a further rapid decrease toward the northern interior, where the average is 16 in., but strongly marked local variations are observed.

BY COURTESY OF NORWEGIAN GOVT. RAILWAYS

WOMEN DRESSED IN THE NATIVE COSTUME OF GUDBRANDSDAL AND SETESDAL

The amount of cloudiness is great. The coast of Finnmark has more than three cloudy days to one clear day; in the interior of the country clear and cloudy days are about equally divided. Summer fog is frequent on all coasts but fog is rare in winter, though occasionally experienced in the southeast. Sometimes, in severe winters, a frosty fog ("smoke frost") appears on the western fjords, caused by the piercingly cold land wind passing over the relatively warm water.

Norway was one of the first countries to establish a meteorological service, the Meteorological institute in Oslo being set up in 1866. There are meteorological observatories at Bergen, on Jan Mayen Island and on Bear Island, in East Greenland and on the mountain peaks of Fanaråken and Gausta. There are also 550 stations where meteorological observations and measurements are taken. Weather forecasts nine times a day are made regionally by the institutes at Oslo, Bergen and Tromsö.

The Midnight Sun.—Part, at least, of the sun's disk is above the horizon at the North cape continuously from May 13 to July 31 and at Bodö, in lat. 67° 17′ N., from June 1 to July 13. Even at Trondheim there is practically no night from May 23 to July 20, while the long twilight gives the extreme south of Norway no real darkness from the end of April to the middle of August. In winter, on the other hand, the sun does not rise above the horizon at the North cape for more than two months and there is only a twilight at midday. In the extreme south midwinter night is 17½ hours long.

Flora and Fauna.—The forests of Norway consist chiefly of conifers. The principal forest regions are in the southeast and south. In the Trondheim area and in Nordland there are extensive forests of pine and spruce with the pine on the drier, higher and less congenial parts. In southeastern Norway the conifer tracts extend from sea level to 2,500 to 3,000 ft.; in the inland parts of the Trondheim region the upper limit sinks to 2,000 ft.; while on the coast the upper limit is only from 600 to 1,200 ft.; farther north the spruce disappears and the pine limit falls to 700 ft. about 70° N. Above and north of the conifers is the birch belt; next follow various species of willows and the dwarf birch and last of all, before the snow line, the lichen belt, in which the reindeer moss is always conspicuous but a few flowering plants, shrubs and trees of the willow belt sometimes extend close up to the snow line. Even among the conifers there is a sprinkling of other trees —lowland birches, aspens and rowans in the high north, while in the southern and less elevated districts the lowest zone of forests includes the ash, elm, lime, oak, beech and black alder; but the beech is much rarer than in Sweden and, in fact, flourishes only near the Skagerrak; there and elsewhere the extreme coastal region is destitute of forest. The richest flora is found in the inland fjord valleys, but the Dovrefjell is the district in which arctic flora may be studied in great variety and within narrow limits. Marine flora is very finely developed on the coastal banks. There are 2,000 varieties of flowering plants.

The great forests were once the haunt of the bear, the lynx and the wolf. The bear and the lynx are now almost exterminated. The wolves decreased very suddenly in southern Norway about the middle of the 19th century, probably because of disease, and continued to decrease thereafter in the north; but they are still found in the Röros district and northward to Finnmark where they are abundant. Wolves are the worst enemy of the reindeer. The elk occurs in the eastern forests and near the coast in the Trondheim district, but is now becoming rare. The red deer is confined chiefly to the western coast; its principal haunt is the island of Hitra, off the Trondheim fjord. It is usually regarded as a survival of the oak age. On the high fjells are found the wild reindeer, glutton, lemming and the fox. The wild reindeer is now very rare in Finnmark, though large tame herds are kept by the Lapps. The lemming is noted for its curious nonperiodic migrations; at such times vast numbers of these small animals spread down country, even swimming lakes and fjords. They are pursued by beasts and birds of prey, and even the reindeer kill them for the sake of the vegetable matter they contain. Hares are very common all over Norway up to the snow line, and the badger and hedgehog also occur in the south and southeast. The beaver, formerly widespread, decreased seriously, but strict protection has saved it and it is fairly plentiful in the southern valleys.

Game birds are fairly abundant in most districts. Black grouse are widely distributed in the region of conifers and birches south of Finnmark. Hazel grouse are found mainly in the spruce forests

of the southeast and east and fairly generally in the north, as are capercaillie, but the former is lacking in the west and the latter is found near certain fjords only. Woodcock and snipe are moderately plentiful. The partridge, an immigrant from Sweden, occurs principally in the east and southeast. A severe winter causes a marked scarcity of them. A very large proportion of the Norwegian avifauna consists of migratory geese and ducks, various birds of prey, golden plover, etc. These birds leave in autumn by three well-defined routes—one from Finnmark into Finland, one by the Oslo valley and one by the western coast, where they congregate in large numbers on the lowlands immediately south of Stavanger—but certain high arctic birds as the king eider, Spitsbergen guillemot and the little auk move on to the northern coast of Norway from higher latitudes at the end of summer. The arctic type of bunting, the snowy owl and the rough-legged buzzard are exceedingly numerous. In some localities the puffin and kittiwake form great colonies (*fugleberg,* "bird cliffs").

The common seal is very frequent; and arctic seals visit the northern coasts; among these the harp, or Greenland, seal is believed to be particularly destructive to the fisheries. A large number of the best European food fisheries occur along the coasts, including cod, herring, mackerel, sprat and flatfish. Various species of whales visit the coast; the most important is the rorqual, or finner; the largest is the blue whale, which appears off the coast of Finnmark from June to August. Other finners are the true finner and the smaller fish whale. The most important of other types of whales are the bottlenose, the humpback and the caaing whale. Of fresh-water fish the Salmonidae are by far the most valuable. Next to these, perch, pike, grayling and minnow are most common.

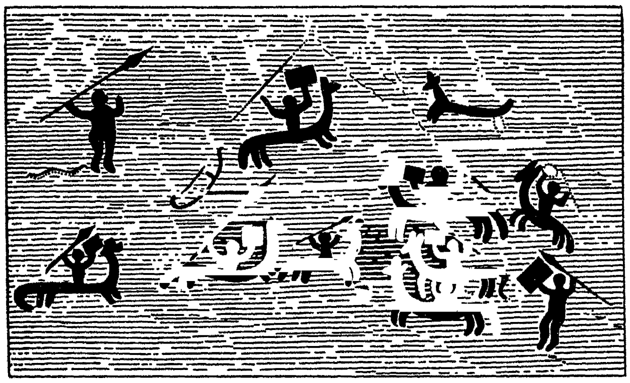
Southern Norway is richer than western Norway in insects and the north has numerous characteristic arctic types.

Norway is much frequented by British anglers. The Salmonidae have penetrated considerable distances inland, and though the trout is the only one to reach many of the upland lakes yet it is very abundant there. Most of the owners of water rights have a full appreciation of the value of good fishing to sportsmen, especially when netting rights are given up for the sake of rod-fishing.

(O. J. R. H; X.)

HISTORY

Prehistory.—Norway can be shown to have been inhabited for about 14,000 years, since the withdrawal of glaciation to the central highlands of the country. The primitive dwelling sites represent a culture derived from the palaeolithic cultures of western and central Europe and introduced from the southwest via Jutland, from Poland via the Baltic and from Russia via the White sea. Further cultural elements were added with every new accession of population, the different groups probably representing more or less different races which, however, have left neither skeletal remains nor traces of their language or languages.



BY COURTESY OF CAMMERMEYERS FORLAG

NORWEGIAN HORSEMEN IN THE BRONZE AGE. FROM A ROCK CARVING IN BAAHUSLEN, FORMERLY SOUTHERN NORWAY

Among these primitive hunters there gradually appeared distinct settlements of farming colonists from Denmark and Sweden; and by about the beginning of the Christian era the native hunters had come to adopt these farmers' way of life, language and religion and had in turn enriched the farmers' culture with their own experience in fishing, fowling and hunting. The two peoples were now completely assimilated.

All the ancient place names in Norway are of Germanic origin, and the first runic inscriptions, from the 3rd century A.D., show an archaic type of Germanic that was certainly the mother language of the later Scandinavian dialects.

Earliest History.—Before the consolidation of the kingdom the principal parts of Norway were markedly distinct. Viken, the country around Oslo fjord, was dependent on Denmark, under local kings. The inland regions were divided into several small kingdoms, open to influences from Sweden and united by the common Eidsiva-thing at Eidsvoll. The coast in the south and the west clearly enjoyed cultural relations with Flanders and France and formed from *c.* A.D. 700 an aristocratic confederation, with the common Gula-thing on Sogne fjord. The eight counties (*fylker*) round the Trondheim fjord had their primary political centre in the Oere-thing at Trondheim, where later kings of Norway, from the time of Haakon the Good, received the homage of the people. The northernmost province, Hálogaland, was a monarchy ruled by an ancient dynasty, later to be called the jarls of Lade.

The first exact date in Norse history is 813, given by a Frankish annalist with the information that Vestfold, on the Oslo fjord, was subject to the king in Jutland. The first Norse Vikings to come to Great Britain are described in the Anglo-Saxon chronicle, under the year 787, as "norðmanna of Hareðalande"; viz., Hordaland in Norway. Graves and place names attest Norse settlements in the Scottish isles from *c.* 800, and Dublin was fortified in 839.

The Dynasty of Harald Haarfager.—While the nobles of southern and western Norway were engaged in Scotland and Ireland Harald Haarfager (Fairhair), ruler of several scattered territories, took the opportunity to conquer the whole confederation of Gula-thing by the victory in Hafrsfjord (872; sometimes dated 20 years later). Apparently he acted in alliance with the jarl of Lade, who had annexed Tröndelag to his possessions. After the conquest Harald resided in estates confiscated from exiled nobles, and parts of Viken were assigned to his sons. The purpose of the conquest was simply to acquire larger means of subsistence, to increase the king's retinue of warriors and to maintain his sons.

Harald Haarfager, as Harald I, was undisputed king of all Norway. He had designated as his successor Eric I Bloody Axe (Eirik Blodóks, *c.* 930–*c.* 935), his son by his Danish queen, who was moreover married to the sister of the king of Denmark. Chosen as most highborn, perhaps because of reminiscences of Vestfold's vassalage to Denmark, Eric started his reign by killing two of his eight brothers and within a few years had got rid of all but one, the youngest, Haakon (Hákon), who was reared at the court of the English king Aethelstan. Later tradition reports that Eric reigned for five years and then left the country, on Haakon's arrival from England. He was killed at Stanmoor, Cumberland, in 954.

Sigurd, jarl of Lade, had summoned young Haakon and now had him received as king in several parts of the country. The considerable concessions that he had to make to claims for local independence won him his surname of "the Good." Haakon I was the first missionary king of Norway, but he totally failed to convert his people. The saga assigns to him the credit of organizing the naval levy all along the coast, the first important step toward the political consolidation of the kingdom. At the time this force, or *leidang,* was required against Eric's sons, who, assisted by Danish forces, made repeated attacks to regain the kingdom. The levy proved efficient, but Haakon was mortally wounded in the battle at Fitjar (*c.* 960; possibly as early as 945).

The next king was Harald II Graafell (Grey Fur), the eldest surviving son of Eric. He resumed his father's efforts to assert himself as lord of the whole country and killed two petty kings (his father's cousins) in Viken and Sigurd, jarl of Lade. Reputed a hard oppressor of the people, he became the more unpopular because he prohibited the public worship of the gods—no surprise

was felt when the harvest was bad and fisheries failed. The reign was not likely to last long: one of his brothers was killed during a revolt in Tröndelag, another in Hordaland, and Harald himself in a battle (*c.* 970) against Haakon, son of Sigurd of Lade.

This Haakon now succeeded as jarl of Lade and took over the Gula-thing counties as a fief of Denmark, while Denmark annexed all eastern Norway. Haakon Jarl assisted his Danish lord in a war against the emperor Otto II in 974 but refused to convey Christian missionaries into Norway. A contemporary scald praises him as the pious champion of the ancestral faith, the restorer of temples and worship. He repulsed Danish attacks with his *leidang* and remained for about 25 years the sovereign of western and northern Norway, like Haakon the Good, though he preferred his ancestral title of jarl. He was killed in 995 at a peasant riot in Tröndelag, coincidentally with the arrival of a fresh royal pretender from England.

Olaf I Tryggvessön was a descendant of Harald Haarfager. Bred from boyhood in Russia, he had become a Viking chieftain and had been the leader of the invasion of England in 991. On the conclusion of peace, he had been confirmed a Christian by the bishop of Winchester and adopted by Aethelred II, who probably incited him to convert Norway. He landed in 995, was recognized as king all along the coast and ensured acceptance of Christianity everywhere, partly by negotiation, otherwise by cruel force. He extended the mission even to Iceland and Greenland. As he encroached upon the Danish dominion in Norway he provoked a war and was slain in the battle of Swold (1000). Norway remained divided between the jarl of Lade and the king of Denmark.

Olaf II Haraldsson, another descendant of Harald Haarfager, had been a Viking from his boyhood till his landing in Norway in 1015, at the favourable moment when Eric jarl of Lade had gone with Canute of Denmark on his expedition to England. Olaf was the first king who really ruled all Norway, including the inland counties. He organized a regular royal administration by *lendmenn* (selected from the old aristocracy as military and judicial officials) and *armenn* (mean-born servants of the king who managed his estates). He completed the christianization and started the organization of the church. But he was not popular, being too severe in maintaining his royal power.

Olaf was let undisturbed as long as Canute was seriously engaged in England but was expelled when Canute had further leisure to invade Norway (1028). After two years he returned and was killed in the battle at Stiklestad (1030). Canute made his son Sweyn (Svein; 1028–35) king of Norway. But soon rumours were spreading that Olaf was a saint: his body was enshrined in the cathedral, Sweyn was exiled, and Olaf's son Magnus I was called back as king (1035–47). Magnus became king also of Denmark in 1042 and crushed a Slav invasion of Jutland by the victory at Lyrskog. He came to be known as Magnus the Good. But soon Sweyn II Estrithson, nephew of Canute, revolted against him, and Magnus died during a campaign in Denmark, the last descendant of Harald Haarfager.

The Dynasty of Harald III Hardraade.—Harald Sigurdsson, uterine brother of Olaf II, who had escaped from Stiklestad and taken service in the imperial bodyguard in Constantinople, had in 1046 returned to Norway, where Magnus complied with his demand to share the kingdom as Harald III. For several years he continued the war for Denmark, but finally had to leave it in Sweyn Estrithson's possession. In Norway his reign caused much unrest and gave rise to his epithet Hardraade (harðráðr), "the hard ruler." He was killed at Stamford bridge on his expedition to England in 1066.

Harald III's son Olaf III Kyrre (*i.e.*, the Quiet; 1066–93), who shared the kingdom with his brother Magnus II till the latter's death in 1069, made formal peace with Denmark and was never involved in war. He gave the dioceses fixed territories and permanent seats, which led to the rise of the first Norse towns and to the development of trade. Olaf's son Magnus III Barfot (Barefoot; 1093–1103) formed a striking contrast to the father, engaging in three expeditions to Scotland to establish Norse sovereignty over the Orkneys and the Hebrides (with Man). He got his epithet because he assumed the Celtic dress, with a kilt. He met his death in Ireland and was succeeded by his sons Olaf IV (1103–15), Eystein I (1103–22) and Sigurd I Jorsalafar (1103–30; so-called because of his visit to Jerusalem). These kings reigned jointly, paying special attention to the church. They imposed the tithes to better the clergy's income, founded the first Norse monasteries and built cathedrals. The clergy of the Scottish isles was incorporated into the church of Norway.

The unity of the kingdom had been made sacred by Olaf II's martyrdom, but all royal princes still had equal right to the succession. Thus Harald IV Gylle, Gille or Gilchrist, from Ireland, who after submitting to ordeal by fire had been acknowledged by Sigurd Jorsalafar as a bastard son of Magnus III Barfot, was able when Sigurd was dead to capture and blind the legitimate prince Magnus IV and to reign for a year till he was himself killed (1136) by a fresh pretender, who likewise failed and was executed. Similar tragedies recurred for the next 100 years, causing continual wars between rival parties of *lendmenn* and provinces. The troubles reduced the royal authority but invigorated the church by giving rise to the institution of the Norse archbishopric (1151) and of the right of testamentary donations, Peter's pence, etc., and, particularly, to the privileges granted to it in order to obtain the coronation (1163) of Magnus V Erlingsson, which made the king, now St. Olaf's vassal, recognize the tithe dues and also the independence of clerical jurisdiction.

Magnus V was long successful till (1177) he met his last antagonist, Sverre, born in the Faeroes, who claimed to be a grandson of Harald Gilchrist. After bitter fighting for several years Sverre in 1184 was recognized king of all Norway, though there were rebellions even up to his death 1202. Sverre radically reformed the administration. He established the *hird,* comprising both court officials and men resident on their estates, as a new aristocracy and reserved for its members the career of sysselmenn in local administration, in the place of the *lendmenn.* Of equal importance was the institution of *lagmenn* ("lawmen") as instructors of the juries, the first step toward creating royal judges.

The troubles lasted till 1217, when Sverre's grandson Haakon IV Haakonsson, aged 13, became king with Duke Skule as regent. They suppressed the last rebellion in 1227, after which Haakon reigned in peace for 36 years. Haakon made Norway a model state: the administration was modernized by creating the chancellor's office and the royal council; trade flourished, and blood feuds were prohibited. The northern frontier was regulated by a treaty with the Russians, and constant diplomatic relations were maintained with foreign courts, most of all with England. Iceland and Greenland voluntarily agreed to the union with Norway; but Haakon's expedition to Scotland failed to vindicate Norse suzerainty over the Hebrides, and he died at Kirkwall in 1263. His son Magnus VI Lagaboeter (Law-Mender; 1263–80), who ceded the Hebrides to Scotland in 1266, is renowned for his code of national laws, besides special laws for the towns and the *hird.* His efforts to reach a compromise with the church led to bitter controversies during the minority of his son Eric II (1280–99). In conflict with Lübeck, Eric had to give way when a blockade was imposed, but a long war with Denmark ended to his advantage. His brother and successor Haakon V (1299–1319) was a vigorous personality who dispossessed the aristocracy of influence and noble titles, surrounding himself with new men. He replaced the ancient naval levy by regular taxes, professional mercenaries and frontier castles. He made energetic efforts to restrain Hanseatic penetration into Norwegian cities. At his death the national male line of the royal family became extinct.

The Union of Kalmar, 1397.—Haakon V was succeeded in 1319 by the three-year-old Magnus VII, the son of his daughter Ingeborg and Duke Eric, son of Magnus I of Sweden. At the same time the boy was elected king of Sweden in the place of the exiled Birger, last king of the Folkunge dynasty. But this union of Norway and Sweden was personal, not political. The two countries were governed each by its separate regency: a conference in Oslo concluded nothing more than an alliance. The Norse regency was especially watchful to prevent the king's mother from intermingling the affairs of the two kingdoms. King Magnus' Swedish policy, after his coming of age, provoked rebellions in Norway;

and Magnus was forced to recognize his infant younger son Haakon as king of Norway in 1343 and to surrender the kingdom to him when he in turn came of age in 1355. Meanwhile the Black Death (*Svartedauen;* 1349–50) decimated the population, most of all the clergy, and caused lasting political disorganization.

Haakon VI (1355–80) however married Margaret, daughter of Valdemar IV of Denmark, the last of the royal line descended from Sweyn Estrithson and Canute. Their son Olaf V, who had been elected king of Denmark in 1375, succeeded to Norway in 1381 but died, at the age of 17, in 1387. Then his mother Margaret was elected "the mighty lady and the right sovereign" of the three Scandinavian kingdoms, a position unique in the whole history of those countries. But she soon found it more convenient to conform to national traditions by presenting her great-nephew Eric of Pomerania as candidate for the three crowns. In Norway he was acknowledged heir to the kingdom at Oere-thing in 1389, and he was crowned at a general Scandinavian meeting in Kalmar in 1397, where Margaret opened the discussion of her plan for a political union of the three countries. A committee of spiritual and temporal lords drafted a treaty of union which, however, was apparently never ratified, as the draft was not sealed by the Norse lords present.

Margaret remained the regent of the three kingdoms till her death in 1412.

The following list of sovereigns of Norway from the 9th to the 15th century may be found useful (dates before A.D. 1000 are approximate):

Harald Haarfager	c. 870–c. 930	Inge I Krokrygg	1136–61
Eric I Blodöks	c. 930–c. 935	Sigurd II Munn	1136–55
Haakon I	c. 935–c. 960	Eystein II Haraldsson	1142–57
Harald II Graafell	c. 960–c. 970	Haakon II Herdebreid	1161–62
Haakon Jarl	c. 970–c. 995	Magnus V Erlingsson	1162–84
Olaf I Tryggvessön	c. 995–1000	Sverre Sigurdsson	1184–1202
Eric Jarl	1000–15	Haakon III Sverresson	1202–04
Olaf II Haraldsson	1015–28.	Gutorm Sigurdsson	1204
Sweyn Knutsson	1028–35	Inge II Baardsson	1204–17
Magnus I the Good	1035–47	Haakon IV Haakonsson	1217–63
Harald III Hardraade	1046–66	Magnus VI Lagaboeter	1263–80
Olaf III Kyrre	1066–93	Eric II Magnusson	1280–99
Magnus II Haraldsson	1066–69	Haakon V Magnusson	1299–1319
Magnus III Barfot	1093–1103	Magnus VII Ericsson	1319–55
Eystein I Magnusson	1103–22	Haakon VI Magnusson	1355–80
Sigurd I Jorsalafar	1103–30	Olaf V Haakonsson	1381–87
Olaf IV Magnusson	1103–15	Margaret	1387–89
Magnus IV the Blind	1130–35	Eric III (of Pomerania)	1389–1440
Harald IV Gille	1130–36		

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Danish Rule.—Eric of Pomerania continued Margaret's unitary policy, with the consequence that, since support for the crown came primarily from Denmark, lands, offices and sees throughout Scandinavia were generally assigned to Danes. National resentment at this led to Engelbrekt Engelbrektsson's rebellion in Sweden, which was followed by a Norwegian rising in the Oslo district under Amund Sigurdsson in 1436. But the Danish nobility itself then turned against Eric, who was deposed in 1439, and Norway came to accept his nephew and successor Christopher of Bavaria (Christopher III of Denmark) as king in 1442. Henceforth till 1814 the Danish kings ruled Norway: her fleet and army decayed, and her language gradually gave place to Danish; Germans plundered her coasts and monopolized her commerce, and after 1450 Danes began to appropriate the higher posts in her administration. When in 1448 Karl Knutsson was chosen king by the Swedes and Christian of Oldenburg by the Danes, it was by force that Norway fell to the latter. The Norwegians protested, but the next year the Swedes assented to a separation. Christian I (1450–81) gave estates and offices in Norway to his Danish subjects and pawned her ancient possessions, the Orkneys and Shetland Islands, to the king of Scotland as security for a dowry which remained unpaid. His son Hans (1481–1513; jointly recognized by Denmark and Norway in 1483) purchased the obedience of the Norwegian nobles by concessions to their power. The imposing union continued in name, but the weakness of the nation and its government was strikingly illustrated when the Germans in Bergen besieged a monastery in which a high official had taken refuge.

After the downfall of Hans's son Christian II (1513–23) the position of Norway was changed for the worse. She was ruled for a century and a quarter by Danish officials; her churches and monasteries were sacked by Danes, and Danes were installed as pastors after the Reformation, which the Norwegians were compelled to accept in 1539. Soon Norway was dragged by Denmark into the so-called Seven Years' War of the North (1563–70). However, the power of the Hanseatic league in Bergen was broken. The rule of the Oldenburg dynasty proved neglectful rather than tyrannical, and under it the mass of the peasants was not flagrantly oppressed. Christian IV (1588–1648), who founded Christiania (Oslo), may almost be said to have discovered Norway anew. He reformed its government and strove to develop its resources, but his policy involved the loss of Jemtland and Herjedalen, which were ceded to the Swedes by the peace of Brömsebro (1645). The Danish war of revenge against Charles X of Sweden resulted in further loss by Norway. By the peace of Roskilde (1658) she was compelled to renounce Trondheim and Baahus, and although the former was restored by the peace of Copenhagen (1660) her population fell below 500,000. From the middle of the 17th century, however, the Dutch and English made their influence felt, and the political status of Norway could no longer be regarded as a purely Scandinavian affair. The establishment of hereditary autocracy in Denmark by Frederick III in 1660 conferred many benefits upon Norway. The Norwegian peasant remained a freeman while his counterpart in Denmark was a serf. Norwegian law was revised and codified under Christian V (1670–99), who was well served by the Norwegians in his attempt to regain the lost provinces from Charles XI.

Under the sons of these monarchs, Frederick IV and Charles XII, Norway was once more compelled to pay for Danish aggression. Her shipping was destroyed and in 1716, when driven from continental Europe, Charles XII fell upon her. Only his death, in 1718, averted the danger. During this war Peder Wessel, the greatest among a long series of Norwegian heroes who served in the Danish fleet, won undying fame: in 1716 he was ennobled under the name of Tordenskjold (*q.v.*), by which he is best known. Before the close of the 18th century increasing prosperity developed the national consciousness of Norway. The growth of the timber trade with England gave rise to a great increase in wealth and population. In a century and a half the number of the Norwegian people was doubled, so that by 1814 the population was 900,000. In 1788 the oppressive law that grain should be imported into Norway only from Denmark was repealed. Thanks moreover to Danish policy, Norway actually drew financial profit from the wars of the French Revolution.

In 1770, freedom of the press was introduced by the reforming zeal of Christian VII's German doctor J. F. Struensee, who exercised at this time a more real power in Denmark-Norway than did his insane master. The national aspirations of Norway were then at once voiced, though at first they went little further than the demand for a Norwegian university, which was to be conceded by Frederick VI in 1811. The crisis destined to break the union did not develop until 1807, when George Canning's coup against the Danish fleet drove Christian VII to abandon neutrality and to embrace the cause of Napoleon. Norway, whose interests and sympathies were closely linked with Great Britain, suffered great and immediate damage from a British blockade and was more or less cut off from Denmark, so that a separate administrative commission had to be set up. In 1809 the head of this commission, Prince Christian Augustus of Augustenburg, was elected by the Swedes

as heir to Charles XIII of Sweden in pursuance of a plot, originated by the Norwegian national leader, Herman Count Wedel-Jarlsberg, to transfer the allegiance of Norway to that country. Christian Augustus, however, relinquished his connection with Norway immediately after his election, and the scheme was finally frustrated by his death in May 1810, whereupon the choice of Sweden fell upon Napoleon's marshal Jean Bernadotte, in the hope that so distinguished a solider might recover Finland (taken by Russia in 1808). But Bernadotte was too wise to attempt this and planned to annex Norway instead. With this object he forced Frederick VI, by the treaty of Kiel (Jan. 14, 1814), to renounce his sovereignty over Norway in favour of the king of Sweden. In return for support against his former master Napoleon, the allied great powers had given their support to Bernadotte's policy.

Union with Sweden.—The treaty of Kiel was, however, immediately repudiated by the Norwegians, who contended that it violated the principles of international law by purporting to dispose of an entire nation without its consent and claimed the right to determine their own sovereignty. A representative assembly, convened at Eidsvoll, prepared and adopted on May 17, 1814, a national constitution based on the democratic models of the U.S., France (1791) and Spain (1812) and unanimously elected as king of Norway the viceroy Christian Frederick, who later succeeded to the throne of Denmark as Christian VIII. A Swedish invasion followed, but negotiations were almost simultaneously opened, and it was agreed that Norway should retain her independence and her new constitution, subject to a merely personal union under the Swedish king. Christian Frederick abdicated and left the country, and the terms drawn up in the convention of Moss (Aug. 14) were ratified by an extraordinary *storting* in November.

Charles XIV John.—The settlement thus reached held from the first the seeds of conflict and misunderstanding. Even Bernadotte, who succeeded to the dual monarchy as Charles XIV John on Charles XIII's death in 1818, believed that circumstances would soon bring about the complete absorption of Norway in Sweden, as he had originally planned—a view rendered plausible enough by the poverty and trade depression in Norway which followed the end of the Napoleonic wars and reduced the national finances to a parlous condition. The inevitably severe taxation made the new *storting* unpopular and led to a local rising of the peasantry in 1818, promoted by Halvor Hoel, a wealthy farmer in Hedemarken; this, however, was easily crushed. Swedish opinion generally continued to regard Norway as a conquered country and the treaty of Kiel as the title deed to it. Such an attitude naturally inflamed the outraged national sentiment of Norwegians and made them more than ever determined to guard and to emphasize their newly won independence. Moreover, the Norwegian constitution, based on Montesquieu's theory of complete separation between executive, legislature and judiciary, promoted conflict rather than collaboration between the first and second of these powers. The king, as head of the executive, controlled, among other things, the foreign affairs of both his kingdoms on which he was advised by a Swedish foreign minister; and his Norwegian councillors, whom he chose with little or no regard for public opinion as expressed in the *storting*, were excluded from membership or even from attendance in the legislature. Thus, while the *storting* grew increasingly democratic, executive power still rested with a bureaucracy appointed by the crown. The king was principally resident in Sweden and represented in Norway by a viceroy who was generally a Swede, so that Swedish influences predominated in all questions where the interests of the two countries differed.

Such a case arose in the "Bodö affair" of 1818–21, when an English merchant, who had been arrested on charges of smuggling and other irregularities (of which he was certainly guilty), launched a claim against the Norwegian authorities and, with the help of forged and falsified documents, succeeded, through British diplomatic pressure on the king and his Swedish advisers, in securing heavy damages which the Norwegian government was reluctantly compelled to pay. But even earlier the inevitable conflict had begun. When the Norwegian *stortings* of 1815 and 1818 passed a bill for the abolition of titles of nobility, the king at once exercised his constitutional right of veto and it ultimately became law without his sanction on its being passed by a third successive *storting* (1821). A further dispute arose over the settlement with Denmark of Norway's share in the joint national debt of the two countries. Charles John, with British mediation, concluded in Sept. 1819 a convention with Denmark, by which Norway was made liable for no more than 3,000,000 specie dollars (about £700,000). These terms, however, were accepted by the *storting* with a tardy recalcitrance that nearly occasioned a fresh intervention by the powers and made the king doubt the Norwegians' sincerity and, apparently, contemplate a coup d'état. In July 1821 he assembled a force including 3,000 Swedish troops near Christiania (Oslo), ostensibly for manoeuvres, having previously circularized the powers (June 1) with a note courting their sympathy for an attempt to force a revision of the constitution. Induced to abandon this idea, he submitted his proposals for revision to the *storting*, which however unanimously and repeatedly rejected them, thus coming to be regarded as the defender of the constitution against a would-be autocrat.

Trouble also arose over the king's attitude to the celebration of May 17 (on which day Christian Frederick had become king) as the anniversary of Norwegian independence, which he considered as a demonstration of disloyalty toward himself. His attempts to prohibit these celebrations culminated in 1829 in the "*torveslag*" or "battle of the market place," when an inoffensive gathering of both sexes was charged by soldiers on the orders of the Swedish viceroy.

In addition to these conflicts between the executive and the legislature, an antagonism soon developed in the *storting* itself between the views of representatives of the old governing class and the growing democratic aspirations of the peasantry. The constitution of 1814 was based on the democratic principle that the choice of a sovereign rested with the people, and the Eidsvoll assembly had had to be a widely representative gathering in order to bring home to the world the strength of national opinion on the issues involved. Nevertheless for some time afterward political power remained in the hands of the old official class, which indeed was the only one at that time experienced in the arts of government. The seeds of democracy, however, began to germinate after the "July revolution" in France and the similar disturbances throughout Europe (1830). From 1833 the peasant representation in the *storting* acquired a competent leader in Ole Gabriel Ueland, and an opposition developed to challenge the supremacy of the bureaucracy in the legislature as well as in the executive. The first important victory for democracy was won in 1837, when, after considerable difficulty in obtaining the royal assent, the local government of the country was placed on a popularly elected basis —a measure which contributed more perhaps than anything else to awaken and educate the political consciousness of the general population.

The tension between the king and the *storting* reached its climax in 1836, when Charles John arbitrarily dissolved the legislature and the latter retaliated by impeaching and fining a minister who had supported the king's decision. From this date to the close of his reign Charles John became more conciliatory, acquiring before his death (March 8, 1844) remarkable popularity with his Norwegian subjects. An important step toward this change was made in 1836, when the post of *stattholder* or viceroy was conferred on Count Wedel-Jarlsberg. But chief among the royal concessions was the permission, granted in 1838, for merchant ships to fly the Norwegian flag in all waters, its use having been previously severely restricted. The question of the general use of the national flag, destined later to emerge in another form, was under consideration by a mixed committee of Norwegians and Swedes at the time of the king's death.

Oscar I.—Charles XIV John's son and successor Oscar I (1844–59) soon showed his desire to meet the wishes of the Norwegian people, decreeing that in all documents concerning her internal government Norway was to stand first in the royal title; that Norway and Sweden should each carry its own national flag as the naval flag, with the mark of union in the upper corner; but that the merchant flag should bear the same mark of union.

The condition of the country had now considerably improved, and King Oscar's reign was marked by the carrying out of important legislative work and reforms. New roads were made, the first railway built, steamship routes established, lighthouses erected and trade and shipping developed. The abolition of the English Navigation acts in 1850 opened up a great future for the Norwegian merchant fleet.

In 1826, by the treaty of St. Petersburg, the frontier with Russia in the polar region had been definitely delimited; but in 1851 Russia demanded for her frontier Lapps the right to fish on the Norwegian coast and to settle upon a portion of the coast on the Varanger fjord. The Norwegian government refused, and serious complications might have ensued if the attention of Russia had not been turned in another direction. Durmg the Crimean War the king concluded a treaty with England and France by which these countries guaranteed Norwegian and Swedish territory against Russia. Relations with Russia therefore became strained; but after the peace of Paris in 1856 and the accession of Alexander II the Russian ambassador at Stockholm restored harmony.

Charles XV.—Because of the king's ill-health his son was appointed regent in 1857. Two years later he succeeded as Charles XV. This gifted, genial and noble king desired to inaugurate his reign by proof of his willingness to acknowledge the claims of Norway, but he did not live to see his wishes carried out. According to the constitution, the viceroy might be either a Norwegian or Swede. Since 1829 no Swede had held the post, and since 1859 no appointment had been made. But the paragraph in the constitution still existed, and the Norwegians naturally wished to have this stamp of "provinciality" obliterated. A proposal to abolish the office was passed by the *storting* in 1859. The king had privately promised that he would sanction the proposed change in the constitution; but a violent outcry arose in Sweden. Under pressure the king eventually refused to sanction the resolution; but he added that he shared the views of his Norwegian counsellors and would, when "convenient," himself propose the abolition.

In the following year the Swedish government pressed the demands of the Swedish estates for a common parliament which, according to population, would contain two Swedish members to every Norwegian. The Norwegian government did not seem at all disposed to entertain the proposal; but some dissensions arose with regard to the form of its reply. The more obstinate members of the ministry resigned, and others, of a more pliable nature, were appointed under the presidency of Fredrik Stang, minister of the interior from 1845 to 1856. Both the new and old governments agreed that no proposal for the revision of the Act of Union could then be entertained. The king, however, advocated a revision based upon full equality. In 1863 the *storting* assented to his appointment of a second Union committee. It was not until 1867 that its report was made public, and it could not be discussed by the *storting* before 1871. Meanwhile, Denmark's troubles over Schleswig-Holstein (1863–64) threatened to draw the two kingdoms into war. The king favoured a defensive alliance with Denmark, but the *storting* would only consent if an alliance could also be effected with at least one of the western powers.

In 1869 the *storting* passed a resolution by which its sessions were made annual instead of triennial. The first yearly *storting* in 1871 had once more to consider revision. The Norwegians steadily postulated: (1) the full equality of the two kingdoms; and (2) no extension of the bonds of the union. However, the new draft implied the supremacy of Sweden and introduced important extensions of the bonds of the union. Strangely enough, the new Stang ministry accepted it, and it was even supported by some of the most influential newspapers under the plausible garb of "Scandinavianism." In these circumstances the Lawyers' party, under the leadership of Johan Sverdrup, and the Peasant party, led by Sören Jaabaek, allied themselves to defend the constitution of 1814. Thus was founded the great national party of the Venstre ("the left"). The proposed revision in 1871 was rejected by an overwhelming majority.

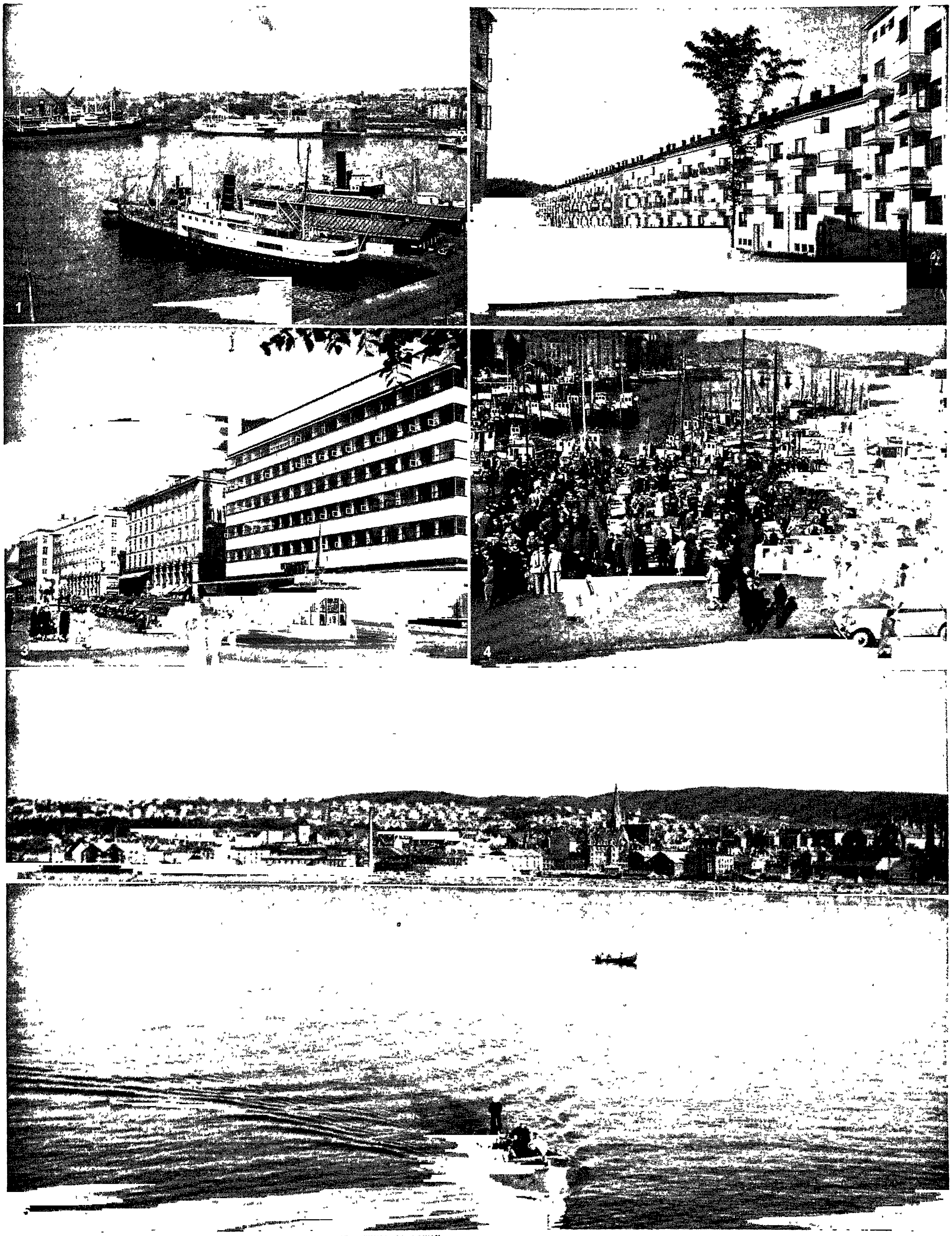
In 1872 a private bill proposed that ministers should be admitted to the *storting* and take part in its proceedings. After stormy debates, Sverdrup carried the bill by a large majority, but the government, jealous of the new Liberal party, advised the king to refuse his sanction. In the preceding half century the government party had several times introduced a similar bill, but the opposition had feared lest the superior skill in debate and political experience of the ministers should turn the scale too readily in favour of government measures. Now, on the contrary, the opposition had gained more experience and had confidence in its own strength; but the government saw in the proposed reform the introduction of full parliamentary government, by which they could not remain in office unless supported by a majority. The Liberals carried a vote of censure against the government, but the king declared that the ministers enjoyed his confidence. Three, however, resigned, and enthusiastic public meetings were held all over the country in support of the proposed reform.

Oscar II.—In Sept. 1872, Charles XV was succeeded by his brother Oscar II, who in the following year sanctioned the abolition of the office of viceroy, the president of the ministry being afterward recognized as the prime minister. In 1874 the government, in order to show the people their good will, laid before the *storting* a royal proposition for the admittance of the ministers to the national assembly. But this was to be accompanied by other constitutional changes, such as the royal right of dissolving the *storting* and the providing of fixed pensions for former ministers, as a guarantee against the majority's misusing its new power. The bill was unanimously rejected by the *storting,* who in the same year and again in 1877 passed a modified version of the bill of 1872. On both occasions the king refused his sanction. The *storting* accordingly resorted to the procedure provided by the constitution to carry out the people's will: in 1880 the bill was passed for the third time, by 93 votes out of 113.

To the general surprise, the king again refused his sanction, declaring that his right to the absolute veto was "above all doubt." Sverdrup, the Liberal leader and president of the *storting,* therefore proposed that the bill, which had been passed three times, should be declared to be the law of the land. This was carried by a large majority on June 9, 1880, but the king and his ministers declared the resolution invalid. The faculty of law at the Christiania (Oslo) university with one dissentient upheld the king's right to the absolute veto in questions concerning amendments of the constitution, although they could not find that it was expressly stated in the fundamental law of the country. The ministry also advised the king to claim a veto in questions of supply, which still further increased the ill-feeling in the country against them.

The prime minister, Stang, now resigned, and C. A. Selmer became his successor—an appointment which indicated that the conflict was to be continued. In June 1882 the king came to dissolve the *storting* and astonished the people by censuring their representatives in a speech from the throne. In the elections the Liberals won 83 seats to the Conservatives' 31. The ministry, however, showed no sign of yielding and when the new *storting* met in Feb. 1883 the *odelsting* (the lower division of the national assembly) decided to impeach the whole of the ministry. They were charged with having acted contrary to the interests of the country by advising the king to refuse his sanction: first, to the amendment of the law for admitting the ministers to the *storting;* second, to a bill involving supply; and third, to a bill by which the *storting* could appoint additional directors on the state railways.

After ten months' trial, the *riksrett* sentenced Selmer and seven of his ministers to be deprived of their offices; while three, who had either recommended the king to sanction the bill for admitting the ministers to the *storting* or had entered the cabinet at a later date, were heavily fined. The excitement in the country rose to fever height. It was generally believed that the king would attempt a coup d'état. Fortunately, after some hesitation, he issued (March 11, 1884) an order in council announcing that the judgment would be carried into effect. King Oscar, however, in his declaration upheld the constitutional prerogative of the crown, and in April asked Christian Homann Schweigaard, one of the ministers who had been fined, to form a ministry. His "April ministry" sent in its resignation the following month; a similar nomination failed, and the king was at last compelled to appoint

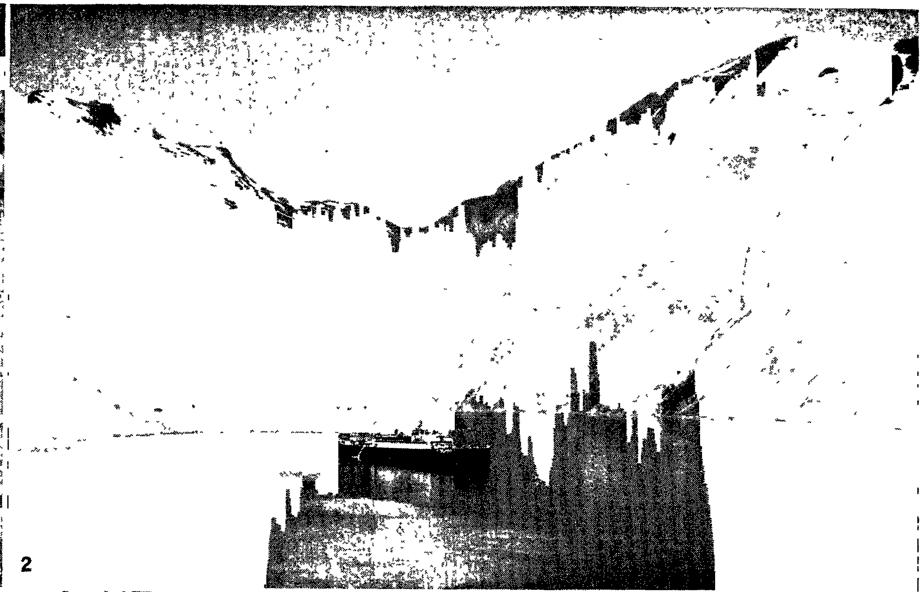


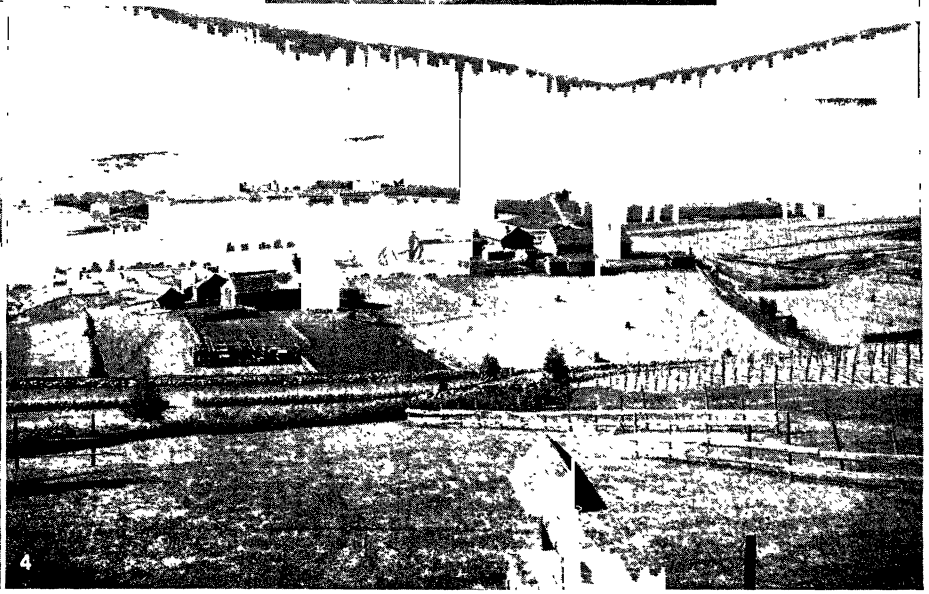
PHOTOGRAPHS, (1-4) BURTON HOLMES FROM EWING GALLOWAY, (5) EWING GALLOWAY

NORWEGIAN CITIES

1. The harbour of Oslo
2. Modern apartment houses in Trondhjem
3. Torval Menning, the main business street of Bergen
4. The great fish market at Bergen
5. View of Trondhjem from the bay

NORWAY





PHOTOGRAPHS, (1) PIX, (2) EWING GALLOWAY, (3) DE COU FROM EWING GALLOWAY, (4) BURTON HOLMES FROM EWING GALLOWAY

TYPICAL SCENES IN NORWAY

1. An open-air flower market in Oslo
2. Gerangerfjord, one of the numerous picturesque fjords of Norway
3. A Norwegian farmhouse with roof of sod in which flowers grow
4. Farm land in the upper Romsdal valley, where the Germans speedily pushed northward from Oslo during the invasion of 1940

Sverdrup. Thus the first Liberal ministry in Norway came into being (1884). The *storting* passed a new resolution admitting ministers and this received formal sanction. During the following years a series of important reforms was carried through.

In June 1889 Sverdrup resigned, and a Conservative ministry was formed by Emil Stang, Fredrik Stang's son. After two fruitful years this was wrecked on the diplomatic question. In 1814 nothing had been settled about the conduct of diplomatic affairs; in 1835 a resolution was issued which in effect gave Norway a right of inspection of business transacted on her behalf by the Swedish foreign minister with the king. The Swedes were willing to grant equal representation in a joint council, but on the assumption that the minister of foreign affairs should continue to be a Swede, and this the Norwegians would not accept. In 1891, after a deadlock, the Stang ministry resigned, and a Liberal ministry under Sverdrup's successor J. V. C. Steen, was appointed.

A new deadlock was produced by the resolve of the *storting* in 1892 to establish a separate consular service for Norway, which provoked the king's veto and the resignation of the ministry. By a compromise the ministry returned to office, on the understanding that the question was postponed. In 1893, the *storting* again passed a resolution for the establishment of the proposed consular service, but the king again refused his sanction. Upon this the Liberal ministry resigned (May 1893), and the king appointed a Conservative government, with Stang as its chief. At the end of 1894, when the triennial elections took place, the majority declared in favour of national independence on the great question then before the country. In 1895, after more than four months without a responsible government, a coalition ministry was formed, with G. F. Hagerup as prime minister. A new committee of Norwegians and Swedes spent more than two years in fruitless labour on the question of separate diplomatic representation. At the elections in 1897, 79 Liberals and 35 Conservatives were returned, and in Feb. 1898 Hagerup was replaced by Steen. Soon afterward the bill for the general adoption of the national or "pure" flag was carried for the third time and became law without the king's sanction. In 1898 universal political suffrage for men was passed by a large majority, but the proposal to include women received only 33 votes. Women received local-government franchise in 1901 and were to be granted a wide but restricted parliamentary suffrage in 1907. Universal political suffrage was not extended to them till 1913.

In Jan. 1902, on the initiative of the Swedish foreign minister Alfred Lagerheim, another joint committee on the consular question was appointed. It unanimously reported that "it was possible to appoint separate Norwegian consuls exclusively responsible to Norwegian authority and separate Swedish consuls exclusively responsible to Swedish authority." Further negotiations resulted in the so-called communiqué of March 24, 1903, announcing an agreement for separate consular services. In due course the Norwegian government submitted to the Swedish their draft of the proposed regulations, but received no reply for several months. The friendly Lagerheim resigned, and in Nov. 1904 E. G. Boström, the premier, suddenly submitted to Norway new conditions for the establishment of separate consuls. These placed the Norwegian consuls under the Swedish foreign minister, who could remove them. Hagerup proceeded to Stockholm, but no satisfactory agreement could be reached. The Norwegians felt themselves compelled to take matters into their own hands. On March 1, 1905, Hagerup resigned and was succeeded by Christian Michelsen and a ministry from both parties. It was resolved to establish a Norwegian consular service not later than April 1, 1906.

During the king's illness the crown prince vainly attempted to reopen negotiations. In April Boström resigned, apparently to facilitate negotiations. On May 23 the *storting* unanimously passed the bill, but on May 27, despite the entreaties of his Norwegian ministers, the king refused his sanction. The Norwegian ministry immediately resigned. The king refused their resignation, but they declined to withdraw it. On June 7 Michelsen informed the *storting* that, since an alternative government could not be formed, the personal union with Sweden was dissolved. The resigning ministry was unanimously authorized to exercise the authority vested in the king. The king sent a telegraphic protest to Michelsen and to the *storting*, and an extraordinary session of the *riksdag* (Swedish parliament) on June 20 appointed a special committee on the crisis. On July 25 it reported to the *riksdag* that Sweden should negotiate on the issue raised, if requested by a newly elected *storting* or a referendum. The report was unanimously adopted on July 27, and next day the *storting* decided on a general plebiscite. On Aug. 13 there were 368,211 votes for severance of the union and 184 against it. It was thereupon agreed that representatives of Norway and of Sweden should arrange for the separation. After more than three weeks' negotiation, agreement was reached on Sept. 23. This provided for a neutral zone on both sides of the southern frontier, the Norwegians undertaking to dismantle some fortifications within that zone. The agreement was to remain in force for ten years, renewable for a similar period, unless one country gave notice to the contrary. On Oct. 27, after ratification by *storting* and *riksdag*, the king relinquished the crown of Norway. Failing acceptance by a Bernadotte, it was conferred upon Prince Charles of Denmark by a second popular vote (259,563 against 69,264) and by the *storting* with no dissentients. On Nov. 25 the king, now Haakon VII, and Queen Maud, the youngest daughter of Edward VII of England, entered the Norwegian capital.

(W. F. Re; G. M. G-H.)

Haakon VII.—The truce to party politics created by unanimity on the question of terminating the Swedish union did not long survive the retirement of Michelsen in Oct. 1907. The coalition government continued for five more months, under the leadership of its former foreign minister Jorgen Lövland, but for the next 12 years the Liberal (Venstre) party generally maintained its predominance, though the elections of 1909 brought it a temporary setback in consequence of a split on the question of the Concession laws, which constituted the main political issue in the earlier years of this period. These laws were designed to control the power of foreign capital and, in the minds of the more radical politicians, of capital generally. They made the industrial exploitation of the natural resources of the country subject to a government concession, with eventual reversion to the state of the property involved, together with the plant and buildings erected upon it, without compensation. In consequence of the secessions from his party, Gunnar Knudsen's Liberal government, which was in power from 1908 to 1910, was succeeded by a coalition of Conservatives and moderate Liberals, under Wollert Konow and Jens Bratlie, till 1913, after which Knudsen ruled without a break until 1920.

The industrial developments with which the Concession laws were concerned were, however, symptomatic of a fundamental change in the economic life of the country, which fortuitously coincided with the restoration of Norwegian independence in 1905 and had far-reaching political and social consequences, including a disturbance of the existing balance of political forces. It was in 1905 that Sam Eyde founded Norsk Hydro, the great Norwegian nitrate organization, based on the use of hydroelectric power. The harnessing of Norway's enormous resources of water power started an industrial revolution with a suddenness which created problems and conflicts of capital and labour not previously experienced. Industrial disputes promoted the growth of organized labour and of a political Labour party the strength of which had hitherto been negligible. In these circumstances the dominance of the old Liberal party could not long continue.

World War I.—On the outbreak of World War I the three Scandinavian countries at once proclaimed a policy of neutrality primarily designed to preclude any possibility of hostile action between them. They co-operated closely, and numerous conferences were held between their representatives. Norwegian shipping, however, rendered most valuable services to Great Britain, and from 1917 such services were the subject of a comprehensive agreement with the Norwegian Shipping association. Losses of life and tonnage were heavy, but the profits earned were extremely large. The wave of speculation which ensued brought temporary prosperity to a new and undesirable class of capitalists and thus further embittered the relations between capital and labour.

1919–39.—The Labour party, at this stage, was of an extreme revolutionary type, and in 1919 it joined the Third International. Its growth in numbers, which in 1921 gained it 29 seats in the *storting,* reduced the Liberal forces to approximate equality with the Conservatives, though these old parties were still each considerably stronger than the Socialists: this situation led to a succession of short-lived governments, alternating between Conservative and Liberal, between 1920 and 1928.

In 1923 the Labour party withdrew from the Third International, and a Communist party was formed by its recalcitrant left wing. This split, however, did not entail any substantial loss, and in 1927 Labour became the strongest single party in the *storting,* with 59 seats. Its policy was still extreme enough to excite fear and suspicion in bourgeois circles, and when in Jan. 1928 it first assumed power as a minority government it only survived for a fortnight, being replaced by a Liberal administration under Johan Ludwig Mowinckel, who remained premier till 1935, except for a break in 1931–32, when an Agrarian government under Peder Kolstad was in office. Kolstad died in March 1932, and the leadership passed to Jens Hundseid until the fall of the government in Feb. 1933. The elections of 1933, however, gave Labour 69 seats, and from 1935 they remained securely in power, under Johan Nygaardsvold, though without an over-all majority until 1945.

After the settlement of the Concessions question, the principal domestic issue in the decade following World War I turned on the prohibition of intoxicating liquors, which had been introduced as a temporary expedient during the war and the continuance of which was supported by a referendum in Oct. 1919. The experiment proved unsatisfactory, leading to widespread smuggling and other evasions of the law, besides producing a trade conflict with Spain and Portugal which caused heavy loss to the fishing industry. The measure was repealed, except in relation to spirits, in 1923; the prohibition of spirits was likewise abandoned in 1927.

In external affairs the most important events were the recognition of Norwegian sovereignty over Spitsbergen (Svalbard) from 1925, and a dispute with Denmark over Norwegian rights in East Greenland, which was decided in favour of Denmark in 1933, by the Permanent Court of International Justice. For the last ten years preceding World War II Norway was seriously affected by the world economic crisis, and widespread unemployment promoted the progress of socialism.

World War II and After.—In the years following the World War I, Norway had been a loyal and active member of the League of Nations, in the work of which Fridtjof Nansen played a conspicuous part; but the experience of the Italo-Abyssinian conflict shook the country's faith in the security offered by this organization, and on July 1, 1936, Norway, together with its associates in the "Oslo group," repudiated the obligation to assist in the enforcement of sanctions under the covenant. The Norwegian government announced in April 1938 its intention to abstain from participation in the event of war.

On the outbreak of World War II in 1939 the Scandinavian countries together proclaimed their reversion to a policy of strict neutrality. This policy seemed at first sight to be more disadvantageous to the western allies than to Germany, which was able to use a long stretch of sheltered territorial waters for the conveyance of Swedish iron from the Norwegian port of Narvik. During the Russo-Finnish campaign of 1939–40, in which Norwegian sympathies were strongly pro-Finnish, France and Great Britain tried to induce Norway to abandon her neutrality sufficiently to allow the transit of Allied troops through Norway to Finland, but the request was refused. In Feb. 1940 British naval forces entered Norwegian territorial waters to rescue a number of Allied prisoners from the German vessel "Altmark," which had taken refuge in the Jössing fjord. On April 8 the Allies went further and announced the mining of various points in Norwegian territorial waters, with the object of preventing their use for the safe conveyance of German supplies. It was not, however, from the west that Norwegian neutrality was seriously threatened: on April 9, 1940, the country was suddenly invaded by Germany.

This event found the Norwegian people completely unprepared. During the interwar period, the defenses of the country had been neglected by all political parties for a variety of reasons. Faith in the protection afforded by the League of Nations and the prevalent view that the reduction of armaments was a virtue played an important part in the earlier stages. With the rise to power of the Labour party, motives of economy or of diverting expenditure from military to social objects combined with the ingrained pacifism of the older Socialists who were also afraid that the army might be used in internal conflicts to the detriment of the working class to produce a similar result. When war between Germany and the western powers became imminent, a considerable body of Norwegian opinion felt that their real interests and sympathies lay with the latter and that neutrality was more in the interests of the Germans than of their opponents. In these circumstances it was considered that any pressure to take sides was likely to come from a quarter which should not be too effectively resisted: it might be as well if the national defenses were not too strong. Halvdan Koht, the foreign minister, while he tried to the last to maintain a strictly neutral policy, was also obsessed with the idea that this neutrality was threatened from the west rather than from Germany and he accordingly ignored a number of warnings that reached him during the final days preceding the invasion.

The project of a German occupation of Norway was, however, under consideration in Germany as early as Oct. 1939, where it was strongly pressed by the admiralty. By the middle of Jan. 1940 the plan was adopted by Adolf Hitler, who had been more or less converted after an interview with the Norwegian traitor Vidkun Quisling in the previous month.

The destruction of the German cruiser "Blücher" by the Oscarsborg batteries in the narrows of the Oslo fjord threw out the German timetable sufficiently to enable the king and his government to escape from the capital to Elverum, where an extraordinary meeting of the *storting* voted full powers to the government to act during the emergency. The German demands, which included the appointment of Quisling to the premiership, were rejected by the king and his ministers, and active resistance by the improvised forces available at once began. This was continued for about two months, but by the beginning of June dangers on other fronts compelled the withdrawal of the assistance meanwhile provided by the Allies. The king and government moved to England at the same time, and active hostilities in the country came to an end. From London, nevertheless, the king and his ministers retained continuous contact, through the radio, with the loyal elements in Norway, while they had from the first succeeded in diverting practically the whole Norwegian merchant fleet to the service of the Allies, thus securing them a considerable advantage.

The Germans were remarkably slow in grasping the extent of the antagonism that they had aroused in the Norwegian population and made a particularly serious mistake in the support which they insisted on giving to Quisling and his party, who were despised by all but a negligible fraction. The people rapidly grew more and more united in opposition to the occupying power. In the temporary depression induced by the fall of France, indeed, there was a dangerous moment when the presidential board of the *storting* was prevailed upon to request the abdication of the king and the resignation of the government; but when this demand was met with a dignified refusal a bolder spirit quickly developed, and in September Germany was compelled to abandon the hope of giving to the occupation any appearance of voluntary acceptance by the Norwegian people. A German *Reichskommissar* was appointed, under whom various members of Quisling's party were given administrative charge of the different departments of state. In Feb. 1942 Quisling himself was raised to the position of "minister president" over a puppet government of his supporters; but this move effected no real change in the situation.

A home front growing spontaneously from the unco-ordinated efforts of individuals became increasingly organized under a central leadership whose members were soon in continuous touch with the Norwegian government in England. The directives issued through secret channels by this organization to the people found a ready and loyal response which obstructed in no small degree the plans of the occupying power and its puppets, while a large number of "illegal" newssheets spread Allied propaganda

and kept the population informed on the facts of the situation. Resort to guerrilla warfare or to unauthorized and sporadic acts of sabotage was wisely discouraged, though a secret military organization existed and was approved. The home front was drawn indifferently from all political parties and classes of the nation and thus fostered a new spirit of unity that ignored and discountenanced political antagonisms.

Immediately after the liberation of the country in May 1945, the government resigned in accordance with a pledge given during the war and was temporarily succeeded by a coalition under the premiership of Einar Gerhardsen. A general election was held in Oct. 1945, which returned the Labour party once more to power, with 76 seats out of 150. Gerhardsen remained prime minister. At the subsequent election of 1949, the situation remained substantially unchanged, though the strength of the dominant party increased to 85 seats and the Communists—who enjoyed a temporary prestige at the close of the war and gained 11 seats in the 1945 *storting*—did not return a single representative. In domestic affairs, the government was mainly occupied with the problems of postwar reconstruction, which were approached on lines laid down in an agreed program of all parties at the close of the war.

In the external field, however, the experience of World War II led Norway to a revolutionary departure from the policy of neutrality hitherto pursued. In the first years after the war, hopes in the security afforded by the United Nations combined with a traditional desire for Scandinavian unity to delay this change. The aspiration of all the Scandinavian states was, at first, to build a bridge between the conflicting ideals of the western world and Russia, while abstaining from association with a power bloc on either side. With the breakdown of the four-power conference in Dec. 1947, however, Norway began to entertain serious doubts as to the adequacy of the protection afforded by the United Nations, and after the Communist coup against Prague in Feb. 1948 the impracticability of a "bridge-building" policy became increasingly evident. The three Scandinavian states thereupon investigated the alternatives of association with the North Atlantic treaty and a neutral defensive alliance between themselves (as preferred by Sweden); but early in 1949 agreement proved impossible, and Norway turned to the North Atlantic treaty, to be followed more reluctantly by Denmark, who felt that it would otherwise be left in a position of helpless isolation.

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(G. M. G-H.)

POPULATION

The population of Norway at the census of 1946 was 3,156,950 as compared with 2,814,194 at that of 1930. Table I shows its distribution over the 20 counties (*fylker*).

TABLE I.—*Census, 1930 and 1946*

County	Area in sq.mi	Population 1930	Population 1946		
			Rural	Urban	Total
Southern:					
Östfold	1,614	167,030	124,303	54,146	178,449
Akershus	2,064	236,939	298,492	2,657	301,149
Oslo (city)	7	253,124	.	286,222	286,222
Hedmark	10,592	157,942	157,256	12,269	169,525
Opland	9,776	137,710	142,446	12,288	154,734
Buskerud	5,700	143,073	111,132	38,816	149,048
Vestfold	903	134,107	103,614	43,941	147,555
Telemark	5,876	127,754	92,656	39,023	131,679
Aust-Agder	3,609	73,816	56,099	18,762	74,861
Vest-Agder	2,815	81,233	61,058	32,922	93,980
Western:					
Rogaland	3,544	173,258	122,901	79,351	202,252
Hordaland	6,126	164,376	188,389		188,389
Bergen (city)	14	98,303	.	110,424	110,424
Sogn og Fjordane	7,143	91,808	95,263	1,586	96,849
Möre og Romsdal	5,810	165,064	147,790	35,069	182,859
Sor Tröndelag	7,268	174,946	136,784	57,128	193,912
Nord Trondelag	8,657	96,016	97,146	8,533	105,679
Northern:					
Nordland	14,797	186,920	188,836	27,136	215,972
Troms	10,071	97,467	98,647	15,075	113,722
Finnmark	18,799	53,308	50,041	8,749	58,790
Total	125,185	2,814,194	2,272,853	884,097	3,156,950

With an average population per square mile of only 25, Norway is the most thinly populated political unit in Europe. Towns are few and, apart from Oslo and Bergen, none has a population of more than 100,000. According to the census of 1946 Trondheim had 57,128 inhabitants, Stavanger 50,320, Drammen 26,994 and Kristiansand 24,343. In 1948 the adjoining district of Aker was incorporated with Oslo, thus increasing the population of the capital to 417,238 (on the basis of the figures of 1946) and the land area to 166 sq.mi. Most of the built-up areas are found along the coast, in the lowlands of the east (*Östlandet*), in the area around Trondheim (*Tröndelag*) and in the larger valleys. The most sparsely populated area is the north, particularly the county of Finnmark, where most of the 20,000 Lapps are found. By mid-20th century less than one-tenth of the Norwegian Lapps (*Samer*) were reindeer keepers; most had deserted their nomadic existence and settled as farmers and fishermen along the coast.

The population of Norway in 1801 was less than 1,000,000 but from 1815 there was a fairly rapid increase, much of it, however, absorbed by emigration, chiefly to the United States. Between 1836 and 1936 the total number of emigrants was 860,694. After 1931 emigration declined considerably, in view of immigration restrictions in the United States and increased economic opportunities at home.

The number of live births rose steadily from 41,321 (the smallest figure recorded in the 20th century) in 1935 to 70,727 in 1946 and then declined yearly to 63,236 in 1949. The excess of births over deaths was 34,653 in 1949. The live-birth rate in 1949 was 19.56 per 1,000 inhabitants, the death rate 8.84. The marriage rate, at 9.50 per 1,000 inhabitants, reached its peak in 1946. In 1946 there were 1,557,278 men and 1,599,672 women—an excess of women over men of 42,394 as compared with 70,356 in 1930. The percentage of illegitimate live births fell from 7.10 in 1930 to 5.77 in 1946 and 4.91 in 1948.

The age distribution of the population in 1946 was strongly influenced by the great variations in the birth rate—the fall from 1920 to 1935 and then the rise from 1935 to 1946. While the population increased as a whole by 12% from 1930 to 1946, the number of children under 15 diminished by 11%. The proportion of old people over working age was tending to increase.

Table II shows the number of persons with dependents engaged in various occupations, according to two censuses.

TABLE II.—*Employment*

Occupation	1930		1946	
Agriculture and forestry	838,848	(29.81%)	783,963	(24.83%)
Fishing and hunting	196,772	(6.99%)	183,922	(5.83%)
Industry and handicraft	783,547	(27.84%)	992,477	(31.44%)
Commerce	294,961	(10.48%)	313,389	(9.93%)
Communications	252,963	(8.99%)	287,821	(9.12%)
Administration, teaching, defense, etc.	156,177	(5.55%)	233,451	(7 39%)
Other occupations and none, or unstated	290,926	(10.34%)	361,927	(11.46%)

POLITICAL AND ECONOMIC CONDITIONS

Government and Law.—Norway is a constitutional and hereditary monarchy. The constitution or fundamental law (*grunnlov*) was adopted by the constituent assembly at Eidsvoll on May 17, 1814, and altered in detail at various times since. Executive power is vested in the king, exercised through a council of state consisting of the prime minister (*statsminister*) and at least seven other councillors (*statsråder*). The councillors are the heads of the ministries (*departementer*) of foreign affairs, industry, agriculture, social affairs, communications, justice, trade, fisheries, defense, finance, church and education, and municipal affairs and public works. The councillors sit in the parliament (*storting*) but do not vote. The king has no power to dissolve parliament, the life of parliament being fixed at four years. The 150 members of parliament (*stortingsmenn*) are elected directly by the people in electoral districts so arranged that the towns are represented by one-third of the total membership.

The franchise is enjoyed by all Norwegian citizens, men and women, over 21 years of age who have resided five years in the country. Candidates must possess the franchise in their constituencies, must have resided ten years in the country and must be over 21 years of age. Anyone who has held office as prime minister or councillor may stand for election outside his own constituency. Substitutes as well as members are elected. Parliament is elected in October every fourth year, meets in Oslo on the first weekday after Jan. 10 each year and remains assembled as long as may be found necessary. After the opening, parliament divides itself into two sections, the *lagting* consisting of 38 members and the *odelsting* of the remainder. A bill is first introduced in the *odelsting* and, if passed, is sent to the *lagting*. If the two sections do not agree, a joint session is held and a decision made by a two-thirds majority of the combined votes. A bill can become law without royal assent if passed by two ordinary sessions of parliament after two separate and successive elections, these sessions having to be separated by at least two other ordinary sessions of parliament, provided no divergent legislation has been passed between the first and last passage of the bill. Budget proposals and other financial and political questions not taking the form of bills are dealt with by parliament as a single body. There are a number of standing committees where most questions are discussed before reaching the full assembly.

The country is divided into 20 counties (*fylker; see* Table I), including the cities of Oslo and Bergen. There are 66 urban and 680 rural districts run by councils (*kommuner*) elected every fourth year. The electoral system for local councils is the same as the parliamentary system. Each council elects a presidency of one-quarter of its members. The chairmen of rural district councils in each county constitute the county council (*fylkesting*) presided over by the county governor (*fylkesmann*). The scope of municipal affairs in Norway is very wide. Revenue derives from local income tax, municipal trading profits and state grants.

Justice.—An outstanding characteristic of Norwegian legal procedure is that civil cases are usually brought first before the town or county mediation council (*forliksråd*) from which an appeal lies to the town and county courts (*by-og herredsrettene*) which are also tribunals of first instance. The town and county courts have a professional judge, sometimes assisted by two lay judges. There are five courts of appeal (*lagmannsretter*) in Oslo, Bergen, Trondheim, Skien and Tromsö, composed of three professional judges; and a supreme court (*höyesterett*) in Oslo, whose decision is final. Criminal cases are tried either in the *lagmannsrett* with three judges and ten jurors or in summary courts (*forhörsrett*) with one professional judge or in town and county courts with a professional judge usually assisted by two lay judges. The *lagmannsrett* is for more serious offenses; the others for minor offenses. Punishment takes the form of imprisonment and fines, capital punishment being abolished for all except certain military and treasonable crimes. There is a state police force subordinate to the ministry of justice.

Defense.—The king is supreme commander of the armed forces. Under the ministry of defense is a defense staff with combined control of all land, sea and air forces. There is a system of local command areas for the three services. A considerable reconstruction of the armed forces was started in 1945 and accelerated after 1949, when Norway subscribed to the North Atlantic treaty. Compulsory military service in peacetime was fixed at 12 months, with 3 months repetition training. In 1950 the total number of regular officers and noncommissioned officers was about 4,050; but about 200,000 men could be mobilized at short notice in all branches, including the national guard. The army could mobilize field units corresponding to about two divisions, with many of the men trained in Germany (where Norway after World War II maintained an occupation brigade of about 4,000). The national guard was formed in 1946 and soon had a membership of about 100,000, mostly volunteers. The air force supplemented its wartime British aircraft with Vampire and Thunderjet fighters. The navy in 1951 had as its main strength seven destroyers and five submarines and a number of corvettes, mine sweepers and motor torpedo boats. Coastal artillery, with powerful batteries left by the Germans, was concentrated in particular areas, and aircraft artillery was strengthened. Military budgets were: kr. 440,000,000 for 1949–50, kr. 520,000,000 for 1950–51 and kr. 700,000,000 for 1951–52. Air-raid precautions taken after World War II included the construction of underground shelters and power stations.

Religion, Education and Social Services.—The endowed state religion, to which the king must conform, is Evangelical Lutheran. There were 120,106 dissenters at the census of 1946, as compared with 91,459 at that of 1930. The king, with the advice of the ministry of church and education, appoints the clergy of the established church. Norway is divided into eight bishoprics (*bispedömmer*), with sees at Oslo, Trondheim, Stavanger, Hamar, Kristiansand, Bergen, Tromsö and Tönsberg; and these into 91 archdeaconries (*prostier*) with subdivisions into 533 clerical districts (*prestegjeld*) and 1,025 parishes (*sogn*). There are 17 organizations for missionary work abroad.

Elementary education has been free and compulsory for all Norwegian children between 7 and 14 years of age since 1860. Above the elementary schools are the secondary modern and grammar schools with three-year and five-year courses. There are also one-year continuation schools. Norway's two universities are at Oslo and Bergen, and there is a university college of technology at Trondheim. Educational institutions of high standing are the agricultural, dental, veterinary, commercial and teachers' colleges. Education is financed jointly by the state and the municipalities, and all instruction is free.

There are national insurance schemes to meet most contingencies. Compulsory health insurance was enacted in 1909, and 75% of the population receive medical and pecuniary benefits. Old-age pensions were introduced in 1936 for all citizens 70 or more years of age. There are accident-insurance schemes for industrial workers, seamen and fishermen. Compulsory unemployment insurance was introduced in 1938; family allowances in 1946; and holidays of three weeks with pay for all workers in 1947.

Economics.—For more than 30 years the economic life of Norway had developed on an increasingly industrial scale when the dissolution of the union between Norway and Sweden, in 1905, gave it a fresh impetus. Soon an extraordinary expansion set in, aided by the supply of cheap and plentiful hydroelectric power. This industrial expansion was further accelerated after 1945.

Agriculture and Forestry.—Agriculture remained one of the principal resources of the country, supporting 25% of the population in 1946, as against 30% in 1930. According to the agricultural census of 1949, 2.63% of the land area was cultivated, and there were altogether 345,125 farms and holdings, most of them very small and nearly all owned freehold by the farmers. Natural conditions are favourable to fodder growing and livestock keeping, and Norway is self-sufficient for nearly all livestock products. Only half the domestic consumption of cereals is produced in Norway: of 328,000 tons of grain harvested in 1949, half were of oats, a quarter barley and less than one-fifth wheat. More than 1,000,000 tons of potatoes and about 3,500,000 tons of hay and straw were produced.

Farmers derive an important part of their income from forest

holdings. Forests covered 24.30% of the land area in 1949. About 83% of the forest area was privately owned, while the state and local authorities owned the rest. There were about 120,000 forest holdings. For centuries sawn and planed timber was Norway's main forest export, but most of the timber is now exported as pulp and paper. Each year after 1945 about 247,202,900 cu.ft. of timber were cut for sale and about 1,000,000 tons of pulp and 500,000 of paper produced.

Fisheries.—According to the fisheries census of 1948 there were 85,518 fishermen, of whom 68,442 had fishing as their main occupation. There were 22,484 fishing vessels, of which half were decked motor vessels, mostly owned by the fishermen themselves. Fishing is carried on for the most part close to the shore. Catches exceed 1,000,000 tons a year and consist mainly of herring and cod. Much of the herring catch is processed into oil and meal. Pelagic whaling was pioneered by the Norwegians in the antarctic early in the 20th century. In the 1950–51 season Norway sent ten expeditions to the antarctic, and production of whale and sperm oil was about 185,000 tons.

Industrial Production.—The expansion of industry in the 20th century is particularly notable in the electrochemical and electrometallurgical spheres. The manufacture of pure nitrogen was 160,669 tons (equivalent to more than 1,000,000 tons of fertilizer products) in 1950, and more than 200,000 tons of ferroalloys and aluminum were produced, nearly all for export. The construction of electrical and other machinery and of ships also made marked headway. The mining industry, extracting mostly iron ore and pyrites, is concentrated mostly in the northern part of the country. Copper and zinc are important by-products, and the output of sulphur in 1950 was 96,000 tons. According to the census, 31.44% of the population was supported by industry in 1946, as compared with 27.84% in 1930.

After 1945 a determined effort was made to rebuild and strengthen Norway's economy. A high rate of investment, particularly in hydroelectric development, industry and shipping, was instituted. Of Norway's estimated 10,500,000 kw. of exploitable water power, about 1,960,000 had been harnessed by 1950, as against 1,377,000 in 1939. The output of electricity per capita was the highest of any country in the world. As the result of this expansion, the industrial production index for 1950 was 144 as against 68.6 for 1945 and 100 for 1938. In farming, fishing and forestry, production also improved through mechanization despite the loss of labour to industry. For the first six years at least after World War II the number of employed persons increased steadily.

Commerce.—Norway's foreign trade, which had always been large in relation to population, increased still more after 1945, and in 1950 the value of imports amounted to kr. 4,846,000,000 and that of exports to kr. 2,789,000,000. The large trade deficit was very largely financed by freight earnings and Marshall plan grants. Principal imports in 1950, in order of value, were: ships, kr. 845,000,000; textile goods, kr. 673,000,000; machinery, kr. 500,000,000; coal, oil and other fuel, kr. 488,000,000; grain, kr. 302,000,000; and iron and steel, kr. 294,000,000. Exports in the same year comprised: pulp, paper, etc., kr. 651,000,000; fish, kr. 454,000,000; fats and oils, kr. 381,000,000; nonferrous metals, kr. 277,000,000; fertilizers, kr. 210,000,000; and iron and steel, kr. 200,000,000. Relatively few sorts of commodity are exported from Norway: the products of the pulp and paper industry, the electrochemical and electrometallurgical industries and the fisheries together account for more than 70% of them.

On Sept. 1, 1951, the Norwegian merchant fleet amounted to 2,162 vessels or 5,654,535 gross tons, almost half the tonnage consisting of tankers. This fleet, which is the third largest in the world, lost half its tonnage during World War II but was rapidly rebuilt after 1945, with replacements mostly from British and Swedish yards. The great majority of the vessels are engaged in overseas traffic between foreign ports. Net foreign earnings by the fleet in 1950 were estimated at more than kr. 1,000,000,000.

State Control and Ownership.—After 1945 (when the Labour party secured a parliamentary majority which it was to increase in 1949), the economy of Norway was fairly strictly controlled and directed along the lines set out in the annual national budgets (economic surveys). Those budgets set out economic policy in such spheres as investment, consumption, imports, exports, manpower and materials. A system of licences, quotas, price controls and subsidies was used to ensure the desired development of the national economy. The government also influenced economic development by direct or indirect ownership or part-ownership of mines, factories and other concerns in such fields as aluminum, hydroelectricity, chemicals and transport. State monopolies over grain and alcohol had been set up before World War II.

Communications.—Norway, with its long, narrow stretch of land, its fjords, mountains and islands and its sparse population, presents transport problems of especial difficulty. Coastal shipping and ferry connections play an important role. The road system totalled almost 28,000 mi. in 1950. There were then 120,000 motor vehicles, including 65,000 private cars, 45,000 trucks (lorries) and more than 5,000 buses. The first railway, from Oslo to Eidsvoll, was opened in 1854. By 1950 the rail system covered 2,778 mi., of which less than a quarter was electrified. Most air traffic in Norway is based on Fornebu and Gardermoen airfields near Oslo, Sola airfield near Stavanger and Kjevik airfield near Kristiansand; elsewhere seaplane bases are used. The latter counted more than 100,000 passengers in 1950. In the same year there were 125 civilian aircraft.

Currency and Finance.—The unit of currency is the krone (100 öre: kr. 1). The value of the krone is fixed at 20 to the pound sterling and (since devaluation in 1949) 7.14 to the U.S. dollar. The gold stock of Norges Bank (Bank of Norway) in 1951 was kr. 185,000,000 (kr. 120,000,000 in 1939), and its foreign assets totalled kr. 732,000,000 at the end of 1951 (kr. 185,000,000 in 1939). Norges Bank, founded in 1816 and completely state-owned since 1949, is the sole note-issuing institution. Note circulation was kr. 575,000,000 in 1939, but increased greatly during World War II and stood in Jan. 1945 at kr. 3,015,000,000. Germany made drawings on Norges Bank amounting to kr. 11,300,000,000 during the war; the "occupation account" was reduced after the war and stood at kr. 6,202,000,000 in Dec. 1951. Reconstruction and economic expansion after the war made heavy demands on liquid funds, and though anti-inflationary measures halved the note circulation for a while, circulation had, by the end of 1951, gone up to kr. 2,610,000,000. Norges Bank's discount rate was reduced after the war from 3% to 2.5%. The government's fiscal policy after the war sought to establish stable economic conditions and yet encourage expansion. The increasing scale of government expenditure and revenue made state budgeting a decisive factor in the national economy. The growth of the state budget is shown in Table III.

TABLE III.—*Budgets*
(millions of kroner)

	1930–31	1939–40	1945–46	1950–51
Current income	346.1	641 1	1,590 2	3,091 7
Expenditure:				
Current	333 4	671 4	1,901.1	2,547.5
Capital	23.1	63 5	110 5	250.8
Balance	−10 4	−93 8	−421.4	+293.4

In the financial year 1950–51, taxes on income and capital raised kr. 925,800,000 of the government revenue. Most of the balance came from indirect taxes, including purchase tax. At the end of 1951 the national debt amounted to kr. 4,873,000,000, of which 1,173,000,000 represented foreign loans.

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a number of booklets including *Social Insurance in Norway* (Oslo, 1949) and *Housing in Norway* (Oslo, 1951). Useful are the annual reports from Norway to the U.N. Food and Agriculture Organization. Other publications are: Royal Agricultural Society, *Norwegian Agriculture* (Oslo, 1951); Norges Industriforbund, *Industry in Norway* (Oslo, 1951); Walter Galenson, *Labour in Norway* (1948); Norwegian Federation of Labor, *The Trade Union Movement in Norway* (Oslo, 1951); O. B. Grimley, *Cooperatives in Norway* (Oslo, 1950); W. Warbey *et al., Modern Norway* (London, 1950). For an exhaustive geographical guide to Norway *see* Werner Werenskiold, *Norge Vårt Land,* 2 vol., new ed. (Oslo, 1950). (O. F. K.)

NORWAY, a city of Dickinson county, Mich., U.S., in the southern part of the Upper peninsula, on the Chicago and North Western railway and federal highways 2 and 141, near the Menominee river. Pop. (1950) 3,258; (1940) 3,728. Lumbering is the principal interest.

NORWEGIAN LANGUAGE. Norwegian, like English, is a Germanic language. The close relationship between the languages is apparent in both vocabulary and grammar; *e.g., arm* (arm), *land* (land), *rik* (rich), *binde* (bind), *mann, menn* (man, men), *vi, oss* (we, us), *god, bedre* (or *betre*), *best* (good, better, best), *leve, levde* (live, lived). The similarity may have been more perceptible in ancient days. Old sagas relate that Norsemen who came to England during the Anglo-Saxon period were understood when speaking their native tongue. Norwegian together with Danish and Swedish constitute the northern branch of the Germanic languages, which among other things agree on the specific use of a suffigated definite article; *e.g., arm-en* (the arm), *land-et* (the land). In general the Scandinavian peoples have never had much difficulty in understanding one another in either the spoken or written language.

History.—The oldest written form of Norwegian is found in the runic inscriptions. They disclose no evidence of dialect dissimilarities within Scandinavia, although these certainly existed in prehistoric time. By the end of the Viking age (about 1050), when the Latin alphabet was brought to Norway along with Christianity, the divergencies were so manifest that they justify a distinction between West Norse used in Norway and by Norwegian settlers in Iceland and the Faeroes, and East Norse, spoken by Danes and Swedes. The language in Norway up to the second half of the 14th century is called Old Norwegian, and it became the instrument of a high literary culture. During that period it was characterized by maintaining more of the diphthongs that were monophthongized in the neighbouring countries, such as *stein* (stone), *öy* (island), *lauv* (foliage), in contrast with Danish and Swedish *sten, ö, löv.* Like Swedish, Norwegian preserved the voiceless consonants *p, t, k* after a long vowel at the end of a syllable, where they were early changed into *b, d, g* in Danish; for instance, *krype* (creep), *fot* (foot), *bok* (book), Danish *krybe, fod, bog.* They also retained for a longer period the "full vowels" *a* and *o* (or *u*) in unaccented syllables, which in Danish were weakened into a slack *e* in that position. Thus large districts of Norway had, and still have, such forms as *leva* (live), *kastar* (throws), *timar* (hours), *visor* or *visur* (ballads), where Danish equivalents developed into *leve, kaster, timer, viser.* This accounts for Norwegian's generally preserving a distinction between three grammatical genders of the nouns, whereas in Danish masculine and feminine coalesced into a common gender taking the same suffigated definite article *-en.* However, there were never high linguistic barriers between the countries. Many of the dialects in the southeast of Norway, which from about 1300 became a political and cultural centre, evolved features like those of Swedish and Danish. This tendency strengthened the influence from abroad when Norway was politically united to Sweden in 1319 and to Denmark in 1380. But long before that the commercial and cultural contact with other European countries had led to the assimilation of many loan words into Norwegian. From English came at an early date religious words such as *kristen* (Christian), *prest* (priest), *biskop* (bishop), *kirke* (church). From French and Low German came terms of chivalry and commerce. The German impact grew particularly strong when trade began to be taken over by the Hanseatic league in the 13th century. The supremacy of Latin in Roman Catholic Church usage during the middle ages was seen in the introduction of a copious technical terminology and also a learned style which still prevails in religious and administrative literature.

The Middle Norwegian of the 15th and 16th centuries was marked by a development toward the later highly simplified grammar. The old four-case system of the nouns was being reduced, the nominative and accusative, partly also dative, getting the same form; even the genitive was in many instances superseded by prepositional expressions; *e.g., far til barnet* (father of the child) instead of *barnets far* (the child's father). The same tendency was to be seen in the declension of adjectives and pronouns, and the conjugation of verbs eventually grew quite independent of person and number.

This intrinsic evolution of a national language was modified by political events underlying the union of Norway and Denmark (1380–1814). During the 400 years of the union Danish influence on the language became more and more marked. Written Norwegian was gradually replaced by Danish in public administration, in the church, the schools and the courts of law. Official support for the spread of Danish in Norway was also helped by the fact that the dialects in some of the large cities and most densely populated areas in the southeast were subject to a linguistic development parallel to that of Denmark. After the dissolution of the union in 1814 Danish was used almost exclusively in official letters, printed books and newspaper articles. Certain scattered Norwegian elements were present only in cases where the writers had to express themselves on typically Norwegian topics. There were authors who tried to write perfect Danish, and grammarians would extirpate national elements which they considered provincialisms and vulgarisms. Even the spoken language was in some degree influenced by the written idiom, primarily on the stage and among persons of the higher professions, who took pride in attempting to speak a pure Danish. But they seldom attained more than pronouncing written Danish with a Norwegian accent, thus laying the foundation of a "solemn language" distinguished from the local vernacular. In the remote rural districts people used their native speech, little influenced by the written norm and less coloured by spoken Danish.

In the first half of the 19th century many persons were anxious to show that the reborn nation had a written language of its own, different from the foreign idiom. Authors and poets initiated the usage of distinctly Norwegian words and phrases in their works and sometimes wrote minor poems in country dialects. The collection of folklore in the 1840s had a decidedly national influence upon both style and morphology. The philologist Knud Knudsen (1812–95) laid the linguistic and practical foundation of a Norwegianized language and thereby made a valuable contribution to Norwegian literature. The language used by the realists in the second half of the 19th century could no longer be labelled Danish. Accordingly the terms Norwego-Danish, Dano-Norwegian and *riksmål* (state language) were employed. There were, however, others who cherished the plan of making a completely new national norm. In the mid-19th century Ivar Aasen (1813–96) constructed his *landsmål* (country language) on the basis of the spoken dialects throughout the country, particularly those freest from foreign influence and most in accord with the linguistic traditions of the classical past. Consequently, his normalized idiom acquired a rather old-fashioned appearance. It had a complex system of inflections, adopted three genders, the old full vowels and voiceless consonants, and also excluded many German loan words. This purism has, incidentally, also been noticeable as part of the policy to Norwegianize *riksmål.*

Bilingual Norway.—The new language was immediately put to use by Aasen himself and other eminent writers, and attempts were made to have it sanctioned officially. This was accomplished in 1885, when it was placed on a level equal with *riksmål.* From then Norway had two written languages, or rather two closely interrelated aspects of one language, *riksmål* and *landsmål;* after 1929 these were officially termed *bokmål* (book language) and *nynorsk* (new Norwegian). Local school boards decide whether *bokmål* or *nynorsk* is to be used in their community, but all schoolchildren learn both. In secondary schools students must acquire a writing proficiency in both forms. Laws and decrees, public post-

ers and forms may be printed in either form, and programs in *bokmål* and *nynorsk* are transmitted over the Norwegian state broadcasting system. Little by little *nynorsk* has gained a wider usage, not only in public administration but also in the press, literature, scientific publications and theatre. It has its stronghold, however, in rural districts, mainly in west and central Norway. *Bokmål* is used by the majority of the population and predominates in cities and densely inhabited districts and also in the northernmost counties.

During the 20th century there was a common desire to arrive at one norm suitable to all Norwegians. Action taken by the *storting* (Norwegian parliament) favoured a prospective synthesis of the two in the so-called *samnorsk* (combined Norwegian), and the spelling reforms of 1907, 1917 and 1938 were passed to that effect. They produced a steady Norwegianizing of *bokmål* and a concurrent simplification and modernizing of *nynorsk*. In 1952 a permanent language committee (Norsk Språknemnd) was established to bring the existing forms closer together.

Dialects.—The dialects of Norway are roughly divided into: (1) East Norwegian, the chief characteristics of which are the cacuminal, "thick" *l* in words like *dal* (dale), *kalv* (calf), and the double infinitive ending *-a* or *-e*, depending on the length of the verbal stem: *leva* (live) but *kalle* (call); (2) West Norwegian, with no thick *l*, and the infinitive ending irrespective of the length of the verbal stem: *leve, kalle* or *leva, kalla;* (3) North Norwegian, with traits common partly to East and partly to West Norwegian. Inside these groups there are many variations. The monophthongization of diphthongs occurs widely, especially in the east; the dialects north of a partition line across south Norway have the palatal pronunciation of *nn* and *ll* in words like *mann* and *kalle;* some dialects in a strip of land on the southern coast exhibit the above-mentioned transition *p, t, k* to *b, d, g*. Intonation and musical accent may differ considerably, but dialect differences do not at all prevent intercourse among persons. Improved communications of all descriptions are having a unifying and levelling effect upon the language.

Foreign Vocabulary.—The increasing international traffic strongly influenced the written and spoken language. The political development before, during and after World War II added notably to the stock of loan words, above all from English. Words like "all right," "shorts," "taxi," "film," technical terms such as "back," "halfback," "corner," "game" had been adopted long ago. Later incorporations were "tank," "jet," "jeep," "radar," and an influx of abbreviations such as U.N.E.S.C.O., U.N.R.R.A., F.A.O. and NATO. Norway on its part has contributed to the cosmopolitan vocabulary with *fiord, ski* and *slalom*. Quite significant was the expansion of Norwegian through immigration in the United States.

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NORWEGIAN LITERATURE.

From a linguistic and artistic aspect the literature of ancient Norway is inextricably bound up with Icelandic; Old Norse literature, therefore, is dealt with under Iceland (*see* ICELANDIC LANGUAGE; ICELANDIC LITERATURE); yet it should not be forgotten that the psychological features revealed through the so-called *Elder Edda*, as well as through the sagas, are so typically Norwegian in all essentials that this literature forms the very basis on which the literary fabric of Norway has been raised in the course of centuries. The literature of the Old Norse language came to an end in the beginning of the 14th century simultaneously with the decline and fall of Norway as a sovereign state with a culture of its own. The chief characteristic of this literature, formed as it was in "an age of axes, an age of swords," is the remarkable fighting spirit by which it is pervaded and which quite naturally makes it abound in dramatic scenes and striking personalities; at the same time, in poetry as well as in prose, it is imbued by a serene view of life, which reveals a remarkably high moral standard. Another very distinct feature is its decidedly aristocratic leaning, with a pronounced hero-worshipping tendency, as might be expected in an age when the king generally appeared surrounded by his faithful chieftains and frequently with a young poet before him, singing his praises in glowing terms.

The Literary Revival.—Meanwhile the political union between Denmark and Norway (concluded in 1380) gradually brought Danish nobles and officials to the front in the latter country, with the result that the Old Norse language was replaced by Danish. This development, which constitutes perhaps the most remarkable event in the cultural history of the nation, may be considered as completed by the middle of the 16th century. Accordingly, when about the same time the literary revival set in, which to some extent was a result of the introduction into Norway of the Lutheran Reformation, the new literature came to be composed in the Danish language, which for nearly three centuries was to hold an unchallenged position as the official language of Norway.

The first outcome of the revival of literary interest in Norway was the appearance of the first book ever printed in Norway, an almanac, printed in Christiania in 1643. During the following years Christen Bang (1580–1678) published a number of religious tracts and also a *Description of Christiania* (1651), which at that time had only recently completed the 25th anniversary of its foundation. These curiosities, however, have nothing to do with literature in the true sense of the word, and the first name of importance in Norwegian literature after the spiritual revival in the Reformation century was Peder Claussön (1545–1614), a clergyman by profession and at the same time a highly gifted author who by his translation of Snorri Sturluson (*q.v.*) as well as by his independent works on Norway made a lasting reputation. The next striking personality in Norwegian literature is Petter Dass (1647–1708), whose *Nordlands Trompet* (*Clarion*) with its lyric-topographical description of the scenery and life of north Norway is still considered one of the gems of Norwegian literature. On the other hand, Dorthe Engelbrechtsdatter (1635–1716), who among her contemporaries enjoyed a great reputation as an author of religious poetry, is now practically forgotten.

Holberg.—Contrasted with these authors, all of whom spent their lives in Norway, Ludvig Holberg (1684–1754) (*q.v.*) early found his way not only out of Norway but out of Denmark. Leaving Norway for ever at the age of 21, after having taken his degrees at the University of Copenhagen, he went to England, where he studied for more than 18 months at Oxford, from which he carried with him an indelible impression of England and the English. Later travels brought him to France, Germany and Italy, but wherever he went he lived in the English world of thought and reasoned on the basis of his Oxford experiences. In this way, thanks to his inborn genius and his unbiased mind, he prepared himself for the life work by which he became the founder of modern Norwegian and modern Danish literature. He revolutionized the conception of life in two kingdoms and paved the way for the intellectual and political liberty of the future. His most famous works next to his comedies (*see* DRAMA: *Norwegian Drama*) are *Peder Paars* (1719), a heroic poem, the humour and satire of which has stood the test of two centuries; *Niels Klim's Underground Travel* (1741), originally written in Latin, a classic evidence of his mental independence; and finally, from the closing years of his life, his *Epistles* and *Moral Reflections,* which are the best source of information for Holberg students. Holberg restored the cultural connection between Norway, England and western Europe in general, which had been broken off since the end of the saga period.

English native poets, such as James Thomson and Edward Young, had their counterpart in Norway in Christian Tullin (1728–65), a manufacturer and merchant of importance in the business community of Christiania and a central figure in the extremely sociable life of the city. By his famous poem "The May-Day" (1758), composed on the occasion of a wedding among the "upper ten" of Christiania, Tullin became the first interpreter in Norwegian literature of the long pent-up love of nature which three-quarters of a century later found such splendid expression

in the poetry of H. A. Wergeland.

Det Norske Selskab.—Meanwhile, the importance of Holberg's work, along with a number of other factors, among them a constantly growing awareness of being an individual nation with historical traditions and cultural and economic possibilities, gradually began to prevail. The centre of this movement was Copenhagen, where the Norwegian students, partly graduates staying there in search of employment, felt themselves aliens in the midst of a display of public sympathy which made the name of Norway and the Norwegians resound in a way bearing promise for the future. In 1772, to mention a particular year of lasting importance in Norwegian literature, the Norwegian poets and other men of letters were so strong in Copenhagen that they formed a society which was to become famous under the name of Det Norske Selskab (the Norwegian society). The two most conspicuous members of this society with whom its name has forever been associated were Johan Herman Wessel (1742–85) and Johan Nordahl Brun (1745–1816); besides them should be mentioned Claus Fasting (1746–91), Claus Frimann (1746–1829) and his brother Peter Harboe Frimann (1752–1839), as also their younger contemporaries Jonas Rein (1760–1821) and Jens Zetlitz (1761–1821). No student of Norwegian literature who wants to understand the undercurrents in the Norwegian nation in the 40 years before the dissolution (1814) should pass by these poets, among whom Claus Frimann still lives in a few songs of popular reputation. The sovereign talent among them, however, is Wessel (*see* DRAMA: *Norwegian Drama*), the spiritual inheritor of Holberg, a champion in the fight against pedantry and prejudices, a *gamin* spirit full of irony and good humour in the midst of adversities.

Norwegian literature has no finer display of comic fiction than his three immortal poems "The Smith and the Baker," "The Dog-murder" and "The Fork," while a number of his pithy and pointed epigrams long ago became classic. Nordahl Brun's fame with posterity rests less on the poetic value of his works than on the tradition of his striking personality, which in his lifetime made him the very embodiment of the national aspirations of Norway.

The Renaissance of 1814.—In literature this renaissance, in its first stage, was represented by three poets, Henrik Anker Bjerregaard (1792–1842), Mauritz Christopher Hansen (1794–1842) and Conrad Nicolai Schwach (1793–1860). Bjerregaard was famous for his "Sönner av Norge" ("Sons of Norway"), written in 1820, which for half a century was the national anthem of Norway. His merry musical piece "A Highland Adventure" (1824) is inspired by a genuine love of nature and a sound common sense.

Wergeland and Welhaven.—The commanding genius of this generation is Henrik Arnold Wergeland (1808–45), (*q.v.*), who, as has justly been said, contrived within the limits of a life as short as Byron's to concentrate the labours of a dozen ordinary men of letters. As a poet he was inspired alike by an intense love of nature. Besides larger poems, among which may especially be mentioned *The English Pilot* (1844), he wrote in addition a quantity of lyrics with dramas, essays, historical works and journalistic articles—all stamped by his vivid imagination, many of them also by his sound common sense and his high moral standard.

His contemporary Johan Sebastian Cammermeyer Welhaven (1807–73) is primarily known for his highly critical nature, with its keen sense of beauty and harmony. His early poems are associated with his literary clash with Wergeland, but notwithstanding the interest attached to them for their polemic character, the memory of Welhaven as a poet chiefly rests upon his beautiful romances. This Romantic movement was evident about 1840, and it is the same spirit which led to the discovery of the folklore, with its wonderful prose and poetry, in which the soul of the nation and the nature of the country faithfully reflected themselves.

The ideal was that every piece of folklore should be rendered in the form given to it by the people in the course of time, and here the Norwegian nation was particularly fortunate. At the right moment the two friends Peter Christen Asbjörnsen (1812–85) and Jörgen Moe (1813–82), whose names are forever associated with the Norwegian folk tales which bid fair to challenge the most famous folk tales in any European country, made their appearance in literature. Asbjörnsen was a first-rate storyteller with a broad, jovial nature; Moe was a true poet with humour and a rare gift of self-criticism. There was also the Rev. Magnus Brostrup Landstad (1802–80), who in 1853 published his famous collection, *Norwegian Folk-Songs,* the poetical part of the Norwegian folklore of which the folk tales constitute the prose. The former are older than the latter and accordingly differ from them in several ways; but jointly they constitute what up to the middle of the 19th century was the missing link between the *Eddas* and the sagas on one side and the literature of modern Norway on the other.

The Landsmål Movement.—Along with this literary revival there also set in a linguistic and historical renaissance of paramount importance to literature as a whole. In 1848 Ivar Aasen (1813–96) published a grammar and in 1850 a dictionary of the Norwegian folk language, whereby the intimate connection between the peasant dialects of the day and the Old Norse language was revealed in the most convincing way. A few years after Aasen's appearance in literature the famous historian Peter Andreas Munch (1810–63) published his mighty work, *History of the Norwegian Nation* (8 vol., 1852–63), an event of paramount importance in the field of literature.

This Romantic movement leading to the foundation of the national stage in Norway, with Björnstjerne Björnson and Henrik Ibsen as the two pioneers (*see* DRAMA: *Norwegian Drama*), it is easy to see why both of them turned to the saga period for suitable subjects and characters. At the same time, however, realism had already set in. During the 1850s the Rev. Eilert Sundt (1817–75) started his epoch-making investigations of life and manners in the rural districts, which made the Norwegian peasant appear in a light considerably different from that in which he appeared in the flattering illumination of the former "peasant worship." Accordingly, Björnson's famous peasant novels, the first of which was *Synnöve Solbakken* (1857), of a decidedly poetical turn, must be described as imbued by romanticism more than by realism so far as the outward surroundings are concerned.

The Big Four.—In 1855 Camilla Collett (1813–95), Henrik Wergeland's sister, published her famous novel *The Governor's Daughters,* the first true description in Norwegian literature of ordinary life, which dealt a heavy blow to the conventional marriage and education of young girls. In this way Madame Collett became a pioneer in the movement for the emancipation of women in Norway to whom both Björnson and Ibsen felt themselves indebted. Next to Madame Collett, the fame of the realistic novel is chiefly developed through Jonas Lie (1833–1908) and Alexander Kielland (1849–1906), who, together with Ibsen and Björnson, constitute the famous constellation in the golden age of Norwegian literature popularly known as the "big four." Lie is the author of a number of pure, fresh and eminently characteristic novels dealing with various aspects of everyday life within different ranks of society. *The Pilot and His Wife* (1874), *Rutland* (1880) and *Go On!* (1882) should be mentioned in this connection, no less for the spirit of the white sails and foaming sea by which they are imbued than for their intimate humanity in substance and psychological analysis. The latter qualities also are displayed splendidly in *The Commander's Daughters* (1886) and *Matrimonial Life* (1887), which, together with his beautiful novel *The Family at Gilje* (1883), a masterpiece of historical review and human psychology dealing with life and characters of the 1840s, rank among the crowning works of Lie's extensive authorship. Contrasted with Lie, whose highly impressionistic style not infrequently becomes colloquial to a fault, Kielland is a sovereign master of form and at the same time a keen psychologist with a decided vein of irony and a heart full of compassion for human suffering. His social novels *Garmann and Worse* (1880) and *Skipper Worse* (1882) long ago became classic, as did a number of his short stories, which by their delicacy of style represent the highest attainment of modern Norwegian prose.

Among other authors from the same epoch should be mentioned Kristian Elster (1841–81), who showed great talent in his pessimistic novels *Tora Trondal* (1879) and *Dangerous People* (1881), and Amalie Skram (1847–1905), wife of the Danish novelist

Erik Skram, whose novels, while deficient in literary beauty, are of a considerable crude force and excellent in their local colour, dealing chiefly with Bergen and west coast life. The outstanding feature of all the writings of the 1880s, which may be described broadly as an age of entirely prosaic writers, is the "problem setting," to which there is no parallel in Norwegian literature and to which Björnson himself contributed in his great novel *Town and Harbour Beflagged* (1884), to mention one of the most typical "problem" novels of the age.

Vinje and Garborg.—The *landsmål* literature produced two remarkable authors, Aasmund Olafsen Vinje (1818–70) and Arne Garborg (1851–1924). Vinje was a fine lyric poet and a keen critic, who exercised a great influence on Ibsen in his first period as a dramatist and who, broadly speaking, was one of the most striking literary figures of the 1860s. Garborg, who was brought up under sternly pietistic influences in the southwest corner of Norway known as Jaeren, carried with him from these surroundings a gloomy view of life, but being at the same time a revolutionary spirit and an imaginative thinker with a considerable training, principally as a critic, he seemed predestined to make his appearance in literature. His novel *Peasant Students* (1883) is partly of a polemic nature. Like the rest of Garborg's novels (some of them so important that we might properly speak about the "big five") this was written in the *landsmål,* which at the time to a certain extent was a drawback to their circulation. In 1891, however, he suddenly turned to the *riksmål* in his extraordinary novel *Tired Men,* an exquisite example of Norwegian prose.

Hamsun.—Meanwhile another author had already made his appearance in Knut Hamsun (1859–1952) (*q.v.*), whose powerful romance *Hunger* (1888) marked a new departure in Norwegian literature. He was, in fact, its central figure throughout the 1890s in the midst of a number of authors of an entirely different stamp from those of the 1880s. The most unmistakable genius, however, was Hans Kinck (1865–1926). As a typical feature of the 1890s it should be mentioned especially that the art of poetry, which had been practically banished from Norwegian for a number of years, again had its exponents, chiefly in Niels Collett Vogt (1864–1937) and Vilhelm Krag (1871–1933). The sensitive spirit of the age, however, is revealed nowhere more remarkably than in Sigbjörn Obstfelder (1866–1900), whose exquisite poetry, as it can be studied in his *Posthumous Works,* is rivalled only by his fascinating prose. In both he gives promise of something new in Norwegian literature; the promise was unfulfilled because of his early death. At the same time the *landsmål* poetry witnessed a revival, chiefly through Per Sivle (1857–1904), an excellent national poet whose poems dealt with the episodes and characters of the saga period.

The consummate work in the *landsmål* lyric during the 1890s, however, is Garborg's *Haugtussa* (1895), inspired by the strange and impressive scenery of the Jaeren. Thus, at the end of the 19th century, there was a revival both in the *riksmål* and in the *landsmål* literature.

The first decade of the 20th century will be forever memorable for the deaths of the four greatest writers of the preceding age: Ibsen, Björnson, Lie and Kielland. Thereby the field of fiction was thrown open to a new generation of authors, who found themselves confronted with problems essentially different from those which had taxed the attention of the former generation. Norway was no longer the country of consuls, shipowners, vicars, rectors, chamberlains and estate owners, representing official views and opinions against which persons not "made of that self metal" occasionally revolted and always with deplorable result to their own social interests; nor was Norway the country of women suffering in silence under slow torture of an apparently correct marriage, or a country of workers imbued by a patriarchal respect for their employers, based on personal connections from generation to generation. It was a community in which democracy had established itself on a broad basis.

Recent Literature.—No dramatic work of lasting influence has appeared since the age of Ibsen and Björnson, but an examination of the history of the Norwegian novel leaves a more satisfactory impression. Hamsun produced works, generally written in an exquisite style and filled with an exuberant vitality, of which *Pan* (1895) and *The Growth of the Soil* (1917; English translation 1920) rank particularly high.

Kinck, who is by all critics admitted to be an author of rare gifts, has not yet received general recognition either at home or abroad. Yet by his daring metaphors, his exuberant passions, his deep psychology, supported by extensive historical studies, he is one of the most intimate guides to the depths of the Norwegian mind. His Hardanger novel, *The Avalanche* (1919–20), is considered his greatest work, but generally speaking he is at his best in the short story. Another important writer is Trygve Andersen (1867–1920), a self-controlled author with a limited production.

Besides these three poet-artists and classics should be mentioned Johan Bojer (1872–), whose novels have become famous in the English-speaking world and elsewhere. A more intimate author is Peter Egge (1869–), a conscientious writer with an artistic style which adds to his original gifts as a narrator and psychologist. These qualities are happily displayed in *Hanna Solstad* (1926), one of the finest novels written during the period.

The most remarkable figure in later Norwegian literature, however, was Sigrid Undset (1882–1949) (*q.v.*), who held a position of her own by her mighty cycles of historical novels, of which *Kristin Lavransdattar* (3 vol.) shows a remarkable psychological insight and a rare power of appreciating bygone ages.

One of the chief characteristics of Norwegian literature during the first half of the 20th century was the ever-increasing number of local authors who, substituting particular districts for the country as a whole, gave rise to local literature, partly written in the literary tongue of the country known as the *riksmål,* partly in the *landsmål,* or in a *riksmål* coloured to a marked degree by local dialects. Conspicuous among these authors were Oskar Braaten, Hans Aanrud (1863–1953), who scored success as a playwright of broad humour in the 1890s, and Johan Falkberget (1879–) —all typical east Norway novelists. Braaten's literary domain, not only as a playwright but as a novelist, was the industrial quarters of Oslo and its surrounding districts. Aanrud was a keen observer of life and manners in the midland countries round Lake Mjösen. Falkberget was intimately acquainted with the miners of the mountain districts of the valley of Österdalen.

Gabriel Scott, in an idyllic novel, *The Source* (1918), found an exquisite expression of the typical Sörland (literally Southerland) nature and Sörland temper as they reveal themselves all through the charming coastland. West Norway country life was ably sketched by Jens Tvedt (1857–1935), who wrote in the *landsmål.* The particular district of the north Trondhjem country known as the Valley of Namdalen produced in Olav Duun (1876–1939), whose works all dealt with life and manners in his native valley, the most gifted author of modern times writing in the *landsmål.* Another significant author in the same language is Kristofer Uppdal (1878–), originally a navvy, whose works are imbued by the ideals of the labour movement.

In poetry Niels Collett Vogt proclaimed his emotions in stanzas of vigorous and beautiful metaphors. Olaf Bull (1883–1933) combined to a rare degree a refined versification with silent resignation and lofty enthusiasm. Herman Wildenvey (1885–) sings out his joys, his cares and his whims in easy verses and metaphors, striking for felicity of phrase. Simultaneously with this lyric flourishing in the *riksmål,* the *landsmål* literature produced the genial lyric poet Olav Aukrust (1883–1929), inspired by a deep sense of spiritual strife and by religious visions.

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NORWICH (nŏr′ĭj), **GEORGE GORING,** Earl of (1583?–1663), English soldier, son of George Goring of Hurstpierpoint and Ovingdean, Sussex. He was knighted in 1608 and became a favourite at court, benefiting largely from monopolies granted by Charles I. He became Baron Goring in 1628 and privy councillor in 1639. When the troubles between Charles and his

parliament became acute Goring devoted his fortune freely to the royal cause; and the king in November 1644 renewed for him the title of earl of Norwich which had become extinct at his uncle's death. He went with the queen to Holland in 1642 to raise money for the king, and in the autumn of the next year he was seeking arms and money from Mazarin in Paris. His proceedings were revealed to the parliament in January 1644 by an intercepted letter to Henrietta Maria. He was consequently impeached of high treason, and prudently remained abroad until 1647 when he received a pass from the parliament under a pretext of seeking reconciliation. Thus he was able to take a prominent part in the Second Civil War of 1648 (*see* GREAT REBELLION). He commanded the Kentish levies, which Fairfax dispersed at Maidstone and elsewhere, and was forced to surrender unconditionally at Colchester.

He was condemned to death on March 6, but petitions for mercy were presented to parliament, and Norwich's life was spared by the speaker's casting vote. He then joined the exiled court of Charles II, by whom he was employed in fruitless negotiations with the duke of Lorraine. He became captain of the king's guard at the Restoration, and in consideration of the fortune he had expended in the king's service a pension of £2,000 a year was granted him.

He died at Brentford on Jan. 6, 1663.

NORWICH, city and county borough of Norfolk, England, 114 mi. N.E. by N. from London. Pop. (1951) 121,226. Area 12.4 sq.mi. Served by the L.N.E., the L.M.S., and the M. and G.N. railways. Caistor-by-Norwich, 4 mi. S. of Norwich, is on the site of what was probably a Romano-British town. According to tradition Uffa made a fortification here about 570, but its history as a royal borough cannot be traced before the reign of Aethelstan (924–940), when it possessed a mint. After being destroyed by the Danes, Norwich enjoyed a period of prosperity under Danish influence and was one of the largest boroughs in the kingdom at the Conquest. Ralph de Guader, earl of East Anglia under William I, formed the nucleus of a French borough with different customs from the English, and after his forfeiture a castle was built and the centre of burghal life gradually transferred to the new community west of it. By 1158, when Henry II granted the burgesses a charter confirming their previous liberties, the two boroughs seem to have amalgamated. A fuller charter given by Richard I and confirmed by later sovereigns made Norwich a city enjoying the same liberties as London. The city lies in the valley of the Wensum, which joins the Yare immediately below. The ancient city lay in a deep bend of the Wensum, and the walls (1294–1342), with their many towers and 12 gatehouses, of which fragments only remain, were 4 mi. in circuit. These narrow limits, however, were outgrown even by 1671. Of the castle, only the early Norman square keep remains, with four tiers of arcading without, and an ornate doorway into the great tower. The building was acquired in 1884 by the corporation and in 1894 adapted as a museum and art gallery. It contains one of the finest collections of raptorial birds in Europe. The city established in 1608 a public library, the oldest provincial library with a continuous history.

The cathedral church of the Holy Trinity lies between the castle and the river. In 1094 the seat of the East Anglian bishopric was removed by Bishop Herbert de Lozinga or Lorraine from Thetford to Norwich, where in 1096 he laid the foundation of the cathedral and dedicated it in 1101, establishing at the same time a Benedictine monastery. As completed before the middle of the 12th century the cathedral was purely Norman; and it still retains its original plan. The Perpendicular spire belongs to the 15th century; the west window and porch and the lierne stone vaulting of the nave, with its 328 bosses, to the 15th, and to the 16th the vaulting of the transepts and Bishop Nix's chantry, while the fine cloisters, with 45 windows, were begun in 1297 and not completed till 1430. The chief entrance on the west is a Perpendicular archway, above which is a window of modern stained glass. The nave is divided by 14 semicircular arches, whose piers are in two instances ornamented with spiral mouldings. The triforium is composed of similar arches. The choir is of unusual length, and terminates in an apse. The oak stalls and *misereres* are of the 15th century. Of three circular apsidal chapels two remain. The War Memorial chapel (1932) replaced the old Lady chapel. In 1942 the cathedral was damaged in an air raid, the north transept suffering most. Two richly sculptured gateways lead to the cathedral—the Erpingham gate (1420) and the Ethelbert gateway (*c.* 1300).

The citizens obtained a charter (1404), making their city a county with a mayor and two sheriffs instead of four bailiffs, and Henry V added 24 aldermen and 60 common councilmen (1418). The cathedral precinct became parcel of the city at the Dissolution and in 1556 the neighbouring hamlets were incorporated in the county of Norwich. The charter of Charles II (1683) remained in force till 1835. The city in 1943 was governed by 16 aldermen and 48 councillors. The chief magistrate was created lord mayor in 1910. After 1298 Norwich was represented in parliament by two members. Two annual fairs, existing before 1332, were formally granted to the city in 1482. These have been succeeded by the Maunday Thursday horse and cattle fair, and the pleasure fairs of Easter and Christmas.

The market, which must have existed before the Conquest, was held daily in the 13th century, when citizens enclosed stalls by royal licence. Edward III made Norwich a staple town, and the importance of its trade in wool and worsted dates from his reign.

The majority of the Norwich churches are of Perpendicular flint work, mostly of the 15th century. Six churches and a synagogue were destroyed in 1942 during an air raid. At Carrow, east of the city, there remain the hall, a doorway, and other fragments of a Benedictine nunnery. The house in which Borrow resided with his parents when in Norwich is now a Borrow museum, and the Stranger's Hall, a 15th century house on Charing Cross, is an English Folk museum. In 1921 the city was presented with the Lazar House, a Norman relic contemporary with the cathedral, for a branch public library.

In 1925 Miss E. M. Colman, the first lady in England to be lord mayor, and her sister restored and presented to the city the 14th century Suckling House. The city Bridewell, late 14th century, is a museum of local industries, opened in 1925.

The grammar school is in a Decorated edifice, formerly a chapel of St. John, of *c.* 1316, with crypt below. Sir Edward Coke, Lord Nelson, Raja Brooke and George Borrow were educated here. St. Andrew's Hall is the seven-bayed nave of the Black Friars' church, rebuilt with the aid of the Erpinghams between 1440 and 1470. It is Perpendicular, with 28 clerestory windows and chestnut hammer-beam roof, and has served since the Reformation as a public hall. The guild-hall is a flint Perpendicular structure of 1408–13; the mayor's council-chamber, with furniture of the time of Henry VIII, is a specimen of a court of justice of that period.

The city regalia, kept here, include several objects of historical interest, among them a sword of a Spanish admiral captured by Nelson, with his autograph letter presenting it to the city, and a curious figure formerly used in the procession of the mayor elect through the city. A new city hall, however, was opened in 1938. The corporation owns an aerodrome on the outskirts of the city. The charitable institutions include St. Giles's or old men's hospital (an ancient foundation), and Doughty's hospital (1687).

The industries of Norwich include foundries and engineering works, ironware, brewing, brick works, chemical works, tanneries, and the production of mustard, starch, malt vinegar, chocolates, and crêpe, gauze and lace; and there are large boot and shoe factories.

The great cattle market lies below the castle.

The establishment of large housing estates on the outskirts of the city led to considerable changes in the centres of population.

NORWICH, a city of Connecticut, U.S., at the confluence of the Yantic and the Shetucket (Thames) rivers. It is on the Central Vermont and the New York, New Haven and Hartford railways. There is also a town of Norwich which incorporates the city of Norwich. Pop. of town and city combined, 37,571 in 1950; of city alone, 23,429. It is the seat of a state hospital for

the insane and a state tuberculosis sanatorium. Under a monument in Sachem street is buried the Mohegan chief Uncas, a friend to the early settlers; and in the eastern part of the city is a monument to Miantonomo, a Narraganset sachem who was put to death there. The channel of the Thames river is 25 ft. deep to Norwich. Its manufactures are varied, including cotton and woollen goods, velvets, Thermos bottles, locks, leather goods, shoes, paper boxes, textile printing, metals and machinery. Norwich was settled in 1659 by colonists from Saybrook, led by Capt. John Mason, who had crushed the Pequots in 1637, and the Rev. James Fitch, who became a missionary to the Mohegans. The land was bought from three Mohegan chiefs, and until 1662 the settlement was called Mohegan. It was the home of the Huntington family, which furnished many leaders in the civil and military affairs of the colony, the state and the nation; and the birthplace of Benedict Arnold, Mrs. Lydia H. Sigourney and Donald G. Mitchell ("Ik Marvel"). Before and during the Revolution the people of Norwich were ardent Whigs, boycotting English goods in 1767, ostracizing a schoolmaster (1770) who continued to drink tea, and disregarding the Stamp act in 1776. The town was chartered as a city in 1784. The *Bulletin,* a newspaper established in 1796, is still published.

NORWICH, a city of New York, U.S., on the Chenango river, 42 mi. N.E. of Binghamton; the county seat of Chenango county. It has an airport, and is served by the Lackawanna and the New York, Ontario and Western railways.

Pop. (1950) 8,816; (1940) 8,694 by the federal census. Norwich is a manufacturing city, in one of the principal dairying districts of the state.

Norwich was settled in 1792, incorporated as a village in 1857 and as a city in 1915.

NORWOOD, a residential area of London, Eng., partly in Surrey and partly in the county of London (metropolitan borough of Lambeth). The district is hilly and well wooded. It is divided into Upper, Lower, South and West Norwood.

NORWOOD, a town of Norfolk county, Mass., U.S., 14 mi. S.W. of Boston, on the Neponset river, and served by the New York, New Haven and Hartford railroad. The population was 16,636 in 1950 and 15,383 in 1940 by the federal census. It is a residential suburb, and it has important manufactures, notably roofing and siding, flooring, a tannery and the plants of three large printing and publishing houses. Norwood was incorporated (from parts of Dedham and Walpole) in 1872. In 1915 it adopted a municipal-manager form of government.

NORWOOD, a city of Hamilton county, O., U.S., adjoining Cincinnati on the northeast. It is served by the Baltimore and Ohio, the Pennsylvania and the Norfolk and Western railways.

The population was 35,001 in 1950 and was 34,010 in 1940 and 33,411 in 1930 by federal census. Developed originally as a residential suburb, it has extensive manufacturing industries. Playing cards, automobiles, trucks, laundry machinery, cans, office furniture and electric goods are leading products, and there are large printing and lithographing establishments.

Norwood was founded (as Sharpsburg) about 1798 and laid out in 1873; it was incorporated as a village in 1888 and chartered as a city in 1903.

NOSARI, or NAVSARI, a town in India, in the state of Baroda, and the capital of the gaekwar's southern possessions. It lies on the left bank of the Purna river, 147 mi. by rail N. of Bombay. Pop. (1941) 35,445. It is an ancient place, known to Ptolemy as Nasaripa. It was one of the earliest settlements of the Parsees in Gujarat, after their banishment from Persia in the 12th century. It is still the home of their *mobeds,* or sacerdotal class, and contains their most venerated "fire temple." The public buildings and the private houses, especially those in the suburbs, are unusually good.

NOSE, the organ of the sense of smell (*q.v.*) in man and other animals; it also acts as a filter and a warmer for inspired air (*see* OLFACTORY SYSTEM).

NOSOLOGY, that branch of medical science which deals with classification of diseases.

NOSSI-BÉ, properly Nòsy-bé (*i.e.,* "Great Island"), an island about 8 mi. off the N.W. coast of Madagascar, in 13° 23′ S., 48° 15′ E. It has an area of 130 sq.mi. Nossi-bé is volcanic, the north and south parts of older, the central part of more modern date. There are numerous volcanic craters and crater-lakes. (Lòkobé, the highest point, is 1,075 ft. above the sea.) The climate is trying, but European colonization is, nevertheless, highly developed. Pop. about 10,000. Hellville, the chief town (pop. 2,500) is a port of call for the Messageries Maritimes and a centre for the coasting trade along the western shores of Madagascar. There is excellent anchorage. The soil is very fertile, and there are forests of palms and bamboos. The chief products are coffee, sugarcane, cocoa, vanilla and tobacco. There are numerous sugar factories and rum distilleries. Shellfish, shells, mother of pearl, pearls and sponges are objects of trade.

In 1837 Tsioméko, chieftainess of one of the numerous divisions of the Sàkalàva, was expelled by the Hova and fled to Nossi-bé and to the neighbouring islet of Nossi-komba. She accepted French protection in 1840, ceding such rights as she possessed on the northwest coast of the mainland. The French took possession in 1841. Nossi-bé is under the administration of Madagascar (*q.v.*).

NOSTRADAMUS (1503–1566), the assumed name of MICHEL DE NOTREDAME, French astrologer, of Jewish origin, who was born at St. Remi in Provence on Dec. 13, 1503. After studying humanity and philosophy at Avignon, he took the degree of doctor of medicine at Montpellier in 1529. He settled at Agen, and in 1544 established himself at Salon near Aix in Provence. Both at Aix and at Lyons he acquired great distinction by his labours during outbreaks of the plague. In 1555 he published at Lyons a book of rhymed prophecies under the title of *Centuries,* which secured him the notice of Catherine de' Medici; and in 1558 he published an enlarged edition with a dedication to the king. The seeming fulfilment of some of his predictions increased his influence, and Charles IX named him physician in ordinary. He died on July 2, 1566.

The *Centuries* have been frequently reprinted, and have been the subject of many commentaries. Nostradamus also wrote a number of smaller treatises. *See* also Bareste, *Nostradamus* (Paris, 1840).

NOTARY, or NOTARY PUBLIC. In Roman law the *notarius* was originally a slave or freedman who took notes (*notae*) of judicial proceedings in shorthand. The modern notary corresponds rather to the *tabellio* or *tabularius* than to the *notarius.* In canon law it was a maxim that his evidence was worth that of two unskilled witnesses.

The office of notary in England is a very ancient one. It is mentioned in the Statute of Provisors, 25 Edward III, stat. 4. The English notary is an ecclesiastical officer, nominated, since the Peterpence Dispensations act, 1533–34, by the archbishop of Canterbury through the master of the faculties (now the judge of the provincial courts at Canterbury and York), in order to secure evidence as to the attestation of important documents. All registrars of ecclesiastical courts must be notaries. A notary's duties, however, are mainly secular. "The general functions of a notary consist in receiving all acts and contracts which must or are wished to be clothed with an authentic form; in conferring on such documents the required authenticity; in establishing their dates; in preserving originals or minutes of them which, when prepared in the style and with the seal of the notary, obtain the name of original acts; and in giving authentic copies of such acts" (Brooke, *On the Office of a Notary*). The act of a notary in authenticating or certifying a document is technically called a "notarial act." In most countries the notarial act is received in evidence as a semijudicial matter, and the certificate of a notary is probative of the facts certified. But English law does not recognize the notarial act to this extent. An English court will, in certain cases, take judicial notice of the seal of a notary, but not that the facts that he has certified are true, except in the case of a bill of exchange protested abroad. The file of a year's documents is often termed the protocol.

One of the numerous duties of an English notary is the noting and protest of foreign bills of exchange in case of nonacceptance or nonpayment. This must be done by a notary in

order that the holder may recover. He also prepares ship protests relating to mercantile matters, and authenticates and certifies copies of documents and attests instruments to be sent abroad. The office of notary is now usually held by a solicitor. In London he must be free of the Scriveners' Company.

In Scotland the office of notary is *munus publicum* and his notarial acts are probative. A roll of notaries public is kept, and under the Law Agents (Scotland) Act, 1873, any law agent is entitled to admission to the roll on payment of additional stamp duty. In addition to noting and protest of bills of exchange, notaries in Scotland have important functions in relation to completion of titles to land. They act as commissioners of the Sheriff Court of Chancery for taking affidavits in the process of service of heirs, they prepare and execute notarial instruments for giving service in land, and they may execute deeds notarially on behalf of persons who cannot write. Notaries also are supposed to keep their protocol books which are probative of the intimation of certain protests by mariners and others. Modern legislation has made serious inroads on the exclusiveness of the notary's functions.

In France, notaries receive all acts and contracts to which the parties thereto must give or desire to give the authenticity attached to the acts of a public authority; they certify the date, preserve the originals and give copies or duplicates. Notaries are nominated by the president of the republic on the recommendation of the keeper of the seals. They cannot act as notaries and also practise as advocates, or hold any magisterial office, nor can they engage in business.

In the more important British colonies and in foreign countries generally notaries are governed by special statutory legislation.

In the United States, the President appoints notaries in the District of Columbia, and the governor alone appoints them in most States. Many states have laws limiting the numbers who may be appointed for a particular county, usually a number in proportion to the population. Notaries are not empowered to act outside their own states, and often not outside their own counties. In most cases their seals must be affixed to the affidavit or other document. They attest deeds and other instruments, take affidavits and depositions and protest bills of exchange. Certain other officials may have notarial functions in addition, such as commissioners of deeds in New York state.

NOTE, a mark, particularly a sign by which a musical sound (also called a note) is indicated in writing (*see* MUSICAL NOTATION). A comment or addition added to a passage in a book, or a communication in writing shorter or less formal than a letter. The term is also applied to an abstract or memorandum of documents, speeches, etc., especially in the process of the transfer of land by fine and recovery (*see* FINE).

The ordinary distinction between note and letter is reversed in diplomacy. *Diplomatic notes* are written communications exchanged between diplomatic agents or between them and the ministers of foreign affairs of the government to which they are accredited. Sometimes, by agreement, a mere exchange of notes has the force of a convention. *Collective notes* are those signed by the representatives of several powers acting in concert. Sometimes *identical notes* are substituted for collective, *i.e.,* notes identical as to form and substance, but signed and delivered separately by the representatives of the several powers. *Circular notes* are those addressed by one power to the other powers generally. *Confidential notes* are directed to inspiring confidence by giving an explicit account of the views and intentions of the plenipotentiaries and their governments. The so-called *notes verbales* are unsigned, and are merely of the nature of memoranda of conversations, etc. *Notes ad referendum* are addressed by diplomatic agents to their own governments asking for fresh powers to deal with points not covered by their instructions. Diplomatic notes are usually, but not invariably, written in the third person.

For notes of hand or promissory notes *see* NEGOTIABLE INSTRUMENT and BILL OF EXCHANGE, and for notes passing as currency *see* BANKING; BANK NOTES, PRINTING OF; and POST AND POSTAL SERVICES.

NOTHOMB, JEAN BAPTISTE, BARON (1805–1881), Belgian statesman and diplomat, was born at Messancy in Luxemburg on July 3, 1805. He was educated at the Athenaeum of Luxemburg and the university of Liége. He was in Luxemburg when the revolution of August broke out, but was nominated a member of the commission appointed to draw up the constitution. He was a member of the national congress, and became secretary-general of the ministry of foreign affairs under Surlet de Chokier. He supported the candidature of the duke of Nemours, and joined in the proposal to offer the crown to Prince Leopold of Saxe-Coburg, being one of the delegates sent to London. When the Eighteen Articles were replaced by the Twenty-four less favourable to Belgium, he insisted on the necessity of compliance, and in 1839 he faced violent opposition to support the territorial cessions in Limburg and Luxemburg, which had remained an open question so long as Holland refused to acknowledge the Twenty-four Articles. His *Essai historique et politique sur la révolution belge* (1838) won for him the praise of Palmerston and the cross of the Legion of Honour from Louis Philippe. In 1837 he became minister of public works, and to him was largely due the rapid development of the Belgian railway system, and the increase in the mining industry. In 1840 he was sent as Belgian envoy to the Germanic confederation, and in 1841, on the fall of the Lebeau ministry, he organized the new cabinet. In 1845 he retired. He died at Berlin on Sept. 6, 1881.

See T. Juste, *Souvenirs du baron Nothomb* (Brussels, 1882); and F. de Ryckman de Betz, *Le Baron Nothomb et la question Luxembourg* (1918).

NOTICE, a term primarily meaning knowledge as in "judicial notice"; thence it comes to signify the means of bringing to knowledge, as in "notice to quit"; at last it may be used even for the actual writing by which notice is given. The most important legal uses of the word are judicial notice and the equitable doctrine of notice. Judicial notice is the recognition by courts of facts or events without proof. Thus in England and the United States the courts take judicial notice of the existence of States and sovereigns recognized by the sovereign of England, of the dates of the calendar, the date and place of the sittings of the legislature, etc. The equitable doctrine of notice is that a person who purchases an estate, although for valuable consideration, after notice of a prior equitable right, will not be enabled by getting in the legal estate to defeat that right. On the other hand, a purchaser for valuable consideration without notice of an adverse title is as a rule protected in his enjoyment of the property. Other common uses of the word are notice to quit, *i.e.,* a notice required to be given by a landlord to tenant, or by tenant to landlord in order to terminate a tenancy (*see* LANDLORD AND TENANT); notice of dishonour, *i.e.,* a notice that a bill of exchange has been dishonoured; notice of action, *i.e.,* a notice to a person of an action intended to be brought against him, which is required by statute to be given in certain cases; notice of trial, *i.e.,* the notice given by a plaintiff to a defendant that he intends to bring on the cause for trial; notice in lieu of personal service of a writ, *i.e.,* by advertisement or otherwise; notice given by one party in an action to the other, at a trial, to produce certain documents in his possession or power; notice to treat, given under the Land Clauses acts by public bodies having compulsory powers of purchasing land as a preliminary step to putting their powers in force. Notice may be either express or constructive. The latter is where knowledge of a fact is presumed from the circumstances of the case, *e.g.,* notice to a solicitor is usually constructive notice to the client. In the United States the doctrine of constructive notice is particularly important in view of the recording acts subordinating purchasers of real estate who have no actual notice of prior encumbrances on land to those whose rights have been placed on record in the registry of deeds, such purchasers being deemed to have constructive notice of whatever could have been discovered by an examination of the records. (*See* LAND TITLES.)

NOTKER, a name of frequent occurrence in the ecclesiastical history of the middle ages. NOTKER BALBULUS (*c.* 840–912) was a native of northern Switzerland, and for many years *magister* in the school of St. Gall. He compiled a martyrology and other works, but is famous for his services to church music and for the "sequences" of which he was the composer. He was canonized in

1513. His life is in the Bollandist *Acta Sanctorum*, April 6th. NOTKER LABEO (d. June 29, 1022) was also an instructor at St. Gall. His numerous translations, including those of the Old Testament Psalms, the categories of Aristotle, the *De nuptiis Mercurii et Philologiae* of Martianus Capella, and the *De consolatione* of Boëthius, into Old High German, may possibly have been the work of his pupils.

NOTO, city, Sicily, Italy, province of Syracuse, 20 mi. S.W. of it by rail, 520 ft. above sea-level. Pop. (1936) 18,923 (town), 29,992 (commune). The town, rebuilt after the earthquake of 1693, has some fine buildings of the early 18th century. The older town lies 10 mi. direct to the north (1,378 ft.). It was the ancient *Netum*, a city of Sicel origin, left to Hiero II by the Romans by the treaty of 263 B.C. Little remains but the ruins of the mediaeval town.

NOTRE DAME, UNIVERSITY OF, situated at Notre Dame, Ind., on a campus of 1,700 ac., was founded in 1842 by the Rev. Edward Sorin, C.S.C., and six brothers of the Congregation of Holy Cross, a religious community originating in France. The government of the university is vested in a corporation, which includes the trustees and an associate board of lay trustees, composed of alumni and nonalumni members.

The university is Roman Catholic, though about six per cent of the student body is non-Catholic. Until 1865 the only courses offered were classics and letters. Science was added in that year and in 1869 a law course, the first at any Catholic university in the United States. Engineering was inaugurated in 1873 and commerce in 1920. The more important buildings are the Administration building, with administrative offices, classrooms and art studios; the University church; and the library, with a capacity of 600,000 volumes. Special collections are the Zahm Dante library, the Edward L. Greene Botanical library and the Wightman Art gallery. Other buildings are Washington hall, the student auditorium with a wing for the department of music; the buildings for science, law, architecture, chemistry, commerce, biology and engineering; a gymnasium; a post office; a cafeteria; a student infirmary; residence halls for students; the Notre Dame stadium, with a capacity of 60,000; and a printing plant.

The bachelor and master degrees are conferred in practically all courses offered and the degree of doctor of philosophy in a number of the departments.

There were 4,968 students, including 421 graduate students, enrolled in 1949–50. (P. R. B.; X.)

NOTT, ELIPHALET (1773–1866), American divine, was born on June 25, 1773, at Ashford, Conn. He was pastor and teacher at Cherry Valley (N.Y.) (1796–97), pastor of the Presbyterian church in Albany (1798–1804), and thereafter president of Union college, Schenectady (N.Y.), a position which he held till his death on Jan. 29, 1866. He found the college financially embarrassed, but succeeded in placing it on a sound footing. He invented the first stove to burn anthracite coal.

NOTT, SIR WILLIAM (1782–1845), English general, was the second son of Charles Nott, a Herefordshire farmer, obtained a cadetship in the Indian army and proceeded to India in 1800. In 1839, he held a command at Quetta and in November 1840 he captured Khelat, and in the following year compelled Akbar Khan and other tribal chiefs to submit to the British. On receiving the news of the rising of the Afghans at Kabul in November 1841, Nott took energetic measures. On Dec. 23, the British envoy, Sir William Hay Macnaghten, was murdered at Kabul; and in Feb. 1842 the weak and incompetent commander-in-chief, General Elphinstone, sent orders that Kandahar was to be evacuated. Nott at once decided to disobey, on the supposition that Elphinstone was not a free agent at Kabul; and as soon as he heard the news of the massacre in the Khyber Pass, he urged the Government at Calcutta to maintain the garrison of Kandahar with a view to avenging the massacre and the murder of Macnaghten. In March he inflicted a severe defeat on the enemy near Kandahar, and in May drove them with heavy loss out of the Baba Wali Pass. In July he received orders from Lord Ellenborough, the governor-general of India, to evacuate Afghanistan, with permission to retire by Kabul. Nott arranged with Sir George Pollock, now commander-in-chief, to join him at Kabul. On Aug. 30 he routed the Afghans at Ghazni, and on Sept. 6 occupied the fortress, from which he carried away, by the governor-general's express instructions, the gates of the temple of Somnath; on the 17th he joined Pollock at Kabul. The combined army recrossed the Sutlej in December. (*See* AFGHANISTAN: *History*.) Nott was appointed resident at Lucknow and received the G.C.B. and a pension. He died at Carmarthen on Jan. 1, 1845.

NOTTINGHAM, EARLS OF. The English title of earl of Nottingham has been held by different families, notably by the Mowbrays (1377 to 1475; merged in the Norfolk title from 1397), the Howards (1596–1681), and the Finches (1681; since 1729 united with that of Winchilsea).

HENEAGE FINCH (1621–1682), first earl of Nottingham in the Finch line, lord chancellor of England, was descended from an old family (*see* FINCH, FINCH-HATTON), and was the eldest son of Sir Heneage Finch, recorder of London. He was educated at Westminster and at Christ Church, Oxford, and was called to the bar at the Inner Temple in 1645. He was a member of the convention parliament of April 1660, and shortly afterwards was appointed solicitor-general, being created a baronet. He sat in parliament for Oxford. In 1670 he became attorney-general, and in 1675 lord chancellor. He was created Baron Finch in 1674, and earl of Nottingham in May 1681. He died in Great Queen Street, London, on Dec. 18, 1682, and was buried in the church of Ravenstone in Bucks.

NOTTINGHAM, CHARLES HOWARD, 1ST EARL OF (in the Howard line) (1536–1624), English lord high admiral (also known as 2nd Lord Howard of Effingham), was the eldest son of William, 1st Baron Howard of Effingham, lord high admiral. He was nearly connected with Queen Elizabeth, his father's sister, Elizabeth Howard, being mother of Anne Boleyn. In 1559 he was sent as ambassador to France to congratulate Francis II. on his accession, and in 1569 was general of the horse under the earl of Warwick for suppressing the Roman Catholic rebellion in the north. The next year he commanded a squadron to watch the Spanish fleet which came to conduct the queen of Spain from Flanders. In the parliaments of 1563 and 1572 he represented Surrey, and succeeded to his father's title in 1573. He was installed a knight of the Garter in 1574, and made lord chamberlain of the household, an appointment which he retained till May 1585, when he became lord high admiral of England. He also filled the offices of lord lieutenant of Surrey and high steward of Kingston-upon-Thames. He was one of the commissioners at the trial of the conspirators in the Babington Plot and of Mary, queen of Scots, in 1586.

In Dec. 1587 he hoisted his flag on the "Ark." His letters at this time reflect vividly his sense of the impending danger. "For the love of Jesus Christ, Madam," he writes to Elizabeth, "awake thoroughly and see the villainous treasons round about you, against your Majesty and your realm, and draw your forces round about you like a mighty prince to defend you. Truly, Madam, if you do so, there is no cause for fear." On the approach of the Armada on July 6, 1588, Howard describes thus the disposal of his forces: "I have divided myself here into three parts, and yet we lie within sight of one another, so as if any of us do discover the Spanish fleet we give notice thereof presently the one to the other and thereupon repair and assemble together. I myself do lie in the middle of the channel with the greatest force. Sir Francis Drake hath 20 ships and 4 or 5 pinnaces which lie beyond Ushant and Mr. Hawkins with as many more lieth towards Scilly." He directed the various engagements (*see* ARMADA), and stayed himself to conduct the attack on the "San Lorenzo," stranded off Calais, arriving in consequence at the great fight off Gravelines some time after the engagement had begun. His tactics have been criticized both by contemporary and by later authorities. Instead of risking all in a pitched battle with the enemy, he resolved to pursue the less heroic method of "plucking their feathers little by little"; and his prudence, while justified by the extraordinary results, was also greatly praised by so good a judge as Raleigh. Shortly afterwards, under Howard's directions, a "Relation of Proceedings" was drawn up (now printed in the *Navy Records*

Society Publications, i 1–18).

In 1596 Howard and Essex commanded the expedition against Cadiz, when a squadron of the enemy's ships was destroyed and two of the number brought home. Essex insisted on landing, and Howard, who had been specially charged by Elizabeth to protect her favourite, was obliged to follow in his support. The town was sacked and the forts destroyed. Howard was created (Oct. 22, 1596) earl of Nottingham.

In February 1598, and again in 1599, when there were fears of invasion, Howard was appointed "Lord Lieut.-general of all England," and exercised full authority both over the army and the navy. He took a leading part in suppressing the rebellion of Essex, and served as a commissioner on his trial in 1601. It was to Nottingham that Elizabeth named James as her successor on her deathbed. He continued to hold office as lord high admiral under the new king, and in 1605 was despatched as ambassador to Spain, where he secured peace. He served on numerous commissions, including those on the union of the two kingdoms in 1604, for the trial of the conspirators of the Gunpowder Plot and of Henry Garnett in 1606, and for reviewing the articles and rules of the order of the Garter in 1618, and he attended Princess Elizabeth on her marriage to the elector palatine with a squadron to Flushing in 1613. Nottingham, who, unlike many of the Howards, was a staunch Protestant, was commissioner in Surrey for inquiring after recusants, and in the diocese of Winchester for hearing ecclesiastical causes; he sat on the government commission for discovering and expelling Roman Catholic priests, and was mentioned in 1602 from Douay as one of the three enemies most feared by the recusants.

On the report of the commission on the navy in 1618 and of the abuses then exposed, Lord Nottingham, though no blame was attached to himself, being now over 80 years of age, vacated his office of lord high admiral. He died at Haling house, near Croydon, on Dec. 14, 1624, and was buried at Reigate, a monument being afterwards placed to his memory in St. Margaret's church at Westminster. He was a striking and almost heroic figure in the Elizabethan annals. By his splendid character and services he was placed beyond the reach of the intrigues which troubled the reputation of many of his contemporaries.

Lord Nottingham married (1), in 1563, Catherine, daughter of Henry Carey, 1st Lord Hunsdon, (2), when in his 68th year, Margaret, daughter of James Stuart, earl of Murray.

NOTTINGHAM, a city, county borough, municipal and parliamentary borough and the county town of Nottinghamshire, England. Pop. (1938) 278,300. Area 25.3 sq.mi.

The highly advantageous position of Nottingham (*Snotengaham, Notingeham*) on the Trent, where it was crossed by an ancient highway, accounts for its origin. The Saxon form of the name is taken to refer to the caves, anciently used as dwelling-places, which were hollowed out in the Castle rock, in the Rock Holes west of the castle, in the suburb of Sneinton and elsewhere. It was chosen by the Danes for their winter quarters in 868, and constituted one of their five burghs. In 922 it was secured and fortified by Edward the Elder, who in 924 built a second "burgh" opposite the first and connected with it by a bridge over the river. In the time of Aethelstan, the successor of Edward the Elder, there was a royal mint there. In 1013 the town submitted to Sweyn. William I erected a castle, and mention of a new borough occurs in Domesday Book, and this seems to be the first evidence of the existence of the "French borough" which grew up in Nottingham under the Normans, and was distinguished from the English borough by the different customs which prevailed in it. Parliaments were held at Nottingham in 1334, 1337 and 1357, and it was the scene of the conference of the judges with Richard II in August 1387. David II of Scotland was imprisoned in the castle. Edward IV assembled his troops at Nottingham in 1461; and it was the headquarters of Richard III before the battle of Bosworth in 1485. In 1642 Charles I finally broke with the Parliament by setting up his standard at Nottingham, and during the ensuing Civil War the castle was held by each of the two parties more than once. In 1644 it was dismantled by Cromwell's orders.

The first charter (Henry II) confirmed to the burgesses the liberties they had under Henry I, referred to a market on Saturdays, and forbade the working of dyed cloth, except in Nottingham, within ten leagues of the borough. John confirmed this and granted a guild merchant. Henry III allowed the burgesses to hold the town in fee-farm, and Edward I granted them a mayor and two bailiffs, one to be chosen from each borough. Henry VI in 1448–49 confirmed all preceding privileges, first incorporated the mayor and burgesses, and granted that the town, except the castle and gaol, should be a county of itself. This grant was superseded by that of Victoria in 1897. Henry's charter remained, except for temporary surrenders under Charles II and James II, the governing charter of the corporation until the Municipal act of 1835. Nottingham returned two members to parliament from 1295 until 1885, when the number was increased to three, and again to four in 1918. Edward I granted an eight-days' fair in September and a fifteen-days' fair in November, the last altered by Richard II to a five-days' fair in February. Two other fairs were granted by Anne; one large fair, Goose fair, is still held. This begins on the first Thursday in October and lasts three days. The markets on Mondays and Saturdays are held by prescriptive right. Besides the Reform riots of 1831, Nottingham witnessed in 1811 the Luddite disturbances. In 1870 Nottingham was made the seat of a bishop suffragan in the diocese of Lincoln, but is now in the diocese of Southwell, created in 1884. In 1924 the Elizabethan Wollaton hall and park (744 ac.) were bought from Lord Middleton by the corporation. The hall in 1926 was made the natural history museum. In 1931 Sir Julien Cahn bought Newstead Abbey, 11 mi. N. of Nottingham, and presented it to the corporation. It was the home of the poet Lord Byron. In 1943 the city owned about 2.3 sq.mi. of parks and recreation grounds.

Nottingham stands on the Trent and Leen, 125 mi. N.N.W. of London by the L.M.S.R.; it is also served by the L.N.E.R. Water communications are afforded by the Grantham canal, the Nottingham and Erewash canals, communicating with the Cromford canal in Derbyshire, and by the Trent, which affords the city a highway to the sea. A railway line to Mansfield was opened in 1917, giving access to the docks at Immingham. An airport was established at Tollerton in 1938. The plan of the town is irregular and in the centre is an open market place 5½ ac. in area, but no longer used for market purposes. Its successor is the Central market, opened in 1928. Nottingham castle occupies a fine site to the south, on an abrupt rocky hill. The ancient remains include a restored Norman gateway and fragments of the fortifications. The site was acquired on a 500-yr. lease from 1875 by the corporation, and the building was opened as the Nottingham and Midland Counties Art museum. The church of St. Mary is a Perpendicular cruciform structure, with a central tower. St. Peter's church is mainly Perpendicular, but shows traces of an earlier building.

The University college, opened in 1881, contains the free municipal library. New buildings were built for the college by Sir Jesse Boot (later Lord Trent) on the west side of the town, on a site of 220 ac. called Highfields, and were opened in 1928. The free grammar school, founded in 1513, for some time in disuse, was revived in 1807, and on its removal in 1868 to new buildings, became known as the High school. There are also the Nottingham High school for girls; the blue-coat school, founded in 1723; and the Nottingham school of art, for which a fine building was erected in 1865 in the Italian style. The Midland Baptist college was transferred from Chilwell to Nottingham in 1882. The new Council House was opened in 1929. The General hospital was founded in 1781.

To the northwest, but within the city boundaries, are the industrial districts of Radford and Basford, beyond which lies Bulwell, with collieries, limestone quarries and earthenware manufactories. To the north, Sherwood is a growing residential district; another extends toward Gedling on the east. Southward, across the Trent, West Bridgford is another large residential suburb. To the west is Lenton; and Beeston has become a populous suburb mainly owing to the establishment of large cycle and motor works.

Nottingham itself became an important seat of the stocking trade toward the close of the 18th century. It was here that Richard Arkwright in 1769 erected his first spinning frame, and here James Hargreaves had the year previously removed with his spinning jenny, after his machine had been destroyed by a mob at Blackburn. Nottingham has devoted itself chiefly to cotton, silk and merino hosiery. Up to 1815 point lace was also an important manufacture. In 1808 and 1809 John Heathcoat obtained patents for machines for making bobbin net, which inaugurated a new era in the lace manufacture. The industries also include bleaching, the dyeing, spinning and twisting of silk, the spinning of cotton and woollen yarn, hosiery and drugs; the leather industry has grown considerably, and manufacture of boots and shoes, furniture making, rubber manufacture, engineering and brewing, cycle works and particularly tobacco factories are important, and the industries, especially the iron and steel and manufacture of machinery, have the advantage of the close proximity of coal mines. There is a large cattle market and a new wholesale fruit and vegetable market was opened in 1938.

NOTTINGHAMSHIRE, a county of England, area 844 square miles. The highest land, in places exceeding 600 ft., is found in the west between Nottingham and Mansfield. The hills die away eastward towards the basin of the Trent and Idle. In the Dukeries portions of the Sherwood forest are still preserved.

Early History.—In the limestone caves near Cresswell implements of presumably the Paleolithic age have been found along with remains of the mammoth, cave-lion, rhinoceros, etc., otherwise Nottinghamshire does not seem to have been inhabited until Neolithic times. The chief evidences of settlement in the Neolithic and Bronze ages come from the more open county of the southeast. The town of Nottingham, even in pre-Roman times, seems to have marked the point where the Trent was crossed by the tracks along which salt was distributed from Cheshire and Worcestershire. The presence of river and forest seemed to have caused the Romans to deflect the course of the Fosse Way northeastward from Leicester via Newark to Lincoln, and so they did not influence the history of the county profoundly. The earliest Teutonic settlers were an Anglian tribe who, not later than the 5th century, advanced from Lincolnshire along the Fosse Way, and settled in the fertile districts of the south and east. At the end of the 6th century Nottinghamshire already existed as organized territory, though its west limit probably extended no farther than the Saxon relics discovered at Oxton and Tuxford. Nottingham after the treaty of Wedmore became one of the five Danish boroughs. On the break-up of Mercia, Nottinghamshire was included in the earldom of the Middle English, but in 1049 it again became part of Leofric's earldom of Mercia. The first mention of the shire of Nottingham occurs in 1016, when it was harried by Canute. The boundaries have remained practically unaltered since the time of the Domesday Survey.

The most interesting historic figure in the Domesday Survey of Nottinghamshire is William Peverel. His fief represents the honour of Nottingham, and in 1068 he was appointed constable of the castle which William the Conqueror had raised at Nottingham. The chief lay tenant was Roger de Busli, while the majority of the church lands belonged to the archbishop of York. The Cliftons of Clifton and the Byrons of Newstead held lands in Nottinghamshire at the time of the Survey. Holme Pierrepoint belonged to the Pierrepoints from the time of Edward I.; Shelford was the seat of the Stanhopes, and Langer of the Tibetots, afterwards earls of Worcester. Archbishop Cranmer was a descendant of the Cranmers of Aslockton near Bingham. Of the old castles the principal remains are those at Newark, but there are several old mansions as at Kingshaugh, Scrooby, Shelford, Southwell, Wollaton Hall, near Nottingham (*c.* 1580). The more modern mansions are Welbeck and others in the Dukeries (*q.v.*). Nottinghamshire was originally included in the diocese and province of York, and in 1291 formed an archdeaconry. After the Conquest several monastic establishments were founded, and at the dissolution of the monasteries there were no fewer than 40 religious houses. The only important monastic remains, however, are those at Newstead.

Until 1568 Nottinghamshire was united with Derbyshire under one sheriff, the courts and tourns being held at Nottingham until the reign of Henry III., when with the assizes for both counties they were removed to Derby. In the time of Edward I., the assizes were again held at Nottingham, where they are held at the present day. The Peverel Court, founded before 1113 for the recovery of small debts, had jurisdiction over 127 towns in Nottinghamshire, and was held at Nottingham until 1321, in 1330 at Algarthorpe and in 1790 at Lenton, being abolished in 1849.

In the Wars of the Roses the county as a whole favoured the Yorkist cause, Nottingham being one of the most useful stations of Edward IV. In the Civil War of the 17th century most of the nobility favoured the Royalist cause, but Nottingham Castle was garrisoned for the parliament, and in 1651 was ordered to be demolished.

Industries.—The malting and woollen industries flourished in Norman times. The latter declined in the 16th century, and was superseded by the hosiery manufacture which sprang up after the invention of the stocking loom in 1589. The earliest evidence of the working of the Nottinghamshire coalfield is in 1259, when Queen Eleanor was unable to remain on account of the smoke of the sea coal. Worksop was formerly famous for its liquorice. Numerous cotton mills were erected in Nottinghamshire in the 18th century, and there were silk mills at Nottingham. The manufacture of tambour lace existed in the 18th century, and was facilitated in the 19th century by the manufacture of machine-made net. Coal is mined chiefly around Nottingham, Mansfield and Worksop. Clay, sandstone and limestone are also extensively raised. Nottingham is the principal centre of the lace and hosiery industries. There are silk, worsted and cotton mills, machinery works and cycle and motor manufactures. The manufacture of tobacco is considerable at Nottingham and Hucknall.

In 1939, 403,155 ac. were under crops and grass, the most fertile land lying on the alluvium along the Trent. The chief grain crops were wheat and oats, with 48,522 ac. and 28,732 ac., respectively, barley occupying only 8,636 ac. Turnips and swedes at 10,211 ac. occupied almost as much acreage as potatoes and mangolds, while there were 22,111 ac. of clover and rotation grasses for hay. Beans occupied 4,505 and sugar beets 7,882 ac. Apples and pears are grown. The shire raises cattle, chiefly shorthorn, and dairying is extensively practised. Sheep are not numerous, the chief breed being Leicesters and various crosses.

Communications, Population.—The L.M.S.R. and L.N.E.R. serve the county. The Trent is navigable throughout the county and the Idle between Bawtry and the Trent. A few canals centre upon Nottingham. There were 1,371 mi. of roads in the county in 1943. Area of administrative county 818.5 sq.mi.; pop. (1938) 470,900. Population movements of World War II had raised the population of Nottinghamshire by only 1% by Feb. 1941. The county contains the city and county and municipal borough of Nottingham, the municipal boroughs of Retford or East Retford, Mansfield, Newark and Worksop, and ten urban districts. For parliamentary purposes the county is divided into five divisions (Bassetlaw, Broxtowe, Newark, Rushcliffe and Mansfield), each returning one member; and Nottingham returns one member for each of its four divisions. There is one court of quarter sessions, and there are seven petty sessional divisions. The shire, which contains six wapentakes, is in the diocese of Southwell.

See *Victoria County History, Nottinghamshire;* R. Thoroton, *The Antiquities of Nottinghamshire* (Lond., 1677; republished with additions by J. Thoresby, 3 vols., London, 1797); Thomas Bailey, *Annals of Nottinghamshire* (4 vols., 1852–56); J. P. Briscoe, *Old Nottinghamshire* (1881); J. Ward, *Descriptive Catalogue of Books relating to Nottinghamshire* (Nottingham, 1892).

NOÜMENON, a philosophical term put into currency by Kant and not much used except in definite reference to his doctrine. In the Kantian system the term "noümena" means things in-themselves as opposed to "phenomena" or things as they appear to us. According to Kant the human mind is such that it can never penetrate by its speculative powers to things-in-themselves, but can only know phenomena. Thus we have the odd position that noümena, or the contents of the intelligible world, are just the things to which thought can never penetrate. The term,

however, is a relic of an early period of Kant's mental development. In his fully mature or critical position he held that the noümenal was inaccessible to the speculative reason, and yet that we are not altogether excluded from it, since the practical reason, *i.e.,* our capacity for acting as moral agents, assures us of the existence of a noümenal world wherein freedom, God and immortality have a real place.

The relation of noümena to phenomena in the Kantian system is a most difficult one; and, in view of the fact that the acutest intellects in Europe have been engaged vainly for more than a century in reconciling the various passages on the subject, the safest conclusion is that they are irreconcilable. The course adopted by Kant's immediate successors in German idealism was to reject the whole conception of noümena, for the reason that what is essentially unknowable has no existence for our intelligence.

Kant, however, protested strongly against this development when it was propounded by Fichte, and held that he had precluded it by his "refutation of idealism": he stood unshakably to the belief in an absolutely real world behind phenomena.

Kant's position may be illogical as he himself stated it, but it is the expression of a sound principle: we must connect it with his general tendency to recognize the dynamic side of things. He saw, what so many of his successors failed to see, that the world as we know it is an expression of power; and he could not imagine whence the power could come if not from a world beyond phenomena.

(*See* Kant, Immanuel; Phenomenon.)

NOVA AND SUPERNOVA. A nova is a variable star which brightens up for a short time to a luminosity far exceeding that of its normal state. In typical novae, only one such outburst is on record, though a few recurrent nova-like stars are known (*e.g.,* Nova Coronae Borealis, 1866 and 1946).

A supernova is a nova of very great absolute brightness, and is distinguished by a type of spectrum somewhat different from that of common novae.

In the outburst of a common nova the following phenomena are observed: (1) a very rapid brightening (usually many thousandfold in two or three days) followed by a slower fluctuating decline of brightness; (2) a remarkable sequence of changes in the star's spectrum, which near maximum contains dark lines due to hydrogen and ionized metals (such as iron, calcium, etc.), later shows bright lines of the same elements and eventually develops into a spectrum of bright lines due to ionized atoms of oxygen, nitrogen and helium. like that of a gaseous nebula; (3) the steady expansion of a nebulous disk around the star for several years and eventual fading of this nebula, leaving the star with nearly the same brightness as before the outburst.

The first recorded nova of modern times was Nova Cassiopeiae, 1572, studied by Tycho Brahe, who concluded it belonged to the stellar universe outside the solar system. This nova at maximum was brighter than the planet Venus and easily seen at midday. It is almost certain that it was a supernova.

The first study of a nova with the spectroscope was made by Sir William Huggins, who observed in the spectrum of Nova Coronae Borealis, 1866, bright lines of hydrogen and many absorption lines. Nova Cygni, 1876, was observed by M. A. Cornu, who noted the similarity of its bright-line spectrum to that of the chromospheric layer of the sun's atmosphere which flashes into view as the sun's disk is hidden by the moon at a total eclipse. The first extensive photographic record of a nova spectrum was made of Nova Aurigae, 1891, and showed broadened bright lines with dark lines on their edges of shorter wave length. Such structure is typical of the spectra of novae just after maximum light, and is readily interpreted in terms of the "Doppler effect" (*q.v.*) of velocity of a source of light upon the wave length of the light. The broad bright lines are due to incandescent gases rushing outward from the star in all directions with speeds of hundreds of miles per second. The dark lines are due to absorption of light by the gases between the earth and the star, and the speed of approach shifts these lines toward the violet.

The same expanding cloud of gas eventually becomes large enough to be visible as a hazy disk around the star and expands continuously until it fades away. Such nebulous disks were prominent around Nova Persei, 1901, Nova Aquilae, 1918 and Nova Herculis, 1934. The matter thus ejected is only a minute fraction of the total material comprising the star.

The light variation of a supernova is similar to that of a common nova, but the spectrum consists exclusively of hazy, broad, bright bands. No dark lines have been observed. The Crab Nebula in Taurus is the expanding nebulous remnant of a supernova that was observed by Chinese astronomers in A.D. 1054.

Up to 1944, inclusive, about 100 novae had been recorded in our own galaxy, or star system. Most of these appeared in or near the Milky Way. Their distances range from a few hundred to many thousand light-years. They are strongly concentrated in the direction of the star clouds of Sagittarius; this is the direction in which the centre of our galaxy lies. In the Andromeda spiral nebula (another galaxy about 750,000 light-years distant) a supernova appeared in 1885, and more than 100 common novae have been found, chiefly by Edwin P. Hubble, of the Mount Wilson observatory. Supernovae have been found in many other more distant spiral nebulae in which ordinary stars are quite indistinguishable.

At maximum brightness reliable determinations give absolute magnitudes of individual novae from -4 to -9, with an average near -7, or about 60,000 times the sun's luminosity. At minimum light their luminosities are comparable to that of the sun (absolute magnitude $+5$). The postnova stars are much smaller than the sun but much hotter and denser, and the conditions before the outburst, though not accurately observed, were probably similar. Supernovae at maximum have absolute magnitudes from -12 to -16, or 6,000,000 to 240,000,000 times as bright as the sun. Their condition at minimum is unknown.

Several theories have been devised to account for the explosions of novae. These have included: collision of two stars, or of a planet with a star; eruption of matter due to tidal action of another closely approaching star; and the plunge of a star into a nebula. The collision and tidal theories are inadequate to account for the observed frequency of novae.

The fact that novae at minimum are a very special and peculiar class of stars is opposed to any theory of an accidental cause, including plunge into a nebula. The existence of some novae for which more than one outburst has been observed, their similarity to true recurrent variables of the U Geminorum and other types, the existence in some cases of variability before the explosion and the characteristics of high density and high temperature at minimum light, all suggest that explosive variability is an inherent characteristic of this well-defined class of stars.

The collapse of a normal star to a condition of very high density, as proposed by Edwin Arthur Milne, George Gamow and others, is favourably regarded as a possible cause of a supernova. L. Biermann has suggested that a readjustment in an unstable zone beneath the surface of a dense star would account for the eruption of a common nova. It is best to admit that the actual cause of the outburst is unknown, though the physical processes that follow the explosion are fairly well understood.

See *Handbuch der Astrophysik, Bd. vi* (1927); L. Campbell and L. Jacchia, *The Story of Variable Stars* (1941). (D. B. Mn.)

NOVACULITE is a hard, compact, homogeneous, finely granular rock closely resembling chert and consisting of nearly pure silica. The rock has typically a vitreous lustre and white colour. It breaks with conchoidal fracture, and thin edges are translucent. The largest known deposits, Devonian in age, are in the Ouachita mountains of Arkansas and Oklahoma where novaculite occurs as beds from a few inches to ten feet thick, interbedded with shales, forming many of the mountain ridges. It was first quarried in the early 19th century to make whetstones for sharpening fine tools; hence its name, Latin *novacula,* sharp knife. Indians used novaculite for weapons and implements. Novaculite has been considered to be metamorphosed chert, replacement by silica of a dolomite or limestone, and a deposit of colloidal silica accumulated on the sea floor.

(A. W. G.)

NOVALICHES, MANUEL PAVIA Y LACY, 1st Marquis de (1814–1896), Spanish marshal, was born at Granada on July 6, 1814. In 1833 lieutenant in the guards of Queen Isabella II, he became general of division during the Carlist war (1833–40). Senator in 1845, war minister in 1847, and marquis in 1848, he went out to Manila in 1852 as captain-general of the Philippine Islands, crushed a formidable insurrection in 1854 and carried out many useful reforms. He commanded the reserves in the Peninsula during the Moroccan war, twice refused the war portfolio offered him by O'Donnell and Narvaez, and when the revolution broke out in September 1868 accepted the command of Queen Isabella's troops. He was defeated by Marshal Serrano at the bridge of Alcolea on September 28, 1868, and was so badly wounded in the face that he remained disfigured for

life. He kept apart during the revolution. The Restoration made him senator, and King Alfonso gave him the Golden Fleece. He died in Madrid on Oct. 22, 1896.

NOVALIS, pseudonym of Friedrich Leopold, Freiherr von Hardenberg (1772–1801), German poet and novelist, one of the pioneers of the Romantic movement, was born on May 2, 1772, on his father's estate at Oberwiederstedt in Prussian Saxony. He studied philosophy at Jena, and law at Leipzig and Wittenberg. At Tennstedt, near Langensalza, he was betrothed to Sophie von Kühn. He became auditor to the salt works at Weissenfels where he heard (1797) of Sophie's death. He expressed his grief in the beautiful *Hymnen an die Nacht,* in which the religious poetry of the Romantics reaches its greatest height. He then entered the Mining Academy at Freiberg, in Saxony, to study under A. G. Werner, whom he immortalized as the "Master" in *Die Lehrlinge in Sais.* In the autumn of 1799 he read to the circle of young Romantic poets at Jena his *Geistliche Lieder.* In 1800 he was appointed local magistrate in Thuringia, and after a short illness he died at Weissenfels on March 25, 1801.

His all too short life did not permit him to blend his mystic and philosophical conceptions into a harmonious whole. His longest work was the unfinished romance, *Heinrich von Ofterdingen;* its hero's search for the mysterious blue flower is an allegory of the poet's life. More popular, however, are his shorter lyrics.

There are editions of the collected works of Novalis by E. Heilborn (3 vols., 1901), and by J. Minor (3 vols., 1907; rep., 1923). His *Briefwechsel* with the Schlegels was edited by J. M. Raich in 1880. *See* also E. Heilborn, *Friedrich von Hardenberg* (1901); T. Carlyle's essay on "Novalis"; Obenauer, *Novalis Gesammelte Studien* (1925); H. Hesse and Isenburg, *Novalis. Documente seines Lebens und Sterbens* (1925).

NOVARA, town and episcopal see, Piedmont, Italy, capital of Novara province, 31 mi. by rail W. of Milan, 538 ft. above sea-level. Pop. (1936) 52,269 (town), 62,570 (commune). Till 1839 circled by Spanish ramparts, Novara is now an open, modern town. The cathedral, except for the octagonal dome-roofed baptistery (10th century), was rebuilt (1863–65); the church of S. Gaudenzio, dedicated to Bishop Gaudentius (d. 417), who is buried under the high altar, rebuilt by Pellegrino Tibaldi about 1570, has a baroque campanile and a dome (1875–78) 396 ft. high. The city also contains handsome market buildings erected in 1817–1842, a large hospital dating from the 9th century and a court-house constructed in 1346. The town has also a museum of Roman antiquities. The principal industry is the carding and spinning of silk; there are also iron-works and foundries, cotton mills, rice-husking mills, organ factories, dye-works, printing and map-making works.

Novara, the ancient *Novaria,* lay on the road between Vercellae and Mediolanum. Its rectangular plan probably survives from Roman days. A dukedom of Novara was constituted by the Lombards, a countship by Charlemagne. In the 12th century it accepted the protection of Milan. In 1706 it was occupied by Savoy troops. At the Peace of Utrecht it passed to Austria with Milan; but was granted to Charles Emmanuel in 1735. Under the French it was the chief town of the department of Agogna. Restored to Savoy in 1814, it was in 1821 the scene of the defeat of the Piedmontese by the Austrians, and in 1849 of the more disastrous battle which led to the abdication of Charles Albert and an Austrian occupation of the city.

Novara was the scene of a battle on March 23, 1849, between the Austrians, 70,000 strong with 182 guns, under Radetsky and King Charles Albert, who led the Sardinian forces, 65,000 men with 140 guns. Chzarnowski, a Pole, virtually directed the army. Armistice, concluded Aug. 9, 1848, was to terminate March 20. Radetsky retreated from Milan on March 17, feigning to retire to Lodi-Cremona, but on reaching San Angiolo he made for Pavia, crossing the Ticino on March 20. Meanwhile Chzarnowski marched on Magenta without encountering the enemy, but here news reached him that the Austrians were at Pavia; thereupon he halted the army and turned it back to Vigevano. Radetsky had advanced so swiftly that Ramorino's Sardinian division south of the Po was cut off, the bridge at Mezzano Corte being destroyed, though it had orders to stand at Cava, threatening the hostile advance. Fighting took place at Mortara on March 21, the Sardinians falling back on Novara; where Chzarnowski decided to await Radetsky. A corps of Austrians approached Novara and engaged the whole Sardinian army on March 23. Seriously outnumbered until reinforcements arrived, the Austrians fought with great tenacity and before the end of the day had driven the Sardinians back in confusion. Charles Albert abdicated that night.

NOVA SCOTIA, a province of Canada, lying between approximately 43° 25′ and 47° 15′ N. and 59° 40′ and 66° 25′ W., and composed of the peninsula proper and the adjoining island of Cape Breton (*q.v.*). The extreme length from southwest to northeast is 376 mi. (N.S. 268, C.B. 108); breadth 60 to 100 mi.; area 21,068 sq.mi. The isthmus of Chignecto, $11\frac{1}{2}$ mi. wide, connects it with the province of New Brunswick.

Geology and Physical Features.—Nova Scotia may be described as an ancient mountain land almost completely worn down. The original folds apparently ran either east or northeast and were complicated by intrusive granite in the country southwest of Halifax. The province forms the eastern portion of a somewhat complex basin, with the youngest Triassic beds in the Annapolis valley. The general disposition of the folds seems to be indicated in the coast and in the lines of higher land, which, however, rarely reach above the 1,000 ft. level, save in the Cobequid hills, which rise to a few feet above this figure. They occupy the neck between New Brunswick and Nova Scotia, and represent the axis of a fold. The Chignecto bay to the northwest, and the Minas basin and Cobequid bay to the south, indicate by their directions the divergence of the old worn folds of Nova Scotia on the one hand, and of St. John, N.B., on the other. Around the southeast of the Bay of Fundy are horizontal Triassic deposits including volcanic elements, which give rise to a precipitous coast from Brier Island to Cape Split. The western railway of Nova Scotia runs on low ground between this structural feature and the main mountain fold-axis farther southeast. This feature is broken at Digby Gut, and a portion of the lowland within it is submerged as the long Annapolis basin (called the garden of Nova Scotia).

One of the last geological changes has been a land-sinking, which has given rise to the remarkable succession of cliff-fringed rias, with islands offset along the Atlantic coast, Halifax harbour being the most famous of these. The north shore is, as a rule, low, and Pictou has its chief harbour.

Cape Breton Island is essentially a continuation across the narrow strait of Canso. The granitic northern plateau is rugged and barren, and is devoid of settlement. The coasts of the province are famous for their tides. Though they rarely exceed 8 ft. at Halifax, they average 42.3 ft. in the Bay of Fundy, and 53 ft. at the top of the funnel in Cobequid bay.

Climate.—The maritime influences are more marked in this province than in New Brunswick (*q.v.*). The temperatures at Halifax range from 23° F. in January to 65° in July. The average rainfall is between 40 and 45 in., except along the southern coast, where it is nearly 10 in. greater. The winter snowfall is about 80 in.

History.—Nova Scotia may well have been the Markland of early Norse and Icelandic voyages, and Cape Breton was visited by the Cabots in 1497–98, but not till 1604 was any attempt at permanent colonization made by Europeans. In that year an expedition was headed by a Frenchman, Pierre du Guast, Sieur de Monts (1560–*c.* 1630), who had received from Henry IV full powers to explore and take possession of all lands in North America lying between the 40th and 46th parallels of north latitude. De Monts and his friend de Poutrincourt (d. 1615), endeavoured to form settlements at Port Royal (now Annapolis), St. Croix (in New Brunswick) and elsewhere, but quarrels broke out with the Jesuits, and in 1613 the English colonists of Virginia invaded the settlement and expelled the greater part of the inhabitants. In 1621 Sir William Alexander obtained from James I a grant of the whole peninsula, which was named in the patent, Nova Scotia, instead of Acadia, the old name given to the colony by the French. During the reign of Charles I the still existing order of baronets of Nova Scotia was instituted, and their patents ratified in parliament. The Treaty of St. Germain-en-Laye (1632) confirmed France in the possession of Acadia, Cape Breton and New France;

but fierce feuds broke out among the French settlers, and in 1654 a force sent out by Cromwell took possession of the country, but by the Treaty of Breda (1667) it was restored to France by Charles II. Continual fighting went on between the French and the British colonists of New England, the Indians taking part, usually on the side of the French; in 1710 the province was finally captured by Great Britain and ceded to it in 1713 by the Treaty of Utrecht, under the name of "Acadia or Nova Scotia," the French remaining masters of Cape Breton. In 1749 Halifax was founded as a counterpoise to Louisburg in Cape Breton, and more than 4,000 colonists were sent out.

Shortly after the foundation of Halifax occurred that expulsion of the Acadians in 1755 which remains, not in magnitude but in significance, one of the great episodes of American history, celebrated afterward in Longfellow's *Evangeline*. About 3,000 Acadians were removed from their settlements on Minas basin and elsewhere, and transferred, with no compensation for property or livestock, to various American colonies. Those who found their way back later on made new homes mostly in New Brunswick. The plea of the British government was that since the Treaty of Utrecht these Acadians had a status rendered impossible by recurrent war with France.

In 1758 the province of Nova Scotia was accorded an elective representative assembly in view of a decision of the British law officers that this was an inherent privilege of British settlers overseas. The precedent has remained of great importance. During the American Revolutionary War a large number of Negroes were set free by British armed forces and transported as free men to Nova Scotia. These, with freed Negroes from Jamaica, originated the Negro population of today. In 1769 Prince Edward Island (formerly Isle St. Jean) was made a separate government. An influx of American loyalists led in 1784 to the erection of New Brunswick into a separate colony.

During the wars of the American and French revolutions Halifax grew apace. Between 1784 and 1828 a large Scottish emigration, chiefly from the Highlands, had settled in the counties around Pictou, and the lumbering industry rose to great proportions. Agriculture was neglected, but in 1818 the letters of "Agricola" (John Young, 1773–1837) gave it an impetus.

After peace in 1815, the middle 19th century witnessed a great economic advance in Nova Scotia due to the fisheries, the timber trade and the building of wooden ships. Nova Scotia shipbuilding seemed (1846) to be conquering the world, with 2,583 vessels as compared with 605 for Canada, representing one-third as much tonnage as that of France. But political life lagged behind owing to the peculiar privileges of a small official class and the Anglican Church. Hence there was a movement for reform by responsible government, as in upper Canada, led by Joseph Howe, whose "twelve resolutions" of 1836 became the platform of reform. Refused for years, responsible government (1848) came painlessly as a result of its institution in Canada. The political struggle was interwoven with an agitation for free secular education (1864) and for reorganizing Dalhousie university on a secular basis. Charles Tupper (Sir Charles, 1873) of Amherst, Conservative, and "Joe" Howe, Liberal, were the great protagonists of the province at this period. Tupper's influence carried confederation (1867) but only by a legislative, not a popular, vote. The province was rent by the subsequent agitation for repeal, weakened by Howe's defection (1869) (to enter the federal cabinet), but never lost from Nova Scotia politics. In the middle '80s it took the form of secession into a maritime union, sponsored by W. S. Fielding as the platform of election in 1886 and carried by a legislative vote of 2 to 1. The imperial government joined the Canadian federal government in getting "better terms" for the maritime provinces, but opposed secession.

Nova Scotia had prospered greatly between 1855 and confederation as the result of British trade and the reciprocity treaty (1854) with the United States. The abrogation of the reciprocity in 1866 and the embrace of the Canadian tariff on manufactures after 1867 were followed by a change of fortune alleviated only by the war-created booms of 1914–18 and 1939–45. Politics in the 20th century have largely turned on this unsatisfactory economic status in spite of the changes effected by the steel and coal industries, by local manufactures and by the construction of the railway systems and the development of Halifax (along with St. John, N.B.) as Canadian winter ports. In the period between World Wars I and II, attention continued to be turned on economic relations with central Canada, the subject of various investigations and reports. Two royal commissions (Duncan commission, 1926; Jones commission, 1934) investigated and reported in favour of better "terms" for the province.

Area and Population.—The area of the province is 21,068 sq.mi. of which 20,743 are land and 325 water. The population (1951) was 642,584. At the census after confederation (1871) it stood at 387,800. The great majority of the people, more than 75%, are of British race, either direct or through American loyalists. The Acadian French, including nearly 7,000 in Cape Breton Island, constitute about 11%.

Government and Public Finance.—The government of Nova Scotia is based on the (imperial) British North America Act of 1867 and its amendments, together with all preconfederation institutions, including the common law, except as altered or abolished by confederation itself or later imperial statutes. The act provided representation in the senate (12 members 1867–72; 10, 1873–1951) and a membership in the house of commons at Ottawa adjusted according to population after each census (10 in elections of 1949), and distributed federal and provincial powers. The administration of Nova Scotia consists of a lieutenant-governor, appointed and paid by the federal government, and by custom a resident of the province; a premier and cabinet on the recognized constitutional model and a nonpolitical civil service: the judges are appointed by the federal government. There is a legislative assembly sitting at the capital, Halifax, 37 members elected for five years unless sooner dissolved. Municipal government in Nova Scotia, as in all the maritime provinces, is less developed than in central Canada. In 1951 there were in Nova Scotia 24 rural municipalities of which 12 were counties and 12 represented 6 divided counties. With these were two incorporated cities, Halifax (84,433) and Sydney (31,207) and 41 incorporated towns. The provincial revenue of Nova Scotia was $525,000 in 1871 and $38,798,000 gross in 1947.

Education.—Primary public education is compulsory, free of charge and nondenominational. Ordinary day schools of this character in 1948 had an enrolment of 124,128 pupils (average daily attendance 103,858) as compared with 3,414 in denominational and private schools and 1,011 in "business colleges." The number of teachers in public schools (1948) was 3,958 of whom 2,150 received salaries ranging from $525 to $1,024 a year. The universities of the province include King's college, Anglican, established at Windsor, N.S., in 1790 but after 1923 amalgamated with Dalhousie university for all subjects except divinity; Dalhousie university, Halifax, established in 1818; St. François Xavier, Antigonish, Roman Catholic (1866); and Acadia university, Wolfville, Baptist (1839).

Commerce and Manufactures.—Nova Scotia is naturally a seagoing province, and till about 1881 had the largest tonnage, in proportion to population, in the world. Halifax is still one of the chief winter ports of Canada, and Sydney is also a favourite port of call for steamers in need of "bunker" coal. The water power provided by the rivers supports many manufactures. Several sugar refineries exist.

The fisheries of Nova Scotia are the next most important in Canada, after those of British Columbia. Lobsters, cod, mackerel, herring and haddock constitute the bulk of the catch. Many boats are fitted out in Lunenburg, Digby, Yarmouth and other ports for the Grand Banks of Newfoundland. A large number are employed in the lobster canneries and other kindred industries. Trout and salmon abound in the lakes and streams.

The classified returns of 1947 showed the manufactures of Nova Scotia as having 30,285 employees, of whom 4,340 were in the iron and steel industry, 3,996 in sawmills, 3,441 in fish curing and packing, 3,024 in shipbuilding and repair, 1,043 in textiles, and the rest in 12 other major industrial groups. The 1947 gross value of all industrial products was $204,219,433.

Lumber.—Lumbering was long the chief industry of the province, and is still very important, though the 1950 estimated stand of accessible raw material was 6,110,000,000 ft. b.m. (242,072,000,000 for all of Canada). In 1948 the cut was 319,403,000 ft. b.m. The network of small lakes and rivers enables the logs to be brought to the mills with great ease, and little rough timber is now exported. The chief

trees include spruce, fir, pine, birch, oak and maple. The manufacture of wood pulp for paper is also carried on.

Minerals.—Bituminous coal is mined in various parts of Cape Breton (*q.v.*) and in the counties of Cumberland and Pictou. The seams dip at a low angle, and are of great thickness, especially in Pictou county. The known coal fields cover about 1,000 sq.mi. Other important centres are Springhill, Acadia mines, Stellarton and Glace Bay (C.B.). It is shipped as far west as Montreal, and to the New England states of the U.S. The by-product industries are very important. Iron was mined from 1876 to 1913, with a peak of 102,201 tons in 1893. Iron ore for the large blast furnaces at New Glasgow, Sydney and North Sydney is now imported from Newfoundland. There are quarries of easily worked limestone, the product of which is used as a "flux" in the blast furnaces. Some gold has been produced every year since 1862, rising to a peak of 29,943 oz. in 1939 but falling to 64 oz. in 1949. Large deposits of gypsum occur, especially at Windsor, in Hants county. Manganese and copper are worked on a small scale. In 1949, 97% of the barite produced in Canada came from Nova Scotia.

Statistics of mineral production for 1949 showed a total value of $56,093,000, with coal at $47,998,000. Gypsum stood at 2,556,000 tons, which was 84% of Canadian production.

Agriculture.—The attention paid to lumbering, fishing and shipping, and the subsequent emigration westward have lessened the importance of this industry. Mixed farming is, however, largely carried on, and dairy farming has been greatly extended. Nova Scotia is specially famous for its fruits, the export of apples being the main feature. The centre of this industry is the valley of Annapolis. At the head of the Bay of Fundy and on Minas basin the low-lying meadows produce splendid crops of hay and good pasture, while the cool climate and moisture make the region well suited for dairy farming and stock raising.

Statistics show the total agricultural land of Nova Scotia, actual and available, as 12,640 sq.mi. or 60.9% of the land area of the province. Of this area 2,412 sq.mi. was represented in 1950 by farm lands and unimproved pasture; 3,551 sq.mi. was occupied but unimproved woodland; 6,677 sq.mi. was unoccupied grass and brush land with agriculture possibilities. The rest of the land area is productive forest.

Communications.—The geography of Nova Scotia and the great number of harbours make communication by sea a principal feature. The Canadian National railways connects with Halifax via Moncton and Truro with a branch to Sydney. The Canadian Pacific connects from St. John, N.B., via steamer ferry to Digby and to Halifax and also westward to Yarmouth. The total railway mileage in 1951 was 1,396. The province had 15,143 mi. of motor roads in 1948, of which 1,109 were bituminized. The Trans-Canada Airlines air mail and passenger service was extended from Montreal to Moncton, N.B., in 1940 and in the same year from Moncton to Halifax. Telegraph and telephone connections extend throughout the province with Atlantic cables at Canso and Sydney.

Environment and Settlement.—The control of the distribution of population by the geological features is quite marked in Nova Scotia. The oldest rocks as usual are found to be the least favourable for close settlement. The plateau (built of Pre-Cambrian granite for the most part) in the north of Cape Breton Island stands well above 1,000 ft., and is almost uninhabited. The granites of the Cobequid hills and to the east of Annapolis Royal, though barely reaching 1,000 ft., are also empty. The ancient Cambrian and Devonian sandstones along the coast to the north and south of Halifax are sparsely occupied by small dairy farms. There is, however, a fairly close settlement of fishermen, as well as the large population clustered at Halifax.

The younger formations are the Carboniferous in the northeast, the Permian on the isthmus of Chignecto, and the Triassic along the east side of the Bay of Fundy. The Carboniferous and Permian contain the very valuable coal fields of Sydney, Inverness, Stellarton, and Joggins; while the Triassic produce the soils devoted to the best apple culture in Canada. Oats and dairy cattle are grown on these younger formations, especially on the red sandstones of Permian Age to the north of the Cobequid hills.

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(S. Lea.; C. Cy.)

NOVATIANUS, Roman presbyter, and one of the earliest antipopes, founder of the sect of the Novatiani or Novatians, was born about the beginning of the 3rd century. On the authority of Philostorgius (*H.E.* viii. 15) he has been called a native of Phrygia. He was ordained at Rome by Fabian, or perhaps by an earlier bishop; and during the Decian persecution he maintained the view which excluded from ecclesiastical communion all those (lapsi) who after baptism had sacrificed to idols—a view which had frequently found expression, and had caused the schism of Hippolytus. Bishop Fabian suffered martyrdom in January 250, and, when Cornelius was elected his successor in March or April 251, Novatian objected on account of his known laxity on the above-mentioned point of discipline, and allowed himself to be consecrated bishop by the minority who shared his views. He and his followers were excommunicated by the synod held at Rome in October of the same year. He is said by Socrates (*H.E.* iv. 28) to have suffered martyrdom under Valerian. Novatian has been confused with Novatus, a Carthaginian presbyter, who held similar views.

Novatian was the first Roman Christian who wrote to any considerable extent in Latin. Of his numerous writings three are extant: (1) a letter written in the name of the Roman clergy to Cyprian in 250; (2) a treatise in thirty-one chapters, *De trinitate;* (3) a letter written at the request of the Roman laity, *De cibis judaicis.* They are well-arranged compositions, written in an elegant and vigorous style. The best editions are by Welchman (Oxford, 1724) and by Jackson (London, 1728); they are translated in vol. ii. of Cyprian's works in the *Ante-Nicene Theol. Libr.* (Edinburgh, 1869). The Novatian controversy can be advantageously studied in the *Epistles* of Cyprian.

NOVATION, a legal term derived from the Roman law, in which *novatio* was of three kinds—substitution of a new debtor, of a new creditor, or a new contract. In English law the term (though it occurs as early as Bracton) is scarcely naturalized; substitution of a new debtor or creditor being generally called an assignment. A new contract either tacitly or expressly operates as a release from the original contract. Where the substituted contract is one of a higher nature, as where a contract under seal supersedes a simple contract, it is called a merger. The extinction of the previous contract is held to be sufficient consideration. The particular points on which novation turns are whether the new firm or company has assumed the liability of the old, and whether the creditor has consented to accept the liability of the new debtors and discharge the old. The question is one of fact in each case. (*See* especially the Life Assurance Companies' Act, 1872, s. 7, where the word, "novations" occurs in the marginal note to the section, and so has quasi-statutory sanction.) Scots law seems to be more stringent than English law in the application of the doctrine of novation, and to need stronger evidence of the creditor's consent to the transfer of liability. In American law, as in English, the term is something of a novelty. In Louisiana, and generally in systems much influenced by Roman law, novation forms a more specific department of the law of contract (*q.v.*).

NOVAYA ZEMLYA. An Arctic land off the coast of European Russia, to which it belongs, consists of two large islands separated by a narrow winding channel 56 mi. long, the Matochkin Shar. It lies between 70° 31′ and 77° N., and between 51° 35′ and 69° 2′ E. and forms an elongated crescent, being nearly 600 mi. long with a width of 30 to 90 mi., and an area of about 30,000 sq.mi. It separates the Barents sea on the west from the Kara sea on the east. With Vaigach island 30 mi. to the south, and the mainland, Novaya Zemlya forms a continuation of the Pai-Khoi hills, a branch of the Ural folds.

The greatest heights occur in the neck of the south islands where near Matochkin Shar are altitudes of about 4,000 ft. In the middle part of the south island there are few elevations over 1,400 ft., but in the south the summits rise to over 2,000 ft. The north island seldom rises to greater altitudes than 3,000 ft.

Geology.—A central zone of upper Cambrian and Devonian rocks extends along the islands. These quartzites, conglomerates and dolomites are flanked by carboniferous shales and limestones. The minerals of value are some lignite and a little copper ore.

Climate.—Novaya Zemlya is colder than Spitsbergen (which lies more to the north) as in some degree it shares in the continental conditions of northern Russia and Siberia. The middle and northern parts of the west coast are not so cold as the east. Temperatures at Karmakul are 2·3° F. (Feb.) and 43·2° (July). Snow is universal from October to May.

Flora and Fauna.—Vegetation is solely tundra and decreases from south to north. It is most luxuriant in Gooseland on the southwest. There are no trees or bushes. The flowering plants number 187.

In the ice-free areas there are foxes, lemmings, bears, reindeer and an occasional wolf. Insects are numerous near the coast. Countless birds come from the south for the breeding season, and at certain parts of the seacoast the rocks are covered with

millions of guillemots, while great flocks of ducks of various sorts, geese and swans swarm every summer on the valleys and lakes of the south. Whales, walruses and various seals are frequently seen. The goltzy occurs in the rivers.

The numbers of sea mammals and birds attracted Russian hunters, and even in the 16th century they had extended their huts (*stanovishtcha*) to the extreme north of the island. Many of them wintered for years on Novaya Zemlya. Because of the ice in the White sea Russian hunters found Novaya Zemlya less easy of access than did the Norwegians. But about 1877 systematic attempts at settlement were begun by the Russian government, several families of Samoyedes being established at stations on the west coast of the south island, including Karmakul on Moller bay, Pomorskaya bay and Byeloshya bay. There is a Russian observatory on Matochkin Shar.

History.—Novaya Zemlya was probably known to Novgorod hunters in the 11th century and to Norse hunters a century earlier. In 1553 Sir Hugh Willoughby may have sighted Gooseland. In 1556 Stephen Borough reached the south extremity of the Novaya Zemlya, being the first western European to do so. Willem Barents touched the island (1594) at Sukhoi Nos (73° 46′) and followed the coast north to the Orange Islands and south to the Kostin Shar. In 1596, after his discovery of Spitsbergen, Barents wintered at Ice haven in 76° 12′ N. (*see* ARCTIC REGIONS). Rumours of silver ore led the Russian government to send out expeditions. In 1760 Savva Loshkin cruised along the east coast, spent two winters there, and in the next year returned along the west coast, thus accomplishing the first circumnavigation; but the records of his voyage have been lost. In 1768 Lieut. Rozmyslov explored Matochkin Shar, where he spent the winter. The first scientific information about the island is attributable to the expeditions (1821–24) of Lütke (1797–1882), after whom part of the north island is named Lütkeland. Nearly all the west coast as far as Cape Nassau, as well as Matochkin Shar, was mapped and valuable scientific information obtained. In 1832 and 1835 Lieut. Pakhtusov mapped the east coast as far as 74° 24′. The work of Karl von Baer in 1837 was untrustworthy. In 1870 the Norwegian Capt. L. E. H. Johannesen accomplished the second circumnavigation of Novaya Zemlya, and in 1871 E. Carlsen found Barents' winter hut. In 1878 M. Grinevetskiy crossed the south island. Among later expeditions may be mentioned those of C. Nossilov (1887–92), T. N. Chernychev (1895), who made a crossing of the south island, H. J. Pearson (1895 and 1897), A. A. Borisov (1899 and 1900), O. Ekstam (1900 and 1903), W. Russanov (1908), who crossed the south of the island, Pavlov and Weise (1912) of the Sedov expedition, who crossed the north island (*see* ARCTIC), as did O. Holtedahl (1921). P. V. Vittenburg explored the south island in 1925.

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(R. N. R.-B.)

NOVEL, a written prose fiction. The term, in English, is very loosely used and is being constantly modified to include new experiments in fictional writing. The word first came into common use in English in the 18th century, gradually superseding the term "romance." But the distinction between the two has never been precise. The generic term "romance," however, included work not in prose, whereas the word novel has never been applied (except for a very few specific "novels in verse") to any but prose writing, though the style and texture of the prose has varied from the plain and "factual" to the complex and "poetic." If there is good ground for emphasizing a written prose as the accepted medium of the novelist, the fictional nature of the novel raises more complex problems, for, particularly in the early novel, the dividing line between fact and fiction is not always clear. Nor is it possible to dogmatize on the question of length. William Congreve's *Incognita* runs to little more than 20,000 words, as opposed to the 4,000 pages of Marcel Proust's *A la Recherche du temps perdu;* yet both are called novels. Many early novelists seem to have thought of the novel as more realistic, less fanciful, than the romance, which had in their minds an escapist connotation, generally associated with aristocratic values and attitudes, in particular the chivalric and pastoral traditions. The 18th-century novel was in general an attempt to replace the aristocratic romance by a literature more in keeping with the views of reality and morality of the middle class, or, at least, of a society in which the middle class played an increasingly important part. The modern novel was something new in literature and yet owed debts to many previous traditions: to the prose stories of classical Greece and Rome (*e.g.,* Longus, *Daphnis and Chloe;* Apuleius, *The Golden Ass;* Petronius, *The Satyricon*); to spoken prose epics (*e.g.,* the sagas of the Icelanders); to the parables and allegories of the mediaeval pulpit; to the Bible (*e.g.,* the books of Ruth, Job and Esther); to the mediaeval prose romance (*e.g.,* Sir Thomas Malory, *Morte d'Arthur*); to the chroniclers and early historians; as well as to a great deal of verse (*e.g.,* Chaucer). It is with François Rabelais's *Gargantua and Pantagruel,* with the Spanish picaresque stories and the Italian *novelle* of the 16th century, and above all with Cervantes' *Don Quixote* that the modern novel begins.

THE ENGLISH NOVEL

Growth of the Form.—Elizabethan fiction falls largely into two categories: the aristocratic and the plebeian. Examples of the aristocratic or courtly genre, developing from the chivalric and pastoral stories of the middle ages and antiquity and stimulated particularly by the development of the Italian *novella,* can be seen in the *Euphues* of John Lyly, the *Arcadia* of Sir Philip Sidney and a host of smaller works such as Thomas Lodge's *Rosalind,* on which Shakespeare based *As You Like It.* In these stories a sophisticated verbal artifice is combined with open didacticism and highly conventionalized plots in which idealized characters speak and occasionally act. The tone is aristocratic and sophisticated, presupposing an audience to whom the conventions and values of feudal society and literature are altogether acceptable. Although the implications of these books are occasionally, as in the case of the *Arcadia,* profound, they possess little if any psychological or social realism. The word "courtly" best conveys their tone and function. This courtly fiction continued to be produced in a more or less modified form throughout the 17th century. The tradition changes and finally becomes almost unrecognizable as the feudal world itself gradually disappears. Emanuel Ford's *Ornatus and Artesia* (1595?) is in the tradition, still fairly pure; while the stories of Aphra Behn (1640–89) form the link between the courtly romance and the 18th-century novel. The tone and assumptions remain aristocratic, but there is more action and plot, more social observation, more interest (though little realism) in personal psychology and emotion.

The second category of Elizabethan fiction, very much smaller in volume yet more significant as a developing force, is the plebeian element. Here the influence of the Spanish picaresque novel is paramount, though it was no mere formal literary influence, rather a common response to a comparable social and intellectual situation. Thomas Nashe's *The Unfortunate Traveller* (1594) and Thomas Deloney's *Jack of Newbury* (1597)—plebeian but not picaresque—express a sensibility quite different from that of the courtly writers. Jack Wilton, the hero of Nashe's story, is in spirit a sheer *picarò* (rogue), an outcast of feudal society, respecting none of its sanctities. His story, violent, ill-organized, racy, episodic, ununified, sensational, is in content and hence in form quite different from that of a courtly hero. In place of a chivalric moral code there is a crude and often cynical individualism; in place of a refined sophistication there is irreverence and vigour; realistic detail and a journalistic interest in the contemporary scene are in contrast to the polite and conventionalized forms of aristocratic literature.

From Nashe to Defoe (they were both journalists and pamphleteers, both middle-class writers) there is a direct line; *Moll Flanders* (1722) has most of the characteristics of the picaresque novel. But between Nashe and Defoe there is the century of the Civil War, during which the middle class became ever more power-

ful, ever more self-conscious. Between Nashe and Defoe there took place the rise of Puritanism (note Defoe's determination to be at all costs what Nashe never was, respectable). And in the history of literature, between Nashe and Defoe in the plebeian tradition, there stands John Bunyan, inheritor of the allegorical tradition of the middle ages but deeply, militantly antiaristocratic, antifeudal, forging a Puritan style, biblical and yet colloquial, producing a moral fable of enormous popular, traditional power and profound psychological and moral realism.

The 18th-century novel has behind it, then, at least two lines contributing to its immediate development: the aristocratic line against which the middle-class writers are in reaction (as Cervantes attacked the romances of chivalry) but which contributes nevertheless to their work, and the plebeian line with its more vigorous realism and its deepening tinge of Puritan morality.

The 18th Century.—Daniel Defoe (*c.* 1659–1731), Samuel Richardson (1689–1761) and Henry Fielding (1707–54) are the three great figures of the 18th-century novel. Taken by and large the most significant quality of their work is a degree of realism, social and psychological, previously unknown in English prose fiction. All three are much concerned with moral problems, and both Defoe and Richardson affect to regard the didactic element in their work as the most important. In fact Defoe's great contribution lies in the remarkable verisimilitude of the imaginative world he creates, his power to describe with the utmost vividness any form of material activity, and the psychological acuteness of his character portrayal. Richardson, whose *Pamela, Clarissa* (1747–48) and *Sir Charles Grandison* achieved an enormous vogue on the continent as well as in Great Britain, vastly extended the sphere of the novel in the direction of analysis of individual feeling. His long novels, in letter form, probe deep into the emotions and psychology of his characters and reveal with an intense power the situation of women in 18th-century middle-class society. Richardson's conscious moral standpoint is superficial if not worse, and his determination to wring from every situation "the tribute of a tear" is also unsympathetic to modern readers. But *Clarissa,* in particular, is a work of great intensity, dramatizing its tragic theme in a way which closely involves the emotions of even the sceptical reader. Fielding, the literary and moral opponent of Richardson (his *Joseph Andrews* is, among other things, an anti-*Pamela*), was the conscious disciple of Cervantes. An epic sense, an extremely acute critical eye and an urbane manner combine to produce what he defined as a "comic epic poem in prose." The involvement of the reader is far less intense and close than in the case of Richardson's novels, the technique being what Percy Lubbock has described as "panoramic." The plot (not in itself of the deepest interest) and the characters (seldom closely analyzed) are presented within a "haze of reflectiveness," the total effect being a broad critical survey of social life and morality.

From the middle of the 18th century the popularity of the novel steadily increased. The growth of a middle-class reading public (predominantly female) and the introduction of circulating libraries were the basis of this popularity. But, despite the brilliant exception like Laurence Sterne's *Tristram Shandy* (1759–67), a book which is far more than the idiosyncratic game of a garrulous eccentric, the art of the novel can scarcely be said to have progressed in the latter half of the 18th century. Tobias Smollett (1721–71), a writer of the greatest vigour, added memorably to the group of novels in the picaresque tradition but scarcely modified that tradition. Neither Samuel Johnson's *Rasselas* (1759) nor Oliver Goldsmith's *The Vicar of Wakefield* (1766), for all their qualities, can be said to extend the realm of the novel. The form was indeed not yet taken quite seriously by most critics, and the average novel—whether in the sentimental genre or of the Gothic variety (popularized above all by Ann Radcliffe, 1764–1823)—involved little more than the titillation of the sensations of its readers.

With Sir Walter Scott (1771–1832) and Jane Austen (1775–1817) new developments take place. It is, above all, the sweep of a historical sense that Scott brings to the novel. His stories embody a great sense of change and movement as well as a deep feeling for the national traditions and aspirations of the Lowland Scots. He took the old Gothic novel and by putting new content into it fundamentally modified the form. Jane Austen's contribution, on the other hand, lies in her transformation of the sentimental domestic novel of Fanny Burney and her predecessors. There is an extraordinary concreteness and intensity in her examination of a small social area. She is the least allegorical of novelists, the least concerned to capture the vaster pattern of human experience. But by presenting the reader with a world defined and analyzed to its minutest detail she is able to examine the precise quality of personal relationships. Her world and values are secure and in one sense narrow, but within these limitations her realism is complete.

The Victorians.—The Victorian novel, so widely read and influential in its numerous repercussions, seemed to many later critics insufficiently "adult." "As for our novel," wrote Henry James in 1888, ". . . as we find it in England today it strikes me as addressed in a large degree to 'young people,' and that this in itself constitutes a presumption that it will be rather shy." Closely connected with this accusation of moral inadequacy is the sense of a somewhat lackadaisical artistic concern, a feeling that the 19th-century novel is amorphous and undisciplined, not self-conscious enough. Certainly from Jane Austen to James there was little tendency to regard the novel as an "art form." Edmund Gosse could say, "The novel has been made the vehicle for satire, for instruction, for political and religious information; but these are side issues. Its plain and direct purpose is to amuse by a succession of scenes painted from nature, and by a thread of emotional narrative." Serial publication, with its emphasis on "what happened next," no doubt encouraged this view of the novel (often a "three-decker" with final issue in three parts).

Yet it would be quite inadequate to see the work of the Victorian masters—Charles Dickens (1812–70), William Makepeace Thackeray (1811–63), Charlotte (1816–55) and Emily Brontë (1818–48), George Eliot (1819–80), George Meredith (1828–1909)—simply as rather loosely woven stories bound together by no overall artistic unity. These writers were not much given to theorizing on the art of the novel but in practice they extended its scope. Dickens, perhaps the most remarkable genius in the history of English prose fiction, absorbed into his work many popular forms and traditions and achieved effects of unexampled vitality and power. Besides its richness of atmosphere and comic observation of character, his work has at its best a symbolic quality most often associated with poetic drama. In this it is allied with Emily Brontë's *Wuthering Heights* (1847), the greatest single achievement of the 19th-century novel, a work which penetrates with a Shakespearean profundity the deepest issues of life and death. Jane Austen's method was continued, though within a far wider frame of reference, by George Eliot, a writer of the greatest intelligence, compassion and moral acumen, whose *Middlemarch* (1871–72) was perhaps the masterpiece of mid-Victorian fiction.

A schematic analysis of the various types of 19th-century novel might distinguish (without attempting to pigeonhole each novel) between a number of approaches and methods: (1) the panoramic method in which the author assumes a puppetmaster role and in which the reader observes rather than shares the experiences of the characters (*e.g.,* Thackeray's *Vanity Fair*); (2) the symbolic method in which a host of significance is concentrated into certain intensely presented images and conflicts (*e.g., Wuthering Heights*); (3) the "scenic" method (the adjective is Percy Lubbock's) in which, against a very closely defined background, specific personal relationships and moral conflicts are revealed and discussed (*e.g., Middlemarch* and, on a somewhat lower level, the novels of Anthony Trollope); (4) the moral fable, in which the plot and particular incidents retain for the reader the sense of illustrating an originally abstract concept (*e.g.,* Benjamin Disraeli's *Sybil*); (5) the adventure story, in which incidents are related and suspense achieved for their own sake and little or no "criticism of life" is implied (*e.g.,* Wilkie Collins' *The Moonstone,* Robert Louis Stevenson's *Kidnapped*); (6) the sentimental novel which merely plays on and indulges the moral and emotional prejudices of the reader (*e.g.,* Mrs. Henry Wood's *East Lynne*).

Rise of the Modern Novel.—It is toward the end of the 19th century, partly through the influence of the French and particularly

in the work of Henry James, that a really self-conscious attitude to the novel as an art form develops. The growth in self-consciousness is accompanied by significant changes in the relationship of the author to the public. Scott, Dickens, Thackeray, even George Eliot had been "popular" writers, read by a very wide section of the community; the development of their sensibility was not such as to tend to alienate them from the mass of the reading public. But from the time of Henry James a division between the "good" or "high-brow" or "adult" on the one hand and the "popular" on the other becomes one of the dominant features in the development of the novel, as of other branches of literature. Only perhaps by Thomas Hardy and Joseph Conrad has the gulf been fairly firmly bridged, although Hardy's reputation has not been unchallenged by the more sophisticated critics.

To no previous novelist had the ramifications involved in the fictional presentation of any situation seemed so widespread and so subtle as to Henry James (1843–1916), born in the United States but attaching himself more and more throughout his life to Great Britain. This "historian of fine consciences" aimed at the revelation of situations whose moral significance could be fully expressed and apprehended by a sensibility sharpened to the highest, most exquisite point of refinement. Such an attempt involved him in the development of a prose style, in his later books, of enormous complexity. It is as though he can never bear to leave a sentence without a further oblique modification. The critical question in an appraisal of James's achievement is whether the sensibility may not be idealized to a point at which its relation with the necessities of social reality is lost.

Equally conscious of the problems of presentation was Joseph Conrad (1857–1924), a Pole who wrote his novels in English. In his books, which span the earth in their scenes and subject matter and have sometimes a misleadingly "adventure story" surface, are to be found many of the typical themes of 20th-century fiction: a background of violence and frequently horror, an insistence with the extremes of moral and political dilemma, a sense of the constant perilousness of a man's life and decisions; but also—far more rare in 20th-century literature—an epic confidence in human heroism.

Thomas Hardy (1840–1928), technically far less experimental, produced meanwhile his novels of the rural life of southern England. In his capacity to set his characters deep in their natural surroundings, his evocation of the very texture of country life and, above all, in his sympathy for the plight of the vanishing peasantry, Hardy's later novels are the furthest extreme from the pastoral romance and involve a profound and candid if unsophisticated facing of some of the underlying moral issues of society.

Rejecting any kind of narrow aestheticism, D. H. Lawrence (1885–1930) proclaimed "To be alive, to be man alive, to be whole man alive: that is the point. . . . The novel is the book of life." It was the kind of all-embracing claim made also for the novel by H. G. Wells, a writer who turned out to be less successful in combining teaching and art. To Lawrence the quality of life could not be conveyed without an attempt to catch the rhythms and conflicts of the unconscious mind. In his books personal relationships are dramatized at a level which previous novelists had scarcely attempted. Obsessive and perhaps overintense as his stories tend to be, and failing as they often do to achieve a complete artistic unity, the formal modifications and experiments he made in the course of expressing his vision have the significance of the work of a remarkable genius.

In the 1920s especially came a thoroughgoing reaction against the naturalistic methods of many late Victorian and Edwardian novelists, of whom Arnold Bennett (1867–1931) and John Galsworthy (1867–1933) were perhaps the most considerable and widely read. Virginia Woolf's essays on modern fiction are landmarks in this reaction, formulating a growing dissatisfaction with a fictional method from which it seemed that, despite a formidable verisimilitude and technical competence, "life escapes." The novels of Virginia Woolf herself (1882–1941), with their change of emphasis from plot and objective narrative to a sensuous apprehension of the texture of the lived moment, form a part of the new tendency, as does the work of Dorothy Richardson (1882– ; the first English writer to try to develop fully a "stream of consciousness" technique) and—in somewhat different directions—that of E. M. Forster (1879–) and James Joyce (1882–1941). No work in the history of the English novel has exploited more remarkably every resource of language than Joyce's *Ulysses* (1922), an enormously elaborate imposition of a frequently almost unrecognizable Homeric theme on an evocation of a day's life in Dublin. To many it has seemed that the experiments of the 1920s, culminating in Joyce's *Finnegans Wake* (1939), gave to the novel new dimensions and potentialities; to others the 20th-century novel has seemed to find itself in a cul-de-sac of inward-turning individualism. It is difficult to isolate the possible long-term value of the technical experiments of 20th-century novelists from the limitations which their views of life seem often to impose upon the total effect of their work. It has become, overwhelmingly, the most widespread and influential form of literature produced in the 20th century. The great majority of novels, however, can scarcely be regarded as serious works of art or indeed as serious contributions to literature of any kind; they are, rather, the market products of a highly commercialized industry. The future of the novel would seem to depend on the ability of the novelists, and perhaps society in general, to break down the separation that has arisen between the good and the popular. (AD. C. K.)

THE EUROPEAN NOVEL

France.—In France, storytelling goes back to the earliest *chansons de geste* (late 11th century); love as a main theme appeared in the Tristan legend, which also combines magic with high adventure; Chrétien de Troyes's Arthurian romances (*c.* 1160–80) added skilful analysis of motive and sentiment. The *Roman de la Rose* (first part *c.* 1230) developed allegorical presentation, and this, together with idealized sentiment derived from *Aucassin et Nicolette* and idyllic settings taken from the *pastourelle*, established an idealistic tradition. From the mid-13th century a contrary trend became pronounced: down to earth, racy, irreverent, as in the *Roman de Renart* and numerous 13th- and 14th-century *fabliaux*. This trend was expressed in realistic, satirical 15th-century works—the *Cent nouvelles nouvelles*, Antoine de la Salle's *Petit Jehan de Saintré*. Boccaccio's *Decameron* (trans. 1485, 1545) reinforced the liking for gay, licentious stories; it was imitated in the *Heptaméron* (1558) of Marguerite d'Angoulême, queen of Navarre. Bonaventure des Périers and other 16th-century *conteurs* wrote in similar strain, which expanded in the masterpieces of Rabelais (*Gargantua, Pantagruel*, 1533–64).

The greatest writers of the 17th century almost entirely disregarded the novel. Nevertheless the novels of this age, whether precious, heroic or realist, clearly foreshadow subsequent developments. The innumerable pages of Honoré d'Urfé's *L'Astrée* (1607–27), of Georges and Madeleine de Scudéry's *Le Grand Cyrus* (1649–53) and *Clélie* (1654–61), now seem unsubstantial pageants, reviving the last enchantments of mediaeval romance. Yet they prepared the way for those subtleties of moral analysis in which the French novel was later to excel. Similarly, the cumbersome adventure stories of Marin le Roy, sieur de Gomberville, and Gauthier de Costes, seigneur de la Calprenède, anticipated a long-continuing fashion for tales of distant lands and olden times. Fantasy and ingenious philosophic speculation characterized the "science fiction" of Cyrano de Bergerac. The mainly satirical novels of Charles Sorel, Paul Scarron and Antoine Furetière were in sharp contrast, depicting graphically, sometimes crudely, the realities of contemporary bourgeois life. The only 17th-century novel still widely read is Marie de la Vergne, comtesse de la Fayette's *La Princesse de Clèves* (1678). Simple and concentrated, like classical tragedy, it treats moral problems as vital issues, not as agreeably sentimental debating points. Novels in general, however, remained conventional, improbable and diffuse. François de la Mothe Fénelon's idyllic prose-poem *Télémaque* (1699) was a courageous and enlightened manual of statecraft, written for his young pupil, heir to the French throne.

In the 18th century leading authors and thinkers, although not primarily novelists, began writing fiction in ways unknown before, Voltaire's sardonic conte *Candide* (1759) and Rousseau's *La Nouvelle Héloïse* (1761) being the outstanding successes. Alain

le Sage acclimatized the Spanish picaresque novel with his diverting *Gil Blas* (1715–35) and brought fiction closer to everyday reality. Pierre de Marivaux, both realistic and analytical, developed the novel of sensibility (*La Vie de Marianne,* 1731–41) and largely originated a vogue which English influences soon intensified. The abbé Prévost in *Manon Lescaut* (1731) created the first living romantic hero in French fiction. His translations from Richardson changed the course of the novel, particularly through Diderot and Rousseau. Diderot had a modern understanding of the relationships between environment and behaviour; his gift for dialogue and telling detail was equally original, but *Jacques le fataliste* and *Le Neveu de Rameau* appeared posthumously, too late to influence his contemporaries. Rousseau opened up countless new themes and modes of emotional experience and reinforced the growing view that fiction must serve to edify or enlighten. His disciple Bernardin de Saint-Pierre, in *Paul et Virginie* (1787), reintroduced the exotic novel, which Chateaubriand was to endow with the incomparable magic of his prose (*Atala,* 1801). Modern psychological realism owes much to Choderlos de Laclos for *Les Liaisons dangereuses* (1782) and to Restif de la Bretonne (*Monsieur Nicolas,* 1794–97).

The 19th century was the age of great novelists. Its range and resources were extended by the influences, first of Goethe, Byron, Sterne, Scott, Fenimore Cooper, and later of George Eliot, Ruskin, Dostoievski and Tolstoy. "Confessions" were long in favour. Chateaubriand, grand architect of romantic disillusion and melancholy, set the fashion with *René* (1802). Étienne Pivert de Sénancour's *Obermann* (1804) followed, then B. Constant de Rebecque's classically disciplined *Adolphe* (1816). Charles Augustin Sainte-Beuve's *Volupté* (1834), E. Fromentin's keenly perceptive *Dominique* (1862) and Gustave Flaubert's *L'Éducation sentimentale* (1869), less obviously autobiographical, continued this tradition. Madame de Staël, championing feminism and individual rights (*Delphine,* 1802), helped to transform the novel into a social instrument, so typically its function with later writers, notably Victor Hugo in *Les Misérables* (1862). The chief exponents of the historical novel, highly successful about 1830, were Alfred de Vigny, Honoré de Balzac, Prosper Mérimée, Hugo and Dumas *père*. To record and interpret the contemporary scene was pre-eminently the achievement of Stendhal and Balzac. Stendhal takes us deeply into motives, ambitions and frustrations in his great novels *Le Rouge et le noir* (1830) and *La Chartreuse de Parme* (1839); Balzac, in the 91 works which he co-ordinated together in *La Comédie humaine,* transports us into his own fictional world, unique in its vitality, dimensions and complexity. The popularity of novels depicting some particular region of France mainly dates from George Sand, whose descriptions. as in *La Mare au Diable,* though idealized, show understanding and personal observation. Flaubert's *Madame Bovary* (1857), both romantic and realist, marks the summit of artistic perfection; his heroine is one of the great characters of fiction. The naturalists who followed often emphasized the less prepossessing aspects of life: mannered and highly wrought with the Goncourt brothers (*Germinie Lacerteux,* 1865), compellingly powerful and evocative in Émile Zola, with *L'Assommoir* and *Germinal* outstanding in his *Rougon-Macquart* cycle. Alphonse Daudet, partly realist, possesses humour and sympathy, and Guy de Maupassant, greatest as a short-story writer, a sombre realism, tinged with genuine compassion. Charles Louis Philippe, vividly portraying the lowest social levels, has close links with Dostoievski. Toward 1900, and shortly afterward, the moral problems closely analyzed by Paul Bourget (*Le Disciple,* 1889), the nationalist preoccupations of Maurice Barrès and R. Bazin, the left-wing humanitarianism of Anatole France and Romain Rolland, gave a new complexion to the novel. Pierre Loti (real name Julien Viaud), Chateaubriand's heir in some respects, translated his journeyings into nostalgic reveries. Thereafter novelists turned increasingly to travel, exploration or adventure; *e.g.,* Valéry Larbaud, the brothers Jérôme and Jean Tharaud, C. Farrère, Louis Hémon, Louis Chadourne, Pierre Benoît, P. Mac-Orlan. René Boylesve, with his sensitive descriptions of Touraine, and many talented later novelists—A. de Chateaubriant, Henri Pourrat, Jean Giono, C. F. Ramuz, Maurice Genevoix and Henri Bosco—brought the regional novel into still greater favour.

With Marcel Proust, the novel became capable of conveying an immense variety of personal experience—the most elusive workings of the subconscious mind, the mysterious simultaneity of time present and time remembered (*A la Recherche du temps perdu,* 15 vol., 1913–28). André Gide analyzed moral issues, chiefly his own conflicts and self-questionings, with irony and classical lucidity (*La Porte étroite,* 1909; *Les Faux-Monnayeurs,* 1925). E. Estaunié set an ideal of solitude and inward self-fulfilment; Alain-Fournier (Henri Alain Fournier) conjured up a delightful autobiographical dream world in *Le Grand Meaulnes* (1913). Several leading writers linked their novels into many-volumed panoramas following the life history of an individual, family or social group: Romain Rolland, *Jean-Christophe;* R. Martin du Gard, *Les Thibault;* Georges Duhamel, *La Chronique des Pasquier.* The most far-reaching work of this kind was that of Jules Romains, in *Les Hommes de bonne volonté* (27 vol., 1932–46). Jacques de Lacretelle wrote a four-volumed cycle, *Les Hauts-ponts;* he is also a distinguished writer of analytical novels, as are E. Henriot, M. Prévost, Jacques Chardonne and M. Arland. World War I produced its own novelists, among whom Henri Barbusse, Roland Dorgelès and Georges Duhamel (a singularly humane writer) were conspicuous. Political and social issues following the war were discussed by widely differing writers, among them André Chamson and Louis Aragon. Modern uncertainties and disquietudes became a constant theme: François Mauriac concentrated his gaze on unregenerate man, in the intensely visualized setting of Bordeaux (*Noeud de Vipères, La Pharisienne*). G. Bernanos conveyed, with passionate integrity, visions of almost apocalyptic vehemence (*Sous le Soleil de Satan; Journal d'un curé de campagne*); M. Jouhandeau and Julien Green were no less anxiously concerned with the struggle between good and evil. Other novelists, notably André Malraux (*La Voie royale; La Condition humaine*) sought a new metaphysic. Henry de Montherlant (*Les Jeunes Filles,* etc.) stressed assertions of individualism. The generous, questing spirit of Antoine de Saint-Exupéry found an answer in community of effort; so, with rather less certainty, did Albert Camus (*La Peste,* 1947). J. P. Sartre (*La Nausée; Les Chemins de la liberté*) led the existentialist school. Quite distinct were Jean Giraudoux, a master of fantasy; and Colette, exquisitely sensuous in fine prose. (S. C. Gd.)

Germany.—The beginnings of the German novel may be traced back to the late middle ages. Elisabeth von Nassau-Saarbrücken translated French prose romances and Heinrich Steinhöwel Italian stories in the 15th century, and prose versions of older epics were produced. The 16th century saw the rise of popular collections of *facetiae,* anecdotal, satiric and didactic stories; Eulenspiegel and Faust were the most famous subjects. Signs of independence appeared in Jörg Wickram's *Goldfaden* (1557). *Der abenteuerliche Simplicissimus* (1669) by H. J. C. von Grimmelshausen, the story of the adventures of a simple-minded fellow during the Thirty Years' War, was the most important work of the 17th century. Defoe's *Robinson Crusoe,* translated in 1720, gave rise to a vast number of stories, known as *Robinsonaden,* with adventurous, satirical, didactic and utopian themes. The political novel, of which C. M. Wieland's *Der goldene Spiegel* (1772) is the best example, belonged to a kindred stream. Richardson's moralizing works were echoed by C. F. Gellert and S. von La Roche. In 1766–67 Wieland published his *Agathon,* the first German biographical novel or *Bildungsroman.*

In 1774 Goethe's *Werther,* owing much to Rousseau, appeared and let loose a flood of sentimentality and passion. *Wilhelm Meisters Lehrjahre,* Germany's most famous *Bildungsroman,* was published in 1795–96, followed by *Wilhelm Meisters Wanderjahre* in 1821–29. Goethe's *Die Wahlverwandtschaften,* a novel of renunciation, appeared in 1809. *Wilhelm Meister* greatly influenced the novels of the Romanticists J. L. Tieck, Novalis, Friedrich Schlegel, J. von Eichendorff and Eduard Mörike, Jean Paul's *Titan* (1800–03) being a further landmark in the movement that led to Gottfried Keller's *Der grüne Heinrich* (1854–55). The novel and short story were widely cultivated in the German Romantic movement; J. C. F. Hölderlin's elegiac *Hyperion,* the concentrated conflicts in Heinrich von Kleist's stories, the realism and historical in-

terest of Tieck's later works, the historical novels of Ludwig Achim von Arnim and Wilhelm Hauff, the social novels of Elisabeth (Bettina) von Arnim, the legendary stories of Friedrich de la Motte Fouqué, the mysterious and horrific narratives of E. T. W. Hoffmann, the criticism of contemporary insecurity provided by Karl Immermann, all being notable.

The increasing attention to realism in the middle of the 19th century, following the decline of romanticism, found expression in regionalism, historical fiction and social criticism. A. Stifter's still-life landscapes dwelt upon eternal human values, B. Auerbach wrote of Black Forest life, Jeremias Gotthelf (Albrecht Bitzius) composed novels of the Swiss peasantry with a didactic aim and Fritz Reuter wrote of his native Mecklenburg in Low German, pointing the way toward Peter Rosegger, the Styrian author of autobiographical, historical and polemical stories, and his fellow Austrian Ludwig Anzengruber, whose technique is almost naturalistic in his gripping narratives of country life. Willibald Alexis (G. W. H. Häring) wrote a series of well-documented novels on Prussian history, being followed in the sphere of historical fiction by Gustav Freytag (who also wrote important novels of contemporary life), C. F. Meyer and L. von François. Social tendentiousness found expression in the lengthy novels of Karl Gutzkow and afterward in Friedrich von Spielhagen and the longer works of P. J. L. von Heyse. Charles Sealsfield (Karl Postl) was noteworthy for his grandiose stories of North America. Theodor Fontane observed social situations with acute objectivity, and W. Raabe wrote studies of small-town life with resignation and sometimes humour. With the onset of naturalism at the end of the century psychological observation, social criticism, sexuality and materialistic pessimism came increasingly to the fore. Hermann Sudermann's East Prussian stories are not without sensationalism. Gerhart Hauptmann's novels reflect personal experiences and particularly erotic problems.

The most important figures emerged when naturalism gave way to impressionism. Hermann Hesse and Thomas Mann acquired international repute. The former's novels deal with problems of youth and friendship, approaching through self-analysis a new spiritual utopia in *Das Glasperlenspiel* (1943), while the latter is concerned with the contrast between bourgeois normality and artistic refinement which involves physical disintegration in *Buddenbrooks* (1901) and later works, including *Dr. Faustus* (1947), an indictment of Nazidom. J. Wassermann looked for spiritual redemption in face of modern perplexities. Among a number of women writers such as Gabriele Reuter, Clara Viebig and Ina Seidel, Ricarda Huch stands out for both stylistic skill and scholarly penetration, particularly in the field of historical narrative. The historical novel was cultivated as a means of revealing modern problems by parallel or contrast, regionalism (sometimes exaggerated) flourished because of the interest in environmental factors, while the colonial novel (Hans Grimm) was in some measure an offshoot of this latter. War novels appeared in the wake of both world wars, Erich Maria Remarque being popular after the first, T. Plievier acquiring fame after the second. E. Wiechert became important among those seeking spiritual certainty. Hermann Broch, Stefan Andres, E. Langgässer and W. Bergengruen were among the foremost post-World War II novelists, while Hans Carossa's autobiographical stories were extremely valuable documents. (A. Gs.)

Italy.—Boccaccio (1313–75), the father of Italian prose, was the first Italian writer to attempt long novels. This fervent admirer of Dante was certainly influenced by the lyrical inspiration of *Vita Nuova* when he wrote his *Filocolo*, a partly autobiographical novel portraying the story of Florio and Biancofiore; his *Ameto*, a pastoral novel interwoven with verse passages; and his *Fiammetta*, a study of the psychology of a disappointed lover. Unlike his short stories, Boccaccio's novels did not start a lasting fashion; the Italian Renaissance, in spite of its taste for the short story, was too enrapt in the contemplation of antiquity to relish long modern narrative works. It is doubtful whether the name of "novel" applies to Jacopo Sannazaro's *Arcadia* (1504) or to Francesco Colonna's *Hypnerotomachia Poliphili*, both imbued in their different ways with classical feeling; it certainly applies, however, to the humbler romances of Andrea da Barberino (*I Reali di Francia, Guerin Meschino*), whose fanciful treatment of an already declined world of chivalry achieved immense popularity from the early 15th century onward.

Seventeenth-century Italian novels all reveal French or Spanish influence, and although some were widely read and reprinted (G. V. Rossi's *Eudemia*, G. A. Marini's *Caloandro*, G. Biondi's *Eromena*) none had any real merit. With the late 18th century English influences became prevalent, and Alessandro Verri's *Notti Romane* (1792, 1804), a vision rather than a novel, is an example of this trend; Ugo Foscolo's *Ultime lettere di Jacopo Ortis* (1802) bear the mark of his genius in spite of the incoherences of Ortis' character and of the high-pitched style used throughout.

The coming of romanticism brought the historical novel to the fore. Alessandro Manzoni's *I Promessi sposi* (1825–27), by far the best Italian novel, is the only really great one of this kind, thanks to the successful blend of a historic background (Spanish-dominated Lombardy in the 17th century) with a fictional plot. Manzoni managed to infuse into his masterpiece his religious conscience and his outlook on life; his followers failed in varying degrees where their master succeeded. Massimo d'Azeglio's *Ettore Fieramosca* and *Niccolò de' Lapi*, Tommaso Grossi's *Marco Visconti* are enjoyable and their patriotic feeling is still effective; but F. D. Guerrazzi's rhetorical *La Battaglia di Benevento, L'Assedio di Firenze*, etc., Cesare Cantù's *Margherita Pusterla* and the many historical novels of such once highly rated authors as Bazzoni, Rosini, Tommaseo and Varese defy the patience and taste of the modern reader. In the second half of the 19th century the historical novel gave way gradually to the realistic novel; this movement toward *verismo*, already heralded by G. Rovani (*I Cento anni*), I. Nievo (*Confessioni d'un Italiano*) and G. Ruffini (*Lorenzo Benoni, Il Dottor Antonio*), found its highest expression in Giovanni Verga's masterpieces (*I Malavoglia*, 1881; *Mastro Don Gesualdo*, 1889) and affected much or little other novelists of this time (S. Farina, G. Rovetta, L. Capuana, F. de Roberto, M. Serao and G. Deledda), whose works were often inspired by life in their own districts and thus can be described as regional as well as realistic; while A. Fogazzaro's large output was influenced by his religious views and E. de Marchi (*Demetrio Pianelli*, etc.) owed much to Manzoni. The many novels of Gabriele d'Annunzio (1863–1938) cannot be given a definite label—they are, like the rest of his work, the expression of his self-asserting personality, frenzied sensuality and capacity for enjoying and describing all things beautiful.

It is difficult to pick out a prevalent trend in the narrative literature of the first 40 years of the 20th century. Luigi Pirandello's novels, which can be linked with Sicilian realism, develop the same themes as his plays; other distinguished novelists who left their mark in this period were A. Panzini, A. Palazzeschi, M. Bontempelli and G. Papini. Italo Svevo's *La Coscienza di Zeno*, a striking novel which stands out among the output of the 1920s, reveals many European influences; while in the '30s R. Bacchelli (*Il Mulino del Po*) and Ignazio Silone (Secondo Tranquilli), a political exile (*Fontamara, Pane e vino*), were more traditional in their approach. After World War II came the neorealist movement, full of vitality and freshness; it was mainly represented by C. Pavese, E. Vittorini and V. Pratolini, while A. Moravia pursued his quest in the realm of human psychology with ever-refined powers of observation. (U. L.)

Russia.—Nikolai Karamzin's *Poor Liza* (1792) was the first Russian novel proper and first suggests the beginnings of a reading public in Russia. The mediaeval chronicles and prose epic tales, the polemical writings of the 16th and 17th centuries and the beginnings of literary satire in the 18th century—all of which did something to make a way for the novel—will therefore be passed over. The short story, in which Russia has been especially happy (*see*, for example, the many brilliant and widely influential tales or *Rasskazy* of Anton Chekhov), must also be ignored, though it is hard to say whether Alexander Pushkin's *The Captain's Daughter*, which showed (1836) the influences of Byron and Scott in a pioneering masterpiece, is a long story or a short historical novel.

Karamzin's sentimental novel mentioned above shows the re-

sponse of Russia to the common European influences implied in the names of such writers as Sterne and Richardson; but the beginning of the really significant history of the Russian novel proper may perhaps best be placed at Mikhail Lermontov's *A Hero of Our Time* (1840). This gives the character of the Russian "superfluous man" with a blend of poetic sensitiveness and genius for character drawing that is especially Russian.

The greatness of the Russian novel, viewed from the European and world standpoint, covers the period from the publication of Nikolai Gogol's *Dead Souls* (1842) to the death of Maxim Gorky in 1936, though the revival of the historical novel among Soviet writers after that (*e.g.*, Mikhail Sholokhov and Sergei Borodin) produced some very talented and effective work. In this period the outstanding impressions are of profound psychology (including latterly that of the subconscious), deep moral sensitiveness, subjective character painting (especially the abnormal), a gift for what may be called serious comedy and an intense social consciousness. But perhaps the outstanding achievements are to be seen in the philosophical presentation of history on a vast canvas in Count Leo Tolstoy's *War and Peace* (1862–69) and in an almost universal genius for presenting vividly interesting, significant women. The idea of presenting the typical Russian "hero of our time," whether as failure (as in Ivan Goncharov's *Oblomov*, completed 1858) or idealized in the "socialist realism" of Soviet Russia after the Revolution, runs all through Russian fiction.

Gogol's *Dead Souls*, influenced by Dickens, shows the blending of deadly satire with vivid characterization. Ivan Turgenev's novels stand out as almost alone combining a French sense of form with Russian realism. His best work, *Fathers and Children* (completed 1862), also provides the first full-length portrait, in Bazarov, of a Nihilist. Theodore Dostoievski's four greatest novels—*Crime and Punishment* (1866), *The Idiot* (completed 1869), *The Possessed* (1871) and *The Brothers Karamazov* (1880)—have been a potent influence in Europe in their intensely subjective moving qualities and vividness of human pathology, which seems to anticipate existentialism. Tolstoy has been the greatest Russian world influence as a quasi-religious thinker; but his *Anna Karenina* (1875–77) has all the best qualities of a novel proper, and this along with his *War and Peace*, which is one of the world's masterpieces, shows a genius for presenting essentially Russian character including most notably the peasant. A markedly dramatic quality, which characterizes the Russian novel throughout, was continued in the social didactic fiction of Maxim Gorky (*e.g., The Artamonovs' Business*, completed 1926) and in Soviet historical fiction, such as Sholokhov's *And Quiet Flows the Don* (1933) and Borodin's *Dmitri Donskoi* (1942). (C. L. W.)

Scandinavia.—Though Ludvig Holberg already practised the art of the novel, it was not until the 19th century that this genre definitely conquered in Scandinavia. One of its principal forms was the "family" novel, often with a marked preoccupation with the position of woman. Camilla Collett (Norwegian) introduced it with *The Governor's Daughters* (1855); Fredrika Bremer (Swedish, 1801–65) wrote a series of novels about woman and the home in the upper middle class. The family novel reached its highest achievement in *The Family at Gilje* (1883) by Jonas Lie (Norwegian), who also wrote a psychological novel about marriage, *The Pilot and His Wife*, besides his descriptions of life at sea. Historical themes were adopted in some of the novels by B. S. Ingemann (Danish), Z. Topelius (Finnish), Carsten Hauch (Danish) and J. P. Jacobsen (Danish), who wrote the crowning work of the Danish historical novel, *Marie Grubbe* (1876). The pioneer of the novel dealing with folk life is S. S. Blicher (Danish), who already in the 1820s describes folk life in Jutland in a narrative that combines lyrical emotion with telling realism and suggestive power. The charming peasant novels of Björnstjerne Björnson (Norwegian) came in the late 1850s, nearly 20 years after the Swedish K. J. L. Almqvist's short stories, but they belong, like these, to the transition period leading to modern realism. Of the purely realistic novels of folk life should be noted *Hemsöborna* by A. Strindberg (Swedish, 1849–1912), a masterpiece illustrating life in the Swedish countryside, and *Hard Times* and *Woman's Rule* by the Finn K. A. Tavastjerna (1860–98). During the realistic period the folk-life genre, however, often was replaced by the propagandist novel of social themes, inspired by French naturalism. A great number of authors cultivated this form (Sophus Schandorph, Henrik Pontoppidan and Herman Bang in Denmark; Björnson, Alexander Kielland, Lie and Arne Garborg in Norway; Ernst Ahlgren [Victoria Benedictsson], Anne Charlotte Leffler and Gustaf af Geijerstam in Sweden). It attained a peak in Strindberg's *The Red Room* (1879). With some, naturalism developed into a philosophy. Outstanding among these was J. P. Jacobsen, who in *Niels Lyhne* (1880) describes the life and death of a confirmed atheist; here the ways of hope are all closed. Many novels, naturally, fall outside the groups here indicated; among these are Hans Christian Andersen's *The Improvisatore* (1835), an autobiographical travel novel from Italy inspired by Mme de Staël's *Corinne*, Selma Lagerlöf's *Gösta Berlings saga* (1891), permeated by a fervent, rhetorical hero worship, and Knut Hamsun's *Hunger* (1890).

In modern times a great number of novelists appeared on the literary scene. Most universally known are perhaps Pär Fabien Lagerkvist (Swedish) and Sigrid Undset (Norwegian). The novels of the former (*Guest of Reality*, 1925; *The Hangman*, 1933; *The Dwarf*, 1944; *Barabbas*, 1950) are, like his dramas and poems, the testimonies of a ceaseless moral struggle to found a heroic humanism in a world of darkness and confusion. The religious ideas sometimes professed by the author have a character of immanence. Sigrid Undset, who was converted in 1924, was, on the contrary, inspired by the transcendentalism of the Roman Catholic faith. Her masterpieces, the two great historical novels *Kristin Lavransdatter* (1920–22) and *The Master of Hestviken* (1925–27), create a Norwegian mediaeval world of monumental greatness, engaged in the eternal struggle between good and evil but also warm with human passions and with an everyday realism. (D. A. H.)

Spain.—Prose fiction in Spain had its origin in the collections of oriental apologues—*Disciplina clericalis, Calila e Dimna, Sendebar, Barlaam y Josafat*—which from the 12th and 13th centuries circulated in Latin or Spanish translation, mostly through the Arabic. The romance of chivalry, deriving from the Carolingian and Arthurian epic cycles, produced its most famous exemplar in *Amadís de Gaula*, of which the lost original (*c.* 1300) may have been Portuguese. In the Catalan *Tirant lo Blanc* of Joanot Martorell (1460) chivalresque fantasy came down, exceptionally, to earth. The *Amadís*, reworked by Garcí Rodríguez de Montalvo and printed in 1508, spawned a monstrous progeny of Esplandians, Palmerins and other progressively more incredible heroes which held Spain in thrall down the century. The picaresque novel (*q.v.*) was born with the anonymous *Lazarillo de Tormes* (1554), while the pastoral novel, Italian in origin, achieved with the *Diana* of Jorge de Montemayor (*c.* 1559) Spanish garb and a fame to which alike Miguel de Cervantes Saavedra (*Galatea*, 1585) and Lope de Vega (*Arcadia*, 1598) paid tribute. Cervantes' *Don Quixote* (1605–15), begun as a counterblast to the romances of chivalry, proved to be the transition to the modern novel in its blending of different planes of thought and action and its presentation of character in solution. In the same author's *Novelas ejemplares* (1613) there emerged, alongside Italianate tales of romantic adventure, the conception of the short story as a re-creation of atmosphere and character. Later 17th-century fiction was dominated by the picaresque. The 18th century, in which French pseudoclassicism threatened to eclipse the native literary tradition, produced but one novel of note, José Francisco de Isla's *Fray Gerundio de Campazas* (1758–68), a satiric deflation, again picaresque in technique, of the pulpit bombast then current. With romanticism, Scott's *Waverley* novels led poets and dramatists to essay, with scant success, the historical novel (José de Espronceda's *Sancho Saldaña*, 1834; Mariano de Larra's *El Doncel de don Enrique el Doliente*, 1834; Francisco Martínez de la Rosa's *Doña Isabel de Solís*, 1837–46); but not till mid-century, notably with Fernán Caballero's *La Gaviota* (1849), did the novel, aided by the *costumbrismo* of essayists such as Estébanez Calderón, Mesonero Romanos and Larra, rediscover its true Spanish bent to lie in the realistic depicting of the contemporary scene.

In the 50 years following the "regional" novel became the dominant literary kind, with Pedro Antonio de Alarcón, José María de Pereda, Emilia Pardo Bazán, Armando Palacio Valdés and others. The two latter, attracted for a moment by French naturalism, soon discarded it in favour of the more genial Spanish conception of realism, which prefers the optimistic approach. Juan Valera added to regionalism a note of classical detachment and a more analytical psychology. Benito Pérez Galdós (1843–1920), the greatest of modern Spanish novelists, stood outside the regionalist movement; come to Madrid from the Canary Islands, he saw Spain whole and, deeply concerned with social problems, sought their roots in the preceding half-century. His 46 *Episodios nacionales* and 34 novels on contemporary themes depicted on an epic scale, and with a profound sense of character, the life of 19th-century Spain. Miguel de Unamuno (1864–1936) and Pío Baroja (1872–) took to the novel the preoccupations of the "generation of 1898" concerning Spain's role and destiny after the loss of the last American colonies. Unamuno's concern was with the individual soul, hence the introspective probing and the total absence of externals, Baroja's with the indictment of society. Vicente Blasco Ibáñez (1867–1928) allied much crude vigour in portraying the Spanish scene to a strong reformist bias; Ricardo León (1877–1943), by contrast, exalted traditional values in a rich nostalgic prose. The preciosity of the "modernist" Ramón del Valle-Inclán (1869–1936) classed him primarily as a stylist. In Gabriel Miró (1879–1930) a like concern for style was allied to a delight in the minutiae of the external world, as it was in Ramón Pérez de Ayala (1881–) to the sensuous appreciation of human nature. The Civil War of 1936–39 and its aftermath weighed heavily: Camilo José Cela (*La Familia de Pascual Duarte*, 1942; English trans. 1946) and Carmen Laforet (*Nada*, 1944) were among the first to give promise that the novel would with time recover its prestige. (W. C. An.)

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THE U.S. NOVEL

Early Period.—The demand for novels, frowned upon by the Puritan regime in early America, began to be gratified in the mid-18th century by English importations and, a little later, by crude native experiments. The first American novel, William Hill Brown's (1765–93) *The Power of Sympathy* (1789), was compounded of sensational materials—seduction, rape, suicide—which were glossed over by genteel language. Of the few novels published before the time of James Fenimore Cooper, only those of Charles Brockden Brown possess more than historical significance. Brown's *Wieland* (1798), a breathless story of religious mania leading to murder committed under the immediate stimulus of ventriloquism, exhibited genuine tragic power. Cooper, author of many historical romances, was unquestionably a writer of the first rank. After misfiring in an attempt to produce a good "social-life" novel (*Precaution*, 1820), he astonished and delighted the English-reading public with *The Spy* (1821), a story smelling of real American soil, pounding with excitement and invested with an aura of patriotism. Soon thereafter he began his *Leatherstocking Tales*, a series of stories centred in the exploits of the resourceful, courageous, magnanimous Natty Bumppo. The plots were generally a variation on one of the oldest themes known to fiction, namely, flight and pursuit. Not preconceived as a series by Cooper, these stories may be read in the order of Natty's experience: *The Deerslayer* (1841); *The Last of the Mohicans* (1826); *The Pathfinder* (1840); *The Pioneers* (1823); *The Prairie* (1827). A prolific writer, Cooper also produced novels of the sea (*The Pilot*, 1823) and novels critical of American democracy (*Home as Found*, 1838).

Nathaniel Hawthorne had no such spectacular popular success as Cooper. His novels are overlaid by allegory and symbol to such an extent that the outline of the action is shrouded in ambiguity. His major interest was in some form of damage to the soul, whether by concealed sin, as in *The Scarlet Letter* (1850); by the effect of Puritan fanaticism as in *The House of the Seven Gables* (1851); or by a "crime" to which an individual is apparently impelled by a species of determinism, as in *The Marble Faun* (1860). Such remedies and compensations as are available—confession, expiation, recognition of the principle of good out of evil—serve at best to induce a kind of sober satisfaction. A master of probing, psychological study and subtle stylistic modes, Hawthorne inspired many later writers, among them Henry James and T. S. Eliot. Herman Melville was finally also preoccupied with the problem of evil, but his fiction was more robust than Hawthorne's and he was capable of writing stirring adventure stories such as *Typee* (1846). His greatest work, *Moby-Dick* (1851), often regarded as the greatest novel written in English, also may be read as a tale of external adventure relating to a whaling voyage, but inwardly it is lined with metaphysical speculation regarding the "nature of ultimate reality." Melville's philosophical conclusions are not clear-cut, but it is apparent that he tended to be pessimistic about the cosmos and the heart of man. His *Pierre* (1852) and *The Confidence-Man* (1857) are documents revealing profound disillusionment. More faith in humanity and providence was shown by Harriet Beecher Stowe, whose *Uncle Tom's Cabin* (1852), an inferior work of art, became one of the best sellers of all time.

Shortly after the Civil War three novelists of original power and lasting influence made their first appearances: the comic satirist Mark Twain, the realist William Dean Howells and the impressionist Henry James. Mark Twain was essentially a democratic writer. In *Tom Sawyer* (1876) and *Huckleberry Finn* (1884) he showed ordinary American boys in revolt against "culture" and in quest of normal boyhood adventure on the Mississippi river. His *The Innocents Abroad* (1869) made fun of the pretensions of aesthetes. In *The Prince and the Pauper* (1882) and *A Connecticut Yankee in King Arthur's Court* (1889) his humour was put to the service of vitriolic satire whose targets were those institutions—political, religious, economic—which in his opinion oppressed mankind. His posthumous *The Mysterious Stranger* (1916) is a story embodying pessimistic conclusions about the nature of man and God. Stylistically Mark Twain bequeathed to his successors in the novel a superb model of the colloquial idiom.

Howells also wrote of authentic American types and ideals, but his manner was more conservative than Mark Twain's. In *The Rise of Silas Lapham* (1885) he recorded the career of an American businessman of humble origins who proved himself both a self-made man and a good loser. Many of his novels, such as *A Hazard of New Fortunes* (1890), deal with fluctuations of fortune created by social and economic inequalities. Others deal realistically, but not violently, with love; among these are *A Modern Instance* (1882), a story of divorce. Howells was for a time influenced by Tolstoy, but his novels owed their best qualities to his shrewd observation of superficially unexciting middle-class American life.

James largely avoided the U.S. scene but made much use of American character. His typical procedure was to deploy American characters opposite to European characters in a European setting (England, Italy, France) and to reveal, more by means of analysis and dialogue than by "action," their responses to the phases of an ethical or social problem turning on a point of honour. The American characters tend to be frank, unsophisticated, sometimes vulgar and noisy, often spiritually very sensitive. In *The American* (1877) the hero is a rich, uncultivated American whose fine moral perceptions make him "victorious" even though he fails

to win his bride. Isabel Archer in *The Portrait of a Lady* (1881) submits to much suffering because her finely attuned sense of honour forbids her leaving a cruel husband. Charged with reducing his external actions below the threshold of average reader interest, especially in the novels of his maturity such as *The Ambassadors* (1903), James responded that very little outward action is necessary for "impressions *are* experience."

By the end of the 19th century the number of competent American novelists had grown tremendously. Among the significant writers who appeared in the 1890s was Stephen Crane, whose *The Red Badge of Courage* (1895) blended impressionism and naturalism in its study of battle. Frank Norris' *The Octopus* (1901), an economic novel set in California, was one of many American novels to show the increasing influence of Zola. Upton Sinclair's *The Jungle* (1906) was in effect an angry cry for redress of the plight of immigrant workers employed in the Chicago stockyards. Theodore Dreiser's *Sister Carrie* (1900) sounded one of the first notes in the battle to liberate women from earlier standards of morality. Meanwhile there had been a large-scale, gaudy revival of the historical romance, symbolized by Charles Major's (1856–1913) *When Knighthood Was in Flower* (1898). (A. Ce.)

Twentieth Century.—The death of James in 1916 and of Howells in 1920 left Edith Wharton (1862–1937) the most distinguished U.S. novelist for those who thought of fiction, in traditional terms, as a picture and critical-moral evaluation of contemporary life. Mrs. Wharton's moral and aesthetic values were close to James's, but her instinct for the concrete prevented her from forsaking actualities to anything like the extent James did in his final phase. She came closest to his method in *The Reef* (1912). In early novels such as *The House of Mirth* (1905), she is very critical of the inflexibility and insensitiveness of the New York society world of her youth, but by the time she wrote *The Age of Innocence* (1920) her disgust over the collapse of standards and values in postwar United States had caused her to interfuse her satire with a beautifully restrained nostalgia. Later critics showed that *Ethan Frome* (1911), a bitter idyll of rural New England, is less remote from her main themes than was once supposed. They are still inclined to see in her later novels a falling off from her highest standards, but such books as *The Children* (1928) and her last, unfinished novel, *The Buccaneers* (1938), would need to be exempted from this somewhat hasty generalization.

Methods and outlooks not unlike Mrs. Wharton's were manifested by the Boston jurist Robert Grant (1852–1940) (*Unleavened Bread,* 1900; *The Chippendales,* 1909; etc.) and by Robert Herrick (1868–1938), who, in such books as *The Common Lot* (1904) and *The Memoirs of an American Citizen* (1905), applied New England standards in an unflattering study of the corrupting influences of commercialism and industrialism upon men and women, as observed in Chicago between the World's fair of 1893 and World War I. Herrick liked his "idealistic" novels best, but only one of these, *Clark's Field* (1914), ranks with his finest work. His most powerful novel is *Waste* (1924), a castigating survey of American life in its public and private aspects. Booth Tarkington (1869–1946) expresses similar social criticism in *Alice Adams* (1921) and in the trilogy *Growth—The Turmoil* (1915), *The Magnificent Ambersons* (1918) and *The Midlander* (1924)—but he was more popular in less austere manifestations, as in *Seventeen* (1916) and the *Penrod* books (1914 ff.)

Three significant later writers in the Wharton tradition were F. Scott Fitzgerald (1896–1940), Sinclair Lewis (1885–1951) and John P. Marquand (1893–). Fitzgerald (*This Side of Paradise,* 1920) lived and recorded the tragedy of the Jazz Age; he died before full development, but both *The Beautiful and Damned* (1921) and *The Great Gatsby* (1925) are serious in outlook, and his last, uncompleted novel about the cinema, *The Last Tycoon* (1941), tantalizes with suggestions of unfulfilled possibilities. Sinclair Lewis became the most talked-of novelist in the U.S. with his indictment of culture-starved small towns in *Main Street* (1920); he went on to attack the shortcomings of businessmen, scientists and preachers, respectively, in *Babbitt* (1922), *Arrowsmith* (1925) and *Elmer Gantry* (1927). The name of the Dickensian hero of the first of these has passed into the language; the second best expresses Lewis' values—his faith in science and the free life; the third reveals his prickly, village atheist side. Perhaps his last quite first-rate book was *Dodsworth* (1929), a more thorough picture of the American businessman abroad than either James or Howells achieved. Later Lewis novels are less powerful and more respectful of established standards; he reflects the pressures of the period in his attacks on fascism in *It Can't Happen Here* (1935) and race prejudice in *Kingsblood Royal* (1947). Marquand's special subject is the New England gentleman in an uncongenial and "hard-boiled" environment. *The Late George Apley* (1937) was a satirical apotheosis of the Beacon hill aristocrat; *Wickford Point* (1939), *H. M. Pulham, Esquire* (1941) and *Point of No Return* (1949) were perhaps the most notable among the novels that followed.

Long before Mrs. Wharton's death, her position was sharply challenged by two other women—Willa Cather (1873–1947) and Ellen Glasgow (1874–1945). Because she began writing about Nebraska pioneers, Bohemian and Scandinavian, in *O Pioneers!* (1913) and *My Ántonia* (1918), Willa Cather was often called a regionalist. Actually she was interested in pioneers as in great artists—*The Song of the Lark* (1915), etc.—because of a reality in them that fascinated her imagination. In her early phase she seemed more vital than Edith Wharton, closer to the roots of America and of life itself, but she had no sympathy with the dominant interests of her own time, and her studies of her contemporaries in *One of Ours* (1922) and *The Professor's House* (1925) reflect bitter disillusion. Now frankly regarding herself as one of the "backward," she retreated to the past and to traditional religious values in the lovely *Death Comes for the Archbishop* (1927) and *Shadows on the Rock* (1931). Ellen Glasgow had been writing the social history of Virginia in fiction since the beginning of the century, but not until after *Barren Ground* (1925) did she receive adequate recognition for either her fine art or her service in demolishing the old southern sentimental tradition. *The Romantic Comedians* (1926), *They Stooped to Folly* (1929), *The Sheltered Life* (1932) and *Vein of Iron* (1935)—ingenious blendings of old and new values—were all widely read.

Mary Austin (1868–1934), Zona Gale (1874–1938), Dorothy Canfield (1879–), Elsie Singmaster (1879–) and Elizabeth Madox Roberts (1886–1941) were other prominent women novelists of the period; of these, Miss Roberts received the widest critical acclaim. *The Time of Man* (1926), which made her reputation, combined the values and methods of Sherwood Anderson and Virginia Woolf; *My Heart and My Flesh* (1927) in some aspects anticipated Faulkner. Even in that luminous historical novel *The Great Meadow* (1930), most of the action lies within the mind. The symbolical *He Sent Forth a Raven* (1935) represents the fullest development of Miss Roberts' extremely subtle art.

Naturalism, meanwhile, was having its great American triumph in the post-World War I vogue of Theodore Dreiser (1871–1945), who had begun as early as 1900 with *Sister Carrie* but until now had won no adequate hearing. The trilogy comprising *The Financier* (1912), *The Titan* (1914), and *The Stoic* (1947) was based on the career of the "robber baron" Charles T. Yerkes. Dreiser's greatest success came with *An American Tragedy* (1925), but by this time the mechanistic philosophy to which he once adhered was beginning to seem inadequate to him. *The Stoic,* accordingly, imposes mystical overtones upon a character originally conceived in naturalistic terms, and the central figure of *The Bulwark* (1946) is a Quaker saint, sympathetically portrayed.

James T. Farrell (1904–)—the *Studs Lonigan* trilogy (1932 ff.), etc.—became Dreiser's most important disciple; like Dreiser, he developed his own brand of Marxism. John Dos Passos (1896–) was considered radical in his earlier years, but his disillusionment over the New Deal changed all that. In *Manhattan Transfer* (1925) and the trilogy *U.S.A.* (1937), Dos Passos attempted the "collectivist novel," describing the life of city and nation and introducing interesting technical innovations: "biographies," "news reels" and "the camera eye." There are naturalistic elements, too, in the Idaho novelist Vardis Fisher (1895–);

see the tetralogy beginning with *In Tragic Life* (1932).

A much more "professional" radical, Upton Sinclair (1878–), well-known from his exposé of the Chicago stockyards in *The Jungle* (1906), found a large public with a long series of novels dramatizing contemporary history, beginning with *World's End* (1940). The proletarian novel movement of the 1930s produced Albert Halper (1904–), who began with the regional *Union Square* (1933) and went on to depict occupational backgrounds in *The Foundry* (1934) and *The Chute* (1937).

The post-World War I years produced a franker fiction than the United States had known before, but this did not always make for naturalism. The preoccupation of Sherwood Anderson (1876–1941) with sex and with humble people was often interpreted as allying him with the naturalists, but his technique was more like that of the impressionists. The postwar years also liberated fantasy. This is seen most impressively in the work of James Branch Cabell (1879–), whose immense *Biography of the Life of Manuel* (1904–30), filling 18 volumes, is the most substantial piece of romanticism since *The Faerie Queene*. The scene ranges from modern Virginia to Cabell's own imagined mediaeval French province, Poictesme—the link between the two worlds is described in *The Cream of the Jest* (1917)—and the tone blends disillusion with mischievous sexuality and a wistful hungering for faith. Long a neglected writer, Cabell was notably served by the New York Society for the Suppression of Vice when it attacked *Jurgen* (1919), one of the most important novels in the *Biography*.

Varied aspects of romance and fantasy appear also in the work of John Erskine (1879–1951), who, after the success of his impudent *The Private Life of Helen of Troy* (1925), proceeded to apply the same formula to other famous historical and fictional characters; of the poet Elinor Wylie (1885–1928), who produced four distinguished and utterly dissimilar novels, of which the most popular was *The Orphan Angel* (1926); of Thornton Wilder (1897–), whose *The Bridge of San Luis Rey* (1927) was one of the unexpected successes of American literature; and of Robert Nathan (1894–), whose beautiful style and ironic sentiment embodied themselves in a number of novels and who came into new and deserved popularity after *One More Spring* (1933).

Ernest Hemingway (1898–), the voice of the "lost generation" and the most famous American writer since Mark Twain, though essentially a short story writer, still exercised an important influence upon the novel, both through his themes and his spare, athletic, deeply felt and disciplined style. *The Sun Also Rises* (1926) was followed by *A Farewell to Arms* (1929), the great love story of World War I. *For Whom the Bell Tolls* (1940) brought a new sense of social responsibility out of the Spanish Civil War. His *The Old Man and the Sea* (1952) concerned his favourite theme, man's naked strength and courage pitted against the worst that life can do to him.

After Hemingway, the American novelists who received the largest amount of critical attention in this period were Thomas Wolfe (1900–38), William Faulkner (1897–), Erskine Caldwell (1903–) and John Steinbeck (1902–).

Like Fitzgerald, Wolfe, the most autobiographical of all U.S. novelists, died in the making. The surging, tumultuous power of *Look Homeward, Angel* (1929), *Of Time and the River* (1935) and their successors make it hard to believe that Wolfe was influenced by so highly disciplined a writer as Joyce. Caldwell's early novels—*Tobacco Road* (1932) and *God's Little Acre* (1933)—were taken seriously at first, but most critics later dropped him as a writer of "shockers." Steinbeck, who scored his greatest success when *The Grapes of Wrath*, published at the height of New Deal economic experimentation in 1939, became the most widely read sociological novel of the time, is hard to classify, for he has never stopped experimenting. Both *Tortilla Flat* (1935) and *Cannery Row* (1945) glorified a natural, animallike existence, but *East of Eden* (1952) reaffirms man's freedom of choice and moral responsibility. Steinbeck's biological training inclined him to apply an optimistic naturalistic determinism to human affairs, but he also shows tendencies toward mystical transcendentalism, and he is much given to symbolism.

Many critics, however, would rate the Mississippi novelist William Faulkner as possessing the most powerful imagination of any American novelist of the period. He, too, has often seemed a sensationalist, notably in *Sanctuary* (1931), and many readers were astonished when, upon receiving the Nobel prize for 1949, he declined "to accept the end of man . . . because he alone among creatures has a soul, a spirit capable of compassion and sacrifice and endurance." It is man's failure to live on his highest spiritual level which produces the horrors that Faulkner so often depicts and deplores. All his most significant novels—*Sartoris* (1929), *The Sound and the Fury* (1929), *As I Lay Dying* (1930), *Light in August* (1932), *Absalom, Absalom!* (1936), *The Hamlet* (1940), etc.—are a part of the Yoknapatawpha saga, the history of an imaginary southern county, from the 1830s, treated on the level of legend and myth.

Another characteristic of the period was the revival of the historical novel, moribund since the revival at the turn of the century had spent itself. Mary Johnston (1870–1936) linked the two revivals; her later, deeply mystical books, beginning with *Foes* (1918), though neglected by the public, were far more significant than *To Have and To Hold* (1900) and its successors. Just after World War I, Joseph Hergesheimer (1880–1954) displayed his great knowledge of early Americana in *Java Head* (1919) and other books. But the real revival dated from the sensational success of the *Anthony Adverse* (1933) of Hervey Allen (1889–1949) and the *Gone With the Wind* (1936) of Margaret Mitchell (1900–49). Equally plethoric at a later date were Carl Sandburg's one novel, *Remembrance Rock* (1948), and the remarkable and many-levelled *Raintree County* (1948) of Ross Lockridge, Jr. (1914–48). During years of war and depression, novels about the American past furnished strength and courage, and clarification of values, to many Americans. Substantial reputations were won by, among others, Kenneth Roberts (1885–), Walter D. Edmonds (1903–), Esther Forbes (?–) and Conrad Richter (1890–), who rightly insisted that his purpose, in his trilogy comprising *The Trees* (1940), *The Fields* (1946) and *The Town* (1950) and elsewhere, was "not to write historical novels but to give an authentic sensation of life in early America."

The biblical and religious novels ministered even more directly to the same needs. Lloyd C. Douglas (1877–1951), whose career culminated in *The Robe* (1942) and *The Big Fisherman* (1948), was the most "successful" of religious novelists, but there were better artists among them, such as Gladys Schmitt (1909–) (*David the King*, 1946) and Florence Marvyne Bauer (?–) (*Behold Your King*, 1945). Since Sholem Asch (1880–) long lived in the U.S. though still writing in Yiddish, his New Testament trilogy, beginning with *The Nazarene* (1939), might also be classified here.

The traditional western novel found a fine artist in Eugene Manlove Rhodes (1869–1934) (*e.g.*, his *Best Novels and Stories*, 1949) and was despecialized and brought into line with the main tendencies of serious modern fiction by H. L. Davis (1896–) (*Honey in the Horn*, 1935; and *Winds of the Morning*, 1952), Walter Van Tilburg Clark (1909–) (*The Ox-Bow Incident*, 1940) and A. B. Guthrie, Jr. (1901–) (*The Big Sky*, 1947; and *The Way West*, 1950).

World War II produced many novels, generally much more throughly disillusioned than the books which came out of World War I. Values are honoured in such books as *Mister Roberts* (1946), by Thomas Heggen (1919–49); *Tales of the South Pacific* (1947), by James A. Michener (1907–); and certainly in *A Bell for Adano* (1944) and *The Wall* (1950), by John Hersey (1914–). But the same cannot always be said of the work of such writers as Norman Mailer (1923–) (*The Naked and the Dead*, 1948); John Horne Burns (1916–53); and others. Other products of the war generation, though not essentially writers of war books, include Truman Capote (1925–) (*Other Voices, Other Rooms*, 1948) and Gore Vidal (1925–), both technically adroit but spiritually hollow. There is more to be hoped for, however, from Frederick Buechner (1926–) (*A Long Day's Dying*, 1950; and *The Seasons' Difference*, 1952).

Other novelists whose work attracted attention and who cannot be classified as belonging to any school include the varied and prolific Louis Bromfield (1896–); Gerald Warner Brace (1901–), best known for *The Garretson Chronicle* (1947); Benedict Thielen (1902–), one of the most undeservedly neglected writers (*The Lost Men*, 1946; *Friday at Noon*, 1947; etc.); the accomplished James Gould Cozzens (1903–); Robert Penn Warren (1905–); J. D. Salinger (*The Catcher in the Rye*, 1951); Pearl S. Buck (1892–), who specialized in China; Katherine Anne Porter (1894–); the Florida novelist Marjorie Kinnan Rawlings (1896–1953) (*The Yearling*, 1938); Jean Stafford (1915–); and Carson McCullers (1917–).

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Geismar: *Writers in Crisis* (Boston, 1942), *The Last of the Provincials* (Boston, 1947; London, 1948) and *Rebels and Ancestors* (Boston, 1953).

Important books on individual novelists include Blake Nevius, *Edith Wharton* (Berkeley, 1953); Arthur Mizener, *The Far Side of Paradise* (Fitzgerald) (Boston, 1951); E. K. Brown and Leon Edel, *Willa Cather* (New York, 1953); Robert H. Elias, *Theodore Dreiser, Apostle of Nature* (New York, 1949); Irving Howe, *Sherwood Anderson* (New York, 1951); Carl Van Doren, *James Branch Cabell,* rev. ed. (New York, 1932); Carlos Baker, *Hemingway: The Writer As Artist* (Princeton, 1952); Herbert J. Muller, *Thomas Wolfe* (New York, 1947); Irving Howe, *William Faulkner* (New York, 1952); Harry T. Moore, *The Novels of John Steinbeck* (Chicago, 1939). (E. Wt.)

NOVELDA, a town of east Spain, in Alicante province, on the right bank of the river Vinalopó and on the railway from Madrid to Alicante. Pop. (1940) 8,798 (mun. 10,349). The country is flat and fertile, producing much wine, dates, oranges, oil, saffron and aniseed. At Salinetas de Elda near by are warm sulphur and saline baths.

NOVELLO, the name of a family of English musicians. VINCENT NOVELLO (1781–1861) was born in London on Sept. 6, 1781. From 1796 to 1822 he was successively organist at the Sardinian, Spanish and Portuguese chapels, and from 1840 to 1843 at St. Mary's chapel, Moorfields. He was an original member of the London Philharmonic society, which he sometimes conducted. In 1849 he went to live at Nice, where he died on Aug. 9, 1861. He composed a great quantity of sacred music; but his finest work lay in the introduction to England of unknown compositions by the great masters. The masses of Haydn and Mozart were unknown in England until he edited them, as were also the works of Palestrina and the treasures of Italian music in the Fitzwilliam museum, Cambridge. The first work Novello published, *Novello's Sacred Music, as Performed at the Royal Portuguese Chapel,* appeared in 1811 and marks the founding of the publishing house of Novello.

JOSEPH ALFRED NOVELLO (1810–1896), eldest son of the above, was born in London on Aug. 12, 1810, and died at Genoa on July 16, 1896. He had a career as a bass singer and in 1829 became a regular music publisher. He really created the house of Novello. He first introduced cheap editions to England and departed from the method of publishing by subscription. His assistant Henry Littleton became a partner in 1861 and, when J. A. Novello retired in 1867, sole proprietor. The firm of Ewer and Co. was acquired in 1867 and with it all the copyrights of Mendelssohn's works then existing. On Littleton's death (1888) his two sons carried on the business. His grandsons also eventually became directors. Novello's grew, and became the sole British agent for many continental music publishers.

CLARA ANASTASIA NOVELLO (1818–1908), daughter of Vincent Novello, was one of the most famous sopranos of her time. She was born in London on June 10, 1818. She won continental as well as English renown after she sang at Mendelssohn's invitation at the Gewandhaus concerts in Leipzig in 1837. She died in Rome on March 12, 1908.

NOVEMBER, the ninth month of the old Roman year [Lat. *novem,* nine], which began with March. By the Julian arrangement, according to which the year began with Jan. 1, November became the 11th month and had 30 days assigned to it. Nov. 11 was held to mark the beginning of winter; it is now the day of solemn commemoration of the end of World War I. The senate desired to rename the month in honour of Tiberius—his birthday occurring on the 16th, but the emperor declined, saying, "What will you do, Conscript Fathers, if you have *thirteen* Caesars?" The Anglo-Saxon names for November were *Windmonath,* "wind month" and *Blodmonath* "bloodmonth."

NOVERRE, JEAN GEORGES (1727–1810), French dancer and ballet master, was born in Paris on March 29, 1727. He composed his first ballet in 1747 for the Opéra Comique. After a year spent in Berlin, he mounted the ballets of Christoph Willibald Gluck and Niccola Piccini in Paris in 1749. He was in London (1755–57) and in Lyons (1758–60). From the publication of *Lettres sur la danse et les ballets* may be dated the revolution in the art of the ballet for which Noverre was responsible. (*See* BALLET.) He was next engaged by the duke of Württemberg, and afterward by the empress Maria Theresa, until, in 1775, he was appointed, at the request of Queen Marie Antoinette, *maître des ballets* of the Paris Opera. This post he retained until the Revolution reduced him to poverty. He died at St. Germain on Nov. 19, 1810.

Noverre's friends included François Voltaire, Frederick the Great and David Garrick (who called him "the Shakespeare of the dance"). The ballets of which he was most proud were his *La Toilette de Vénus, Les Jalousies du sérail, L'Amour corsaire* and *Le Jaloux sans rival.* Besides the letters, Noverre wrote *Observations sur la construction d'une nouvelle salle de l'Opéra* (1781); *Lettres sur Garrick écrites à Voltaire* (1801); and *Lettre à un artiste sur les fêtes publiques* (1801).

NOVGOROD (formerly known as *Velikiy-Novgorod,* Great Novgorod), a town of the Russian S.F.S.R., in the Leningrad region, in 58° 33′ N., 31° 20′ E., on the navigable Volkhov, 2 mi. below the point where it issues from Lake Ilmen. Pop. (1933) 38,000. The town has sawmills and manufactures boots and shoes, candles, bricks and tiles and has a brewery and a distillery.

The date at which the Slavs first erected forts in the marshy region of the Volkhov near Lake Ilmen is unknown. That situated on a low terrace close by Lake Ilmen was soon abandoned, and Novgorod or "New-town" (in contradistinction to the Scandinavian Aldegjeborg or Ladoga) was founded by Scandinavian searovers as Holmgård on another terrace which extended a mile lower on both banks of the river. The older fort (Gorodishche) existed in the 13th century. Even in the 9th century the new city on the Volkhov exercised a kind of supremacy over the other towns of the lake region, when its inhabitants in 862 invited the Varangians, under the leadership of Rurik, to the defense of the Russian towns of the north. Down to the end of the 10th century Novgorod to a certain extent depended on Kiev; yet in 997 its inhabitants obtained from their prince Yaroslav a charter which granted them self-government. For five centuries this charter was the bulwark of the independence of Novgorod. From the end of the 10th century the princes of Novgorod, chosen either from the sons of the great princes of Kiev (until 1136) or from some other branch of the family of Rurik, were always elected by the *vyeche;* but they were only its military defenders, and their delegates were merely assessors in the courts which levied taxes for the military force raised by the prince. The *vyeche* invariably expelled the princes as soon as they provoked discontent. Their election was often a subject of dispute between the wealthy and the poorer classes; and Novgorod, which was dependent for its corn supply upon the land of Suzdal, was sometimes compelled to accept a prince from the Suzdal branch instead of from that of Kiev. After 1270 the city often refused to have princes at all, and the elected mayor was the representative of the executive. Novgorod in its transactions with other cities took the name of "Sovereign Great Novgorod" (*Gospodin Velikiy Novgorod*). The supreme power was vested in the *vyeche.* The city, with a population of more than 80,000, was divided into wards, each ward constituting a distinct commune. The wards were subdivided into streets, which corresponded to the occupations of their inhabitants, each being quite independent with regard to its own affairs.

Trade was carried on by corporations. By the Volkhov and the Neva, Novgorod—then known also as Naugart and Novwerden—had direct communication with the Hanseatic and Scandinavian cities, especially with Visby or Wisby on the island of Gotland. The Dnieper brought it into connection with the Bosporus, and it was an intermediary in the trade of Constantinople with northern Europe. The Novgorod traders penetrated to the White sea shores, hunted on Novaya Zemlya in the 11th century, colonized the basins of the northern Dvina, descended the Volga, and as early as the 14th century extended their trading expeditions beyond the Urals into Siberia. Two great colonies, Vyatka and Vologda, organized on the same republican principles as the metropolis, favoured the further colonization of northeast Russia.

It is said that the population of Novgorod in the 14th century reached 400,000, but the pestilences of 1467, 1508 and 1533 carried off no fewer than 134,000 persons. These figures seem to relate rather to the whole Ilmen region.

Invasions of Novgorod.—Novgorod's struggle against the Suzdal region (now the government of Vladimir) began in the

12th century. In the following century it had to contend with the Swedes and the Germans, who were animated not only by the desire of territorial acquisition, but also by the spirit of religious proselytism. Their advances were checked by battles at Ladoga and Pskov in 1240 and 1242 respectively. Protected by its marshes, Novgorod escaped the Mongol invasion of 1240–42, and repelled the attacks of the princes of Moscow by whom the Mongols were supported. It also resisted the attacks of Tver.

The first serious invasion, in 1332, was rolled back with the aid of the Lithuanians. But in 1456 the great prince of Moscow imposed a heavy tribute. Ivan III of Moscow took possession of the colonies in the northern Dvina and the Perm regions, and began two bloody wars, during which Novgorod fought for its liberty under the leadership of Martha Boretskaya, the mayor. In 1475–78 Ivan III entered Novgorod, abolished its charters, and carried away 1,000 of the wealthier families, substituting for them families from Moscow; the old free city then recognized his sovereignty. A century later Ivan IV (the Terrible) abolished the last vestiges of the independence of the city. Having learned that a party favourable to Lithuania had been organized in Novgorod, he took the field in 1570, and entered the city (much weakened by the recent pestilences) without opposition. His followers killed the heads of the monasteries, the wealthier of the merchants and clergy, and burned and pillaged the city and villages. No fewer than 15,000 were massacred at Novgorod alone (60,000 according to some authorities). A famine ensued, and the district of Novgorod fell into utter desolation. Thousands of families were transported to Moscow, Nijni-Novgorod, and other towns of the principality of Moscow.

In the beginning of the 17th century Novgorod was taken and held for seven years by the Swedes; and in the 18th century the founding of St. Petersburg (now Leningrad) finally destroyed its trade. Its position on the water highway from the Volga to St. Petersburg and on the trunk road from Moscow to the capital, still gave it some commercial importance; but even this was destroyed by the opening of the Vishera canal, connecting the Msta with the Volkhov below the city, and by the construction of the railway from St. Petersburg to Moscow, which did not reach Novgorod. Later a branch loop linked the town with the main line and its position improved.

Antiquities.—The town consists of a Kremlin (old fortress), and of the city, which stands on both banks of the river, connected by a handsome stone bridge. The Kremlin was much enlarged in 1044, and again in 1116. Its stone walls, originally palisades, were begun in 1302, and much extended in 1490. Its historical monuments include the cathedral of St. Sophia, built in 1045–52 by architects from Constantinople to take the place of the original wooden structure (989), destroyed by fire in that year. Apart from minor changes the building remained unaltered until its restoration in 1893–1900. It contains highly-prized relics, including 12th century bronze doors, one brought reputedly from Sigtuna, the ancient capital of Sweden. Another ancient building in the Kremlin is the Yaroslav tower. Other remarkable monuments are the church of St. Nicholas (1135), the Znamenski cathedral (14th century), and churches of the 14th and 15th centuries. Within the town itself there are four monasteries and convents, two of them dating from the 11th century and two from the 12th century; and the large number in the immediate neighbourhood shows the great extent which the city formerly had. A monument to commemorate the 1,000th anniversary of the foundation of Russia (the calling in of the Varangians by Novgorod in 862) was erected in 1862. Another monument commemorates the repulse of the Napoleonic invasion of 1812.

NOVI PAZAR (ancient *Rashka*), the capital of the department of Novi Pazar, South Serbia, Yugoslavia, lies at the head of the fertile valley of the Upper Rashka, on the site of the ancient Serbian city of Rashka. Pop. (1931) 10,364, comprising Serbs, Albanians and some Greeks. Agriculture is the only industry. There are Roman baths in the vicinity, and in the old church of St. Peter and St. Paul, the metropolitan church of the bishopric of Rashka, Stephen Nemanya, founder of the Serbian empire, passed from the Roman to the Greek church in 1143. The town was taken by the Serbs and Montenegrins in the Balkan Wars (1912–13), and assigned to Serbia by the Treaty of Bucharest (1913). It was occupied by German troops in 1941.

NOVI SAD (German *Neusatz*), a town of the Voivodina, Yugoslavia. Pop. (1931) 63,985. It is the seat of a Greek Orthodox bishop, and is a prosperous town with wide, well-paved streets, public gardens, a cathedral, a hospital, schools, theatres and barracks. There is a daily market for household commodities, and for the artistic pottery and cotton goods manufactured in the town. Before the union of the province with Yugoslavia at the close of World War I Novi Sad was the literary and religious centre of the Serbians in Hungary, especially after the foundation in 1864 of the *Matica Srbska*, or Serbian Literary society. The town was founded in the middle of the 18th century, and was almost totally destroyed during the revolution of 1848–49. In 1941 Hungarian troops occupied the town and it was reincorporated into Hungary.

NOVOCAINE, an artificial alkaloid, and the most satisfactory of the local anaesthetics introduced in recent years. The hydrochloride is employed in medicine ($C_{13}H_{21}O_2N_2Cl$) and it is a substitute for cocaine. It is very soluble in water and for subcutaneous injections is far superior to cocaine for several reasons: its solutions can be sterilized by boiling whereas cocaine would decompose; it has no irritant action and is of very low toxicity, whereas cocaine is both irritant and toxic. (*See* DRUG ADDICTION and COCAINE.)

NOVOCHERKASSK, a town of the Russian S.F.S.R., in the North Caucasian area, at the confluence of the Don and Aksai rivers, in 47° 28′ N., 40° 5′ E. Pop. (1939) 81,286. It manufactures cloth and machinery and is a collecting centre for corn, wine and timber exports.

Novocherkassk was founded in 1805, when the inhabitants of Old Cherkassk were compelled to leave the site because of the frequent inundations of the Don.

NOVOMOSKOVSK, a town of the Ukrainian S.S.R., 16 mi. N.E. of Dnepropetrovsk (Ekaterinoslav), in 48° 38′ N., 35° 16′ E. Pop. (1926 census) 10,564. It extends some distance along the right bank of the Samara river, a tributary of the Dnieper; its main industry is brickmaking. The Zaporogian Cossacks occupied the site in the 17th century, when it was known as Samarchik. In 1687 Prince Golitsuin founded the Ust-Samara fort there, destroyed after the Treaty of Pruth (1711), but rebuilt in 1736. Near it is the Samarsko-Nikolayevskiy monastery.

NOVOROSSIISK (nŏv-ō-rŏss′ĭsk), Russian S.F.S.R. port on N.E. coast of the Black sea in 44° 42′ N., 37° 45′ E., in the North Caucasian area. Pop. (1939) 95,280. It has connections with the net of Russian railways, with Baku, and with Rostov-on-Don. It has large cement works, and its exports are mainly cement, naphtha, potash, leaf tobacco and champagne, its imports being machinery, coke and coal. Its grain export trade, formerly about 70%, is insignificant, naphtha and cement having largely replaced it. The bay, nearly 3 mi. wide at its entrance and 5 mi. deep from east to west, is exposed to the violent northeast wind (bora), sweeping down from the Caucasus. There is accommodation for 36 steamers. The town became Russian in 1829.

NOVOSIBIRSK (formerly Novo-Nikolayevsk), the chief town in the Siberian Area of the Russian S.F.S.R., in lat. 55° 6′ N., long. 83° 6′ E., situated on the navigable Ob river, where the trans-Siberian railway crosses it on a 9 span bridge 30 ft. above high water level. The town was founded in 1896, but had in 1939 a population of 405,589. In 1915 a branch line was opened from Novosibirsk going through Barnaul, with a branch to Biisk, and on to Semipalatinsk, and a link with the railways of the central Asiatic Russian republics was completed in 1930. There is telegraphic communication with Mongolia. The town is a centre for distributing agricultural machinery. There are also grain elevators, one with a capacity of 16,070 tons, and several well set up flour mills. Butter trains, with ice trucks, start daily for the west, and frozen meat is also exported to Leningrad and Moscow. There are three electric sawmills in Novosibirsk dealing with the timber from this region. The town also exports the woodcock, hazelhen and quails. Other industries are brickmaking, iron-

smelting, oil pressing, distilling, brewing and leather preparation.

NOWATA, a city of northeastern Oklahoma, U.S., in the valley of the Verdigris river; the county seat of Nowata county. It is served by the Missouri Pacific railway. The population was 3,965 in 1950 and 3,904 in 1940 by the federal census. It is the trade centre of a farming, stock-raising and oil-producing region. The city was founded in 1889, when the Missouri Pacific came through, and was incorporated in 1892. In 1913 it adopted a commission-manager form of government.

NOWAWES, a town of Germany, in the province of Brandenburg, 2 mi. E. from Potsdam, on the Berlin-Potsdam railway. The town was founded by Frederick the Great in 1754, and in 1907 the village of Neuendorf was incorporated with it. The industries of Nowawes include the spinning and weaving of jute and silk and the manufacture of cloth, electrical apparatus, boots and locomotives.

NOWELL, ALEXANDER (1507?–1602), dean of St. Paul's, London, son of John Nowell or Read hall, Whalley, Lancashire, was educated at Brasenose college, Oxford, where he is said to have shared rooms with John Foxe. He was elected fellow of Brasenose in 1526. He became master of Westminster school (1543) and prebendary of Westminster (1551). In Mary's reign he was deprived of his prebend, probably as being a married man, before May 1554, and sought refuge at Strasbourg and Frankfort, where he developed puritan and almost presbyterian views. He submitted, however, to the Elizabethan settlement of religion and was rewarded with the archdeaconry of Middlesex, a canonry at Canterbury and in 1560 with the deanery of St. Paul's. His sermons occasionally created some stir and on one occasion Elizabeth interrupted his sermon, telling him to stick to his text and cease slighting the crucifix. He held the deanery of St. Paul's for 42 years, surviving until Feb. 13, 1602. Nowell is believed to have composed the Catechism inserted before the Order of Confirmation in the Prayer Book of 1549, which was supplemented in 1604 and is still in use. Early in Elizabeth's reign he wrote a larger catechism, to serve as a statement of Protestant principles; it was printed in 1570, and in the same year appeared his "middle" catechism, designed for the instruction of "simple curates."

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NOWGONG, a town and district of India, in the Assam Valley division of Assam province. The town (pop. [1941] 12,972) is situated on the Kalang river. The district of Nowgong has an area of 3,898 sq.mi. and a pop. (1941) of 710,800. It consists of a wide plain overgrown with jungle and canebrakes, intersected by numerous tributaries of the Brahmaputra and dotted with shallow marshes. The Mikir hills cover an area of about 65 mi. by 35 mi. in the south of the district; the highest peak is about 3,500 ft. The slopes are very steep and are covered with dense forest; reserved forests cover 500 sq.mi. The Kamakhya hills near the bank of the Brahmaputra are about 1,500 ft. high. On the summit of the highest peak is a celebrated temple of Kamakhya, the local goddess of love, where three annual festivals are held. The staple crop is rice. Tea cultivation and manufacture are carried on but the soil and climate are not so favourable as in upper Assam.

The section of the Assam-Bengal railway from Gauhati to the hills passes through part of the district, and a branch runs through it from Chaparmukh to Silghat steamer station. Lumding is a railway centre of some importance.

NOWGONG, a town of India, headquarters of the Bundelkhand agency, in the state of Chhatarpur, on the border of the former British district of Jhansi. Pop. (1941) 5,999. Kitchener college, an Indian army institution for the training of noncommissioned officers, is situated there.

NOWY SACZ (NEU SANDEC), town, Poland, in the province of Kraków. Pop. (1931) 30,278; (1946) 23,049. It grew to importance through the oriental trade in the 14th century and owed much to the patronage of Casimir the Great. It is near the Carpathians in the valley of the Dunajec, in the country of the Gorale, or Polish Highlanders, It has a church founded by the Franciscans in the 14th century.

Germany took the town in 1939. It was returned to Poland in 1945.

NOYES, ALFRED (1880–), English poet, was born in Staffordshire on Sept. 16, 1880, and educated at Exeter college, Oxford. The *Loom of Years*, his first volume of poems, appeared in 1902, and his *Collected Poems* in 1910, 1920, 1927 and 1947. His *Forty Singing Seamen* (1907) and *Drake* (1908) struck the patriotic note of a poet of the sea. A volume of lectures given in America, *The Sea in English Poetry*, was published in 1913 and in 1914 he was elected to a professorship of modern English literature at Princeton university, Princeton, N.J., which he resigned in 1923. His other publications include: *The Wine Press* (1914); *The Watchers of the Sky* (1912); *Aspects of Modern Poetry*, essays (1924); *The Torch-bearers* (3 vol., 1922, 1925 and 1930; 1 vol., 1937); *Robin Hood*, poetic drama (1927); *Ballads and Poems* (1928); *The Return of the Scarecrow*, novel (1929); *The Opalescent Parrot*, essays (1929); *Voltaire* (1936); *Orchard's Bay* (1939); *The Edge of the Abyss* (1944); and *Shadows on the Down* (1945).

NOYON, a city of northern France, in the department of Oise, 67 mi. N.N.E. of Paris by the railway to Brussels. Pop. (1946) 6,035. Noyon is built at the foot and on the slopes of a hill.

Noyon, the ancient Noviomagus Veromanduorum, was Christianized by St. Quentin at the end of the 3rd century; and about 530 St. Medard, bishop of the district of Vermandois, transferred his see there from St. Quentin. St. Eligius was bishop in the 7th century. Charlemagne was crowned there in 768 and Hugh Capet elected in 987. Till the French Revolution the bishopric was one of the ecclesiastical peerages of the kingdom.

At the beginning of the 12th century Noyon obtained a communal charter through the favour of its bishops. Toward the middle of the 12th century the diocese of Tournai was split off. Noyon was ravaged by the English and the Burgundians during the Hundred Years' War. The city was captured by the Spaniards in 1552, and by the Leaguers who were expelled in 1594 by Henry IV. John Calvin was born there in 1509.

Noyon was occupied by the German army in 1914 and was abandoned, bombarded and reduced to ruins, 1917–18. Its beautiful transitional Romanesque Gothic cathedral was burned, and so was the old *hôtel-de-ville*. A good deal of the stone work of the cathedral survived the fire and was later restored. Again in June 1940 Noyon was occupied by the Germans. The town has good trade in livestock and grain and contains chemical and artificial manure works and iron foundries.

NUBA, THE. The Nuba may be regarded as the Negro or negroid aborigines of Kordofan, although at mid-20th century the northern half of the area was inhabited by Arabic-speaking tribes professing Islam, so that Dar Nuba, the country of the Nuba, occupies only the southern half of the administrative province, extending over 2½° to 10° N.

One of the most remarkable features of Dar Nuba is the multiplicity of languages spoken within its bounds. The inhabitants of hills only a few miles apart may speak languages mutually unintelligible, and even on the same *massif* there may be two or three communities speaking different languages and coming little in contact with one another, though their customs and beliefs are fundamentally the same.

The inhabitants of the hills of southern Kordofan situated but little north of the Bahr-el-Ghazal have a series of languages with grammatical structure and vocabularies differing substantially from the Berberine dialects. The resemblances noted between the latter and those of Kordofan apply only to those spoken by a limited number of northern communities which have been subjected to foreign (*i.e.*, Berberine) influence for a considerable period. Moreover, as Meinhof points out, such "Nubian" or "Hamitoid" languages extend scarcely a hundred miles south of El Obeid. Farther south in the territory recognized by the Arabs as the true home of the Nuba (Dar Nuba corresponding on the administrative side roughly to the Jebel subprovince) two groups of languages must be recognized. One includes a number of "Sudan" lan-

guages, the other a series of tongues, called by Meinhof "pre-Hamitic," which, in some respects, resemble Bantu and Fulani and which Struck now terms "Bantoid." These latter languages, first noted in 1910, differ from the Berberine dialects, in which grammatical changes in both nouns and verbs are produced by suffixes, in that in the Bantoid languages these are brought about by initial change.

Struck, who has also studied the Nuba physical material available from the standpoint of its distribution among the linguistic groups considers that each is to be distinguished physically, and although the small number of individuals measured belonging to the Nubian and Sudanic groups renders some of Struck's conclusions premature it is probably true to say that the Bantoid group, with an average stature of 68 in. and a cephalic index of 76.5, is rather longer headed and narrower nosed than the Sudanic who are themselves rounder-headed than the Nubian-speaking group from whom they do not substantially differ in breadth of nose or face.

Mode of Life.—The Nuba are for the most part agriculturists, the regulation of public life in each community being ultimately in the hands of the rainmaker. There is no clan organization among the southern Nuba and no restrictions upon marriage other than those imposed by blood relationship. No bride-price is paid, and either party can break the marriage at pleasure; property passes in the female line. This applies especially to the southern communities speaking Bantoid languages; further north, where a bride-price is paid, matters are less simple. Neither circumcision nor infibulation is practised, but the women of Jebel Talodi and the hills round it perforate the lower lip, in which they wear a quartz ornament. On many hills, especially where the lip ornament is worn, the lower incisors are removed in both sexes.

Darfur.—The non-Arab races of Darfur belong ethnically to, or originated from (many are now mixed) the hill stock, spoken of in Kordofan as Nuba (*supra*). In the north are the Bedayat, a nomad people related to Zaghawa; to the north of these are the Kura'an, who have been identified with the ancient Garamantes. The Zaghawa to the south are mentioned by Mas'udi, while Ibn Khaldun speaks of them as living further east, and at the present day there is a colony of them at Jebel Kagmar in Kordofan. These folk, although Mohammedans, have not yet given themselves Arab pedigrees; they retain their belief in rainmakers and are noted as potters. The people of Jebel Midob about 400 mi. west of Khartoum, described by MacMichael, differ but little from the Nuba of Kordofan; they are perhaps the least unknown of the pagan tribes of Darfur. The Tungur and Dargu are other ancient peoples of Darfur, the latter living by cultivation and breeding cattle in the fertile areas to the west of Dara. None of these peoples are as important as the Fur, from whom the country takes its name. Their stronghold is or was the considerable range known as Jebel Marra, whence they descended probably in the 17th century. Now nominally Mohammedans they still worship stones or trees to the extent that certain spots associated with rocks or trees are regarded as holy and are the scenes of sacrifice. (C. G. S.)

NUBAR PASHA (1825–1899), Egyptian statesman, was born at Smyrna in Jan. 1825, the son of an Armenian merchant named Moghreditch who had married a relative of Boghos Bey, an influential minister of Mohammed Ali. He was educated at Vevey and by the Jesuits at Toulouse. After about 18 months' training he was made second secretary to Mohammed Ali. In 1845 he became first secretary to Ibrahim Pasha, the heir apparent, and accompanied him on a special mission to Europe. Abbas Pasha, who succeeded Ibrahim in 1848, maintained Nubar in the same capacity and sent him in 1850 to London as his representative to resist the pretensions of the sultan, who was seeking to evade the conditions of the treaty under which Egypt was secured to the family of Mohammed Ali. There he was so completely successful that he was made a bey. In 1853 he was sent on a similar mission to Vienna, where he remained until the death of Abbas in July 1854. The new viceroy, Said, at once dismissed him from office, but two years afterward appointed him his chief secretary and later gave him charge of the important transport service through Egypt to India. Nubar was then mainly instrumental in the completion of railway communication between Cairo and Suez. After falling a second time a victim to Said's caprice and being dismissed, he was again sent to Vienna, but returned as principal secretary to Said, a position he held until Said's death in Jan. 1863.

On the accession of Ismail (*q.v.*), Nubar Bey was in the prime of life. He was already on friendly terms with Ismail; he even claimed to have saved his life—at all events, it was a coincidence that the two had together refused to travel by the train the accident to which caused the death (on May 14, 1858) of the prince Ahmed, who would otherwise have succeeded Said. Ismail charged him with a mission to Constantinople, to notify his accession and to smooth the way for various projects, notably the completion of the Suez canal, the change in title to that of khedive and the change in the order of succession. The sultan, believing as little as every one else that the canal was anything more than a dream, gave his consent at a price the moderation of which he must afterward have regretted. The gratified Ismail created Nubar a pasha, and the sultan himself, persuaded to visit Cairo, confirmed the title so rarely accorded to a Christian. Nubar was sent to Paris to complete the arrangements and to settle the differences between Egypt and the canal company.

On his return Nubar created the department of public works; but in 1866 he was made minister of foreign affairs and at once went on a special mission to Constantinople, where he obtained the sultan's consent to the adoption by Ismail of the title of khedive and the change in the law of succession. Nubar now had a harder task to undertake than ever before. The antiquated system of "capitulations" which had existed in the Ottoman empire from the 15th century had grown in Egypt until there were practically 17 *imperia in imperio* (*see* EGYPT: *History*). That in spite of the jealousies of all the powers, in spite of the opposition of the Porte, he should have succeeded in replacing the 17 consular courts by mixed international courts with a uniform code puts Nubar in the first rank of statesmen of his period.

The extravagant administration of Ismail, for which perhaps Nubar can hardly be held wholly responsible, had brought Egypt to the verge of bankruptcy, and Ismail's disregard of the judgments of the court at last compelled Great Britain and France to interfere. Under pressure, Ismail, who began to regret the establishment of the international courts, assented to a mixed ministry under Nubar, with Charles Rivers Wilson as minister of finance and De Blignières as minister of public works. Nubar, finding himself supported by both Great Britain and France, tried to reduce Ismail to the position of a constitutional monarch, but he lost the support of Great Britain and France and was dismissed. (*See* ISMAIL.) He remained out of office until 1884, when he was induced to become premier as the instrument of British policy, but he soon found himself in disagreement with Lord Cromer and was dismissed by the khedive Tewfik in 1888. Riaz Pasha, who succeeded him, was, with one interval of eight months, prime minister until April 1894, when Nubar returned to office. By that time Cromer had more completely grasped the reins of administration as well as of government, and Nubar had realized more clearly the role which an Egyptian minister was called on to play: Lord Cromer was the real ruler of Egypt, and the death of Tewfik in 1890 had necessitated a more open exercise of British authority. In 1895 Nubar completed his 50 years of service and retired. He died in Paris in Jan. 1899.

See P. Crabitès, *Ibrahim of Egypt* (London, 1935).

NUBIA, a region of northeastern Africa, between upper Egypt, the Red sea and the Libyan desert and extending south indefinitely to about Khartoum. It includes the Nile valley from Aswan near the First Cataract to the confluence of the White and Blue Niles, stretching for about 560 mi. between latitudes 16° and 24° N. Nubia, however, has no strictly defined limits and is little more than a geographical expression. Its name is derived from *nob* (slave) in the Mahas dialect of the language known as Nubian, of which four different dialects are spoken between Aswan and Dongola.

The first historical mention of the Nuba is in Strabo, *Geography*, book 17, ch. 1 and 2, where they are described as "a large tribe,

who beginning at Meroe, extend as far as the bends of the river and are not subject to the Ethiopians but are divided into several separate kingdoms."

The country consists mainly of sandy desert and rugged and arid steppes and plateaus through which flows the Nile. In this section of the river there occurs a continuous series of slight falls and rapids, and between Khartoum and Philae it makes a great S-shaped bend, the region west of the Nile within the lower bend being the Bayuda desert and that east of the Nile the Nubian desert, which districts roughly correspond to the conventional divisions of upper and lower Nubia respectively. Most of Nubia is within the almost rainless zone. An auriferous district lies between the Nile and the Red sea, in 22° N. Politically Nubia is now divided between Egypt and the Anglo-Egyptian Sudan and has no administrative existence.

The life and agriculture of Egypt and the Sudan depend upon the Nile (*q.v.*), which, for a great part of its course, flows through Nubia. The railway from Alexandria and Cairo terminates at El-Shellal and is joined by a steamer service with Wadi Halfa. The Sudan railway system connects Wadi Halfa, Atbara, Port Sudan, Kassala, Gedaref, Sennar, Kosti and El Obeid. Kosti is connected by river steamer and road with east Africa. (D. M. H. E.)

ARCHAEOLOGY

In Nubia the early Stone Age ran its usual course. Pre-Chellean tools occur at Wadi Halfa and at Nuri below the Fourth Cataract. Chellean tools are found at Wadi Halfa, between the Second and Third Cataracts at Sai Island and Wawa, in Wadi Hudi near the mouth of the Atbara river and near Omdurman. Acheulean tools occur near Wadi Halfa, at Lagiya in the Wadi el-Gaab and at Omdurman. Early Levallois occurs near Tangâsi between the Third and Fourth Cataracts; and Acheulean-Levallois hybrid cultures near Wadi Halfa, at Selima oasis, north of Abri and, in the Tumbian form, at Omdurman.

The Levalloisian technique lasted long. It is seen in the Sebilian culture from Kom Ombo and in surface finds all over Nubia; and it still affected cultures at the beginning of the historic period.

Fossils have been found associated with the Sebilian at Wadi Halfa. In the Upper Sebilian, microliths become dominant, suggesting the Capsian culture from North Africa with its backed-blade technique. Similar microliths are widely found on the surface; and at Khartoum a culture with Capsian connections and indistinguishable from the Wilton of South Africa occurs with bone spears with four or more barbs, barbed bone arrowheads and red-ware pottery bowls decorated with wavy-line impressions made by a catfish spine. The makers were Negroes who lived by hunting and fishing. They had no domestic cattle and did not cultivate. This culture has been found as far north as the Fourth Cataract and between Wadi Howar in the west and Kassala in the east.

It was followed between Jebel Aulia and the Second Cataract by one in which gouges, celts and amazon stone beads, all typical of the Fayum Neolithic, occur with pottery, most of which is burnished and the most typical of which is a hard red ware decorated with triangular impressions in a pattern imitating basketwork. This pattern developed out of the wavy-line pottery of Early Khartoum. Early forms of black and black-topped red ware occur; and shards burnished after combing or incision show how easily rippled ware could have developed. With this Khartoum Neolithic culture occur zeolite lip plugs, notched fishhooks of shell and bone harpoons, most of which have four or more barbs and a perforated butt and resemble examples from Taferjit and Tamaya Mellet in French West Africa. The next culture so far known is one with pottery sometimes decorated with ripples made by pebble burnishing over combing. One such pot found at Omdurman is identical in all but size with one from the A-group cemetery at Faras near Wadi Halfa, which has been dated to the reigns of Zer and Zet (about 3000 B.C.) by pottery and copper tools imported from Egypt. At Omdurman about 18 pots were buried in each grave. Gourd shapes were common and small deep bowls. Large deep bowls of coarse red ware decorated with squares alternately plain or hatched by impressions made by catfish spines show connections with both Early Khartoum and the Gerzean of Egypt.

Rock pictures are frequent along the Nile between the First and Third Cataracts, and while no doubt a few representing wild animals date from the prehistoric period, all historic periods are represented. Sites of the earlier Egyptian predynastic have not been found south of Dakka. There is on a rock near the Second Cataract an apparent reference to the conquest of lower Nubia by Zer, third king of the 1st dynasty, and Egyptian imports dating from his and the succeeding reign were found in the neighbouring A-group cemetery of Faras. Lack of sites in Nubia associated with the Old Kingdom may be because of the activities of those Pharaohs: the earliest historic reference to Nubia is to a raid by Seneferu (*c.* 2750 B.C.) who built ships and "hacked up" the land of the Nehesi (*cf.* modern Mahas) and brought back many prisoners and cattle; it is probable that such raids devastated a land in which civilization had flourished during the Neolithic and predynastic periods. Under the 5th and 6th dynasties (2500–2300 B.C.) Egypt's contact with the south became rather more peaceful. Although under Pepi I military expeditions had been led by Uni to the Nehesi lands of Irthet, Medju (*cf.* modern Beja), Yam, Wawat, Kau and the land of Temeh, nevertheless Herkhuf of Elephantine made four trading expeditions during the reigns of Merenre and Pepi II, as far as Yam (Darfur ?), returning with donkeys laden with incense, ebony, leopard skins and ivory.

After the fall of the Old Kingdom a cattle-owning people (the C-group) came into the area between the First and Second Cataracts and survived until the beginning of the 18th dynasty. They lived on the river bank in settlements of round huts of wood and grass and buried their dead beneath mounds of earth protected by circular walls of dry stone. They wore leather clothing; and bowls of black or brown ware, decorated with elaborate incised patterns often filled with white and later with coloured pigments, are characteristic of their pottery. Under the 11th dynasty Egypt turned its attention to the south again. An inscription near Aswan records the dispatch of ships to Wawat.

The first Pharaohs of the 12th dynasty, Amenemhet I and Senusret I, occupied Nubia as far as Semna, about 50 mi. S. of the Second Cataract. Communications with Egypt were protected by massive mud-brick forts. A trading post was built probably in the reign of Amenemhet II (1938–04 B.C.) at Kerma at the downstream end of the Dongola reach and 150 mi. S. of Semna. Kerma was probably the home of the chief of Cush. In graves excavated locally the principal occupant was laid in native fashion on a bed in a large low tumulus, while women and retainers, sometimes numbering hundreds, were buried alive with him. It is in any case most unlikely that G. A. Reisner was correct in thinking that it was the headquarters of successive Egyptian governors. The Egyptian statues found in these graves were presumably traded to the princes of Cush by Egyptian merchants during the Second Intermediate period (*c.* 1700 B.C.). At Kerma Egyptian craftsmen developed local industries. They made exquisitely fine burnished black-topped red pottery never again equalled, objects in faïence and quartz decorated with blue glaze and short copper swords with ivory hilts.

The southern group of Egyptian forts (Mirgissa, Shelfak, Uronarti and Semna) were probably built by Senusret III (*c.* 1887–50 B.C.) after a local rising. Until the 13th dynasty the level of the Nile flood was recorded at the forts at Semna. These levels show that the Nile was 26 ft. higher in flood then than it is today, and the rainfall must have been greater than now to provide grazing for the C-group cattle and to allow tribes to live on the west bank in what is now desert.

At some period subsequent to this, and probably connected with the expulsion of the Hyksos from Egypt, these forts were all destroyed by fire. Shards of C-group and Pan-grave pottery and stone axes copying bronze axes typical of the 17th dynasty have been found as far east as Agordat in Eritrea.

Ahmose I, the founder of the 18th dynasty, began the reoccupation of Nubia and built a temple at Buhen (Wadi Halfa); and his successor Tuthmosis I occupied the whole of Cush at least as far as 50 mi. S. of Abu Hamed, where he set up a boundary inscription. Cush was now incorporated in Egypt under a viceroy, whose first duty was to dispatch the tribute of Nubia to

Egypt. Informative representations of the arrival of this tribute in Egypt may be seen in tomb and temple at Luxor. Almost every Pharaoh founded a town or built one or more temples in Nubia from the local sandstone. The most splendid was that at Sulb dedicated to Amon and himself by Amenhotep III, who also built a smaller one at Seddenga for the worship of his queen Tiy. Other temples include those built by Hatshepsut at Buhen, Tuthmosis IV at Barkal, Amenhotep IV at Sesibi and Tutenkhamon at Faras and Kawa.

The construction of temples was continued under the 19th dynasty. Rameses II built two great rock-hewn temples to himself and his queen at Abu Simbel, and also temples or shrines at Gerf Hussein, Beit el-Wali, Wadi Sabu'a, Dirr, Ibrim, Faras and Aksha in lower Nubia; and his name occurs at Amara West, Sai, Kawa and Jebel Barkal in upper Nubia. In places, as at Kawa, he was not above erasing the name of the original builder and substituting his own. Seti I built the town wall at Amara West and probably built the original temple, to which various kings up to Rameses IX made additions. The known antiquities of Nubia under the New Kingdom are entirely Egyptian. They include at Aniba tombs built with pyramidal roofs like those at Deir el-Medina; and farther south inscriptions at Tangur, Dosha, Nauri, Tumbus and Kurgus.

From the period between 1100 and 750 B.C. nothing is known. Napata seems to have been still Egyptianized when in 750 B.C. Kashta set himself up there as king of Cush and conquered upper Egypt, founding the 25th dynasty. Reisner on slight evidence concluded that this dynasty was Libyan. Piankhi (*c.* 725 B.C.) included the rest of Egypt in his empire, and Shabaka his successor transferred the capital to Thebes and was known as king of Cush and Egypt. Piankhi built the great temple of Amon at Napata. The only monuments of Shabaka and Shebitku (Shabataka) in Nubia were their pyramids at Kurru. All the pyramids in this cemetery are now ruined, but the painted chambers of Tanutamon and his sister Kalhata are preserved. The burial chamber was excavated in rock below ground level, approached from the east by a stairway cut in the rock. The pyramid was built on ground level above the chamber and had a small mortuary chapel on its eastern face. (These chapels have all disappeared at Kurru and Nuri, but some of those at Meroe remain, and the designs with which they are decorated are of considerable interest and importance.) Taharka built more than one temple at Napata, carved four colossal figures out of the face of Jebel Barkal and built the largest pyramid of a new cemetery at Nuri. A disastrous clash with the Assyrians, who were armed with iron weapons and had recently included Palestine in their empire, led to the evacuation of Egypt by Taharka. His successor Tanutamon temporarily reoccupied upper Egypt, but was soon forced to abandon it (661 B.C.). The dynasty, however, continued to reign, first at Napata (with a palace at Meroe) and subsequently at Meroe, for about 1,000 years. The immediate successors of Tanutamon (Atlanersa, Senkamanseken, Anlaman, Aspalta, Amtalka and Malenakan, *c.* 653–538 B.C.) were able to construct pyramids and temples in the pure Egyptian style. A temple at Jebel Barkal was begun by Atlanersa and finished by Senkamanseken. The sun temple at Meroe (mentioned by Herodotus) was built by Aspalta; and the temple of Amon at Meroe was apparently built by Aspalta, Amtalka and Malenakan.

It is not unlikely that Meroe became the political capital soon after the loss of Egypt, although the kings were buried at the old religious capital of Napata up to Nastasen (*c.* 308 B.C.). The kingdom no doubt stretched as far as Sennar, where a scarab of Shabaka has been found, and Jebel Moya, where objects dating from Taharka to Aspalta and later were discovered; and it is reasonable to suppose that from Sennar it extended to the gold country of Beni Shangul, and from Jebel Moya to the Shilluk country on the upper White Nile.

In lower Nubia, there are the graffiti of Greek and Syrian mercenaries of Psammetichus II (594–589 B.C.) at Abu Simbel and Buhen in the reign of Aspalta. The Persians are said to have invaded Nubia under Cambyses in 522 B.C., but of this there is no evidence, although Nubians with carnelian-tipped arrows served in the army of Xerxes.

From his study of the royal cemeteries of Napata and Meroe, Reisner constructed a king list covering this period. Twenty kings and some of their queens were buried at Nuri, and all their names have been recovered. Forty-one rulers, who succeeded them, of whom 23 have been identified and 4 or 5 were queens, were buried from 300 B.C. in pyramids at Meroe. Reisner thought that during this later period there were two occasions when Napata was for a time independent of Meroe and its rulers buried in the earlier of the two groups of pyramids at Jebel Barkal. But there is some doubt about this, although the names of four kings did turn up at Kawa that were not found at Meroe. Ergamenes (225–200 B.C.) built the temple of Dakka and imported an Egyptian scribe to decorate his tomb chapel. He and his successors (who built six large pyramids) represent the most prosperous period of Meroe, when relations with Ptolemaic Egypt were friendly. But, cut off from Egypt, the Egyptian culture of the kingdom naturally degenerated. The Meroitic cursive script was invented before 200 B.C. When it was in general use, the knowledge of Egyptian and Egyptian scripts was quickly lost. Soon after 150 B.C. the Meroitic hieroglyphic script was invented for decorative inscriptions. The traditional offering scenes, which occur on the older pyramids, were now varied, giving them a distinctive Meroitic tinge. Degeneration was continuous until 45 B.C., when Queen Amanishakhete came to the throne. In 23 B.C. Gaius Petronius had invaded Napata with a Roman army as a result of frontier trouble in lower Nubia, when the statue of Augustus had been looted from Syene (modern Aswan). He destroyed Napata and, retiring, left a garrison at Ibrim. Queen Amanishakhete is buried in the second largest pyramid, in which Giuseppe Ferlini found a hoard of treasure. Her successors, King Natakamani and Queen Amanitere (15 B.C.–A.D. 15), repaired the temple of Amon at Meroe, built two temples at Naga, a temple at Wad Ban Naga and one at Amara East—the last two disappeared during the 19th century—and restored the great temple of Amon at Napata. The colossal royal statues on the temple site on Argo Island probably belong to this period. From this date degeneration was unchecked. The pyramids get gradually smaller, red brick eventually replacing stone in their construction. Red brick was much used for building in the latter centuries at Meroe, and in the last palace it was used in a crude imitation of a Roman bath.

Nubia entered the Iron Age during the Meroitic period. A few manufactured iron objects were imported in the 6th century B.C., but by 480 B.C. Nubia was still practically without iron. Pyramid foundation deposits first include iron about 360 B.C., when it probably began to be smelted at Meroe, although remaining a royal monopoly for several centuries. Meroitic pottery at Faras was predominantly wheel-made with some elaborate painted designs in the 2nd century A.D. To the same date belong fine ware, with repeated impressions of small stamps with designs such as the ankh, and imported barbotine cups. Handmade pottery including black ware with impressed designs filled with red or yellow pigment also occurred and was probably more frequent in the south. Artificial reservoirs in the island of Meroe, some of them associated with small temples (as at El-Musawwarat, Naga, Hardan, Awateib, Basa, Duanib and Umm Usuda) and in the Gezira were a feature of the Meroitic period and suggest decreasing rainfall.

The last record of the kings of Meroe is a demotic inscription from Philae recording an embassy of King Tekerideamani in A.D. 253. The knowledge of writing died out. There are no inscriptions on the walled group of temples at El-Musawwarat. The Blemmyes of the eastern desert (Beja) destroyed the Meroitic culture in lower Nubia; and Meroe itself was destroyed *c.* A.D. 350 by an expedition dispatched by Aeizanes, king of Axum, to crush a trade rival.

The Meroitic culture is followed in Nubia by one attributed by Reisner to the X-group. These may have been the Nobatae, a name possibly derived from confusion between Nuba and Napata (the "Red Nuba" of Aeizanes). They replace the northern kingdom of Napata, which had twice made itself independent of Meroe. The X-group tumulus is a direct descendant of the Meroitic pyra-

mid, and X-group pottery is in the Meroitic tradition. X-group cemeteries occur at Napata (Zuma and Tangāsi) and at Wawa, Sai Island, Firka, Atiri, Gemai, Adindan, Ballana, Kustul, Ibrim and Kalabsha. The royal cemeteries at Ballana and Kustul covered two centuries. The kings were buried with Meroitic insignia, and human beings and animals were sacrificed to accompany them. Grave goods included imported Byzantine objects; but no evidence of a written language was found. In the Meroe area graves contemporary with the X-group contain many large handmade mat-impressed pots and smaller bowls burnished and decorated with incisions near the rim. Large mound graves of this period are common as far south as Khartoum. The X-group have also been identified with the Blemmyes, who from the 3rd century had continually troubled Egypt and by the 5th century were established at Talmis, combining with the Nobatae to raid upper Egypt. They were compelled by Florus in A.D. 452 to keep the peace but were allowed to visit the temple of Philae and to borrow the statue of Isis.

About A.D. 540 the Nobatae were converted to Christianity, and shortly after that, at Kalabsha, their king Silko, now a Christian, records his defeat of the Blemmyes and of the upper Nobatae (of Napata?). After this the capital of the Nobatae seems to have been at Pachoras (Faras), until they were amalgamated with Makuria in the single Christian kingdom of Dongola. South of that was the kingdom of Alwa with its capital at Soba near Khartoum. Alwa had become Christian in A.D. 580.

In A.D 652 a Moslem army from Egypt captured Dongola and compelled the kingdom to pay tribute to Egypt. Arabic historians often mention relations between Egypt and Nubia; but the kingdom of Dongola remained Christian until the 14th century, when it was overrun by Mameluke armies from Egypt. The stone castles of Nubia (Sai, Khandag, Bakhit, etc.), which show crusader influence, date from the unsettled period before the final fall of Dongola. Soba survived for another two centuries, and then gave place to the Moslem Fung kingdom of Sennar.

The churches of Nubia were small, when not adaptations of heathen temples. Some were built of stone masonry, but brickwork was commoner. In the north there were two principal types, basilican and domed, and mud brick was usual; whereas in Dongola a typical church had red brick walls with a roof supported by four granite monolith columns with separate granite capitals. Mural paintings covered the walls. Little now remains of any of these churches except one or two small mud-brick buildings in out-of-the-way places (*e.g.*, the church of Abdelgadir near Wadi Halfa), and the ugly atypical fortified church at Old Dongola, which owes its preservation to its conversion to a mosque in the 14th century. In Dongola in the Christian period graves frequently had a rectangular stone superstructure with tombstones inscribed with Greek letters and either Greek or Coptic inscriptions; and circular stone cairn graves of the same period also occur as far south as Khartoum and west across northern Kordofan. Rare inscriptions of Old Nubian in Greek characters have also been found. Pottery in the Meroitic tradition continued in the Christian period, the best being a thin ware coated with a white slip and decorated with designs in sepia.

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NUBIAN LANGUAGE AND WRITING. Nubian is the name given to the language of the Barabra or Nubians in the Nile valley, between Merawi, a few miles below the ancient Napata, and the First Cataract at Aswan. It has there two principal dialects, the Mahass-Fadija being spoken in the central portion, from a little south of the Third Cataract, and the Dongola-Kenzi at either end of the region; the speech of these Barabra is now pervaded with Arabic words.

Moreover, in the hills of Kordofan dialects of Nubian are spoken by many small communities among other languages only remotely akin, and are found westward as far as eastern Darfur. Nubian is without gender, agglutinative and mainly monosyllabic. Nubian roots are traceable in Ethiopian geographical names handed down by classical authors; but perhaps the chief interest of the language is its use in the writings of the Nubian Church.

Probably to fortify their independence against Moslem encroachment, the Nubians adapted the Greek alphabet, with necessary additions from the Coptic and perhaps the Meroitic alphabets, to the purpose of writing their own language. The rare examples of Nubian writing that have been discovered, besides graffiti and two legal documents, comprise portions of a lectionary, homilies and edifying narratives, obviously translated from Greek and not from Coptic. The earliest dates from the end of the 8th century, the latest from the beginning of the 14th.

See H. N. Almquist, *Nubische Studien im Sudān 1877–78*, ed. by Zetterstéen (Uppsala, 1911) (Bibl.); F. L. Griffith, *The Nubian Texts of the Christian Period* (Berlin, 1913); H. Junker and W. Czermak, *Kordofān Texte im Dialekt von Gebel Dair* (Vienna, 1913). (F. LL. G.)

NUBIANS: *see* BARABRA.

ÑUBLE, a province of central Chile, bounded north by Maule and Linares, east by Argentina, south by Concepción and Bío-Bío and west by Concepción and the Pacific ocean. Area, 5,487 sq.mi., according to the redefinition of the limits of the province in the 1930s; pop. (1952 census) 251,607. The province lies partly in the great central valley of Chile, noted for its fine climate and fertility, partly on the western slopes of the Andes and partly in the coast ranges. The Itata river, which forms a part of the southwestern boundary, and its principal tributary, the Ñuble, form the drainage system of the province. Agriculture, including viticulture, and grazing are the principal industries. The state railway from Santiago to the southern provinces passes through Ñuble, from north-northeast to south-southwest, and sends off a branch from Búlnes west to Tomé on the Bay of Concepción. The capital is Chillán, pop. (1952) 52,576; other important towns are San Carlos and Búlnes. The hot baths of Chillán (Termas de Chillán), in the eastern part of the province on the slope of the volcano of that name, are popular in Chile.

NUCERIA, an ancient city, Magna Graecia, on the west coast of Italy near the modern Nocera Tirinese. It was a small city in an important strategic position between two rivers, the valley of one of which afforded a route to the valley of the Crathis, but had no harbour.

NUCLEUS, the term used in biology to designate one of the two main structural components of the living cell, the other component being the cytoplasm. Usually the nucleus is a spherical or ovoid vesicle. It derives its importance fundamentally from the presence of the hereditary materials (chromosomes, genes, *q.v.*) which it encloses and keeps separated from the cytoplasm by its surrounding membrane, except at the time of cell division (*see* CYTOLOGY). It is present in the cells of practically all animals and plants except the bacteria and the blue-green algae. In the latter

the hereditary materials appear to be scattered in the cytoplasm. (C. W. M.)

NUCLEUS. The nucleus of the atom is a particle of very small radius and exceedingly great density located at the centre of the atom. All but a negligible fraction of the atomic mass is concentrated in the nucleus. At the same time the size of the nucleus is more than 10,000 times smaller than the size of the atom. The approximate size of the atom, in turn, is a few billionths of an inch (*i.e.*, one, two or three times 10^{-8} cm.). The nucleus carries a positive electric charge which is an integral multiple of the elementary charge (whose magnitude is 4.8×10^{-10} electrostatic units).

DESCRIPTION AND HISTORY

The first clear evidence about the internal structure of the atom was obtained by E. Rutherford in 1911. He was led by his experiments to assume that atoms consist of a nucleus, as described above, and a number of electrons. These electrons carry a negative elementary charge (of magnitude 4.8×10^{-10} electrostatic units) and they have a mass which is a small fraction of the atomic mass. (The fraction representing the total weight of the electrons in the atom to the atomic weight is $\frac{1}{1,840}$ in the case of hydrogen, the lightest element, or $\frac{1}{4,760}$ in the case of uranium, the heaviest element.) The number of electrons in the atom is equal to the number of positive charges the nucleus carries so that the atom as a whole is neutral. The atomic number and the designation Z are used for either of these quantities. All chemical and most physical properties of atoms are determined, apart from exceedingly small variations, by the atomic number, Z. Atoms having a given Z value form an atomic species. For example, if the nucleus has one unit of charge and one electron is present, we have a hydrogen atom. As further examples, nuclei with 2, 6, 26, 79 and 92 charges may be mentioned; the corresponding atoms have 2, 6, 26, 79 and 92 electrons and the atomic species are helium, carbon, iron, gold and uranium, respectively. The chemical transformations, the appearance and common behaviour of materials built from the atoms depend only on the configuration of the electrons. This is influenced, in turn, only by the nuclear charge and is practically independent of other properties of the nucleus. The atomic properties are discussed in detail in ATOM. In the following the interest is in the central particle; *i.e.*, the nucleus.

Formerly it was believed that atoms were immutable entities. This statement did not imply that the configuration of the electrons in the atoms could not change. It was, indeed, soon recognized that chemical changes are caused by the rearrangement of the electrons. As long as the charge of the nucleus has remained the same, however, the atom is considered unchanged. No matter what deformation occurs in the electron arrangement, it will always return to the normal configuration as soon as the disturbing force is removed.

In 1896 H. A. Becquerel noticed that uranium emits unusual radiations, designated as radioactivity. In the next few years the work of Marie and Pierre Curie, E. Rutherford, F. Soddy and others led to the recognition that the phenomenon had to be explained by a spontaneous, permanent and intrinsic change of the atomic species (*see* RADIOACTIVITY, NATURAL). In uranium this is brought about by the emission of a particle from the nucleus which carries away two units of positive charge and which is called an α-particle (alpha particle). Thus the uranium nucleus, originally containing 92 units of charge, disintegrates into a nucleus containing 90 units of charge. This nuclear charge characterizes a different atomic species, thorium. These phenomena will be discussed later in the section on α-decay. The emitted particle has a very high velocity, only 20 times smaller than the greatest possible velocity, that of light. Thus a much larger kinetic energy is concentrated on the α-particle than was ever before found on a body of comparable mass. Actually the α-particle is the nucleus of the helium atom.

In the hands of Rutherford these α-particles became powerful tools in exploring the interior of the atoms. In experiments published in 1911 Rutherford showed that the majority of particles pass through thin (of the order of $\frac{1}{10,000}$ in.) but solid foils without being deflected. A few α-particles were scattered through quite large angles. These observations could be explained by assuming that the α-particles had collided with heavy, charged particles, the atomic nuclei. The greater number of small deviations were the result of "distant" collisions; *i.e.*, of forces acting between two particles which did not approach closely. The large deflections were caused by the larger force of two charged particles more nearly in contact. In order to account for the large number of undeviated particles, the nucleus had to be given a radius small compared with that of the atom. Rutherford assumed that the charge of the nucleus is positive and that the remainder of the atom consists of the light negatively charged electrons.

Collisions between the α-particles and the electrons are much more frequent than the noticeable collisions between α-particles and nuclei, but because of the small mass of the electron these collisions do not result in an observable deflection of the α-particles. Rather they cause a gradual loss of energy of the α-particles. The distance through which the particle travels before it loses all of its available energy is called the range of the particle. The range depends, in general, on the initial energy of the particle, on its charge, its mass and on the density of the electrons with which it can collide. The hypotheses which Rutherford made to explain his experiments have been fully verified by the great body of experimental and theoretical studies of atomic and nuclear physics.

In 1919 Rutherford observed that nitrogen bombarded by α-particles emitted a new product. This turned out to be a nucleus of the hydrogen atom, which is called a proton, carries a single unit of positive charge and is the simplest of all atomic nuclei. The reaction was produced by a close collision of the α-particle and the nucleus of the nitrogen atom, which carries seven positive charge units. The α-particle attached itself to the nitrogen nucleus, producing a so-called compound nucleus ˙ high internal energy. From this structure the fast proton is subsequently emitted. The actual time for the emission is an exceedingly small fraction of a second.

The result of this nuclear reaction is that the nitrogen nucleus, having absorbed the α-particle with two positive charges and having emitted a proton carrying only one positive charge, has now turned into an oxygen nucleus. In this way Rutherford's experiments accomplished the transmutation of nitrogen atoms into oxygen atoms. At the same time the bombarding helium nuclei were transformed into hydrogen nuclei. In the process the kinetic energy of the system had also changed. The final particles contained less energy than the original helium nuclei.

Rutherford's experiments also explained why the transmutation of elements could not be accomplished by the previously used methods of chemistry and physics. Artificial change of nuclear charge requires a nuclear reaction induced by the close contact of two atomic nuclei. Because of the strong electrostatic repulsion of the positively charged nuclei, sufficiently close contacts can occur only if the nuclei approach each other with a high initial velocity. The required high velocities do not occur in chemical processes and thus the endeavour of the alchemists to transmute elements by chemical means was doomed to failure. As soon as methods and techniques specialized in the production and observation of high-velocity particles were developed, transmutation of atoms could be observed.

The study of atomic nuclei remained a field sharply separated from the investigation of atoms and from other branches of chemistry and physics. The reason for this is twofold. First, the details of nuclear structure influence the properties of the atom as a whole and the properties of matter in bulk to an exceedingly small extent.

Thus the study of the structure of matter could proceed without detailed knowledge of the atomic nucleus. Second, the internal behaviour of nuclei can be influenced only when energy is present in very high concentrations. The required high energies are carried by α-particles such as were used in Rutherford's experiments. In chemical and most physical processes, however, the concentration of energy is not high enough to influence the behaviour of

nuclei to a noticeable extent. Thus, nuclear processes occur, so to speak, in a world of their own and unusual special methods must be devised to penetrate into this world.

For several years following the publication of these first experiments on nuclear transmutations, radioactive materials occurring in nature remained the only source of high-energy particles. The study of nuclear processes was handicapped by the relatively small number of particles these sources made available to the experimenter. Observations had to be made over quite long periods of time and results had to be based on the observations of relatively few processes. Nuclear scientists therefore made every effort to produce similarly fast particles by artificial means. The first machine to do this was the "cascade transformer" of C. C. Lauritsen, H. Crane and others which was completed in 1928. This was followed by the machine of J. D. Cockcroft and E. T. S. Walton in 1929 and the "electrostatic generator" of R. J. Van de Graaff in 1931. These machines are called "linear accelerators," a term derived from their common fundamental principle. The charged particles, such as protons or α-particles, are introduced at one end of a cylinder containing a very strong and extended electric field. As the particles move through the field they are continuously accelerated. In order that no energy should be lost by collisions with atoms, the cylinder is evacuated. The fundamental principle of these machines is the method by which the necessary electric fields are obtained.

Another principle was used in the cyclotron (E. O. Lawrence, 1932, *see* CYCLOTRON). In this machine particles are confined by a magnetic field to a spiral-shaped orbit and accelerating electric fields are repeatedly applied while the particles are moving along this orbit.

The betatron (D. W. Kerst, 1940) is similar to the cyclotron in that the particles are confined by a variable magnetic field. The acceleration, however, is accomplished by the principle of induction. According to this principle, increase of current in one coil induces an opposite current in a coaxial coil. In the betatron a change of current in a coil causes an acceleration of electrons which do not move in a second coil but rather in free space. An important practical difference between the cyclotron and the betatron is that the former is used to accelerate atomic nuclei while the latter accelerates electrons.

After 1945 improvements in all these machines became possible through closer control of the electromagnetic fields which are used to confine and accelerate the particles. In some of these, electrons or nuclei are accelerated in straight lines (L. Alvarez, acceleration of protons, 1946; H. H. Hansen, acceleration of electrons, 1948). Acceleration is achieved by the continuous action of an accelerating field which moves along with the accelerated particle. A machine of the cyclotron type is the synchrotron (E. M. McMillan, 1945) for the acceleration of electrons. In this machine electrons are kept in a circular orbit by a changing magnetic field and the acceleration is accomplished by repeated application of an electric field near a certain point in the orbit of the electrons. By a close correlation between the changing magnetic field and the period in which repeated accelerations are applied (synchrocyclotron), it became possible to accelerate nuclei to very high energies; the highest energy reached in the early 1950s was in the cosmotron at Brookhaven National laboratory, Upton, N.Y. The energy obtained was approximately 500 times higher than the energy of the α-particles of uranium.

These high-voltage machines were capable of producing a considerable number of nuclear reactions which were, in principle, analogous to the reaction studied by Rutherford in 1919. In some of these reactions energy was released, in others energy was absorbed, but in all cases the energy changes were great compared with the energy changes involved in chemical reactions.

In 1932 Irène Curie and F. Joliot discovered that by nuclear reactions radioactive nuclei can be produced. In their experiments they used, like Rutherford, α-particles. With these they bombarded boron atoms, whose nuclei carry five elementary charges. The resultant nucleus contained two more charges and was therefore a sevenfold charged nucleus, or a nitrogen nucleus. This nitrogen nucleus differed from all nitrogen nuclei found in nature in that it emitted a particle called the positron. This particle is similar in all respects to the electron discussed above except that it carries a positive rather than a negative charge. In the following years a great number of radioactive nuclei were produced. Many of these emit positive electrons like the nitrogen nucleus just described, others emit the more common negative electrons. Radioactivities of this type are called β-activities, and the positive or negative particles emitted by the nuclei are called β-rays. (*See* RADIOACTIVITY, ARTIFICIAL.) Actually β-radioactivity was discovered practically simultaneously with α-activity, but up to 1932 only a few naturally occurring β-activities were known. All elements can be obtained in a radioactive form.

Considering the great energy release which was frequently encountered in nuclear reactions, the question arose whether it would be possible to utilize this energy. This was not possible for the following reason: in order to release nuclear energy one had to start with highly energetic particles. Most of these particles, if they impinge on a piece of matter, will not get close to nuclei and will not produce reactions but will instead squander their energy by making collisions with light electrons. In this way the originally concentrated energy of the particles will ultimately be transformed into heat. Only a small fraction, less than $\frac{1}{100}$ of 1%, of the originally fast particles get close enough to an atomic nucleus to produce a nuclear reaction. In these rare instances the nuclear energy may be greater, sometimes even 10 or 100 times greater, than the energy of the impinging particle but since these processes occur only rarely, the net gain in energy is small. The bombardment of a piece of material by a stream of energetic, charged particles will thus produce a heating of the bombarded sample which is only slightly increased by the reactions occurring in the sample. Considering the exceedingly high cost of the original source of energy, the actual slight energy production could not be considered as a practical source of power.

A great number of additional nuclear transformations became possible in 1932 when J. Chadwick discovered the neutron (*q.v.*). This particle has a mass which is very slightly in excess of the mass of the hydrogen nucleus, or proton. In contrast to the proton, however, it carries no charge and is the only known nuclear particle that is neutral. Consequently the neutron does not attract any electrons and does not have the property of other nuclei of surrounding itself with an extended electron configuration. Thus one of the striking properties of the neutron is that it may penetrate practically freely through several inches of solid materials, being influenced in its path only whenever it touches an atomic nucleus.

The fact that neutrons are not charged gives rise to a second important consequence. This is that neutrons can approach any nucleus without being repelled by the charge on the nucleus. Therefore a neutron need not have a high velocity, or a high energy, in order to cause a nuclear reaction. Unlike the charged particles the neutrons can approach with equal ease nuclei of small charge like nitrogen nuclei or nuclei of big charge like gold or uranium. This fact was utilized by many investigators following 1932 to explore a great number of nuclear reactions. E. Fermi and his collaborators in Rome, It., were by far the most active and successful workers in the field.

The fact that a neutron need not possess energy in order to approach a nucleus reopens the question whether nuclear reactions can be used to produce useful power. Unfortunately neutrons could be produced only in reactions in which fast particles were involved. A typical example is the reaction described above in which a fast α-particle impinges on a boron nucleus and forms a radioactive nitrogen nucleus. In this reaction a neutron is also ejected. In the final analysis this neutron represents as costly an investment of energy as the fast particle itself and practical power production seems to remain unattainable.

Actual utilization of nuclear energy on a big scale became a concrete possibility at the end of 1938 when O. Hahn and F. Strassmann in Berlin, Ger., discovered uranium fission. These investigators made a careful study of the artificial radioactive substances which were obtained when neutrons impinged on the uranium nucleus. Fermi and his collaborators had noticed several

years previously that when a uranium nucleus is hit by a neutron, a variety of radioactive substances are produced. At that time the reaction was not understood. Hahn and Strassmann specifically identified barium in the bombarded uranium target they were studying. To explain the presence of this much lighter element a very violent reaction must have occurred in the uranium nucleus. It was concluded that the nucleus of uranium, because of its large size and the repulsion of its many positive charges, is on the verge of disintegration. The additional energy brought into the nucleus by the neutron is sufficient to make the nucleus break apart. The process is called the fission of the nucleus. The electrostatic repulsion of the product nuclei at the instant of fission makes them fly apart with great velocity and an amount of energy, unusually large even in the scale of nuclear energies. This splitting of the uranium nucleus can occur in a number of ways, giving a variety of pairs of disintegration products. These nuclei, which are unstable and disintegrate by β-particle emission, add to the energy liberated by the reaction. The above conclusion was reached and verified experimentally by several scientists. The first of these were O. Frisch and L. Meitner in Copenhagen, Den.

It was further guessed that neutrons are liberated in fission making possible a chain reaction. If, for instance, 2 neutrons were emitted, these could react with uranium nuclei producing 4 neutrons. These would multiply to 8, then to 16 and so on. In a few steps the number of neutrons will become extremely large, the reaction is accelerated and energy is liberated at an ultimately explosive rate. Later in 1939 L. Szilard, F. Joliot and others experimentally verified the liberation of a sufficient number of neutrons. This was the necessary proof of the feasibility of a chain reaction and work was begun on producing such a reaction. To control the chain reaction means, first, to allow neutrons to multiply and, subsequently, to strike a balance of neutron production and neutron absorption so that the number of neutrons just maintains itself and does not grow to explosive proportions. This was first achieved under the guidance of E. Fermi on Dec. 2, 1942, at The University of Chicago. Subsequently, many additional nuclear reactors were built, all based on the principle explained above. Some of these reactors liberate considerable amounts of energy and progress has been made toward transforming this energy into useful power.

In 1942 the development of the explosive aspects of the nuclear chain reaction was undertaken by a group headed by J. R. Oppenheimer. On July 16, 1945, the first so-called "atomic" bomb was exploded in the desert near Alamogordo, N.M. Afterward, two atomic bombs were exploded over Japan. In the following years numerous tests of atomic bombs were carried out by U.S. scientists in the Pacific and Nevada; by Russian workers; and by a British group in Australia. Later, atomic explosions based on the building up of light nuclei came to be frequently discussed and were reported to have been achieved by the U.S. and the U.S.S.R. The nuclear reaction involved here is that of the fusion of small nuclei into bigger units rather than a fission of the heaviest nuclei into two parts. The fusion reaction is most easy if hydrogen nuclei are involved which carry only a single unit of charge and if the temperature in the reaction is extremely high so that charged particles can approach each other. The designations "hydrogen bomb" and "thermonuclear bomb" refer to the facts just mentioned.

DETECTION OF NUCLEAR PROCESSES

When a nuclear reactor produces energy, and particularly when an atomic bomb explodes, the effects of nuclear processes are very noticeable, even without elaborate detecting devices. The energy released appears in the form of heat or, in the case of the atomic bomb, partly in the form of motion of air masses, light and other radiations. Some of these radiations are capable of ionizing and rearranging individual molecules. If that happens extensively in living tissue, radioactive burns result and the tissue may suffer serious damage.

In the development of nuclear science, both past and future, observations of an individual process are more important than the observation of the impressive phenomena that accompany the large-scale release of nuclear energy. Individual nuclear processes are observable, in fact, for two reasons. One is that particles participating in nuclear reactions as a rule have exceptionally high energy and are, for that reason alone, noticeable among the myriads of atoms of comparable size but much lower energy through which these nuclear fragments move. Another reason is that the effects of these fast particles can be amplified. Thus, while the effects are usually too small for direct observation, they can easily be detected by the use of suitable apparatus.

Any of the charged particles or electromagnetic radiations connected with nuclear reactions can produce an effect in a photographic plate similar to that of light. This effect essentially consists of producing disturbed grains in the photographic plate. These disturbed grains then are developed in subsequent chemical processes so that a deposition of metal big enough to be visible to the naked eye or under the microscope is formed at the position of the disturbed grain. The process of developing plays in this special instance the role of amplifying the original effect of the nuclear radiation. The characteristic property of nuclear fragments is their high energy by which they can activate a number of grains lying along a straight line. Use of photographic plates of various sensitivities and detailed study of the density of the excited grain and of the length of the track make it possible to recognize the kind and energy of the particles that cause the track. It is interesting to note that the blackening of a photographic plate by the faintly radioactive pitchblende started H. A. Becquerel in 1896 on the first investigation of a nuclear process. Half a century later the finer methods of observation described above made photographic plates most valuable tools of research in nuclear physics.

The Wilson cloud chamber, devised by C. T. R. Wilson in 1912, is a piece of apparatus especially designed for the detection of charged nuclear fragments. (*See* WILSON CLOUD CHAMBER.) In its general principle of action it is similar to the photographic plate. In the latter nuclear radiations give rise to disturbed centres in the photographic emulsion. In the cloud chamber, α-rays or other fast charged particles form ions, *i.e.*, charged atoms or molecules, along their paths. The process of developing is replaced in the cloud chamber by a process of condensation. The cloud chamber contains a vapour, usually water vapour, which is maintained at a temperature just above the condensation temperature. Following the passage of nuclear particles, the cloud chamber is expanded and by this process the vapour contained in it is cooled so that condensation sets in. The water molecules are attracted to the ions which mark the trail of the fast particle. Thus a set of droplets is formed making the path of the particle visible. The process of amplification in this case is the growth of the droplets around the ions.

There is one method of observing nuclear particles without the use of an amplifying mechanism. This is the method of observing fluorescence or scintillations. Along the path of the fast particles atoms and molecules are not only ionized but also disturbed to various degrees. These atoms and molecules return to their normal states and in doing so emit light. The light effects produced in a suitable fluorescing material by a single α-particle are actually visible to the naked eye. These individual processes are called "scintillations." It is remarkable that in a scintillation the effects of a single nuclear process can be seen directly without the use of intervening equipment. This is possible because of the great amount of energy of the α-particle and the extremely great sensitivity of the human eye. As a practical means of studying nuclear reactions the observations of scintillations were of great importance around 1920. The scintillation method, combined with sensitive apparatus for the detection and amplification of light, again proved of great usefulness.

Purely electric apparatus may be used to detect nuclear particles. In these detecting devices the ions produced by the nuclear particles are set in motion by electric fields. This can be done in a variety of ways. The field may be chosen relatively small and its effect may be merely to collect the ions on an electrode. In this case the resulting current is always so small that in order to observe it one has to amplify the current. This is done by

equipment similar to the common radio receiving sets. If stronger fields are used to move the original ions, these ions may acquire enough energy to knock electrons out of other atoms or molecules, thereby producing more ions. In this way some amplification takes place immediately. This initial amplification might become so considerable as to develop into an actual discharge, as happens in the Geiger-Müller counter.

Electric detecting devices are particularly useful because of their great flexibility. They can be set in a way to become selectively sensitive to a specific particle. When arranged and coupled in an appropriate manner these electric devices can count particles of a specified energy. They can be used to study the coincidence in time of two processes. Therefore they are capable of furnishing the important information whether two nuclear particles have been released in the same process. Finally, by purely automatic methods one can keep records of the number of various kinds of particles that have passed through a counter.

While electric fields are most frequently used in collecting the ionized atoms along the path of a nuclear fragment, magnetic fields are frequently used to determine the exact speed and energy of the fragments. Simultaneous use of electric and magnetic fields gives a further piece of important information, namely the mass of the particle with which we are dealing. This latter piece of equipment, the mass spectrograph, is not, properly speaking, an instrument of detection, but a precision instrument, designed to measure one of the basic properties of nuclei.

Among the nuclear fragments there is one which cannot be observed directly by any of the methods described above. This particle is the neutron. The detection of neutrons proceeds as a rule in an indirect way. The collisions of the neutron with atomic nuclei of various kinds produce fast, charged particles or electromagnetic radiation and either of these may be detected by one of the many methods which have been described.

CONSTITUENTS OF THE NUCLEUS

According to ideas in the 1950s the nuclei are built from two simpler particles, the neutrons and the protons. These two particles, which are considered the building blocks of nuclei, are also called nucleons. As has been mentioned above the protons carry the elementary charge (4.8×10^{-10} electrostatic units), whereas the neutrons do not carry a charge. The masses of the proton and neutron are 1.6730×10^{-24} and 1.6752×10^{-24} g., respectively. In nuclear physics it is customary to introduce a special unit of mass, 1.6604×10^{-24} g. This mass is actually $\frac{1}{16}$ of the mass of the most abundant stable variety of the oxygen nucleus.

In general a nucleus contains Z protons and N neutrons, where Z and N are integer numbers. The charge of the nucleus is Z times the elementary charge. It was pointed out in the first section that the atomic species is determined by Z alone. Nuclei of the same atomic species may, however, contain various numbers of neutrons. It is found, for instance, that hydrogen with Z equal to one may have N equal to zero, one or two. Such members of the same atomic species with different N values are called isotopes. It is customary to differentiate isotopes by a superscript equal to $Z+N$ following the chemical symbol of an atomic species. Thus the isotopes of hydrogen are H^1, H^2 and H^3. Frequently the Z value is indicated by a leading subscript, *i.e.*, ${}_1H^2$, but this subscript may be omitted since the chemical symbol also indicates the Z value. As further examples, the isotopes of oxygen may be mentioned, where Z equals 8 and N may be 6, 7, 8, 9, 10 or 11, and isotopes of uranium, in which Z is equal to 92 and N may have any value from 135 to 148. Further isotopes are being discovered.

Because isotopes have the same Z value and hence the same chemical behaviour, it is extremely difficult to separate them. Methods depending on the difference in mass, or N value, have been developed (*see* ISOTOPES) but these are much more expensive and less efficient than chemical processes.

The total number, $Z+N$, of particles in the nucleus is called the mass number and is designated by A. The actual mass of a nucleus differs by a small amount from the sum of the masses of its protons and neutrons. It should be noticed that while the charge of the nucleus is exactly Z times the elementary charge, the mass of the nucleus is not obtainable in a similarly simple manner. A more detailed discussion of this remarkable fact will be given in the next section.

Among nuclei which contain few particles it is often found that the values of Z and N are nearly the same. Some of the most abundant isotopes found in nature such as ${}_2He^4$, ${}_6C^{12}$, ${}_7N^{14}$ and ${}_8O^{16}$ exhibit this phenomenon. As one goes to heavier nuclei the number of neutrons increases faster than the number of protons in the nucleus. In uranium, for instance, the most abundant isotope has 54 more neutrons than protons.

There is no consistent theory as to the forces which hold neutrons and protons together in the nucleus. In order to assure stability it must be assumed that these forces are in the main attractive. In the following there will be occasion to discuss some properties of these forces. Here it is sufficient to mention that these forces have extremely short range. The forces between neutrons and protons become negligible if the distance exceeds the order of magnitude of the nuclear diameter.

In addition to nucleons, that is, protons or neutrons, other particles are known to be emitted in nuclear transformations. Among these the α-particles and β-particles should be mentioned. These occur in the great majority of spontaneous nuclear disintegrations (spontaneous radioactivity) and historically they were the first to be observed. Nevertheless they are not considered to be primary constituents. In fact the α-particle may be considered to consist in turn of two protons and two neutrons, having a charge of two and a mass of approximately four units. The fact that α-particles so often occur as the product of nuclear disintegrations is caused by the extraordinary stability of this particular arrangement of protons and neutrons.

The reason β-particles, which are either negative or positive electrons, are not considered regular constituents of the nucleus is more involved. According to the basic theory of atomic physics one cannot confine a particle of small mass, such as the electron, in a region as small as the nuclear radius without giving it an energy greater than the nuclear energy. In other words, the paradox occurs that the electron, if thus confined, must have an energy great enough to permit the particle to escape.

Nuclear theory describes the emission of negative or positive electrons as a process in which the negative or positive electron is created at the moment of emission. This concept becomes plausible when it is added that both the creation and annihilation of pairs of positive and negative electrons have been observed outside of nuclei. Thus these electrons cannot be considered immutable. Any attempt to assume the presence of these electron pairs in the nucleus leads to a complicated picture where any number of positive and negative pairs may be assumed to be present. In the accepted theory and for the following discussion, the presence of positive and negative electrons is ignored. Attention is confined to a model composed of neutrons and protons.

NUCLEAR ENERGY

Observations of natural and artificial nuclear transmutations prove that the energies involved in nuclear reactions are of great magnitude. In fact, these energies are larger by a factor of 1,000,000 than the energies involved in chemical reactions. The neutrons and protons are bound together in nuclei about 1,000,000 times more strongly than atoms are bound together in chemical compounds or in the most stable crystals known. This great energy is closely associated with a general law of atomic physics according to which the binding or localization of a particle in a smaller region necessarily requires a greater binding energy.

The most direct way to obtain nuclear binding energies is the study of nuclear reactions. Thus if one nucleus of the lithium isotope Li^6 is bombarded by a deuteron, the nucleus of heavy hydrogen, H^2, two nuclei of helium are obtained. The reaction may be written similarly to an equation in chemistry:

$$Li^6+H^2\rightarrow 2He^4.$$

In order to produce the reaction the bombarding deuterons must contain enough kinetic energy to approach the lithium nucleus in spite of the electrostatic or coulomb repulsion of the two

particles. The required energy is a few hundred thousand electron volts. (The electron volt, abbreviated ev, is the usual unit of energy in atomic and nuclear physics. It is the energy an elementary charge gains when it falls through a potential of one volt. One electron volt equals 1.6×10^{-12} ergs or approximately 1.5×10^{-18} of the work done in lifting a pound weight to a height of one inch.) The energy contained in the two resulting α-particles is equal to the energy of the deuteron plus an additional 22.17 million electron volts (Mev). This difference in energy arises from the stronger binding of the neutrons and protons when combined in two helium nuclei, rather than in a lithium nucleus and a deuteron. The total binding energy of the helium nucleus compared with four free particles is 28 Mev or 7 Mev per particle. This is close to the largest binding energy per particle in any nucleus. The binding energy is a negative energy in the sense that one has to add energy to decompose a helium nucleus into neutrons and protons.

A determination of nuclear binding energies is often complicated because of the fact that the reaction products have an excess internal energy, or excitation. The energy of excitation is retained by the nucleus for a very short time and then is emitted as γ-rays. These γ-rays are electromagnetic waves and are similar to light. There are, however, significant differences: γ-rays are emitted by nuclei, light is emitted by atoms; γ-rays carry away in a single process about 1,000,000 times more energy than light does; considered as a wave process, γ-rays have approximately 1,000,000 times shorter wave length than light. The most striking difference is that γ-rays are invisible though they cause physiological changes which are not specifically localized in the eye.

These γ-rays can enter actively into nuclear reactions. The absorption of γ-rays may excite a nucleus and furnish enough energy to cause the nucleus to disintegrate. The most common result of such a disintegration is the splitting off of a neutron. If a nucleus of deuterium is bombarded by γ-rays containing an energy of 2.2 Mev or more, the nucleus may disintegrate into a neutron and a proton, $H^2+\gamma\rightarrow n^1+H^1$. Since the energy of the γ-rays can be measured independently, this type of reaction furnishes an additional method of obtaining binding energies. The reaction just described indicates a binding energy of 2.2 Mev for the deuteron.

The great amount of energy liberated in nuclear reactions makes it possible to use a method of energy measurement for nuclei which in other cases is impractical. The method of energy determination is based on a law obtained from theoretical arguments by Albert Einstein in 1905: whenever the energy of a system is changed, the mass is changed by a corresponding amount.

Energy changes in familiar objects are accompanied by exceedingly small changes in mass and, thus, the mass change postulated by Einstein was beyond the powers of observation. As an example consider a large spring weighing, say, 5 lb. and suppose a force of 3,000 lb. compresses the spring 6 in. The change of mass is $10^{-12}\%$ of the mass of the spring. In chemical reactions the change in mass is a few orders of magnitude larger, but still too small for observation. Let us suppose a gram molecular weight of pyrite (FeS) (87.9 g.) is formed from iron and sulphur. The change in mass, calculated from the heat energy released in the reaction, is 10.7×10^{-10} g. This corresponds to one billionth of 1% change in mass.

If now a neutron and a proton are considered as combining to form a deuteron, the energy liberated is 2.18 Mev per deuteron. This represents a difference in mass between the two particles when free and when combined in a deuteron of about a tenth of 1%. This difference is large enough to be measured accurately. Therefore, by reversing this procedure and measuring the difference in mass of separated and combined particles, the binding energy of the particles can be calculated. Thus the statement of the previous section, that the mass of a nucleus is not equal to the mass of the constituent particles, is explained by the mass change accompanying the energy change.

The relationship between mass and energy changes stated by Einstein may be written:

$$\Delta E=\Delta m\, c^2$$

where ΔE is the energy change expressed in ergs, Δm is the accompanying change of mass given in grams and c is light velocity, equal to 3×10^{10} cm. per second. If the energy is measured in million electron volts (Mev) and the mass is measured in the usual nuclear mass units ($\frac{1}{16}$ of the mass of the oxygen atom) then the above relation gives a change of 1/931 nuclear mass units for every Mev change in energy.

As an example, we consider the mass of deuterium or heavy hydrogen, H^2, which is composed of a proton, H^1, and a neutron, n. The masses in nuclear mass units are:

$$\text{Mass of } H^2 = 2.01412,$$
$$\text{Mass of } H^1 = 1.00754,$$
$$\text{Mass of } n = 1.00894.$$

$\Delta m=$mass of H^1+mass of $n-$mass of $H^2=0.00236$. To convert this mass difference into a binding energy, we multiply by 931 and obtain 2.2 Mev.

The choice of the unit of mass as $\frac{1}{16}$ of O^{16} can now be clarified. On this basis, the masses of other atoms are nearly integer numbers because in O^{16} the binding energy of the nucleons is similar to the binding energy in most other nuclei. Thus the mass of the nucleons in O^{16} is similar to the mass of the nucleons in other nuclei and if the total mass of O^{16} is set equal to the total number of nucleons contained in that nucleus, that is to 16, masses of other nuclei will be close to integer numbers.

FURTHER PROPERTIES OF NUCLEI

The particles that compose the nuclei, *i.e.*, the protons and neutrons, have a property which in a subtle way influences nuclear structure. These particles behave as though they were rotating around their own axes. There is no reason to believe that the statement just made can be taken in a literal sense. A picture as detailed as a definite axis localized in the particle is misleading. Nevertheless, neutrons and protons behave in many respects like rotating tops. The protons and neutrons carry an angular momentum which is half the unit of angular momentum in atomic physics. (The magnitude of unit angular momentum is 1.0546×10^{-27} erg-seconds and is usually called $\hbar$. This quantity is $\frac{1}{2\pi}$ times h, the quantum of action. *See* QUANTUM MECHANICS.) The angular momentum or spin of neutrons and protons behaves according to a certain set of rules. If the spinning motion around a given direction in space is investigated, it will always be found that the magnitude of the proton and neutron spin is one half of a spin unit, but that the sign of the spinning motion may have one of two opposite values. In other words the rotation may be clockwise or counterclockwise. The spin of nuclei may be considered as composed of the spins of the neutrons and protons in the nucleus. In the deuteron, which consists of a neutron and a proton, the spins of the neutron and proton seem simply to add, giving a total spin of one unit of angular momentum. The spin of the α-particle, which contains two protons and two neutrons, is equal to zero. In this case the spins of the constituent particles may be considered as partly clockwise and partly counterclockwise, so that the effects of the individual spins cancel. Indeed the spin was found equal to zero in all nuclei containing an even number of neutrons and an even number of protons.

To the angular momentum caused by the spins of neutrons and protons there must be added the effect of the motion of these particles along their orbits within the nucleus. Consider the nucleus of the lead isotope containing 208 particles. The spin of this lead isotope has been found equal to zero. Now if a proton, which carries one half unit of spin, is added to the nucleus, the result is a nucleus of bismuth (Bi^{209}) and it might be expected that this nucleus had a spin of one half (zero, caused by Pb^{208} plus one half, caused by the proton). Actually the nuclear spin of Bi^{209} is nine halves. Therefore an additional spin or angular momentum is present which is caused by the motion of the proton in its orbit.

Spin values of nuclei show a few simple regularities. If the system contains an even number of particles of spin one half, the total spin is zero or an integral multiple of the atomic unit of angular

momentum. If the system contains an odd number of particles of spin one half, then the system has a spin which is $n+\frac{1}{2}$ atomic units, where n is any positive integer or zero. This rule follows from the basic facts of atomic physics and from this rule was derived a strong argument against the presence of electrons in nuclei. According to earlier ideas the deuteron was considered as composed of two protons and an electron. Now the electron, like the proton, possesses a spin which is one half unit of angular momentum. This would give the deuteron an odd number of particles, each with one half unit of spin and according to the statement made above, the deuteron would be expected to have $n+\frac{1}{2}$ spin units. Actually it has a spin of one unit. If, on the other hand, the deuteron is assumed to consist of a proton and a neutron, the observed spin value agrees with the rule given above.

The spin of neutrons and protons suggests the idea of an internal rotation. Whenever a charged particle like the proton rotates, one expects to find that the particle behaves like a magnet. Furthermore, from the charge and the spin may be predicted the strength of the magnet associated with the proton. The proton, indeed, behaves like a magnet, but the strength of the magnet is 2.79 times the predicted value. This has been considered as an indication that the proton is not quite a simple particle but can undergo some internal change.

According to the simplest ideas the neutron, not carrying a charge, should have no magnetic effects. This again turns out to be incorrect. The neutron carries a magnetic moment whose strength is 1.935 times the predicted strength for the proton and whose sign is opposite to that of the proton. This means that the magnetic properties of the neutron are those of a rotating negative charge. The discrepancies just mentioned do not contradict any rigorous predictions of atomic theory but only those conclusions based on the idea that neutrons and protons are particles of a very simple kind.

The magnetic moment of the deuteron is almost but not quite the sum of the magnetic moments of the proton and neutron. The fact that there is a slight deviation does not constitute a real difficulty if one considers the effect of the orbits of these two particles within the deuteron. In general all nuclei which have a spin have a magnetic moment. Detailed predictions are not possible because knowledge of the internal structure of nuclei is meagre.

Neutrons and protons have a further peculiarity in that two particles of the same kind are never found to occupy the same state. This rule bears the name of the "Pauli exclusion principle." Within a nucleus orbits may be assigned to the nucleons (neutrons or protons). This assignment has to be made in such a manner that no more than two neutrons (or protons) shall be found in one orbit. Further, if there are two neutrons (or protons) in one orbit then these two particles must differ in spin; *i.e.,* one spin must be clockwise and one must be counterclockwise. It is possible for these two particles to be in the same orbit only because they differ in another one of their properties. The rule that two particles cannot be in the same state is thus satisfied. We see that the spin is significant for the details of nuclear structure. The possibility of two spin orientations allows the presence of two neutrons (or protons) in the same orbit of the nucleus.

The configuration of two neutrons or two protons in the same orbit seems to be stable so that, in general, a somewhat greater binding energy is found if the number of neutrons and the number of protons in the nucleus are both even; less if one or the other number is odd. The smallest binding energies are found for odd numbers of both neutrons and protons. In fact, only four stable isotopes are known with odd Z values and odd N values: H^2, Li^6, B^{10} and N^{14}. All others in this category are radioactive, indicating that the nucleus possesses sufficient energy to cause a transformation. Atomic species with even mass numbers are more abundant in the earth's crust and atmosphere than atomic species with odd mass numbers. The most abundant elements, Fe^{56}, Si^{28} and O^{16}, for instance, have even charges as well as even mass numbers. This is further evidence for the stability of the nuclei in question.

The simplest example of a very stable nucleus is helium, He^4. As many particles as possible are put into the lowest orbit which can hold two protons and two neutrons. As mentioned before, the packing fraction of helium is large. Any additional particles, either protons or neutrons, must go into new orbits in which the binding energy per particle is less.

Atomic nuclei behave differently according to whether A is even or odd. If the mass number is odd, then two identical nuclei cannot occupy the same state. If the mass number is even, two identical nuclei can be placed in the same state. In the former case we say that the nuclei obey Fermi-Dirac statistics; in the latter case we say that Einstein-Bose statistics apply. The two kinds of behaviour may be more exactly described by a statement concerning a function, the wave function (*see* QUANTUM MECHANICS), which describes the behaviour of particles, in particular the behaviour of pairs of identical particles. In the case of Einstein-Bose statistics this wave function remains unchanged if the positions of the identical particles are interchanged. In the case of Fermi-Dirac statistics a similar change leads to a change in sign of the function. Which of the two rules applies can be found experimentally by studying the rotation of a diatomic molecule containing the two identical nuclei. In this case the rotation actually brings about the interchange of the nuclei.

The application of these rules gives further proof that neutrons and protons, rather than protons and electrons, are the proper constituents of nuclei. For example, take a nucleus of nitrogen, ${}_7N^{14}$, which experimentally has been shown to obey Bose statistics. Assuming electrons and protons in the nucleus there would be present a total of 14 protons and 7 electrons. According to knowledge concerning protons and electrons, the interchange of two electrons or of two protons changes the sign of the function characteristic of the system. Thus the interchange of 14 protons and 7 electrons will invert the sign 21 times which amounts to a simple reversal of sign. This contradicts Einstein-Bose statistics which imply that interchange does not change the wave function. If on the other hand, ${}_7N^{14}$ is considered an assembly of 7 protons and 7 neutrons the interchange of the nuclei inverts the sign 14 times, which is equivalent to saying that the interchange leaves the sign unchanged.

It is seen, therefore, that a detailed consideration of finer nuclear properties like spins and wave functions gives the same final results as were obtained by more crude arguments: nuclei are built from neutrons and protons. To assume electrons in the interior of the nuclei would lead to a whole series of difficulties.

β-DECAY

A great number of nuclei are known to emit β-particles; *i.e.,* electrons or positrons. The emission of such a particle is accompanied by the transmutation of the nucleus. The resultant nucleus has the same mass number as the original one. If an electron has been emitted the nucleus in the final state will have one more positive charge than the original nucleus. If a positron is emitted the nuclear charge decreases by one unit. C^{11} is an example of a positron emitter, transforming into B^{11}, a boron isotope. C^{14}, another isotope of carbon, emits an electron and decays into nitrogen, N^{14}. An isotope of potassium, K^{40}, is capable of emitting either an electron or a positron and of transforming into calcium or argon, respectively.

The radioactive decay may be considered as a single act which takes an exceedingly short time, about 10^{-22} seconds. This is not, however, the time in which radioactive substances disappear. These elements have "lifetimes" which have been observed to vary from less than one-tenth of a second to more than 1,000,000,000 years. If there is an assembly of radioactive nuclei of a certain kind, then one half of these nuclei will have undergone radioactive decay in this "lifetime," which is more specifically called the half life.

Each radioactive nucleus has a probability of undergoing the radioactive process per unit time and this probability is independent of the previous history. In particular, this probability does not depend on the length of time the radioactive nucleus has existed. Thus is obtained the law for a radioactive population according to which the radioactive population is halved in each lifetime.

One may assume that each β-decay is caused by one of two basic processes. These are the transformation of a neutron into a proton accompanied by the emission of an electron and the transformation of a proton into a neutron with the simultaneous emission of a positron. These processes are intrinsically slow but the reasons causing the transition or determining its rate are not yet known.

The transition of a free proton into a neutron cannot be observed. This transformation could be written:

$$H^1 \rightarrow n + e^+$$

where n stands for a neutron and e^+ is the symbol of a positron. The neutron is known to be heavier than the proton by 0.00136 mass units and the total reaction products are heavier than the proton by 0.0019 mass units. The mass difference corresponds to an increase of energy during the reaction amounting to 1.77 Mev. If the neutron and positron gained kinetic energy during the reaction, the energy needed would be greater still. Thus at least 1.77 Mev must be supplied if the proton is to disintegrate into a neutron and a positron. Thus the reaction does not occur and the free proton is stable.

On the other hand a neutron can decay giving rise to a proton and an electron,

$$n \rightarrow H^1 + e^-.$$

The proton and electron together are 0.00081 mass units lighter than the neutron. According to the equivalence of mass change and energy change 0.754 Mev of energy are set free. The reaction described here is the simplest of all possible β-decays. It has been actually observed and its lifetime is approximately a quarter of an hour. Neutrons usually disappear much more quickly by reacting with other nuclei.

A β-decay process in a complex nucleus is described by one of the neutrons in the nucleus turning into a proton or one of the protons changing into a neutron, emitting an electron or positron, respectively. This picture correctly describes the fact that the mass number of the nucleus remains unchanged while the charge of the nucleus changes by plus or minus one in the two cases mentioned. In complex nuclei it often does pay to convert a proton into a neutron plus a positron. One may consider, for instance, the decay

$$C^{11} \rightarrow B^{11} + e^+.$$

While the sum of the masses of the neutron and positron is greater than the mass of the proton, the sum of the masses of B^{11} and e^+ is actually less than C^{11}. In the

$$C^{11} \rightarrow B^{11} + e^+$$

process a proton is turned into a neutron and a positron. The necessary energy is supplied by the greater binding energy of the resultant neutron. Thus the question whether or not a nucleus can emit an electron or a positron depends on whether or not the transformation of a proton into a neutron or the transformation of a neutron into a proton can lower the energy of the system. In the energy balance must be included: the mass difference between the neutron and proton, the binding energy of these particles in the nucleus and the mass of the positron or electron which is to be ejected.

It may occur that there is not enough energy available to transform a proton within a nucleus into a neutron and to eject a positron at the same time. A nuclear transformation may nevertheless proceed. Instead of the emission of a positron the nucleus may absorb one of the electrons which are always to be found in the vicinity of the nucleus. In this way instead of having to supply an energy equal to the mass of the positron, one gains the energy corresponding to the similar mass of the electron. For instance, the isotope of manganese containing 54 mass units in its nucleus decays by capturing an electron and one obtains an isotope of chromium.

Consider two nuclei: one shall contain N neutrons and Z protons, the other $N-1$ neutrons and $Z+1$ protons. Add to the latter an electron. Of the two systems now considered, one or the other will have a higher energy and whichever one this is will not be stable but will transform into the other system. Nuclei of the same mass number are called isobars. Two isobars, differing by one charge unit, are called neighbouring isobars. The argument shows that of neighbouring pairs of isobars, one must be unstable.

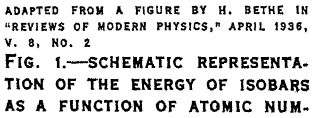
There are a few known cases of neighbouring isobars where both nuclei seem to be stable. The reason for this apparent stability is the small energy difference between the isobars. It will be seen later that β-transformations in which little energy is released may have long lifetimes. In these cases β-processes may be so rare as to escape observation.

Now consider two isobars which differ by two charge units. There are many examples of such isobars. If all other isobars have higher energies than these two, then both of these isobars may be stable. In fact, a single transition will lead to a system of higher energy. A lowering of the energy could occur only if two β-transitions, *i.e.*, the ejection of two electrons or two positrons, occurred simultaneously. It has been mentioned above that the lifetime of radioactive nuclei is very long compared with the time an electron needs to cross the nucleus. This fact can be expressed by saying that the β-process is an improbable one. A process in which two electrons or two positrons undergo this improbable transition simultaneously is so unlikely that one should never expect to observe it.

In the previous section it was stated that nuclei containing an even number of neutrons or an even number of protons have lower energies and are more stable than nuclei containing an odd number of neutrons or an odd number of protons. If a nucleus contains an odd number of neutrons and an odd number of protons then one may suspect that it can assume a more stable configuration in two ways: by emitting an electron and transforming a neutron into a proton or else by emitting a positron and transforming a proton into a neutron. In either case an even number of protons and neutrons will be obtained. It is frequently observed that a nucleus of even mass number and odd Z value emits both electrons and positrons. One example is K^{40} mentioned above.

In a stable nucleus a certain balance exists between the number of neutrons and the number of protons. For a given number of protons the neutron number may vary between narrow limits. If an excess of neutrons is present an electron will be emitted and one of the neutrons turns into a proton. The product will be a stable nucleus or at least one which has a smaller neutron excess. In a like manner, if the nucleus has a proton excess, the nucleus will emit a positron, transforming a proton into a neutron.

These facts can best be summarized in two curves, as shown in figs. 1 and 2. For isobaric nuclei with odd mass number it does not make much difference whether Z is even or odd. In the first case we have an even number of protons but an odd number of neutrons. In the latter case the number of neutrons is even, that of the protons is odd. The result is a smooth dependence of the energy on Z as shown in fig. 1. The arrows indicate possible transitions. For isobaric nuclei with even mass number nuclei with even Z values have a lower energy than nuclei with odd Z values. The former contain an even number of protons and an even number of neutrons, the latter an odd number of protons and an odd number of neutrons. The resulting energies are shown by the curves in fig. 2. The transitions are again indicated by arrows. The figures illustrate that for even mass number one may expect more than one stable isobar, while for odd mass number only one isobar is likely to be stable.

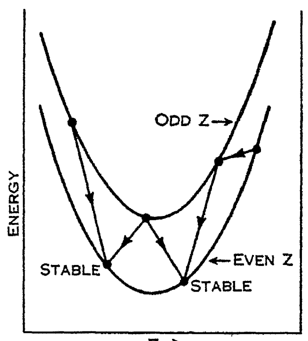


ADAPTED FROM A FIGURE BY H. BETHE IN "REVIEWS OF MODERN PHYSICS," APRIL 1936, V. 8, NO. 2

FIG. 1.—SCHEMATIC REPRESENTATION OF THE ENERGY OF ISOBARS AS A FUNCTION OF ATOMIC NUMBER: ODD MASS NUMBER

It would be expected that when a β-ray is emitted from a nucleus it should carry away with itself in the form of kinetic energy the difference in energy between the original and the resulting nuclei. This is not so. The β-particles emitted from one definite nuclear species have various energies: some carry very little energy, most of them about one-half or one-third of the ex-

pected energy and a few nearly all of that energy. None are found to carry an energy in excess of the expected amount. In fig. 3 it is shown how in two definite examples the frequency of occurrence of β-rays depends on the energy of the β-rays. The frequency of occurrence for β-rays carrying various amounts of energy is plotted on the abscissa. The maximum energy indicated (in the figure the energy corresponding to six electron masses or 6 mc^2 is used; this corresponds to about 3 Mev) is the expected amount. It is seen that the frequency of occurrence goes to zero as the maximum energy is approached. The curves might be expected to go to zero for zero energy also. The coulomb force of the charged nucleus, however, influences the distribution curves for the low-energy electrons and positrons. The nucleus attracts electrons, decreasing their energy and increasing the occurrence of zero-energy electrons. Conversely, the repulsion of the positrons by the nucleus increases their energy. None is emitted with zero energy and few with very low energies.



ADAPTED FROM A FIGURE BY H BETHE IN "REVIEWS OF MODERN PHYSICS," APRIL 1936, V. 8, NO. 2

FIG. 2.—SCHEMATIC REPRESENTATION OF THE ENERGY OF ISOBARS AS A FUNCTION OF ATOMIC NUMBER: EVEN MASS NUMBER

The fact that β-rays of a definite decay process have varying energies is surprising. It has not been possible to explain the varying energies of β-rays by the assumption that β-rays come from nuclei differing to a certain extent in their properties. Neither did it prove possible to assume that β-rays of varying energy leave the nucleus with correspondingly varying residual energy. On the other hand, the law of conservation of energy requires that the energy difference between the expected and the actual amount should appear in some other form.

The simplest explanation of the facts described above is the following: in the decay process not one but two particles are emitted from the nucleus. One of them, the β-ray, is an electron carrying a positive or negative charge. The other one is called the neutrino. It carries no charge and has no intrinsic mass, but it carries away the missing amount of energy from the nucleus in the form of kinetic energy.

The assumption that a neutrino is emitted together with the β-ray has helped to explain a number of peculiarities of the β-process. First, the neutrino hypothesis does not merely explain that β-rays from the same decay process have various energies, but it is also capable of accounting for the frequencies with which various β-energies occur. Fig. 3 gives the energy distribution for the simplest kind. This type of distribution has been predicted by theory and has been verified experimentally in a few cases. Other types of frequency distributions have been observed.

On the basis of the neutrino theory it was also possible to predict that the probability of β-decay increases with the fifth power of the energy released in the decay. In other words, the lifetime of the radioactive nucleus is inversely proportional to the fifth power of the maximum energy of the β-particle. This law is an approximate one and holds only for the simplest type of β-decay, for sufficiently high energies and for similar nuclei. The more complex β-disintegrations seem to have a decay probability which differs from the probability predicted by the simple theory. These anomalous β-decay processes have smaller decay probabilities and considerably longer half lives than the normal processes.

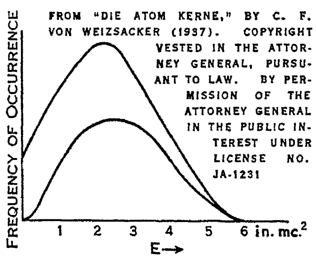


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FIG. 3.—THEORETICAL β-RAY SPECTRUM FOR Z=82. UPPER CURVE IS FOR ELECTRON EMISSION; LOWER CURVE, FOR POSITRON EMISSION

There is a further group of phenomena which can be explained with the help of the neutrino hypothesis. These are the changes of nuclear spin and nuclear statistics during a β-decay. It has been stated previously that a nucleus or, more generally, an association of particles will have a spin which is an even or odd multiple of one-half the elementary unit of spin according to whether the system contains an even or odd number of particles, each carrying one-half unit of spin. Now a β-ray carries one-half of a spin unit and so do the neutrons and protons of which the nucleus is built. If it is assumed that in a β-process the β-ray is emitted by itself, then the number of particles carrying one-half unit of spin would have increased by one during the process. It would be necessary to assume that the total spin of the system changes. It is, however, a very general rule that the spin of a system left to itself, like a nucleus undergoing a β-decay, must not change. The rule of conservation of spin is indeed almost as strongly supported by experience as the rule of conservation of energy. The emission of a single electron would violate spin conservation as well as energy conservation. If it is assumed that together with the electron a second particle, the neutrino, is emitted and, if it is also assumed that the neutrino carries a half unit of spin, the difficulty disappears.

An analogous argument can be put forward for nuclear statistics. It has been mentioned that a nucleus or system of particles has Einstein-Bose statistics or Fermi-Dirac statistics, respectively, if it contains an even or odd number of particles which themselves obey Fermi-Dirac statistics. Protons, neutrons and electrons do behave according to Fermi-Dirac statistics. If the β-process consisted of the emission of an electron only, the total number of particles would change by one and during the process the system would change from Einstein-Bose statistics to Fermi-Dirac statistics or vice versa.

Such a change in statistics is completely alien to our notions about the composition of matter. For instance, two systems obeying Fermi-Dirac statistics cannot be in the same state, but two systems obeying Einstein-Bose statistics prefer to be in the same state. The transformation of a system from one statistics to another would imply a changed behaviour of similar systems. This change would be so peculiar that we find ourselves unable to incorporate it in the mathematical laws which describe physics in the atom. If it is assumed, however, that together with an electron a neutrino is emitted and that the neutrino obeys Fermi-Dirac statistics, the difficulty is resolved. Two particles obeying Fermi-Dirac statistics are emitted in the process and therefore a change in statistics is not expected.

In addition to carrying energy a neutrino also carries away a momentum which can be calculated from the energy which it possesses. If a nucleus which was originally at rest suffers a β-decay, the momenta carried by the decay products must add up to zero. Since the neutrino is invisible, the momenta of the observable particles do not cancel. By measuring these momenta, one can obtain the momentum which the neutrino must have carried. This difficult experiment has been performed and indicates that the neutrino carries the expected momentum.

Finally, since neutrinos are emitted in β-decays, one can show that they in turn stimulate β-disintegration when they impinge on otherwise stable nuclei. Since the β-disintegration is an exceedingly improbable process, this stimulating effect of the neutrinos is very weak. By using the large neutrino fluxes which are emitted by big nuclear reactors, it has been possible to obtain some indication of this stimulating influence of the neutrino. The evidence for the existence of neutrinos is thus partly indirect and partly based on extraordinarily difficult experiments. Nevertheless, the existence of neutrinos can hardly be questioned.

α-DECAY AND SPONTANEOUS FISSION

In the β-decay a nucleus emits particles which, according to our model, the nucleus does not actually contain. The electron and neutrino emitted in the process may be considered as born at the moment of emission. In other radioactive processes, which are discussed now, particles are ejected from the nucleus which were present in a different configuration before the decay took place.

In another respect all radioactivities are similar: the half life of a radioactive nucleus is always exceedingly long as compared with times in which nuclear rearrangements could be expected to take place. The ratio of these times is in most cases larger than 10^{20} and sometimes even much greater than that. The reason for such long lifetimes is unknown in the case of β-processes. The reason must, it is thought, lie in the nature of the birth process of electron-neutrino pairs. In the case of other radioactive processes, such as α-decays and spontaneous fission, G. Gamow, E. U. Condon and R. Gurney have satisfactorily explained the long lifetimes.

In an α-disintegration a nucleus emits an α-particle, which is itself a very stable nucleus containing two neutrons and two protons. α-active nuclei are encountered among the nuclei which carry the highest charges. In these nuclei the repulsion between the α-particle and the rest of the nucleus results in an energy release which is not only sufficient to overcome the short-range attraction between the α-particle and the rest of the nucleus, but also gives the α-particle a kinetic energy of a few million electron volts.

The spontaneous fission process is also observed in the most heavily charged nuclei. In this process a nucleus divides into two approximately equal fragments which under their mutual coulomb repulsion, fly apart with a kinetic energy close to 200 Mev.

Both in the α-decay process and in the spontaneous fission process there is an important obstacle to the disintegration. The initial part of the disintegration, instead of releasing energy, actually would require some added energy which is not available in the cases considered. Thus an α-particle at a large distance from the nucleus has a lower potential energy than when it is inside the nucleus. However, an α-particle outside the nucleus but close to it, *i.e.*, when it is in an intermediate state of the disintegration process, has a higher potential energy than when either in the initial state inside the nucleus or in the final state when it is far away. This is, indeed, not surprising. In order to bring the α-particle from the initial state to the intermediate state it is necessary to do work against the short-range forces holding the α-particle in the nucleus. Again, if it is desired to bring the nucleus from the final state into the intermediate state it is necessary to do work against the coulomb repulsion. It is seen that the α-particle has to overcome a potential barrier in order to get from the initial state to the final state. Since there is not enough energy available to do this the process should be impossible from the point of view of classical mechanics. In the mechanics which is valid for particles of atomic and subatomic size it is not possible to localize sharply any particle without giving it a high amount of energy at the same time. Applying this kind of mechanics to the motion of the α-particle it is found that the α-particle, instead of staying in the nucleus, will leak through the potential barrier. While this statement is in conflict with our intuition concerning the behaviour of particles, it must be accepted on the basis of extensive experience of atomic and subatomic physics. The penetration of the potential barrier by these particles is closely related to the fact that these small particles, as long as they have a well-defined energy, cannot be sharply located on one side of the barrier.

The necessity of penetrating a potential barrier in the process of disintegration explains the long life and small disintegration probability of the α-active substances. This surprising penetration of a potential barrier becomes extremely improbable as the height or the breadth of the barrier or else the mass of the particle in question becomes bigger. The result is that an α-particle may approach the surface of the nucleus 10^{20} times or more often before it actually succeeds in leaving the nucleus. A further consequence is that relatively small differences between α-active substances cause great changes in the decay probability. The most important factor influencing the decay probability is the energy released in the α-process. If the decay energy is high, that energy will approach more closely the top of the barrier. The result is a greatly increased penetration probability and a greatly increased rate of decay. In fig. 4 the half lives of the α-active nuclei are plotted against the energy released in the α-decay. While the range of energies for which observations exist extends only from 3.5 to 9 Mev, the corresponding lifetimes are of quite different orders of magnitude. They range from 10^{-7} seconds to 10^{10} years, a time longer than the age of the earth. In order to plot all of these different times in a single graph a logarithmic scale is used. This means that each unit on the vertical scale stands for a factor ten in the lifetime. Next to the ordinate the half-life values are entered in units of seconds and also in units of years. The dots in the figure represent observations for various α-active nuclei. The curve was obtained by applying the theory of barrier penetration to the α-decay process. While this theory disregards all finer details of nuclear structure it is still in excellent agreement with the general trend of the observed points.

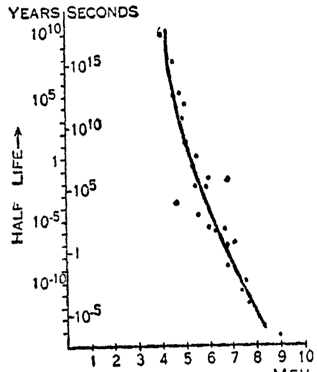


FIG. 4.—HALF LIFE FOR α-DECAY AS A FUNCTION OF α-RAY ENERGY. (SOLID CURVE IS THEORETICAL)

An entirely similar situation is encountered in the theory of spontaneous fission. Here the nuclear division must be considered as the end result of a process in which an originally spherical nucleus first takes on the form of an ellipsoid, then that of a dumbbell, then that of two smaller and nearly spherical pieces close to each other which finally fly apart to form the fission fragments. The initial distortion in this process requires an energy which, as in the case of α-decay, is actually not available. A potential barrier must be overcome if the fission is to proceed. This potential barrier is probably less high than the one encountered in α-decay. The particles to be moved through this barrier, however, are the fission fragments, containing about 100 neutrons and protons instead of the 4 nuclear units contained in an α-particle. The fact that a much bigger mass must be moved through a potential barrier decreases the disintegration probability. The uranium isotope U^{238} is among the α-active nuclei of longest life with a half life of 4.5×10^9 years. Yet this nucleus will have more than 1,000,000 times greater probability to decay by an α-process than to undergo spontaneous fission.

METASTABLE NUCLEI

If a nucleus is not in its lowest state of energy, it is said to be in an excited state. Lifetimes of such excited states, as a rule, are short and the nucleus falls into the lowest energy state, emitting the excess energy as radiation. The time required for this process in many cases is of the order of 10^{-14} seconds. The energy emitted leaves the nucleus in the form of γ-radiation.

If the excitation energy is relatively small, *i.e.*, of the order of 100,000 v., the lifetime of the excited state is relatively longer, in some cases exceptionally long. These transitions are similar to the anomalous β-decay processes which, as has been pointed out, have longer half lives than the normal β-decay processes. The exceptional nuclei are called metastable. Their lifetimes are often of the order of a few seconds, some much longer. An isotope of krypton, Kr^{83}, for instance, has a lifetime of 113 minutes. Two γ-ray energies have been observed: 0.029 Mev and 0.046 Mev. A long lifetime, 13.8 hours, is also shown for Zn^{69}. The γ-ray energy for this metastable state is 0.45 Mev.

Often such nuclei apparently emit electrons rather than γ-rays. The reason for this behaviour is that the electromagnetic radiation transmits its energy to an electron before the radiation leaves the immediate vicinity of the nucleus. While this electron originally has been a part of the same atom to which the nucleus belongs, it should be emphasized that the electron never was a part of the nucleus. That is, the electron is not actually emitted by the nucleus.

The electromagnetic energy has been converted to kinetic energy of an electron which was formerly bound to the atom. These electrons are called conversion electrons. These conversion electrons

can easily be distinguished from β-rays because their energy is well defined, while the electrons emitted from nuclei always have a continuous range of energies. Conversion electrons very frequently accompany γ-rays, but they are found with particularly high probability in the γ-processes of long lifetime which were described above.

NUCLEAR REACTIONS

Up to now, this discussion has considered in some detail processes in which a nucleus undergoes a spontaneous transition. There exists a much more varied class of nuclear transformations, namely the transformations which occur when a nucleus collides with another nucleus or some other particle. Every nucleus is, of course, in practically continuous contact with the electrons which together with the nucleus make up an atom. Stable nuclei are not capable of reacting with these electrons. β-active nuclei may absorb an external electron, as described above. This process is closely related to ordinary β-activity and it has been treated under the heading *β-Decay*. This section will consider the collisions of a nucleus with a fast electron, with a γ-ray, with another nuclear particle, such as a neutron, proton, deuteron, a heavier nucleus or with one of the unstable particles called mesons, which themselves are generated in nuclear collisions.

Bombardment of nuclei by fast electrons throws the nuclei into excited states whose characteristic γ-radiations have been studied. The collision of a nucleus with a γ-ray may also result in the excitation of that nucleus. If the energy of the γ-ray is sufficiently high, absorption of the γ-ray will be followed by a nuclear disintegration, most frequently the emission of one or more neutrons. It has been observed that γ-rays of a characteristic resonance energy are particularly readily absorbed by nuclei. This resonance energy is in the neighbourhood of 20 Mev. It is somewhat higher for light nuclei and somewhat lower for heavy nuclei.

If a reaction between two charged nuclei is to be studied at least one of these particles must have considerable kinetic energy. Otherwise the electric repulsion prevents the nuclei from approaching to a sufficient extent. According to classical mechanics one would expect that the approaching particles must possess a minimum kinetic energy if they are to get in contact with each other and if they are to react. Actually this simple argument is incorrect. The approach of two charged particles is more involved and is similar to the process of α-decay in which two charged particles are moving apart. Even if sufficient energy is not available for the two particles to come into contact according to the classical picture there remains a small probability for the collision partners to penetrate through the barrier separating them. This probability rapidly becomes smaller as the energy of approaching particles decreases. At small energies the resulting nuclear reactions occur so rarely that they become practically unobservable.

It follows that reactions between nuclei are more easily observed when the nuclei contain relatively low charge. The reactions which can be studied at lowest energies are those between two singly charged deuterium nuclei: $H^2+H^2\rightarrow H^1+H^3$ and $H^2+H^2\rightarrow He^3+n$. These reactions have actually been followed down to 10,000 ev bombarding energy; *i.e.,* to the energy of a "soft" X-ray tube.

Reactions between light nuclei and protons are of particular interest because according to present ideas such reactions are responsible for energy production in the sun. In some of these reactions the proton attaches itself to a nucleus and an α-particle is emitted. An example of such a reaction is $Li^7+H^1\rightarrow He^4+He^4$. A second example is $N^{15}+H^1\rightarrow C^{12}+He^4$. When more heavily charged nuclei are bombarded by protons, the emission of α-particles becomes less likely. The reason for this is similar to the reason for the long life of α-emitters. The α-particle to be emitted must surmount a high barrier. This process, therefore, becomes improbable and the nuclear reaction is likely to take another course.

One of these other possibilities is that the proton attaches itself to the nucleus and a neutron is emitted instead. This has been observed in collisions between lithium and protons. The reaction proceeds according to the relation: $Li^7+H^1\rightarrow Be^7+n$. One notices that the colliding partners are the same as those which lead to two α-particles according to: $Li^7+H^1\rightarrow He^4+He^4$. It actually is frequently true that a collision between two nuclei gives rise to several competing processes. Depending on the energy of the colliding particles one or the other of these reactions will occur either preferentially or exclusively. For instance, if the energy of the bombarding proton is less than 1.6 Mev, neutron emission does not occur because the sum of energies of Be^7 and a neutron is higher than the energy of the Li^7 and H^1 by just 1.6 Mev. On the other hand, the formation of two α-particles releases energy and can, therefore, proceed at any energy of the bombarding protons providing the proton gets close enough to the lithium to react with it. Since the neutrons are unaffected by electrostatic repulsion the ejection of a neutron by a proton may proceed without difficulty in more heavily charged nuclei. An example is:

$$Sb^{121}+H^1\rightarrow Te^{121}+n.$$

A proton may also simply attach itself to the nucleus with which it collides. This happens in the reaction

$$C^{12}+H^1\rightarrow N^{13}+\gamma.$$

In reactions of this type the binding energy of the proton in the nucleus is released in the form of γ-rays. This energy release is a relatively slow process. It takes, as a rule, only 10^{-14} seconds, but the time in which a neutron or an α-particle could be released by the reacting partners is very much shorter still, namely 10^{-20} seconds or less. Thus, the reaction between N^{15} and protons could, in principle, lead to the formation of O^{16} according to the scheme $N^{15}+H^1\rightarrow O^{16}+\gamma$. The reaction mentioned above $N^{15}+H^1\rightarrow C^{12}+He^4$ seems, however, to occur almost exclusively because this type of rearrangement between the reaction partners happens to take a much shorter time. On the other hand, $C^{12}+H^1\rightarrow N^{13}+\gamma$ can occur more readily because in this case no competing process exists as long as the proton does not have too high an energy. Actually both the ejection of an α-particle or a neutron from the carbon nucleus would require a very high proton energy.

When a nucleus is bombarded by a deuteron, reactions similar to those discussed above occur. In particular, neutrons and α-particles are found among the reaction products. The reaction to which deuteron bombardment most often leads is the ejection of a proton. This reaction occurs with relative ease even if the bombarded nucleus has a high charge. The deuteron does not need actually to penetrate to the surface of its target. When the coulomb repulsion becomes too strong the deuteron decomposes into a neutron and a proton. The neutron suffers no repulsion and reaches the surface of the nucleus while the energy of the reaction is carried away by the proton.

Among reactions with heavier nuclei mention shall be made only of the reactions with α-particles. Because of the availability of natural α-rays these were the first to be observed; they were of further historical importance in that they led to the discovery of the neutron. One of the easiest and earliest methods of producing neutrons is by the reaction $Be^9+\alpha\rightarrow C^{12}+n$. In reactions with more heavily charged nuclei α-particles can participate only if they carry a rather high kinetic energy. Even more kinetic energy would be required if the bombarding nucleus had more than two charge units.

When a nucleus is bombarded with neutrons whose energy is in excess of 1 Mev, the result is not very different from the reactions that occur when fast deuterons or protons are the bombarding particles. Of course the neutrons, not being repelled by the nuclear charge, can penetrate into heavy and light nuclei with equal ease. The result again may be the attachment of a neutron to the nucleus accompanied by the emission of a γ-ray. An example is $Au^{197}+n\rightarrow Au^{198}$. The resulting isotope of gold is unstable and decays to mercury. The fact that the resulting gold isotope is radioactive makes it easy to establish that the reaction has actually occurred in a bombarded gold sample.

A second type of reaction with neutrons is the re-emission of the original neutron plus the emission of another neutron. The first neutron serves to knock the second neutron out of the bombarded nucleus. Since the second neutron is strongly bound only bombarding neutrons carrying high energy produce this reaction.

The result of this reaction is an isotope of the original bombarded nucleus having a mass number diminished by one. The reaction

$$O^{16}+n \rightarrow O^{15}+n+n$$

may serve as an example.

In another type of reaction the neutron attaches itself to the nucleus and a proton is emitted instead. This is illustrated in the reaction

$$Zn^{66}+n \rightarrow Cu^{66}+p.$$

While in this reaction the neutron is free to penetrate into the nucleus, the proton encounters a potential barrier on its way out. This barrier again results from coulomb repulsion and is higher for more heavily charged nuclei. Thus this reaction will occur with considerable probability only in light nuclei or else in those cases where the outgoing proton receives a rather high energy, sufficient to overcome the potential barrier just mentioned.

The same situation is encountered if an α-particle is emitted after the neutron has attached itself to the bombarded nucleus. As an example we may mention the reaction:

$$N^{14}+n \rightarrow C^{11}+\alpha.$$

The reaction products have, in this case, a greater total mass than the original neutron and nitrogen. The mass difference corresponds to 2.25 Mev and therefore only neutrons having an energy greater than 2.25 Mev will be able to produce this reaction. It might be noted that in this case neutron bombardment also gives rise to the reaction:

$$N^{14}+n \rightarrow C^{14}+p.$$

This reaction releases energy, and therefore proceeds at low as well as high neutron energies. The two reactions just discussed are competing processes. This situation is quite typical. If the bombarding particle does not have much energy few types of reactions can take place. At higher bombarding energies more reactions become possible.

Among the nuclear reactions induced by neutron bombardment the fission of uranium and thorium are of greatest practical importance. As stated above, uranium may disintegrate into two roughly equal fragments even of its own accord. The rearrangement of nuclear matter, however, which leads to this fission process requires an initial investment of energy. Thus the spontaneous fission can take place only if the resultant particles penetrate a potential barrier, which is an exceedingly improbable process. If a uranium or thorium nucleus is hit by a neutron, the neutron attaches itself to the nucleus and delivers to the nucleus the binding energy of the neutron, amounting to several Mev. This energy sets the particles of which the nucleus is composed into motion. This motion may lead to the rearrangement necessary to initiate the fission process. It is interesting to note that the common isotopes of thorium and uranium, Th^{232} and U^{238}, require neutrons of relatively high initial energy if fission is to be produced. The reason is that fission is a quite improbable process unless the neutron furnishes enough energy to deform the nuclear matter to a point from where the further process is a "downhill" motion; *i.e.,* a motion which is connected with a diminution of potential energy. If a neutron fails to deliver sufficient energy to lift the nucleus to the top of the potential barrier, the fission process becomes quite improbable. In this case it is more likely that the excited nucleus will get rid of its energy either by reemission of the original neutron or by the emission of a γ-ray. In the former case the neutron returns to the original bombarded nucleus; in the second case, the reaction product is an isotope of the bombarded nucleus which contains an additional neutron. There is no reason why nuclear fission could not be produced by proton and deuteron bombardment as well as neutron bombardment. The protons and deuterons are, however, strongly repelled by the electrostatic field of the heavily charged uranium nucleus. Thus only highly energetic protons and deuterons are capable of producing fission.

Neutrons with an energy of 20 Mev or more are capable of producing fission in bismuth, lead and even lighter nuclei. In these cases fission probably results after a few preliminary processes have occurred. First the neutron communicates to the nucleus a high excitation energy. Thereafter the nucleus emits several particles, mostly neutrons. This process is called spallation. Neutrons escape preferentially because they need not overcome any potential barrier. Thus the nucleus is left with an unusually great excess of protons. The charge of these protons facilitates fission and a certain fraction of the bombarded nuclei actually divide into two similar particles.

The neutron reactions discussed thus far are usually referred to as "fast" neutron reactions. In contrast to these, "slow" neutron reactions signify events in which nuclei are hit by neutrons carrying a fraction of an electron volt. The neutrons in a typical slow neutron reaction possess about 100,000,000 times less energy than the neutrons in a fast neutron reaction. These slow neutron reactions are in many respects quite different from reactions in which only fast particles participate. These will be discussed in some detail since they play an important part in the release of atomic energy for useful purposes.

All the neutrons observed are products of nuclear reactions. Originally these neutrons are fast. Slow neutrons are obtained by allowing the fast ones to make a considerable number of collisions with other nuclei. There are many nuclei with which neutrons can collide repeatedly without causing nuclear reactions and without being captured by these nuclei. Frequently the only possible process is an elastic collision in which the neutron gives some of its energy to the collision partner. If, for instance, a neutron collides with a proton it loses roughly one-half of its energy in each collision. In collisions with carbon nuclei the neutron is apt to lose one-sixth of its energy. As a result 20 collisions with protons will suffice to deprive a neutron of all but one-millionth of its original energy and roughly 100 collisions with carbon nuclei produce the same result.

The energy loss, however, will not proceed indefinitely. All nuclei of the atoms in and around us participate in a disorderly motion which is caused by the heat energy shared by all bodies. The average energy of the particles at room temperature is about $\frac{1}{40}$ ev. When the neutrons are slowed down to this energy they will cease, on the average, to lose energy in collisions. They will rather participate from then on in the general thermal agitation of all particles. Neutrons of about $\frac{1}{40}$-ev energy are therefore often called thermal neutrons. The term "slow" neutrons is not restricted to the thermal neutrons but includes those of somewhat higher and lower energies. Thermal neutrons, however, are typical representatives of the class of slow neutrons. It is of interest to note that thermal neutrons move with an average velocity of 1.3 mi. per second. It seems peculiar to call such neutrons slow but they are slow compared with neutrons of 1 Mev energy whose velocity is little less than 10,000 mi. per second.

Reactions of slow neutrons differ from other nuclear reactions in several important respects. Slow neutrons may be absorbed very effectively by certain appropriate materials. Thus $\frac{1}{100}$ in. of cadmium is sufficient to absorb most of a beam of slow neutrons. A beam of fast neutrons, on the other hand, penetrates approximately two inches of any condensed material before the beam is strongly absorbed or otherwise altered in its properties. Slow neutrons are not absorbed so strongly by all kinds of nuclei. In collisions with nuclei such as carbon or lead, for instance, slow neutrons are hardly ever absorbed. Furthermore a reaction between a slow neutron and a nucleus depends on the energy of the neutron in a very sensitive manner. The reaction of neutrons with indium nuclei are very characteristic in this respect. A thermal neutron beam is effectively absorbed by an indium foil, while neutrons of one volt energy are considerably less affected. Neutrons of a sharply defined energy of 1.44 ev are more strongly absorbed in indium foils than neutrons of any other energy.

The peculiar behaviour of neutrons described above is the result of two facts. One is that slow neutrons spend a longer time in the neighbourhood of each nucleus and are more likely to be captured in a single collision. The second fact is the existence of compound nuclei which are formed by the initial fusion of the reaction partners and which possess well-defined energy levels. As an example let us continue to consider the reaction of indium with slow neutrons. If a neutron is bound to an indium nucleus an energy of approximately 8 Mev is released. At the time that

a slow neutron enters the binding energy appears as agitation of the compound nucleus. The designation of compound nucleus refers to this original agitated nucleus which is formed as a first step in the nuclear reaction.

The energy of agitation is not arbitrary but can be one of a certain number of rather sharply defined values. If the small kinetic energy of the incident neutron added to its big binding energy is just sufficient to form a compound nucleus in one of these sharply defined energy states then the neutron will enter the nucleus with a high probability. The energy at which the neutron enters with the greatest probability is called the resonance energy. The more the energy of the neutron differs from this resonance energy, the smaller will be its chance to enter the nucleus. A change in neutron energy of only one-tenth of an electron volt is sufficient to alter considerably the chance of the neutron to participate in the reaction.

These sharply defined levels of compound nuclei do not occur in the case of light atomic nuclei. This fact has been explained by a typical law of atomic physics according to which sharply defined energy levels occur only if these energy states have comparatively long lifetimes. If a state has a lifetime of 10^{-21} seconds (which is a typical period for nuclear rearrangements) then the energy levels cannot be defined better than to 1,000,000 v. The sharply defined energy of the compound nuclei indicates a lifetime more than 1,000,000 times longer than the time for a simple rearrangement. Why such long lives should occur when a slow neutron enters a nucleus of high weight, such as indium, may be understood in the following manner. When a neutron of small energy enters a nucleus its considerable binding energy is promptly shared as energy of agitation by the many particles of the nucleus. If the original neutron is to leave the nucleus again all of this energy must once more be concentrated on a single neutron. This process is unlikely and, on the average, takes a long time. If the nucleus consists of few particles then it will be more easily possible to concentrate the energy on a single one of these particles. On the other hand, if we have started with a fast neutron, then it will not be necessary to return to this neutron all of its energy to enable the original neutron to escape again.

Once a slow neutron has entered a nucleus and has found a compound state several reactions are still possible. The most probable of these is the emission of the binding energy of the added neutron in the form of γ-radiation. In this way an isotope of the original bombarded nucleus is formed. Thus we have the reactions:

$$H^1+n\rightarrow H^2+\gamma.$$
$$O^{16}+n\rightarrow O^{17}+\gamma$$
$$U^{238}+n\rightarrow U^{239}+\gamma.$$

The last reaction will be referred to again in the utilization of nuclear energy.

Among the lightest and the heaviest nuclei there are a few more important reactions following neutron capture.

Protons are emitted in the reaction of slow neutrons and nitrogen:

$$N^{14}+n\rightarrow C^{14}+p.$$

The resulting β-active isotope of carbon is most useful in the study of reactions in organic chemistry and biochemistry. This isotope of carbon is formed in small amounts by cosmic rays and occurs, therefore, as a "natural" activity. Its half life is 5,568 years. By measuring the carbon activity in an archaeological sample one may determine the age of that sample.

In reactions with Li^6 and B^{10} the absorption of a slow neutron results in the emission of an α-particle, according to

$$Li^6+n\rightarrow H^3+He^4$$

and

$$B^{10}+n\rightarrow Li^7+He^4.$$

These reactions are important because these nuclei, especially B^{10}, are very strong neutron absorbers. In contrast to indium, which preferentially absorbs neutrons of 1.44 ev energy, all neutrons are absorbed by Li^6 and B^{10}, but slow neutrons, which spend more time in the neighbourhood, are absorbed with greater probability.

The fact that slow neutrons are strongly absorbed by particular materials permits the regulation of the number of slow neutrons and allows or denies them access to certain parts of materials. The control of the energy release in chain reacting materials is based on this property of slow neutrons.

The energy released by slow neutron capture is insufficient to cause fission in any isotope which occurs with great abundance in a natural substance. In some materials, particularly in U^{235} and Pu^{239}, slow neutrons do give rise to fission. The consequence of this fact will be discussed later.

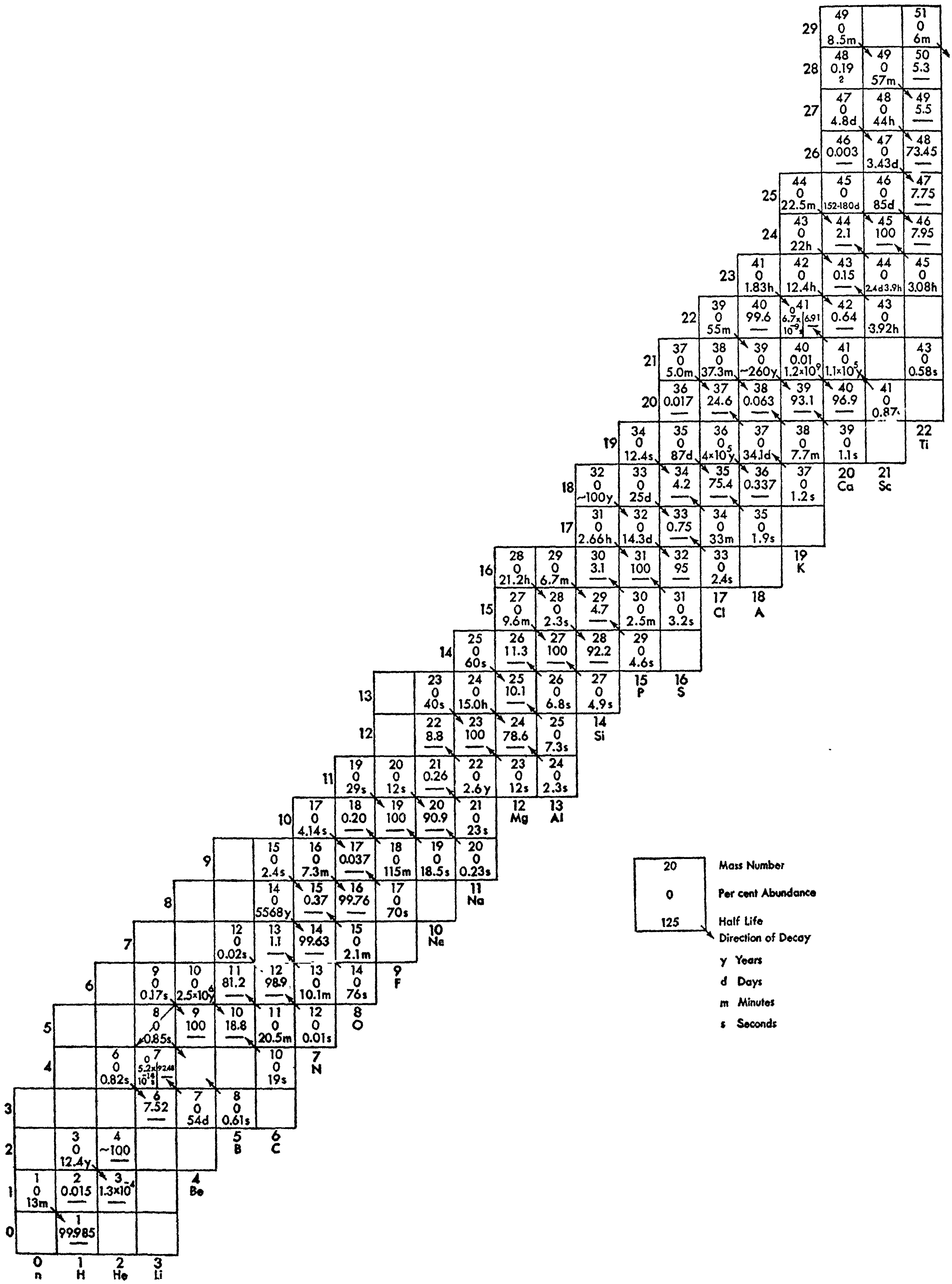
New high-energy accelerators have produced protons carrying several hundred Mev. Bombardment of nuclei by such protons often gives rise to disintegration into several fragments. It is remarkable, however, that more gentle interactions are not unusual. Thus a proton may collide with a nucleus without changing its energy or momentum to a great extent. In the collision, however, the proton turns into a neutron, leaving its charge behind in the nucleus with which it collided. It also happens quite often that the impinging proton picks up a neutron during its contact with a nucleus. The bombarding particle changes, therefore, into a deuteron but continues on its path without any great deflection or loss of energy.

The most important result of experiments in the several-hundred-Mev range has been the production of mesons. These are unstable particles, some of which are neutral while some carry a unit of positive or negative charge. A considerable variety of these particles has been discovered. They differ not only in their charge but also in their masses, spins, lifetimes and modes of decay. At least one class of these mesons, the π-mesons (pi mesons) is closely connected with the forces that bind the nucleons into stable nuclei. This connection will be discussed below.

It has become customary to designate mesons as well as nucleons, electrons and neutrinos as "elementary particles." With the increase in the number of these particles it becomes likely that at least some of them are no more elementary than atoms are indivisible. It is expected that some simple and general laws of physics will eventually explain the properties of all these particles.

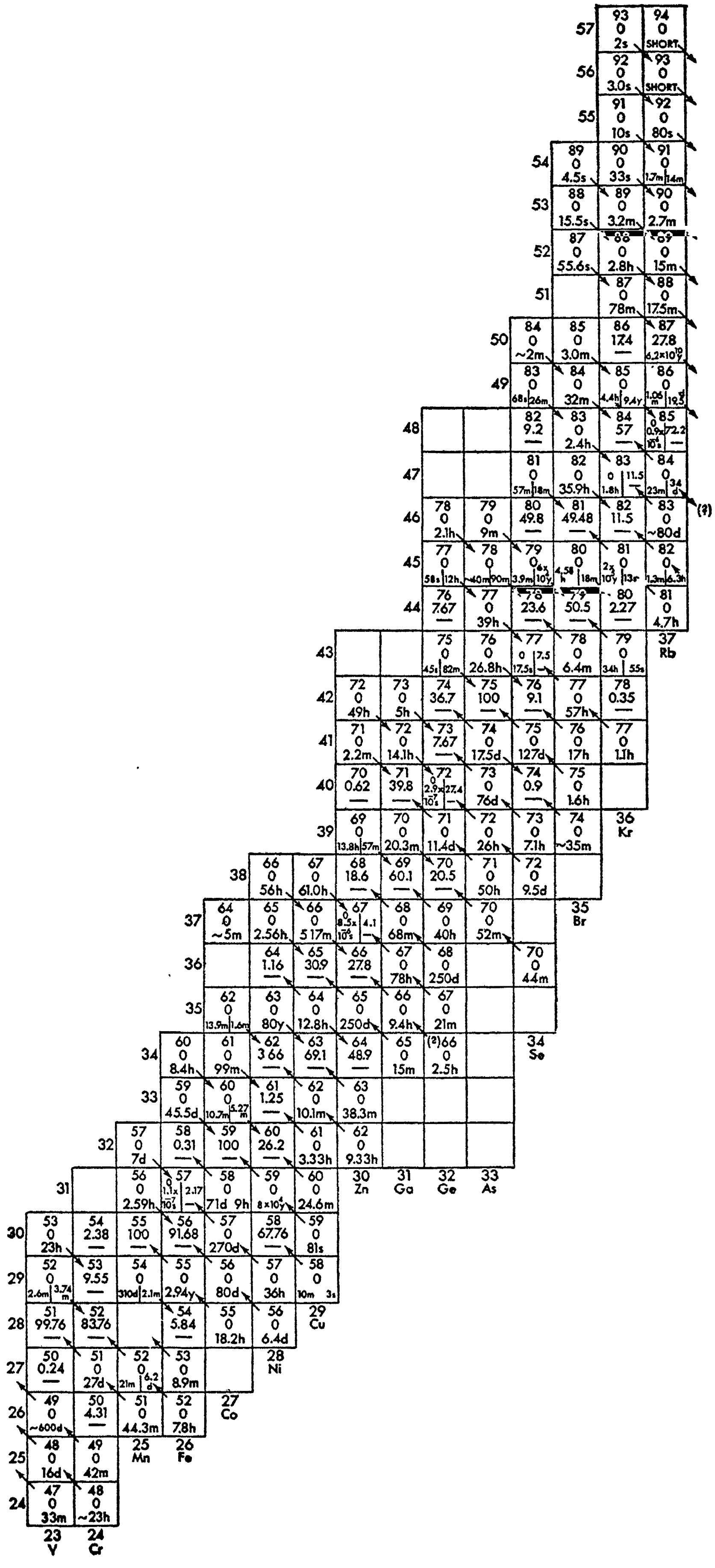
SUMMARY OF NUCLEAR PROPERTIES

The nuclear reactions described in the last section led to the discovery of a very great number of previously unknown radioactive nuclei. These, together with the nuclei which occur in nature, are collected in the accompanying chart. In this chart each nucleus is represented by a square. For instance, in the second column from the left the isotopes of hydrogen appear. The charge number, one, and the atomic symbol, H (for hydrogen) appear at the foot of the column. The lowest square corresponds to a proton. In the square is found the mass number for the proton, which is one, and below it the abundance of protons in ordinary hydrogen is indicated. The figure 99.985 means 99.985% of ordinary hydrogen consists of light hydrogen or protons. The square above the proton corresponds to heavy hydrogen or deuterium with a mass number two. Its abundance in ordinary hydrogen is 0.015%, which is also entered. The third square in the column corresponds to tritium, the radioactive isotope of hydrogen. This isotope does not occur in nature and so the second line in the square contains a zero. Instead the half life, 12.4 years, has been entered in the third line. The arrow attached to this isotope shows that the nucleus decays to He^3, the light isotope of helium, occurring in the next column. On the left-hand side is the number of neutrons in the nuclei. Therefore, next to the proton is found zero, indicating that this lightest isotope contains no neutrons. Next to deuterium and tritium, the figures 1 and 2 indicate that these isotopes contain one and two neutrons, respectively. The next column represents the helium nuclei, of which again two stable and one radioactive nuclei are known. It is significant that the square corresponding to He^5 is empty. The reason for this will be discussed in the next section. The following columns correspond to lithium, beryllium, boron and heavier nuclei. The table is presented in six sections. Throughout the table the three numbers occurring in the squares correspond to the atomic number, the abundance and the lifetime. In the second line zero appears for all nuclei which are not found in the elements as they



BASED ON COMPILATIONS BY E. SEGRÈ AND G. SEABORG

CHART OF NUCLEAR PROPERTIES (1953). EACH NUCLEUS IS REPRESENTED BY A SQUARE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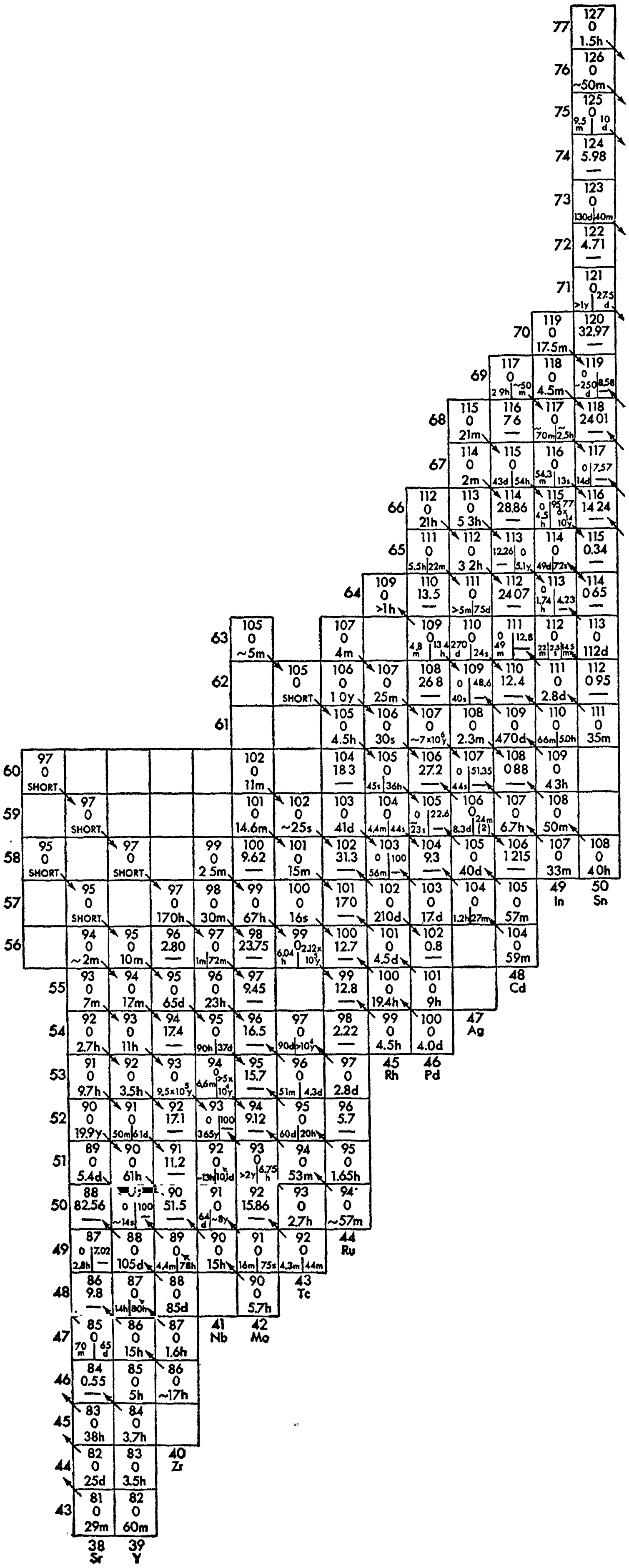
25 Mn
26 Fe
27 Co
28 Ni
29 Cu
30 Zn
31 Ga
32 Ge
33 As
34 Se
35 Br
36 Kr
37 Rb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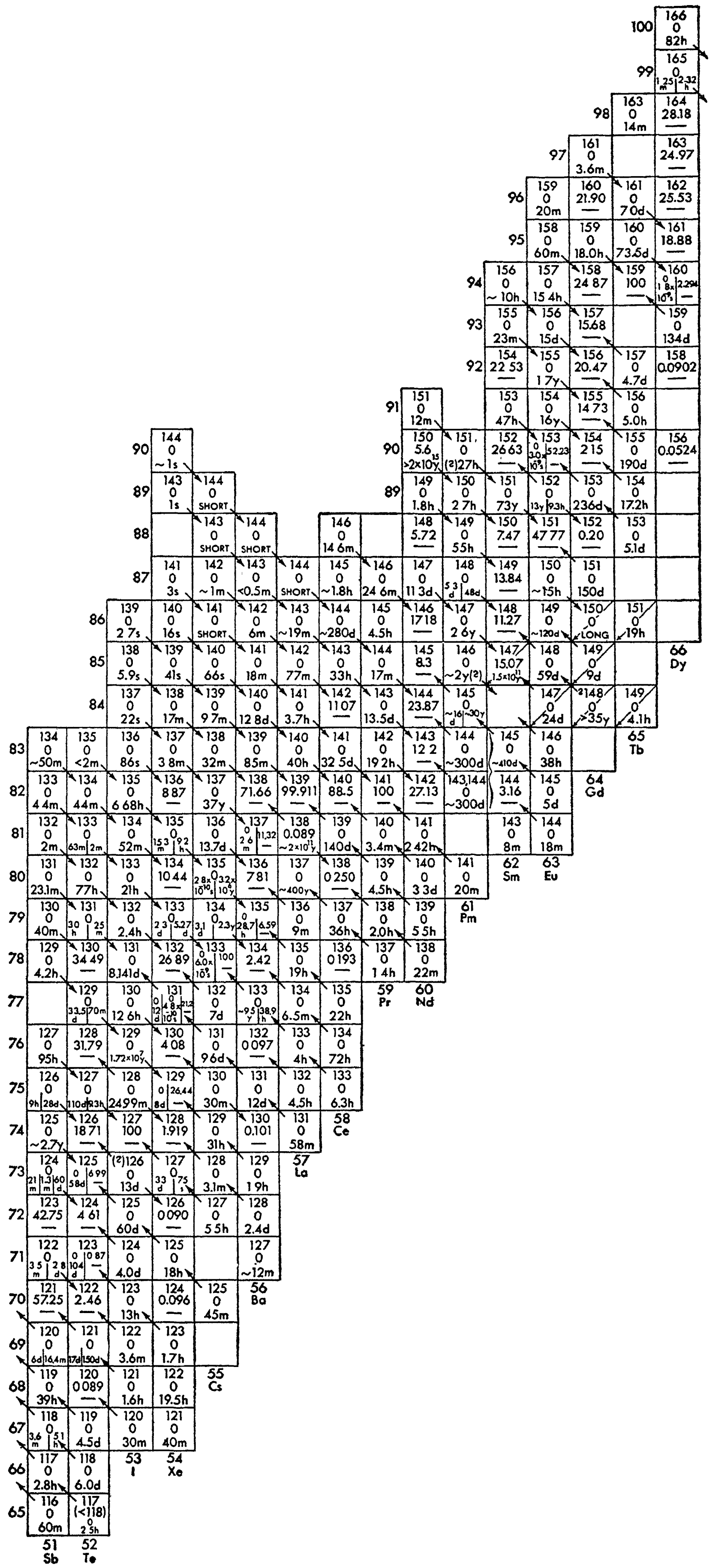
39 Y
40 Zr
41 Nb
42 Mo
43 Tc
44 Ru
45 Rh
46 Pd
47 Ag
48 Cd
49 In
50 Sn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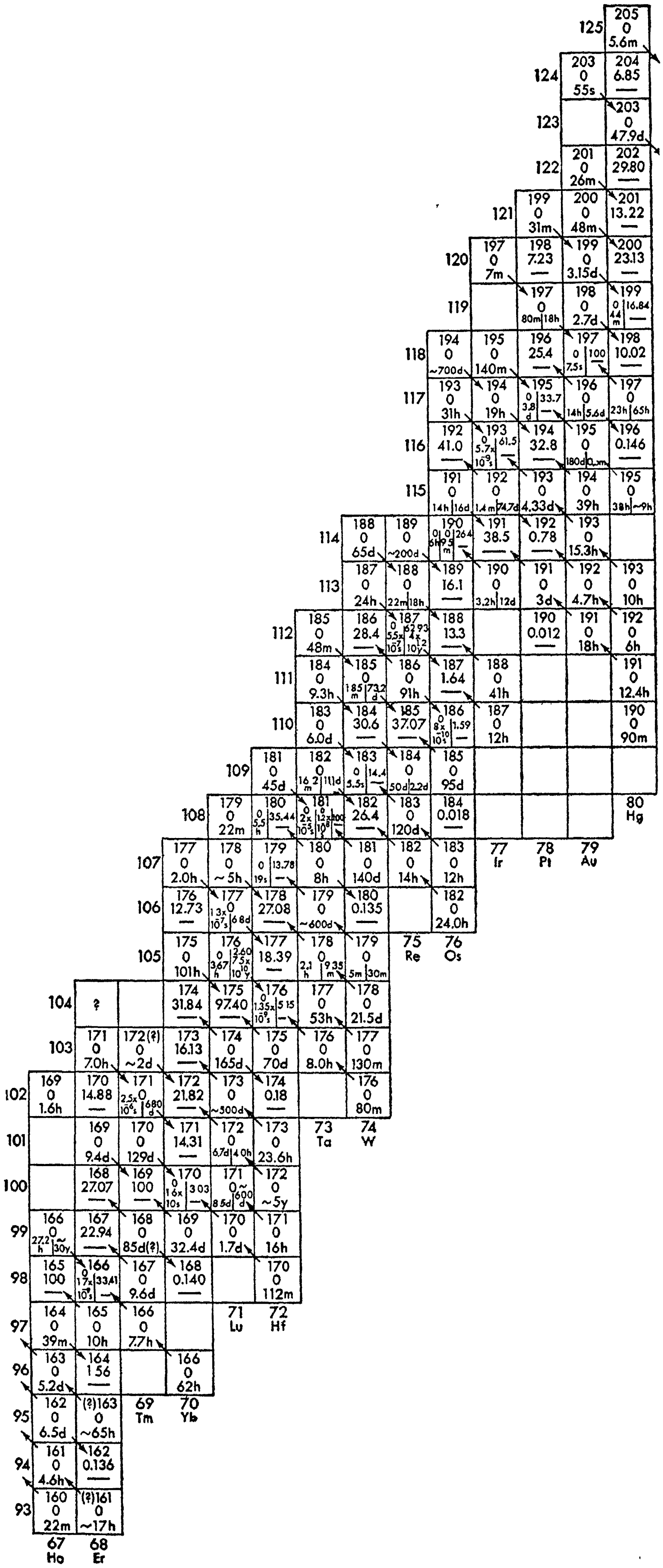
52 Te
53 I
54 Xe
55 Cs
56 Ba
57 La
58 Ce
59 Pr
60 Nd
61 Pm
62 Sm
63 Eu
64 Gd
65 Tb
66 Dy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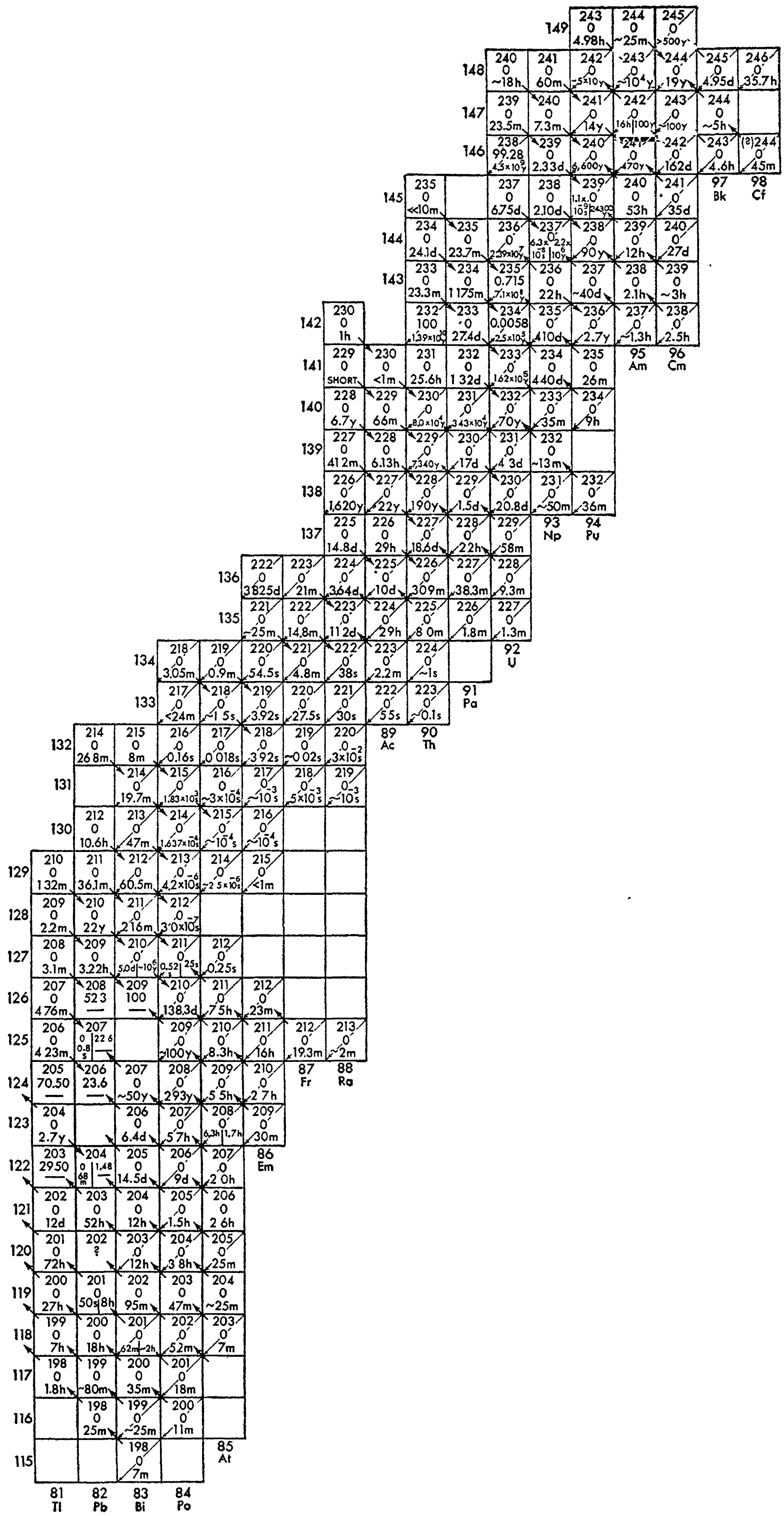
68 Er
69 Tm
70 Yb
71 Lu
72 Hf
73 Ta
74 W
75 Re
76 Os
77 Ir
78 Pt
79 Au
80 Hg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83 Bi
84 Po
85 At
86 Em
87 Fr
88 Ra
89 Ac
90 Th
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92 U
93 Np
94 Pu
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97 Bk
98 Cf
115
116
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occur in nature. In all but a few of the heaviest elements natural terrestrial sources always have the same isotopic abundances. This abundance is indicated by the figure in the second line. It should not be taken for granted that the isotopic abundance outside the earth is the same as on the earth. This, however, seems to be the general rule. The figures on abundance are omitted in some of the heavy nuclei in which all isotopes are radioactive and in which the isotopic abundances are dependent upon the method by which the element is obtained.

The radioactive nuclei are distinguished in the chart, not only by the fact that in their squares a lifetime appears, but also by the arrows which indicate their process of decay. β-active nuclei are distinguished by arrows which point toward the lower right if negative electrons are emitted or by arrows in the opposite direction if positive electrons are emitted. Nuclei which do not have enough energy to emit an electron but capture an atomic electron are indicated in the same way as an ordinary positive electron emitter. Some nuclei may decay both by positive and negative electron emission. This is indicated by two arrows attached to the squares. Alpha-activity of the nuclei is shown by an arrow in the lower left-hand direction and extending to the second diagonal neighbour. Thus in every case the arrow ends on the product of the radioactive decay.

The chart was devised by E. Segrè (1947) and includes added data from the table of isotopes by G. Seaborg *et al.* (1953).

The chart shows several interesting facts. Among the light nuclei only those with approximately equal numbers of neutrons and protons are stable. Those nuclei which have a great neutron excess are β-active and emit negative electrons, thus transforming a supernumerary neutron into a proton. Nuclei having too many protons emit a positive electron and transform a proton into a neutron. The fact that among light nuclei an equal number of neutrons and protons seems to give greatest stability to the nucleus is the result of the exclusion principle. The first neutrons and protons that build up a nucleus will occupy the lowest energy states. Each additional neutron and proton will be forced into an orbit of higher energy. If the number of neutrons greatly exceeds the number of protons, the last neutron will find itself in a state of rather high energy, while states of lower energy are still available for protons. Thus energy may be released by the transformation of a neutron into a proton. A similar argument holds for an excess of protons.

As the number of protons and neutrons becomes greater the stable nuclei tend to have a greater number of neutrons than protons. The reason for this is the electrostatic repulsion between protons. Because of this replusion the presence of many protons in the nucleus causes an increase of the energy of the nucleus and transforming a proton into a neutron will correspondingly lower the energy. Too great a neutron excess will be prevented for the reasons discussed in the preceding paragraph.

It has been mentioned that the electrostatic repulsion in heavily charged nuclei gives rise to α-activity. The frequent occurrence of α-activity in the last elements of the table can be readily observed. Instability of nuclei caused by the excess charge is probably the reason why fewer isotopes of heavy nuclei are known and why nuclei having more than 92 charge units do not occur in nature.

While two neutrons and two protons can never occupy exactly the same state within a nucleus, a pair of such particles may be found in the same orbit. These two particles must differ in the orientation of their spins. It seems that two particles in the same orbit possess similar energies. The result is that two successive particles can be bound in a low-energy state, while the addition of a third particle will release considerably less binding energy. This circumstance is illustrated by two facts in the table of nuclei. First, few stable nuclei exist in which both the number of neutrons and the number of protons is odd. Such nuclei are usually radioactive, emitting a positive electron, a negative electron or both. The decay product is a nucleus in which both neutron and proton numbers are even and all orbits may be considered as doubly occupied. The result of this rule is that nuclei with odd charge number, Z, possess many fewer isotopes than nuclei of even charge number. The other fact appearing from the table is that in nuclei of even charge number the even isotopes, in which the number of neutrons is even, have a greater abundance than the odd isotopes, in which the number of neutrons is odd. It seems that the latter nuclei, containing particles in less stable orbits, originally have been formed in smaller numbers than the isotopes having an even number of neutrons and greater binding energies.

Among the β-active nuclei two general rules may also be observed. First, that β-active nuclei which are located close to stable nuclei usually decay with a long lifetime. Nuclei which are located farther from stability have shorter decay periods. The other regularity is that radioactive nuclei containing even numbers of protons and neutrons have longer lives than nuclei containing an even number of neutrons and an odd number of protons or an even number of protons and an odd number of neutrons. These nuclei in turn live longer than nuclei in which both the proton and neutron numbers are odd. These regularities may be understood in terms of the energies of nuclei. In terms of β-decay it has been mentioned that the lifetime will be short if a great amount of energy is liberated in the β-decay. The lifetime will be long if the transformation energy is small. The transformation energy is apt to be less if the decaying nucleus has relatively low energy. This will be the case if the nucleus is near the region of stability and if the nucleus contains an even number of neutrons and protons. Closer inspection of the table will show that the rules just mentioned are not universally valid and that there are quite a few exceptions. These exceptions occur whenever a β-decay of the anomalous type is encountered, in which case, as has been mentioned, β-active substances have a relatively long lifetime.

The abundances of isotopes show a further marked regularity. Among the light elements the heaviest isotopes are frequently present in small abundance. Among the heavier elements the situation is reversed. It seems impossible to explain this fact on the basis of the stability of nuclei alone and it is likely that a hint is encountered here which may throw some light on the origin of the elements.

In this connection it is also of great interest to compare the abundance of various elements. The determination of the abundance of elements is much more difficult than the measurement of the ratio of isotopic abundances. The reason for this is that while isotopic composition is remarkably constant, at least in terrestrial materials, the mixtures of various elements depend quite strongly on whence one obtains the mixture. Other elements will be found to predominate in the crust of the earth than in meteorites, which are believed to have a composition similar to the interior of the earth. A still different composition is found in the study of the sun. Even if we restrict ourselves to the earth's crust, a different result is obtained if igneous rocks are studied, sedimentary materials, the sea or the atmosphere. Fig. 5 gives the best available guess as to the abundance of various nuclear species through-

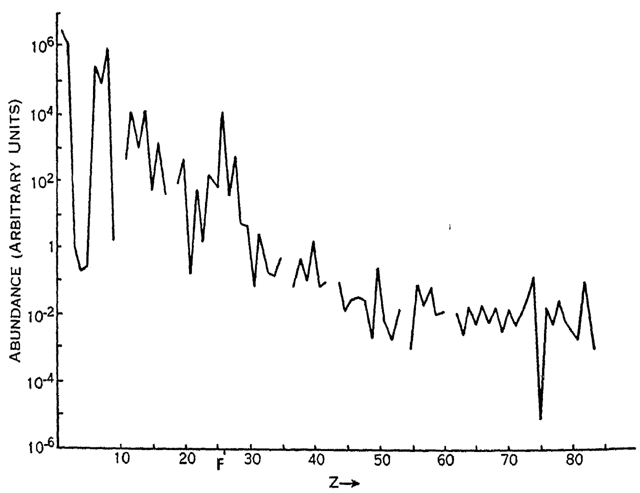


FIG. 5 —GRAPH OF ABUNDANCE OF ELEMENTS IN COSMOS AS A FUNCTION OF Z

out the cosmos. Fig. 5 is based on data taken from calculations of V. M. Goldschmidt. The units of the abundance are arbitrary. The abundance of Si has been set equal to 10,000 and all other abundances have been scaled in proportion.

The very great abundances of hydrogen and helium are immediately apparent. It will also be noticed that the lighter elements up to and including iron are much more abundant than the heavier elements. This has led to the suspicion that the lighter and heavier groups of elements have been formed by two basically different processes.

NUCLEAR STRUCTURE AND NUCLEAR FORCES

We are ignorant about the origin and nature of the nuclear forces. There is not even certainty that it is permissible to talk about forces within a nucleus in the customary sense of the word. Something is known, however, about the magnitude that forces between nuclear particles should have if these forces are to give rise to the effects that are observed.

A detailed theory of the interaction of slow neutrons with nuclei leads to the idea that there is very little interaction between the neutron and the nucleus until the neutron approaches to the distance of approximately one nuclear radius. At that distance the neutron is attracted to the nucleus with a strong force. The last statement is based on the fact that the union of a neutron with almost any nucleus releases a binding energy of several Mev. The facts so far described are summarized in the statement that the interaction between the neutron and other nuclear particles is a strong, short-range attraction.

If a proton approaches a nucleus the interaction at long distances is an electrostatic repulsion. By nuclear forces, of course, is meant the forces acting in addition to these electrostatic forces. As long as the proton is not in contact with the nucleus the effects of nuclear forces are considerably smaller than this electrostatic interaction. Attaching a proton to a nucleus releases a similar energy as when a neutron is attached. Thus, the interaction of the protons with other nuclear particles is again a strong, short-range attraction to which, of course, must be added the electrostatic repulsion, which acts over a greater distance.

Comparison of the binding energies of certain pairs of light nuclei leads to an important conclusion concerning nuclear forces. The first of these pairs is H^3 and He^3. The former consists of two neutrons and a proton, the latter of one neutron and two protons. The second known pair in the series is Li^7 and Be^7. The first is composed of three protons and four neutrons, the second contains four protons and three neutrons. The next pair is B^{11} and C^{11}, in which the numbers of protons and neutrons are five-six and six-five, respectively. In each of these pairs one member is obtained from the other if all neutrons are replaced by protons and all protons by neutrons. A large number of additional pairs of this type are known. For quite a few of these accurate determinations of the energy content of the nuclei are available. These energy contents differ because of the greater electrostatic repulsion prevailing in the nucleus which is more heavily charged than its partner. The remarkable fact is that the electrostatic repulsion is sufficient to explain the observed energy difference of the two nuclei in any of these pairs. We conclude that nuclear forces remain unchanged upon replacing all neutrons by protons and all protons by neutrons.

More detailed investigation of the behaviour of nuclei and also scattering experiments of protons on protons and neutrons on neutrons at various energies have led to a simple general rule. This is that neutrons and protons interact with each other in the same way as they interact with their own kind and that neutrons and protons are bound by the same forces within nuclei.

A detailed study of the proton-proton and neutron-neutron scattering at various energies has led to the conclusion that during such a scattering process the two interacting particles may exchange their charges. This exchange process gives rise to forces between the particles. It is likely, however, that these exchange forces account for only a portion of the total forces acting within nuclei. In spite of the similarity of the behaviour of neutrons and protons, the charge does therefore influence nuclear binding, but it does so in a similar way as the spin. Particles with different charge or different spin may occupy the same orbit, whereas particles with the same charge and spin may not. Furthermore, the exchange of charge and spin exerts an influence upon the nuclear forces.

It is instructive to consider what happens if the lightest nuclei are built up by adding one neutron or one proton at a time. The first combination, that of a neutron and a proton, has a relatively low binding energy of 2.2 Mev. A somewhat greater binding energy is released if a neutron or proton is added (the values are 6.2 Mev and 5.4 Mev, respectively). If a fourth particle is attached in such a way as to build a helium nucleus a very great amount of binding energy is released. The total binding energy of the two neutrons and two protons in the helium nucleus is 28 Mev. The great stability arising from this large binding energy accounts for the appearance of α-particles in radioactive decay. If we now try to attach an additional neutron or proton to the α-particle we find that the fifth particle will not be bound at all. This will seem all the more remarkable if one considers that the α-particle is the only nucleus which fails to combine with a proton or a neutron. A glance at the chart of the previous section will show that atomic number 5 is the only one absent among the nuclei up to atomic number 246.

This situation is undoubtedly connected with the fact that according to the exclusion principle four and only four particles can be placed in the same orbit. Two particles in the same orbit must differ either in spin or charge or both. Now a nuclear particle can take two spin directions and two charge values (O for neutrons and $+1$ for a proton). Thus the maximum number of particles in the same orbit is four and we must consider the He^4 nucleus to consist of two neutrons with opposite spins and two protons with opposite spins. Since a fifth particle cannot differ by charge or spin from the four previous particles, the application of the exclusion principle indicates that the fifth particle must be accommodated in a new orbit. As a consequence, this particle will be more loosely bound and might, in fact, have a binding energy equal to zero. Properties of matter inside nuclei heavier than the helium nucleus have certain simple common characteristics. In particular, nuclear densities for these nuclei seem to be fairly constant so that the cube of the radius is proportional to the mass number, A, that is to the number within the nucleus. The total binding energy of the nucleus is also proportional to this number so that the binding energy per nucleon is constant. This latter statement does not apply very well to the heaviest nuclei for which the binding energy per nucleon shows a marked decrease. This, however, is caused by the coulomb repulsions between the protons within the nucleus rather than by any intrinsic change in the characteristic behaviour of nuclear matter itself. The fact that the volume and binding energy per nucleon is roughly a constant for all nuclei beyond helium has been ascribed to a "saturation" of nuclear forces. Apparently in the helium nucleus the nucleons have achieved a nearly optimal density and binding energy.

Many of the detailed properties of the nuclei were explained by the nuclear shell model (M. G. Mayer, H. Jensen *et al.*, 1949). According to this model, individual nucleons are found in well-defined orbits within each nucleus. Each of these orbits is characterized by an orbital angular momentum, *i.e.*, a momentum around the centre of the nucleus; by a radial momentum, *i.e.*, a momentum away from and toward the centre of the nucleus; and a total angular momentum which is composed of the orbital angular momentum and the one-half unit spin momentum of the nucleon. Increasing angular momenta and radial momenta correspond to increasing energies. According to the Pauli exclusion principle, each orbit characterized by the appropriate momenta and by the spin may contain not more than one neutron and one proton. The orbits are filled in successively, those with lowest energy being filled first. The energies of these orbits can be calculated and one can therefore predict in which order the orbits of various characteristics will be filled up. One finds that a surprisingly low energy is encountered whenever an orbit has practically no radial momentum, that is, whenever the path of the nucleon can be con-

sidered as circular, provided that the angular momentum of the orbit and the angular momentum corresponding to the spin are lined up parallel to each other. There are several orbits of the kind just described which differ from each other by their orientation in the spherical field of the nucleus. When all these relatively low-lying orbits are filled up, one obtains a closed shell configuration and one arrives at a particularly stable nucleus.

The procedure mentioned above agrees with experiments particularly well for heavier nuclei. Application of these ideas shows that nuclei with unusual stability will result if the neutron number or the proton number happens to be either 50, 82 or 126. Stability of such nuclei was noticed before the explanation was given. The peculiar properties of the corresponding nuclei led to the designation of "magic numbers" for the numbers 50, 82 and 126. It is of interest particularly to mention the nucleus Pb^{208}, which is "doubly magic" since it contains 82 protons and 126 neutrons.

The nuclear shell model has been most useful in predicting angular momentum values for a great number of nuclear isotopes both in their lower state and in their excited state. The possibilities of β-decay and also the possibilities of emission of γ-rays are closely connected with these angular momenta. Therefore the shell model made it possible to obtain a consistent connection between β-decays, γ-ray emissions and detailed nuclear structure.

The explanation of nuclear structure by the shell model is similar to the explanation of the periodic system with the help of the shell model of the electrons within atoms. A quantitative difference exists, however, in that in atomic physics the difference between incomplete shells and closed shells is more marked than it is in nuclear physics.

The nuclear shell model suggests that nucleons can move across nuclei in a relatively undisturbed manner. Indeed, if that were not so, it would be hard to understand why well-defined orbits may be ascribed to individual nucleons. This conclusion is somewhat surprising since all nucleons experience strong forces when entering or leaving a nucleus. We are therefore led to the following model of nuclear forces. When a nucleon approaches a nucleus, it is attracted into the interior of the nucleus and is therefore strongly accelerated. Inside the nucleus, the nucleon does not encounter any strong systematic change of the potential and is not exposed to any appreciable average force. It moves in this region almost as though the inside of the nucleus were free space. When leaving the nucleus, the nucleon will experience a strong retarding force, and will lose the kinetic energy which it acquired upon entering. The above discussion ignores the possibility of an energy loss of the nucleon which it may suffer while traversing the nucleus but it gives a qualitative idea of the forces found inside a nucleus.

The nature of nuclear forces cannot be understood unless one considers both the field in a quiescent nucleus and that in a nuclear structure whose components experience violent motion and acceleration. The situation may be clarified by a comparison with the electric forces which confine the electrons to their orbits within the atoms. These forces have actually two manifestations. On the one hand, they influence the orbits of the electrons. On the other hand, they give rise to electromagnetic radiation. The latter phenomenon occurs when the electric configuration within an atom suffers a sudden change and part of the electric field in the neighbourhood of the atom is shaken loose.

The situation is similar in the case of nuclear forces. On the one hand, they confine nucleons to their orbits. On the other hand, one has to expect that if a nucleus is subject to sudden and violent change, a peculiar nuclear radiation will be emitted. This nuclear radiation has been identified with at least some of the mesons which have been described above.

The nuclear radiations, that is, the mesons, differ in two basic respects from electromagnetic radiation. The first difference is that electromagnetic radiation may carry an arbitrarily small amount of energy. A meson, on the other hand, cannot carry an energy less than a certain given minimum amount. To this minimum energy a mass corresponds, according to Einstein's relation of equivalence of mass and energy. For the π-mesons, which have been most closely identified with nuclear radiation, this mass is approximately 270 times greater than the mass of the electron and is roughly one-seventh of the mass of a nucleon. The fact that the nuclear radiation has a minimum energy is connected with the short range of nuclear forces. As a result of this short range the time of vibration of nuclear radiation will necessarily be shorter than a certain minimum time. According to the mechanics of atomic systems, short times are necessarily connected with high energies. The existence of the mesons as a form of nuclear radiation was first postulated by H. Yukawa. These mesons were then found in cosmic radiation and later in nuclear reactions and they possessed the qualitative features which had been predicted.

The second important difference between electromagnetic radiation and nuclear radiation as represented by mesons is connected with the electric charge carried by the radiation. Electric radiation does not carry a charge. Many mesons do. The π-mesons which are known to be connected with nuclear forces appear in three forms: the neutral π-mesons, the positive π-mesons which carry one positive unit of electricity and the negative π-mesons which carry a negative unit. In their interaction with nuclear matter these three kinds of π-mesons behave quite similarly. This fact is connected with the rule mentioned above that nuclear forces act similarly on protons and neutrons. The spin of the π-mesons is known to be zero, that is, they do not carry an intrinsic angular momentum. Their mathematical description, however, exhibits a peculiar behaviour with respect to mirror reflections. It is a consequence of this peculiar property that emission of a π-meson does not in itself cause a change in the angular momentum of the emitting nucleon but it is likely to cause an exchange of angular momentum between the spin and the orbit of the nucleon.

Many other kinds of mesons have been observed and some of these may well be connected with nuclear forces in a manner similar to the connection existing in the case of the π-mesons. It will be, however, clear even to the most superficial observer that present hypotheses concerning nuclear forces have been introduced piecemeal, seem to consist of several independent statements and do not proceed by a cogent reasoning from a number of simple hypotheses. These are the marks of an unfinished theory. The final and complete explanation will probably contain unexpected elements and will probably form a more closed and simple pattern than the present disconnected set of assumptions.

ENERGY PRODUCTION IN STARS

The energy source responsible for the radiation of the sun and stars was the subject of speculation for many years. It was recognized long ago that no known chemical reaction could keep the sun supplied with energy for more than approximately 100,000 years. Yet there is geological evidence that the sun must have been radiating at its present rate for 500,000,000 years; *i.e.*, during the period in which living beings are certain to have inhabited the earth. More recent detailed theories of the interior of the stars did not lead to any suggestions as to some novel kind of chemical reaction (some kind of rearrangement of atoms or extranuclear electrons) which could account for the extremely great amounts of energy that the sun has emitted during its long history.

Somewhat more energy could be obtained from a slow gravitational contraction of the sun. It is not easy to construct a model of the sun (or stars), however, which would permit the sun to radiate at its present rate for more than a few million years without considerable change if gravitational energy were the main source of the energy radiated. Actually, a great concentration of mass near the centre of the sun could give rise to sufficiently high gravitational energies and a slow growth of this very dense core could account for the energy emission of the sun. In order to obtain the necessary energies one would have to assume near the centre of the sun densities of matter which are approximately 10^{12} times greater than the densities of water. Such high densities had been encountered only in the interior of nuclei.

It seems, therefore, most likely that the energy of the sun and stars results from nuclear transformations. The theory of the structure of the sun and stars has led to the conclusions that the

central regions of these bodies are at temperatures approximately 40,000,000° to 50,000,000° F. At these exceedingly high temperatures atomic nuclei move with sufficiently high velocities so that occasionally they come in close contact and give rise to a nuclear reaction. Actually the average energy of atomic nuclei inside the sun is only 2,000 or 3,000 ev. This energy is rather low compared with the energies usually encountered in nuclear reactions. If the kinetic energy in the sun were as high as the kinetic energy of protons or α-particles which are used in the laboratory to produce reactions, then nuclear reactions on the sun would probably go to completion in a very short time and the sun would explode, rather than produce energy at a steady rate. The small kinetic energy of nuclei in the sun has the consequence that nuclear reactions take billions of years to go to completion.

It is, of course, of interest to find out which specific nuclear reactions supply the energy of the sun. While there are numerous reactions which might, in principle, be considered, practically all of them were eliminated as the actual source. Some reactions would proceed too rapidly and result in burning up the nuclear fuel too quickly. Other reactions, in which heavily charged nuclei participate, proceed so slowly that they could not produce sufficient energy. In 1937 H. Bethe and others discussed this question and arrived at the conclusion that there are two series of reactions which jointly or separately may explain the behaviour of the sun and the stars. One of these series is the following: a proton collides with a C^{12} nucleus and is captured; the capture process is accompanied by the emission of γ-rays; the resulting N^{13} nucleus is β-active and transforms into C^{13}; a second proton collides with the C^{13} nucleus and is captured, again emitting γ-rays; by this process a stable N^{14} nucleus is formed; the latter captures a proton, emitting the capture energy as γ-rays; an O^{15} nucleus results; this nucleus is β-active and transforms to N^{15}; finally a collision of a proton and N^{15} gives rise to C^{12} and an α-particle. This series of reactions can be summarized in the following formulas:

$$C^{12}+H^1\rightarrow N^{13}+\gamma$$
$$N^{13}\rightarrow C^{13}+e^+$$
$$C^{13}+H^1\rightarrow N^{14}+\gamma$$
$$N^{14}+H^1\rightarrow O^{15}+\gamma$$
$$O^{15}\rightarrow N^{15}+e^+$$
$$N^{15}+H^1\rightarrow C^{12}+\alpha.$$

It will be noted that as a result of the series four hydrogen nuclei have disappeared and one helium nucleus has been formed. The original C^{12} nucleus has been reproduced at the end of the reactions. Apart from the energy released in γ-rays and kinetic energy, the net reaction can be written:

$$4H^1\rightarrow He^4+2e^+.$$

Indeed, hydrogen and helium seem to be the most abundant constituents of the sun. We have seen in earlier discussions that the building up of the helium nucleus releases more energy per unit mass than any other type of nuclear reaction. Thus the proposed mechanism employs the most abundant materials in the sun in the most effective manner.

The other series of reactions is the following:

$$H^1+H^1\rightarrow H^2+e^+$$
$$H^2+H^1\rightarrow He^3+\gamma$$
$$He^3+He^3\rightarrow He^4+H^1+H^1.$$

The net result is the same as in the previous series, namely the transformation of four protons and two electrons into a helium nucleus

The idea has often been expressed that the same reaction which provides the sun with its source of energy could be utilized by man. The materials involved in the reactions described above are among the most common on earth. Nevertheless it remains apparently impossible to use these reactions in our industries as useful sources of energy. The required steady release of energy would be possible only if materials as hot as encountered near the centre of a star were available. The difficulties that would be encountered in handling such materials are appalling.

UTILIZATION OF THE ENERGY OF THE NUCLEUS

Release of nuclear energy for practical purposes has become possible in recent years. The processes involved are different, however, from the processes occurring spontaneously in the sun. In the latter reactions nuclei of low atomic numbers participate. On the other hand, the reactions utilized by ourselves involve nuclei of the highest charge.

If a uranium or thorium nucleus is hit by a neutron of appropriate energy nuclear fission results with considerable probability (*see* section on nuclear reactions). The two approximately equal fragments into which the nucleus separates carry a total energy of almost 200 Mev in the form of kinetic energy. Some of the energy released is present as internal energy of the fragments and a part of this internal energy splits neutrons off these fragments. As a result of each fission process a few neutrons are obtained in addition to the fission fragments. These neutrons can enter further heavy nuclei, they cause fission and give rise to more neutrons. In each one of the steps the neutrons are multiplied. This results in a rapid increase in the total number of fissions and leads, within a short time, to a number of neutrons and a number of fissions comparable with the number of nuclei in the available material. The multiplication of neutrons and the corresponding multiplication of fission processes is called a chain reaction. This repeatedly branching chain of reactions makes it possible that starting with a few neutrons one may end with so great a number that a substantial fraction of the myriads of nuclei is eventually involved in the process.

The simple type of chain reaction described here explains the functioning of the atomic bomb. When this reaction is initiated in an appropriate piece of material, energy is released so rapidly that a violent explosion results. In explosions carried out so far the energy released is equivalent to that produced by many thousands of tons of T.N.T. Fortunately none of the materials occurring in nature is capable of supporting a simple chain reaction that would give rise to an "atom bomb" type of explosion. In both thorium and ordinary uranium an additional reaction exists which competes with the fission process and renders the process harmless. This competing process is the absorption of a neutron in thorium or U^{238} according to the reactions:

$$Th^{232}+n\rightarrow Th^{233}+\gamma$$
$$U^{238}+n\rightarrow U^{239}+\gamma.$$

In order to produce atomic bombs materials are needed in which competing processes do not occur. Such a material is U^{235}, an isotope which occurs in the natural mixture of uranium with an abundance of 0.7%. Separation of this isotope from naturally occurring uranium was carried out on a large scale in the United States during World War II.

Another material which can support a simple chain reaction and which can be used in atomic bombs is Pu^{239}. Plutonium is an element which carries two more charges than uranium and is the first element that has been artificially made and handled in considerable quantity. Plutonium is obtained from the abundant isotope of uranium, U^{238}. As mentioned above, neutron bombardment transforms this element to U^{239}. This material by two successive β-decay processes becomes Pu^{239}. The latter material was also produced in the United States during World War II.

Energy of the fissionable materials may also be released in a steady manner without any explosion. In order to accomplish this, the energy released in the fission processes must be removed by heat conduction. The energy which has been conducted can then be utilized as a source of power. The excess neutrons created in the fission process must also be absorbed so that instead of a multiplying chain reaction there is a chain reaction in a steady, self-sustaining state. In the process of neutron absorption frequently artificial radioactive products are generated which can be used in research and for medical purposes.

Up to the mid-1950s, the use of nuclear reactors in producing activities for research had been perhaps of greatest importance. This usefulness is due to the fact that a radioactive atom has precisely the same chemical behaviour as its known radioactive counterparts or isotopes. Thus a radioactive carbon or sulphur atom will behave precisely in the same way as a normal carbon or sulphur atom. Because of its activity, however, it can be easily discovered in the most minute quantities. Thus, one can trace the path of substances introduced into a living system or into a piece of machinery through-

out its passage and incorporation in the system.

There is no difficulty in constructing a reactor in which the neutron population remains steady. In order to accomplish this, the neutrons produced in fission must be disposed of either by absorbing them in other nuclei or by allowing them to escape through the surface of the system. In every case one will construct the chain reacting system in such a way that the ratio between neutron loss and neutron gain can be regulated. The regulation can be achieved by lowering into the reactor a neutron-absorbing substance such as a rod containing boron. Neutrons are then consumed in the reaction

$$B^{10}+n\rightarrow Li^{7}+He^{4}.$$

When the system starts to operate there are only a few neutrons around, produced by the cosmic rays or other causes. The neutron-absorbing substance is then withdrawn so that the neutron loss becomes less than the gain of neutrons caused by fissions. The neutrons start to multiply and soon the neutron density and the rate of fission reaches the level at which the system is to be operated. At this time the neutron-absorbing rod is reinserted to an extent that neutron absorption and neutron production are just equal. When the operation of the system is to be shut off, the neutron-absorbing substance is pushed in farther so that the neutron loss exceeds neutron production. The number of neutrons then decreases to the small value that it had originally.

The rate at which such a system releases energy is proportional to the neutron density. The density, in turn, may be regulated at will by choosing the instant at which the neutron-absorbing material is reinserted into the pile and the increase in neutron density is stopped. From a practical point of view the rate of energy release is limited, however, because it is possible to carry out of the system a limited amount of energy in the form of heat. If more energy is produced than can be carried away, this results in an increased temperature of the entire system. As a consequence the system may shut itself off or, failing to do this, may blow up. The main problem to be solved is, therefore, not the production of energy but its control and utilization.

The regulation of the level at which the neutron density is to be kept is greatly facilitated by the fact that some of the neutrons are produced in the fission process with some delay. The delay results from the fact that some fragments of fission undergo a β-decay before they emit a neutron. The lifetime of such a β-decay process ranges from a second to a minute and neutrons are emitted with delays of corresponding duration. These delayed neutrons are utilized in operating the chain reacting system. The system is operated under such conditions that the neutrons produced instantaneously in the process are slightly fewer than the neutrons absorbed or otherwise lost in the system. Under the circumstances the reacting system always has to wait for these delayed neutrons in order that effective neutron multiplication can take place. The multiplication of neutrons is thus slowed down and there is plenty of time to adjust the neutron-absorbing material when the neutron density and energy production approach the desired values, or when there is an excessive increase in power production.

It is possible in principle to construct chain reacting systems of rather small extension and small weight. Nevertheless it is impossible to employ such devices as light and concentrated energy sources such as would be highly desired in aircraft. The reason is that the fission process and also later nuclear processes accompanying it emit considerable amounts of radiation in the form of neutrons, β-rays and γ-rays. If these radiations were allowed to escape everyone who approached the chain reacting machine would be killed. The system must be surrounded with an absorbing shield which is thick enough to reduce these dangerous radiations to an exceedingly small fraction of their original intensity. In order to achieve this purpose the shield must be heavy. This sets a severe limitation on the use of nuclear energy in machines that are small and easily moved. It is nevertheless expected that nuclear energy will prove extremely useful. While the apparatus which produces energy is of necessity both heavy and bulky, once it is set up it can function for a long time without being supplied with additional nuclear fuel. In the long run added fuel will be needed but the weight of the raw material is completely negligible compared with the weight of the coal needed for the same energy production. Thus nuclear power plants are independent of heavy raw materials. At the same time they will be more easily constructed than hydroelectric plants.

The materials which can be most easily used in constructing nuclear power plants are the same as those needed for the atomic bomb. They are the materials in which nuclear fission occurs with greatest ease without too many competing processes which absorb neutrons. It is also possible to build up a nuclear power plant using only common uranium, a substance which cannot be used in atomic bombs. The reason for this is the following. Ordinary metallic uranium cannot sustain a nuclear chain reaction because more neutrons are absorbed in the isotope, U^{238}, than are produced by fissions in both isotopes. Neutron multiplication can be obtained if some appropriate material, such as carbon, is added to the system. The neutrons produced in fission are slowed down by repeated collisions with carbon nuclei. Finally the neutrons are transformed into thermal neutrons and the slowing down process ends. The U^{235} reacts preferentially with these slowed-down neutrons. In spite of the fact that U^{235} is present in the normal isotopic mixture to an extent of 0.7%, successful collisions between slow neutrons and U^{235} become frequent enough to give rise to a sufficient number of fissions and an excess of neutron production. The processes described need only common materials like uranium and carbon, but the neutron excess obtained in this way is small and losses must be carefully avoided. Such neutron losses always occur at the surface of the chain reacting system. These surface losses can be reduced by making the machine bulky.

If a chain reacting system is built up from ordinary uranium many of the neutrons produced are absorbed in the abundant U^{238}. The resulting U^{239} decays into Pu^{239}, a material which is usable in more convenient plants and also in atomic bombs. It should be noticed that every process of useful atomic energy production is closely connected with the destructive use which can be made of this great energy source. The machines described above either use the atomic explosive as fuel or else produce the atomic explosive during their operation. The constructive and destructive uses of nuclear energy are therefore very closely related. (E. TE.; M. L. A.)

NUER: *see* NILOTES.

NUEVA SAN SALVADOR (SANTA TECLA), the capital of the department of La Libertad, El Salvador; on a branch railway from San Salvador (10 mi. N.). Pop. (1950) 18,313. The town was founded in 1854 and intended to replace the capital, San Salvador, which was ruined by an earthquake in that year but soon afterward rebuilt.

NUEVO LEÓN, a northern state of Mexico. Pop. (1944) 625,780, with no native Indians; (1950) 743,297. Area, 25,130 sq.mi., with its capital at Monterrey (*q.v.*). Crossed by paved trunk highways and railways between Laredo, Texas, the gulf port of Tampico, and Mexico City, the state is a major industrial section and an important agricultural region lying just north of the Tropic of Cancer. With an average altitude of about 5,500 ft., the Sierra Madre Oriental runs southeasterly through the state, which lies on the easterly and northern slopes of the Mexican plateau. The climate is arid and semi-arid in the north, where sandy wastes are covered with cactus and scrub. The eastern slopes are endowed with vegetation, and the mountainous sections are covered with forests; subtropical valleys in the east permit sugar-cane cultivation.

With scanty rainfall, Nuevo León has a dry, generally healthful climate which is temperate on the elevated parts. Though there are a number of rivers and streams, none is navigable; the largest is the Rio Salado. Water for irrigation is in part drawn from the international Falcón dam, jointly constructed by Mexico and the United States for hydroelectric power, flood control and agricultural purposes.

Nuevo León produces few minerals, but quantities of sugar, cereals (especially maize and wheat) and vegetables. Its fibres have importance, notably *ixtle* from agaves (cactus), which also

furnish distilled liquor, *mescal.* The main importance of Nuevo León lies in its industries.

Its iron and steel works and smelting plants were the first heavy industry in Latin America, and in addition it supports numerous textile enterprises and other light industrial activities. It has a well-developed rail net. (HD. C.)

NUISANCE, that which gives offence or causes annoyance, trouble or injury. In English law nuisance is either public or private. A public or common nuisance is defined by Sir J. F. Stephen as "an act not warranted by law, or an omission to discharge a legal duty, which act or omission obstructs or causes inconvenience or damage to the public in the exercise of rights common to all His Majesty's subjects" (*Digest of the Criminal Law*). A private nuisance is an act or omission which causes inconvenience or damage to a private person. There must be some sensible diminution of these rights affecting the value or convenience of the property. "The real question in all the cases is the question of fact, whether the annoyance is such as materially to interfere with the ordinary comfort of human existence" (Lord Romilly in *Crump* v. *Lambert,* 1867, L.R. 3 Eq. 409). A private nuisance, differing in this respect from a public nuisance, may be legalized by uninterrupted use for 20 years. (*See* ANNOY.) The remedy for a public nuisance is by information, indictment, summary procedure or abatement. An information lies in cases of great public importance, such as the obstruction of a navigable river by piers. In some matters the law allows the party to take the remedy into his own hands and to "abate" the nuisance. Thus, if a gate be placed across a highway, any person lawfully using the highway may remove the obstruction, provided that no breach of the peace is caused thereby. The remedy for a private nuisance is by injunction, action for damages or abatement. An action lies in every case for a private nuisance; it also lies where the nuisance is public, provided that the plaintiff can prove that he has sustained some special injury. In such a case the civil is in addition to the criminal remedy. In Scotland there is no practical distinction between public and private nuisances, the remedy against either being interdict or damages. The law as to what constitutes a nuisance is substantially the same as in England.

There is a list of statutory nuisances in the Public Health (Scotland) Act 1867, and amending acts. The American law on the subject is practically the same as the English law.

NUKHA, a town of Russia in the Azerbaijan S.S.R. in 41° 11′ N., 47° 8′ E., on a winding road linking Baku with Tiflis, and on the Nakhichevan river. Pop. (1933) 26,300. It is occupied in the breeding of silkworms and has five silk spinning factories. Hajji Chelyabi, the founder of the khanate of Sheki, chose the town as his residence in the 18th century and it remained the capital of the khanate until 1819, when it finally became Russian.

NULLIFICATION, the process of making null or of no effect (Lat. *nullus,* none). In United States history the term is applied to the process by which a state either (*a*) in fact suspended, or (*b*) claimed a constitutional right of suspending, the operation of a federal law within its own territory. The doctrine of nullification as a constitutional theory was probably never held by a majority of the states or of the American people at any one time, though before 1860 most of the states asserted or practised it. The belief in nullification was based on the theory that the union of the states was a voluntary one, each member retaining its sovereignty, though for purposes of convenience delegating certain powers of government to an agent—the federal government. The powers of this agent were strictly limited by the Constitution, and should it transcend these powers the states must interpose to protect their rights. This view held that the Supreme Court created by the Constitution was not a proper tribunal to decide causes arising beyond the Constitution or relating to the nature of the Union, but that its jurisdiction was limited to cases arising under the Constitution. If the Federal Government usurped a right belonging to the state, the latter, being a sovereignty, must judge for itself.

As later perfected by John C. Calhoun (*q.v.*), the theory of nullification required a practice as follows. A state aggrieved by a law of the Federal congress might, in constituent convention, suspend the operation of the objectionable law, and report its action to the other states. If three-fourths of them decided that the law in question was not unconstitutional, then in effect it became ratified (*see* United States Constitution, art. v). The dissatisfied state must then submit or draw out of the Union by secession (*see* SECESSION and CONFEDERATE STATES OF AMERICA).

The earliest assertions of the doctrine of nullification are found in the Kentucky and Virginia resolutions of 1798–99, written respectively by Thomas Jefferson and James Madison in protest against the Alien and Sedition Acts of Congress. Nullification was first practised in 1809 by Pennsylvania, the governor ordering out the state troops to resist the execution of a decree of a Federal court. In the New England states, 1809–15, the United States laws relating to embargo, non-intercourse and army enlistments were nullified by state action. From 1825–29 the state of Georgia forcibly prevented the execution of Federal laws and court decrees relating to the Indians within her borders and in Alabama, 1832–35, there was a similar nullification. The only example of nullification in which theory and practice coincided was the nullification in 1832 by South Carolina of the Federal tariff laws. In this the state acted upon the theory outlined above which was perfected by Calhoun. In the last decade before the Civil War 14 of the Northern states in the so-called "Personal Liberty laws" nullified the Federal statutes relating to slaves and slavery by making it a crime for their citizens to obey these laws. Since the Reconstruction the Southern states have in practice effected a nullification of the Fourteenth and Fifteenth amendments to the Constitution providing for negro suffrage.

See John C. Calhoun, *Works,* vols. i. and vi. (1853–55); D. F. Houston, *Critical Study of Nullification in South Carolina* (1897); C. W. Loring, *Nullification and Secession* (1893); E. P. Powell, *Nullification and Secession in the United States* (1897); and U. B. Phillips, *Georgia and States Rights* (Washington, 1902); D. W. Howe, *Political History of Secession to the Beginning of the American Civil War* (1914); C. S. Boucher, *The Nullification Controversy in South Carolina* (Chicago, 1916); P. M. Hamer, *The Secession Movement in South Carolina, 1847–52* (Allentown, Pa., 1918); L. T. Lowery, "Northern Opinion of Approaching Secession," *Smith College Studies in History,* vol. 3 (Northampton, Mass., 1918); and E. S. Corwin, *John Marshall and the Constitution* (New Haven, Conn., 1919).

(W. L. F.)

NULLITY OF MARRIAGE, a judicial declaration that a marriage was null and void *ab initio* (from the beginning). In the 12th century the Roman law doctrine of nullity of marriage was developed in order to deal with hard cases under the principle of the indissolubility of marriage laid down by the Church of Rome, whose canons at that date governed the matrimonial law for the whole of Christendom. Nullity could be sued for on the grounds of affinity, into which the law of adoption entered very largely, or a previous unconsummated marriage, which latter was a ground for nullity in England as late as 1750. There were, and continue to be in Roman Catholic countries, various other grounds for nullity, but the grounds of nullity in England are at present limited to the following: (1) Where the parties are not by reason of age (14 for a male and 12 for a female), mental capacity, or otherwise capable of contracting marriage; (2) where the parties are within the prohibited degrees of affinity or relationship; (3) where one of the parties is already married; (4) where one of the parties does not freely consent to marry the other or does not understand the nature of the contract or ceremony; (5) where certain forms have not been observed; (6) where the form of marriage is essentially polygamous. Forms of marriage which offend against these rules are void *ab initio.* If at the time of the marriage one of the parties is and continues to be incapable of consummating the marriage by reason of some incurable physical defect, or of some incurable mental disability on the part of the man preventing him from consummating the marriage, or on the part of the woman resulting in her refusal of marital rights, the marriage may be annulled on the petition of the other party. A person may claim as a ground of nullity that he or she was insane at the time of the marriage. For the prohibited degrees of affinity *see* MARRIAGE.

The Royal Commission on Divorce which reported in 1913

recommended the following additional grounds of nullity of marriage: (1) When the other party, though of sufficient understanding to consent to a marriage, is at the time of the marriage either of unsound mind in other respects, or in a state of incipient mental unsoundness which becomes definite within six months after marriage, and the first party is at the time of the marriage ignorant of the defect, provided that (*a*) the suit is instituted within a year of the celebration of the marriage; (*b*) there has been no marital intercourse after discovery of the defect; (2) where the other party at the time of the marriage is subject to epilepsy or to recurrent insanity, and such fact is concealed by such party or his or her parents or either of them, or by anyone who has control over such party and is aware of the intended marriage, and the first party remains ignorant of the fact at the time of the marriage, subject to the same limitations for petitioning as in (1) above; (3) where one of the parties at the time of the marriage is suffering from a venereal disease in a communicable form, and the fact is not disclosed to the other party; (4) where a woman is pregnant by some other man at the time of the marriage and the husband is ignorant of the fact; (5) where there has been wilful refusal, without reasonable cause to allow intercourse, and where in fact there has been no intercourse owing to such refusal. (*See* also DIVORCE.)

See W. Rayden, *Practice and Law in the Divorce Division* (2nd. ed., by C. Mortimer, 1926); Sir L. Dibdin, *Reformatio Legum Ecclesiasticarum*, vol. iii. (1912); Report of the Royal Commission on Divorce and Matrimonial Causes (1913). (W. LA.)

United States.—Three different situations relating to the nullity of marriage must be distinguished. A marriage may in the first place be totally void. No suit is necessary for its annulment and third parties can set up the fact of its invalidity. This, for example, is generally true of a bigamous marriage. Secondly, a marriage may be voidable at the election of one of the parties. No judicial decree is in theory necessary, though it is customary to secure a judicial declaration of nullity. Non-age of a party generally permits him thus to avoid the marriage, rendering it invalid *ab initio,* but until avoided by the act of the party it is valid, and third parties have no rights to contest its validity. Thirdly, as in the cases of marriage within the prohibited degrees of affinity, a suit to annul the marriage may be essential and such suit must be brought within the lifetime of one of the parties. The decree of annulment also relates back to the time of the marriage. The chief tendencies manifested by the many statutes in this field, apart from specifying the grounds for annulment, relate to: preserving the legitimacy of children born prior to the decree of annulment; making all annulments dependent upon judicial action and, in some instances, permitting the court in its discretion to deny or withhold relief; limiting the right to sue for annulment to a short space of time after discovery of the cause for annulment; permitting courts to award alimony upon decreeing annulment; allowing the injured party to a subsisting marriage to bring suit for its annulment; permitting courts in their discretion to hold trials for annulment in camera.

The grounds for annulment commonly recognized are: bigamy, impotency, non-age, marriage within the prohibited degrees of affinity, non-compliance with an essential statutory formality, mental incapacity existing at the time of the marriage. Among grounds that are recognized in some States by legislation, though not generally recognized, are: fraud, duress or mistake in the granting of consent to marriage, wilful refusal of a party to consummate the marriage by sexual intercourse, venereal disease or other serious illness existing at the time of the marriage and unknown to the other party, pregnancy due to some third party at the time of marriage and unknown to the other party. The causes for annulment are now generally specified by statute and these vary from State to State. Wide legislative activity in this field is due to the fact that in the United States no courts succeeded to the jurisdiction of the English ecclesiastical courts. Consequently no action for annulment on grounds entertained by the English ecclesiastical courts could be maintained in the absence of statute though equity courts would entertain such actions on grounds other than the canonical disabilities Under such a theory the intervention of the legislature became necessary and in short time legislation expanded to bring the entire field within its control. (J. M. LA.)

NUMANTIA, an ancient hill fortress in northern Spain, in the province of Soria (Old Castile), overhanging the village of Garray, near the town of Soria, on the upper Douro. Here, on a small isolated high plateau in the middle of the valley, was the stronghold which played the principal part in a famous struggle between the conquering Romans and the native Spaniards during the years 154–133 B.C. Numantia was especially concerned in the latter part of this war from 144 onwards. It was several times unsuccessfully besieged. Once the Roman general Hostilius Mancinus with his whole army was compelled to surrender (137). Finally, Scipio Aemilianus, Rome's first and only general in that age, with some 60,000 men drew round the town 6 m. of continuous entrenchments with seven camps at intervals. After 15 months (134–133) he reduced by hunger the 6,000–8,000 Numantine soldiers, much as Caesar afterwards reduced Alesia in Gaul. The result was regarded as a glorious victory, and in Roman literature the fall of Numantia was placed beside the fall of Carthage. The site was, under the Roman Empire, occupied by a Roman town called Numantia, and the *Itinerary* tells of a Roman road which ran past it. It is to-day a "Monumento Nacional" of Spain, and has yielded remarkable discoveries to the skilful excavations of Dr. Schulten (1905–1910), who has traced the Celtiberian town, the lines of Scipio and several other Roman camps dating from the Numantine Wars. (F. J. H.)

NUMA POMPILIUS, second legendary king of Rome (715–672 B.C.), was a Sabine, a native of Cures, and his wife was the daughter of Titus Tatius, the Sabine colleague of Romulus. He was elected by the Roman people at the close of a year's interregnum, during which the sovereignty had been exercised by the members of the senate in rotation. Nearly all the early religious institutions of Rome were attributed to him. He set up the worship of Terminus (the god of landmarks), appointed the festival of Fides (Faith), built the temple of Janus, reorganized the calendar and fixed days of business and holiday. He instituted the flamens (sacred priests) of Jupiter, Mars and Quirinus; the virgins of Vesta, to keep the sacred fire burning on the hearth of the city; the Salii, to guard the shield that fell from heaven; the pontifices and augurs, to arrange the rites and interpret the will of the gods; he also divided the handicraftsmen into nine gilds. He derived his inspiration from his wife, the nymph Egeria, whom he used to meet by night in her sacred grove. After a long and peaceful reign, during which the gates of Janus were closed, Numa died and was succeeded by the warlike Tullus Hostilius. Livy (xl. 29) tells a curious story of two stone chests, bearing inscriptions in Greek and Latin, which were found at the foot of the Janiculum (181 B.C.), one purporting to contain the body of Numa and the other his books. The first when opened was found to be empty, but the second contained fourteen books relating to philosophy and pontifical law, which were publicly burned as tending to undermine the established religion.

No single legislator can really be considered responsible for all the institutions ascribed to Numa; they are essentially Italian, and older than Rome itself. Even Roman tradition itself wavers; *e.g.,* the *fetiales* are variously attributed to Tullus Hostilius and Ancus Marcius. The supposed law-books, which were to all appearance new when discovered, were clearly forgeries.

See Livy i. 18–21; Plutarch, *Numa;* Dion. Halic. ii. 58–76; Cicero, *De republica,* ii. 13–15. For criticism: Schwegler, *Römische Geschichte,* bk. xi.; Sir G. Cornewall Lewis, *Credibility of early Roman History,* ch. xi.; W. Ihne, *Hist. of Rome,* i.; E. Pais, *Storia di Roma,* i. (1898), where Numa is identified with Titus Tatius and made out to be a river god; J. B. Carter, *The Religion of Numa* (1906); O. Gilbert, *Geschichte und Topographie der Stadt Rom im Altertum* (1883–1885); and ROME: *Ancient History.*

NUMBER means a positive integer such as 17, a real quantity such as π or -2, or an element of any of various abstract mathematical generalizations of the system of positive integers and the system of real numbers. These generalizations include complex numbers, quaternions and other hypercomplex numbers, modular numbers and transfinite cardinal and ordinal num-

bers; all these types of numbers will be defined below.

POSITIVE INTEGERS

Definition of Cardinal Numbers.—The concept of a positive integer arose in prehistoric times from recognition of the fact that the number of elements in any class (say the number of sheep in a herd) can be represented in various ways (say by a pile of stones). The essential idea is that there must be a one-one correspondence between the sheep in the herd and the stones in the pile. By this we mean that it must be possible to pair off one sheep with each stone, in such a way that no sheep is counted twice, and no sheep and no stones are left over.

In the same spirit, modern mathematicians define a cardinal number as a mark associated with a class, and with all other classes in one-one correspondence with this particular class. Thus, the integer 5 is the mark associated with the class of fingers on a hand and with all other classes whose elements can be paired off with the fingers on a hand.

A large variety of marks to represent the different positive integers have been developed by different races. These are discussed elsewhere (*see* NUMERAL SYSTEMS). The positional notation developed by the Hindus and Arabs, in which the position of a digit to the left of the decimal point indicates the power of the radix or base ten involved, is incomparably superior to earlier systems. However, it is not to be supposed that the base ten has any unique qualifications.

Our interest here is not in systems of notation or effective computation (*see* ARITHMETIC; CALCULATING MACHINES), but in the fundamental ideas which underly the use of number. Two of these are addition and multiplication.

Addition and Multiplication.—If a and b are the integers (cardinal numbers) for two classes A and B having no elements in common, and if these classes be combined to form a new class S, then the integer s representing the class S is called the sum of a and b, and we write $s=a+b$.

From this definition we easily prove the commutative and associative laws of addition,

$$a+b=b+a, \tag{1}$$
$$a+(b+c)=(a+b)+c. \tag{2}$$

Here and below the equality sign means that the classes represented by the two sides of the equation can be placed in one-one correspondence. Thus, both $a+(b+c)$ and $(a+b)+c$ represent the combination of three classes A, B, C without common elements, having a, b, c elements, respectively.

Similarly, there may be a classes, each of which contains the same number b of elements, while no two of these classes have an element in common. If all these classes are combined to form a new class P, the integer p representing P is called the product of a and b, written $p=a\times b$.

From this definition, one can also prove the commutative and associative laws of multiplication,

$$a\times b=b\times a, \tag{3}$$
$$a\times(b\times c)=(a\times b)\times c, \tag{4}$$

as well as the distributive law, which asserts that

$$a\times(b+c)=(a\times b)+(a\times c). \tag{5}$$

Brief further discussions of laws (1)–(5) may be found elsewhere (*see* ASSOCIATIVE LAWS; COMMUTATIVE LAWS; DISTRIBUTIVE LAW); formal proofs may be found in textbooks on mathematics (*see* G. Birkhoff and S. MacLane, *A Survey of Modern Algebra*, ch. xii [1941]). Informal graphical proofs follow.

For example, $a\times b$ is the number of elements in a rectangular array of a rows and b columns; rotation through 90° converts this into a rectangular array of b rows and a columns. Again, $a\times(b+c)$ is the number of elements in a rectangular array of a rows and $b+c$ columns. This array is the sum of two rectangular arrays without common elements, having respectively a rows and b columns, and a rows and c columns. This is $(a\times b)+(a\times c)$.

The laws (1)–(5) are often called the five fundamental laws of arithmetic; in addition, the special unit law

$$a\times 1=a \tag{6}$$

is evident. Other laws also follow from a detailed logical analysis of the situation. For example, equality satisfies the reflexive law, that $a=a$; the symmetric law, that $a=b$ implies $b=a$; and the transitive law, that $a=b$ and $b=c$ imply $a=c$. Moreover, addition and multiplication are single-valued operations, so that if $a=b$, then $a+c=b+c$ and $a\times c=b\times c$. To explain the relation of such laws to our definitions, consider the statement that $a=b$ implies $a+c=b+c$. This means that if there is a one-one correspondence between two classes A and B, and if C is any class having no elements in common with A or B, then there is a one-one correspondence between the combination (sum) of A and C and that of B and C.

However, a good understanding of the laws of arithmetic is possible on the basis of (1)–(6) alone.

Ordinal or Inductive Definition.—In the last two sections the concept of a positive integer was based on the concept of a class and general principles of the logic of classes. But it is also possible to take a more formalistic view and to base arithmetic on laws (1)–(6) without referring to the idea that integers represent classes.

We must first know the order of the integers (*i.e.*, which positive integer follows which). Then if we start with the principle that $a+1$ is the successor of a (number following a), and apply repeatedly the special case

$$a+(b+1)=(a+b)+1, \tag{2'}$$

$c=1$ of the associative law, we readily get the addition table. Thus, we get $5+1=6$, $5+2=5+(1+1)=(5+1)+1=6+1=7$, etc.

Similarly, the multiplication table can be constructed ordinally from the unit law (6) and the following special consequence

$$a\times(b+1)=(a\times b)+(a\times 1)=(a\times b)+a \tag{5'}$$

of the distributive laws (5) and (6). Thus, we get $5\times 1=5$, $5\times 2=5\times(1+1)=(5\times 1)+5=10$, etc.

Hence, we can say that the identities (2), (5), (6) imply all the arithmetic of positive integers since they tell us how to add and multiply any two positive integers.

G. Peano put this principle in an even more striking form about 1900. He first characterized formally the sequence of positive integers by the following postulates: (i) each positive integer n has a successor, written n^+; (ii) $m^+=n^+$ implies $m=n$; (iii) there is just one positive integer, called 1, which is not the successor of any number; (iv) any set C of positive integers which includes 1, and which includes n^+ if it includes n, must include every positive integer. Condition (iv) is called the principle of finite induction; it is intuitively evident since C includes 1, includes $2=1^+$ since it includes 1, includes $3=2^+$ since it includes 2 and so on indefinitely. It is really used above when we state that (6) and (5′) define $a\times m$ for all m.

Peano then developed the entire arithmetic of positive integers from postulates (i)–(iv), without making any other assumptions. He first constructed the addition and multiplication tables as we did above, but introducing $m+1=m^+$, (2′), $m\times 1=m$ and (5′) as definitions. He then proved laws (1)–(5). The chain of reasoning involved is long (*see* C. C. MacDuffee, *An Introduction to Abstract Algebra* [1940]). We give here the special case $m+1=1+m$ of the commutative law as a sample. The law $1+1=1+1$ is evident. Assuming $1+n=n+1$, we have $1+n^+=(1+n)^+$ by definition, $(1+n)^+=(n+1)^+$ by assumption and $(n+1)^+=(n^+)^+=n^++1$ by definition. Hence the set of positive integers m for which $m+1=1+m$ is true includes 1, and includes n^+ if it includes n; hence, by postulate (iv), it includes every positive integer.

The other proofs make similar use of postulate (iv). Using it, we can further prove the cancellation laws

$$a+m=a+n \text{ implies } m=n, \tag{7}$$
$$a\times m=a\times n \text{ implies } m=n \qquad (a\neq 0). \tag{8}$$

The proof of the laws of cancellation in terms of the concepts of class and one-one correspondence alone, and without the use of finite induction, is difficult for reasons which will appear later in the discussion of transfinite cardinal numbers.

Order Properties.—We can easily define the relation $a\leqq b$ in terms of classes, to mean that there is a one-one correspondence between a class A containing a elements and a subset of a class B containing b elements. In this definition, we include B as a

subset of itself.

From this definition, it is easy to prove that one can add and multiply inequalities. Thus,

$$a \leqq b \text{ implies } a+c \leqq b+c, \tag{9}$$
$$a \leqq b \text{ implies } a \times c \leqq b \times c \quad (\text{if } c \geqq 0). \tag{10}$$

The restriction $c \geqq 0$ in (10), like the restriction $a \neq 0$ in (8), is added to provide for later generalizations; it is automatically fulfilled in the case of positive integers. Again, $a \leqq b$ and $b \leqq c$ imply $a \leqq c$. In addition,

$$\text{for any } a, b, \text{ either } a \leqq b \text{ or } b \leqq a\text{; if both hold, then } a = b. \tag{11}$$

However, the proof of this, like the proof of (7)–(8), is not easy without the use of finite induction; *i.e.*, no simple proof based on the concepts of class and correspondence is known.

Peano's definitions show that we can define addition and multiplication of positive integers in terms of the order relation. This is because m^+ is defined by the properties that $m^+ > m$, and that $n > m$ implies $n \geqq m^+$. It is curious that we can conversely define order in terms of the operation of addition. In fact,

$$a + x = b \text{ has a solution in positive integers if and only if } a < b. \tag{12}$$

Subtraction and Division.—We have not introduced subtraction and division as fundamental operations for the simple reason that they can be defined as the inverses of addition and multiplication, respectively. Thus, the difference $a-b$ of two numbers a and b is defined as a solution x of the equation

$$b + x = a \tag{13}$$

and the quotient $\frac{a}{b}$ of a by b as a solution y of the equation

$$b \times y = a. \tag{14}$$

If we restrict ourselves to positive integers, differences and quotients need not always exist (*cf.* $3+x=2$, $3 \times y = 2$, [12]), but if they do, laws (7)–(8) guarantee that they are unique.

Furthermore, the usual laws of operation, such as

$$\begin{aligned} &(a-b) = (c-d) \quad \text{means } a+d = b+c, \\ &(a-b) + (c-d) = (a+c) - (b+d), \\ &(a-b) \times (c-d) = (a \times c + b \times d) - (a \times d + b \times c), \end{aligned} \tag{15}$$

and (*see* FRACTION)

$$\begin{aligned} &\left(\frac{a}{b}\right) = \left(\frac{c}{d}\right) \quad \text{means } ad = bc, \\ &\left(\frac{a}{b}\right) + \left(\frac{c}{d}\right) = \frac{(a \times d + b \times c)}{bd}, \\ &\left(\frac{a}{b}\right) \times \left(\frac{c}{d}\right) = \frac{a \times c}{b \times d}, \end{aligned} \tag{16}$$

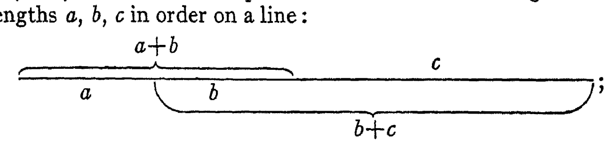
can be proved from laws (1)–(5). This is one reason why laws (1)–(5) are called the fundamental laws of arithmetic.

THE REAL NUMBER SYSTEM

Number as Quantity.—Mankind was early led to the concept of a real number by the need for symbols to represent such geometric quantities as lengths, areas and volumes and such physical quantities as weight and (more recently) electric charge.

The characteristic features of such quantities are that (1) two quantities of the same kind can be added by some obvious geometrical or physical operation (such as laying two segments next to each other on a straight line), and (2) any quantity can be divided into parts. The second feature, of infinite divisibility, is the crudest way of expressing the principle that the real-number system is continuous, and not discrete like the system of positive integers.

The commutative and associative laws (1)–(2) of addition are frequently intuitively obvious from the physical definition of addition. Thus, in the case of lengths, it is obvious that $a + (b+c) = (a+b) + c$ since both represent the sum of three segments of lengths a, b, c in order on a line:



It is also obvious that $a+b = b+a$ since the segment $a+b$ can be transformed into the segment $b+a$ by rotation through 180°.

In representing quantities by numbers, it is usually necessary to choose first an arbitrary unit, such as a foot, a square inch or a pound.

This unit of quantity is assigned arbitrarily the numerical value 1, and exact multiples of this quantity (*i.e.*, sums of an integral number of unit quantities) are assigned corresponding integral values. Since the entire addition table for positive integers can be constructed from the associative law for positive integers (2′), it is clear that the sum of two such quantities must be represented by the sum of the corresponding positive integers.

Multiplication; Number as Ratio.—A simple definition of the product of two quantities is not always possible. For example, if we define the product of two lengths a and b as the area of the rectangle with sides a and b, it may logically be objected that this is a quantity of a different kind.

In order to get around this logical difficulty, the Greeks suggested that a number a should be considered as representing the ratio between a certain quantity and the unit quantity, and never as representing the quantity itself. Thus, 160 lb. is a weight; the number 160 is the ratio of this weight to the weight of a pound.

This idea that numbers are dimensionless ratios has wide applicability. Thus, it leads to plausible "proofs" of the laws of multiplication. For example, the hypothesis that $a \times (b \times c) = (a \times b) \times c$ for all real numbers is given substantial support by the fact that both quantities may be regarded as representing the volume of a box of sides a, b, c. The laws $a \times b = b \times a$ and $a \times (b+c) = (a \times b) + (a \times c)$ can be given similar plausible geometric interpretations in terms of areas.

But these plausible arguments are not proofs in any rigorous sense. They depend not only on postulates for geometry, but also on definitions of area and volume.

The only known way of getting rid of these embarrassing difficulties is to define real numbers abstractly in terms of the system of positive integers, deducing all properties of real numbers by pure logic from these definitions and properties of the positive integers, and using geometrical and physical concepts only to suggest possible postulates and definitions. In this way the properties of real numbers may be made to depend on pure logic and the concept of a class alone (*see* MATHEMATICS, FOUNDATIONS OF).

We shall follow this abstract procedure henceforth.

Rational Numbers.—If we assume that division (except by zero) and subtraction are always possible, we are led inevitably from the system of positive integers to the system of rational numbers (*i.e.*, of positive and negative fractions and integers, and zero).

Thus, let us assume that every equation $by = a$ with positive integral coefficients a, b has a solution y. This corresponds to the idea that a quantity a can be divided into any positive number b of equal parts. Let us try also to preserve the five fundamental laws (1)–(5) of arithmetic and the cancellation law (8).

By (8), $by = a$ can have only one solution, which we write $\frac{a}{b}$. It may be shown that the usual rules (16) for adding and multiplying fractions must hold. For example, if $by = a$ and $dz = c$, then $bdy = ad$, $bdz = bc$; and so $bd(y+z) = bdy + bdz = ad + bc$, which proves that $\frac{a}{b} + \frac{c}{d} = \frac{(ad+bc)}{bd}$. We can also prove

$$\frac{\left(\frac{a}{b}\right)}{\left(\frac{c}{d}\right)} = \frac{ad}{bc}, \tag{17}$$

whence division by fractions as well as by integers is positive in our new system.

Conversely, we can prove that the rules (16) do give a system in which laws (1)–(12) are valid (we let $\frac{a}{b} > \frac{c}{d}$ mean that $ad > bc$ for positive fractions); in most cases, the proof may be reduced

to the corresponding law for the positive integers by substitution in (16) and cancellation.

Similarly, suppose we assume that every equation $\frac{c}{d}+y=\frac{a}{b}$ has a solution. This hypothesis is suggested by the properties of positive and negative electric charges in physics, by the fact that distance on a straight line can be measured in two directions (right = positive and left = negative), etc.

However, it is not necessary to denote the solution of $\frac{c}{d}+y=\frac{a}{b}$ by such a complicated symbol as $\frac{a}{b}-\frac{c}{d}$. In fact, by (11), either $\frac{a}{b}=\frac{c}{d}$, $\frac{a}{b}>\frac{c}{d}$ or $\frac{a}{b}<\frac{c}{d}$. Hence, by (12), which amounts to saying that $\frac{a}{b}+\frac{x}{y}=\frac{c}{d}$ has a solution if and only if $\frac{a}{b}<\frac{c}{d}$, either $\frac{a}{b}=\frac{c}{d}$ or $\frac{c}{d}+y=\frac{a}{b}$ has a positive solution $\frac{f}{e}$, or $\frac{b}{a}+z=\frac{c}{d}$ has a positive solution $\frac{h}{g}$. Corresponding to these three cases, we write $\frac{a}{b}-\frac{c}{d}=0$, $\frac{a}{b}-\frac{c}{d}=\frac{f}{e}$ and $\frac{a}{b}-\frac{c}{d}=-\left(\frac{h}{g}\right)$.

Moreover, instead of proving (15), we can derive the rules for operating with negative fractions and zero from

$$0+a=a, \qquad a\times 0=0, \tag{18}$$

and the mysterious law

$$(-1)\times(-1)=1. \tag{19}$$

These in turn are necessary consequences of our laws (1)–(8). Thus, if we define 0 as $1-1$, by adding $a-1$ to both sides of $0+1=1$, we get $0+a=a$. Multiplying through $0+1=1$ by a, we get $a\times 0+a=a=0+a$, whence (cancelling) $a\times 0=0$. Finally, multiplying the equation $1+(-1)=0$, which defines (-1), through by -1, we get $(-1)+(-1)\times(-1)=0$ by (5), (6) and (18). Adding 1 to both sides, we get (19) after reduction.

A more thorough study would reveal that a considerable reduction in the number of postulates (fundamental laws needed to imply the others) is possible. Thus, all the laws for the positive fractions can be deduced from the associative law for addition, the distributive laws $a\times(b+c)=(a\times b)+(a\times c)$ and $(a+b)\times c=(a\times c)+(b\times c)$, the unit laws $a\times 1=1\times a=a$, and $1+1\neq 1$.

Irrational Numbers.—Fractions were employed as early as 1700 B.C. by the ancient Egyptians, and it was not until Pythagoras (525 B.C.) that the need for other numbers was discovered. The need for such irrational numbers is amply corroborated in modern mathematical analysis, where they play a fundamental role in the integral calculus, trigonometry, etc. Pythagoras showed that the ratio x of the diagonal of an isosceles right triangle to the length of a side must satisfy the equation $x^2=2$ (Pythagorean theorem). However, no fraction $\frac{m}{n}$ can satisfy $\left(\frac{m}{n}\right)^2=2$; that is, $m^2=2n^2$ has no solution in integers. For 2 divides m^2, an even, and it divides $2n^2$, an odd, number of times.

Eudoxus pointed out (375 B.C.) that although $\sqrt{2}$ could not be represented exactly by any one fraction, it could be represented as a limit of a sequence of fractions (*see* NUMBER SEQUENCES). Thus, we can represent $\sqrt{2}$ in the form of an infinite decimal: $2=1.4142\cdots$; this amounts to specifying $\sqrt{2}$ as the limit of the sequence of decimal fractions

$$1, \frac{14}{10}, \frac{141}{100}, \frac{1414}{1000}, \frac{14142}{10000}, \cdots.$$

These ideas are discussed from the Greek point of view in the tenth book of Euclid's *Elements* (300[?]B.C.).

Their clear exposition from the modern point of view is due to G. Cantor (1871). Real numbers, including both rational and irrational numbers, are defined by Cantor as infinite sequences $x=(x_1, x_2, x_3, \cdots)$, $y=(y_1, y_2, y_3, \cdots)$, $\cdots$, of fractions $x_n, y_n, \cdots$, which converge in the sense that (x_m-x_n), (y_m-y_n), $\cdots$, approach zero as m, n increase indefinitely. We regard x as the limit of the sequence $(x_1, x_2, x_3, \cdots)$.

Equality is defined by making $x=y$ mean that x_n-y_n approaches zero as n increases indefinitely. Addition and multiplication are defined by

$$x+y=(x_1+y_1,\ x_2+y_2,\ x_3+y_3,\ \cdots),$$
$$x\times y=(x_1\times y_1,\ x_2\times y_2,\ x_3\times y_3,\ \cdots). \tag{20}$$

Laws such as (1)–(17), valid for rational numbers, are extended to all real numbers by the principle of continuity. For example, each approximating term $(x+y)_n=x_n+y_n$ of $x+y$ is equal to the corresponding approximation $(y+x)_n=y_n+x_n$ of $y+x$; hence, $(x+y)_n-(y+x)_n=0$ for all n, and $x+y=y+x$ by definition of equality. In general, the principle of continuity states that laws involving continuously varying functions like $x+y$ and $x\times y$, which are valid for arbitrarily good approximations $x_n, y_n, \cdots$ of $x, y, \cdots$ must be also valid for the limit values $x, y, \cdots$.

Another interesting definition of real numbers is due to R. Dedekind (1872). By a section in the class R of fractions, we mean a division of all fractions into two classes L and U, such that $x\leqq y$ for every x in L and y in U. Each fraction (rational number) r determines a section: L consists of the $x\leqq a$ and U of the $y\geqq a$. The other sections define the irrational numbers; thus, the section dividing the fractions into the $x<\sqrt{2}$ and the $y>\sqrt{2}$ more precisely, the positive y with $y^2>2$) may be regarded as defining $\sqrt{2}$. Dedekind's definition can be proved to be equivalent to Cantor's.

The real numbers defined by this process have so far been found adequate for the mathematical treatment of quantities such as length, area, weight, electric charge, etc. Not only are the fundamental laws (1)–(6) of arithmetic, the cancellation laws (7)–(8) and the order properties (9)–(11) true, but division (except by zero) and subtraction are always possible. Finally, we have the property that any increasing sequence $x_1<x_2<x_3\cdots$ whose terms are all bounded above by a fixed constant c must tend to a limit.

We shall now discuss other types of numbers; in every case, we shall have to lose some of the properties of real numbers.

GENERALIZATIONS

Complex Number System.—It is clear that the equation $x^2=-1$ can have no real solution since the square of any real quantity is positive or zero. But we can introduce $i=\sqrt{-1}$ as an imaginary number and preserve those laws (1)–(8) and (15)–(19) of addition and multiplication which do not involve the relation $a\geqq b$. To do this, we must clearly introduce all combinations $a+bi=a+b\times\sqrt{-1}$; these are the so-called complex numbers. Moreover, we must put

$$(a+bi)+(c+di)=a+c+bi+di=(a+c)+(b+d)i,$$
$$(a+bi)\times(c+di)=ac+(ad+bc)i+bdi^2=(ac-bd)+(ad+bc)i.$$

If we define addition and multiplication of complex numbers by these formulas, laws (1)–(8) and (15)–(19) will be satisfied. For example, it can be verified by substitution that the equation $(c+di)z=(a+bi)$ has the solution

$$z=\frac{(a+bi)}{(c+di)}=\frac{a}{(c^2+d^2)}+\left[\frac{b}{(c^2+d^2)}\right]i.$$

Furthermore, any quadratic equation $Ax^2+Bx+C=0$ with real coefficients has complex roots

$$\frac{(-B\pm\sqrt{B^2-4AC})}{2A},$$

since even if $B^2-4AC=-D$ is negative, the numbers $\frac{(-B\pm\sqrt{D}i)}{2A}$ can be found as complex numbers.

This is a special case of the fundamental theorem of algebra, which asserts that any polynomial equation $x^n+a_1x^{n-1}+\cdots+a_n=0$ with real or complex coefficients has a complex root (*see* COMPLEX NUMBERS; EQUATIONS, THEORY OF). Thus from a strictly algebraic standpoint, no further generalization is called for.

Although the theory of algebraic equations is greatly simplified by the use of complex numbers, it is necessary to sacrifice the properties of order. If, as by (11), either $a\geqq 0$ or $a\leqq 0$, then

by (9) either $a \geqq 0$ or $-a = -a+0 \geqq -a+a=0$; in either case, by (10), $a^2=(-a)^2 \geqq 0$. That is, there is no way in which we could define order so as to satisfy (9)–(11), and make negative numbers have square roots.

Complex numbers are not only useful in pure mathematics (theory of equations and function theory), they are universally used in discussing electric circuits and simplify the solution of many problems in mechanics.

Quaternions and Hypercomplex Numbers.—If we are willing to sacrifice the properties of order, and the commutative law of multiplication as well, we can obtain an interesting further extension of the complex-number system, the so-called quaternions(*q.v.*).

Quaternions are numbers of the form $a+bi+cj+dk$, where a, b, c, d are real.

The sum $(a+bi+cj+dk)+(a'+b'i+c'j+d'k)$ is defined as $(a+a')+(b+b')i+(c+c')j+(d+d')k$. Multiplication is defined from the equations (generalizing $i^2=-1$), $i^2=j^2=k^2=-1$, $ij=jk=ki=-ji=-kj=-ik=-1$.
Laws (1), (2), (4)–(8) are satisfied, and subtraction and division (except by zero) are possible. Further, any polynomial equation with quaternion coefficients has a quaternion root.

For many years quaternions were widely used in solving physical problems, but since about 1900 their use in physics has been replaced by that of the vector calculus.

The construction of quaternions can be further generalized. For any set of n^3 real coefficients C_k^{ij}, we can define a linear algebra, or system H of hypercomplex numbers, as follows. The elements of H are the expressions $a_1\epsilon_1+\cdots+a_n\epsilon_n$, where the "units" $\epsilon_1, \cdots, \epsilon_n$ take the place of the special quaternions l, i, j, k, and are the same for all elements; $a_1, \cdots, a_n$ are arbitrary real numbers. The sum of $a_1\epsilon_1+\cdots+a_n\epsilon_n$ and $b_1\epsilon_1+\cdots+b_n\epsilon_n$ is defined as $(a_1+b_1)\epsilon_1+\cdots+(a_n+b_n)\epsilon_n$. Their product is defined as the sum $a_1b_1\epsilon_1^2+a_1b_2\epsilon_1\epsilon_2+\cdots+a_nb_n\epsilon_n^2$, where the $\epsilon_i\epsilon_j$ are given by $\epsilon_i\epsilon_j=C_1^{ij}\epsilon_1+C_2^{ij}\epsilon_2+\cdots+C_n^{ij}\epsilon_n$.

Although the study of hypercomplex numbers forms an interesting branch of algebra (*see* LINEAR ALGEBRAS), the complex numbers and quaternions are the only systems of hypercomplex numbers with real coefficients in which multiplication is associative and division is possible.

Algebraic and Transcendental Numbers.—Numbers which, like $\sqrt[3]{5}$ and $\sqrt{-1}$, represent roots of polynomial equations $a_0x^n+a_1x^{n-1}+\cdots+a_n=0$ with integral coefficients are called algebraic numbers. It can be shown that any sum, difference, product or quotient of algebraic numbers is again algebraic, and that so is any root of a polynomial equation whose coefficients a_i are all algebraic numbers. For this reason, algebraic numbers form a closed subsystem of the system of complex numbers, which can be studied without using limits or other infinite processes. Algebraic numbers have many fascinating properties (*see* NUMBERS, THEORY OF).

Real or complex numbers which are not algebraic are called transcendental. In 1851 Joseph Liouville first proved the existence of transcendental numbers; in 1873 Charles Hermite proved that the base e of natural logarithms was transcendental and in 1882 Ferdinand Lindemann proved that π was transcendental. We now know that the vast majority of real numbers are transcendental (see *Infinite Cardinal Numbers*, below).

Modular Numbers: Fields.—Another interesting class of modular-number systems, each containing a finite number of elements, can easily be constructed from the positive integers. For each prime number $p=2, 3, 5, 7, \cdots$, consider the integers $0, 1, 2, \cdots, p-1$. The sum $a+b$ and product $a\times b$ of any two of these integers are defined as the remainders of the ordinary sum $a+b$ and product $a\times b$, when divided by p. Thus, if $p=3$, then $2+1=0$ and $2\times 2=1=4-3$; the complete addition and multiplication tables are

+	0	1	2
0	0	1	2
1	1	2	0
2	2	0	1

×	0	1	2
0	0	0	0
1	0	1	2
2	0	2	1

These number systems satisfy conditions (1)–(6), and subtraction and division (except by zero) in them is always possible. They were first studied by K. F. Gauss (*Disquisitiones Arithmeticae* [1801]).

Number systems satisfying laws (1)–(6), in which subtraction and division (except by zero) are always possible, are called fields. All the fields having a finite number of elements are known—they are called Galois fields; for each prime power p^n, there is exactly one having p^n elements. An interesting theorem, proved by J. H. M. Wedderburn in 1910, asserts that for systems containing only a finite number of elements, the commutative law of multiplication is a consequence of the other laws (*see* FIELDS). Hypercomplex number systems with coefficients in a modular field or any other field can be constructed just as easily as if the coefficients were in the field of real numbers.

Infinite Cardinal Numbers.—In the definition of a cardinal number given at the beginning of this article, there is nothing stated which requires the class to be finite. Thus, it is perfectly legitimate to ascribe the mark d (denumerable infinity) to the class J of all positive integers and every other class which can be put in one-one correspondence with J. Similarly, it is perfectly legitimate to ascribe the mark c (power of the continuum) to the class $R\#$ of all real numbers and every other class which can be put in one-one correspondence with $R\#$.

The definitions of addition and multiplication are still valid, as are the proofs of the basic laws (1)–(6) of arithmetic. The definition of the relation $a \leqq b$ is also valid, and laws (9)–(11) can be proved for infinite numbers as well as for finite numbers; only (11) offers any difficulty.

In fact, we can even define exponentiation for infinite as well as finite cardinal numbers. But we must avoid the usual elementary definition $a^n=a\times\cdots\times a$ (n factors) and define a^s as the cardinal number of the class of all single-valued functions (*see* CALCULUS, DIFFERENTIAL AND INTEGRAL) or rules f assigning to each element x in a class of b elements a single value $y=f(x)$ in a class of a elements. One can then prove easily the usual laws of exponents

$$(a\times b)^s=a^s\times b^s,\quad a^{s+t}=a^s\times a^t,\ (a^s)^t=a^{s\times t}. \qquad (21)$$

One can also connect the infinite cardinal numbers c and d by the interesting formula

$$c=2^d. \qquad (22)$$

The main loss in dealing with infinite cardinal numbers is that the laws (7)–(8) of cancellation are no longer valid. In fact, for every infinite cardinal number γ, it can be proved that

$$\gamma=\gamma+1,\ \gamma+\gamma=\gamma,\ \gamma\times\gamma=\gamma. \qquad (23)$$

These equations imply that every infinite class can be placed in one-one correspondence with a proper subclass of itself. For example, there is an obvious one-one correspondence between the class J of positive integers $1, 2, 3, \cdots$, and the class E of even integers $2, 4, 6, \cdots$; another between J and the class O of odd integers $1, 3, 5, \cdots$; it follows from the definition of addition that $d+d=d$.

From $\gamma=\gamma+1$ we easily get $\gamma+1=\gamma+2$, while $\gamma+\gamma=\gamma$ implies $2\times\gamma=1\times\gamma$; hence, neither law of cancellation holds. For this reason it is impossible to extend the system of finite and infinite cardinal numbers to larger systems in which subtraction or division are possible.

From $\gamma+\gamma=\gamma$ it can easily be shown that the class of all integers $\pm n$, 0 has the same cardinal number d as the class of positive integers; from $\gamma\times\gamma=\gamma$, it follows that the class of all rational numbers $\pm\frac{m}{n}$ also has the cardinal number d; this is even true of the class of all algebraic numbers.

This suggests the conjecture that perhaps the class $R\#$ of all real numbers also has the cardinal number d. We shall now disprove this. It would mean that all real numbers could be written in a sequence, S, just as the integers $1, 2, 3, \cdots$, can be so written. First let us imagine the numbers of this sequence to be written in decimal form. Now certain rational numbers admit of double representation, as is evident from the fact that 0.879999

$\cdots=0.880000\cdots$. Let us agree, in all such cases, to use the mode of representations by 9s, so that every number shall have a unique decimal representation. We may now construct another number $0\cdot x_1x_2x_3\cdots$ as follows. Let the first digit x_1 after the decimal point be chosen apart from 0 and the first digit (after the decimal point) of the first number of S, let x_2 be chosen apart from 0 and the second digit of the second number of S; and so on. There will then be defined a number in decimal form which is obviously distinct from all the numbers of S, which disproves our conjecture.

This disproof by the diagonal process of G. Cantor can be generalized so as to apply to any cardinal number. Thus, there is an infinite sequence of distinct infinite cardinal numbers: $d<2^d=c<2^c<2^{2^c}<\cdots$. It is not known whether or not there are others in between the ones listed.

Since the cardinal number of the class of algebraic numbers is d, the preceding argument proves that there exist real transcendental numbers and, in fact, that there are infinitely more transcendental numbers than algebraic numbers.

Infinite Ordinal Numbers.—Consider the infinite sequence of non-negative integers $0, 1, 2, 3, \cdots$. It has the property that every nonempty subset has a first member (so-called well-ordering property). It was observed by Cantor that one can extend this sequence in exactly one way without losing the well-ordering property. Indeed, there must be a first infinite ordinal ω after all the integers, a first ordinal $\omega+1$ after ω, a first ordinal $\omega+2$ after $\omega+1$ and so on. Immediately after the sequence $\omega, \omega+1, \omega+2, \cdots$, there must be a first ordinal 2ω, followed by $2\omega+1$, $2\omega+2$, $\cdots$; then 3ω, $3\omega+1$, $\cdots$. Evidently this process of ordinal numeration can be continued, giving numbers of the form (*see* NUMBER SEQUENCES)

$$\begin{array}{l} 0,\ 1,\ 2,\ \cdots \\ \omega,\ \omega+1,\ \omega+2,\ \cdots \\ 2\omega,\ 2\omega+1,\ 2\omega+2 \\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot \\ \omega^2,\ \omega^2+1,\ \omega^2+2,\ \cdots \\ \omega^2+\omega,\ \omega^2+\omega+1,\ \omega^2+\omega+2,\ \cdots \\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot \end{array}$$

We can identify each ordinal number α in this sequence with the set of κ preceding α, in order. Thus, 3 corresponds to the ordered set $(0, 1, 2)$, ω with the ordered sequence of all non-negative integers and so on.

If we do this, we can define $\alpha+\beta$ as the result of laying the sequence β after the sequence α, $\alpha\beta$ as the result of substituting the sequence β for each term of the sequence α and α^2 as $\alpha\alpha$ These definitions are consistent with the notations we have introduced; however, $1+\omega=\omega\neq\omega+1$ and $\omega 2=\omega\neq 2\omega$, so that neither addition nor multiplication is commutative. On the other hand, both operations are associative, $(\alpha+\beta)\gamma=\alpha\gamma+\beta\gamma$, and we rescue the one-sided cancellation laws, $\alpha+\beta=\alpha+\gamma$ implies $\beta=\gamma$, $\beta\alpha=\gamma\alpha$ implies $\beta=\gamma$.

There seems to be no reason why the process of ordinal enumeration of the elements of a class C cannot be continued indefinitely until all the elements of the class have been counted. That is, it is plausible to assume that every class can be well ordered. Using this assumption, one can prove that $\alpha+\alpha=\alpha$ and $\alpha^2=\alpha$ for all infinite cardinal numbers. However, inasmuch as no infinite class not equivalent to (*i.e.*, in one-one correspondence with) the class of integers has ever been constructively well ordered, this assumption must still be accepted with reservations (*see* MATHEMATICS, FOUNDATIONS OF).

Ordered Fields.—In each of the preceding generalizations of the real-number system, we have lost either the order properties (9)–(11), as in the cases of complex, quaternion and modular numbers, or the possibility of subtraction and division, as in the cases of infinite cardinal and ordinal numbers. We shall now show that there exist ordered fields, not contained in the real-number system which have both the order properties and the arithmetic properties of the rational and real numbers.

Consider the class of infinite formal power series

$$a(x)=a_{-m}x^{-m}+a_{-m+1}x^{-m+1}+\cdots+a_0+a_1x+a_2x^2+\cdots, \qquad (24)$$

which begin with an arbitrary positive or negative integral power $a_{-m}x^{-m}$ of the symbol x with real nonzero coefficient a_{-m}. To add two such series, add corresponding coefficients; thus, $c(x)=a(x)+b(x)$ means $c_n=a_n+b_n$ for all n. To multiply, let the coefficient c_n of x^n in the product $c(x)=a(x)b(x)$ be the sum of all products a_ib_j such that $i+j=n$; thus $(x+x^2-x^3+\cdots)(2x^{-2}+3x^{-1}-4+\cdots)=(2x^{-1}+5-3x+\cdots)$. Define $a(x)\geqq 0$ to mean that $a_{-m}\geqq 0$ in (24). Finally, add 0 to the system, using (18) to define addition and multiplication by zero.

With these definitions, the fundamental laws (1)–(6) can easily be proved. It is also easy to show that subtraction is always possible. Further, division (except by zero) is always possible; thus, $\frac{1}{(1-x)}=1+x+x^2+\cdots$ as in the familiar high-school formula. Hence, the formal power series (24) and 0 form a *field* (*see* above). Finally, if we define $a(x)\geqq b(x)$ to mean $a(x)-b(x)\geqq 0$, the order properties (9)–(11) hold.

In fact, the only property of real numbers which is not shared by our new system is the completeness property, that any increasing sequence of real numbers, whose terms are all bounded above by a fixed quantity, must tend to a limit. In fact, the increasing sequence $-1<-\frac{1}{2}<-\frac{1}{4}<\cdots$, whose terms are all bounded above by 0, does not tend to a limit in our new system. For example, it does not approach 0, since $-x$ separates 0 from every term of the sequence. Since it can be proved that any ordered field with the completeness property is equivalent to the real-number system, we cannot hope to obtain any closer analogue of the real-number system.

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(G. BF.)

NUMBERS is the fourth book of the Pentateuch, as the five books of the Law, or of Moses, have come to be called. The three previous books carried on the story of Israel's history from the creation, through the captivity in Egypt and the escape therefrom, down to the sojourn at Sinai. Numbers traces out the march from Sinai, the wanderings in the wilderness and the final arrival on the steppes of Moab within sight of the Promised Land. Like the other books of the Pentateuch, it consists of earlier (JE) and later (P) sources; *see* BIBLE: *Old Testament*. But, although the sources come from different ages and from writers of different schools of thought, yet if its significance is properly to be apprehended, it is necessary to remember that for more than 2,000 years it has been a complete whole.

The book falls naturally into three sections which follow a chronological sequence: (1) chaps. i–x, 10 (P), Israel's sojourn at Sinai, the census and the promulgation of various laws by Moses; (2) chaps. x, 11–xxii, 1 (JE and P), incidents which occurred during the wanderings between Sinai and the arrival at the steppes of Moab; these incidents seem to have been chosen mainly for the purpose of casting light on the religious history and character of the people and also to explain the meaning of various place names (*cf.* Taberah and Kibroth hattaavah, xi, 3, 34); they also attempt to give an account of the origin of some religious objects of worship (*e.g.*, the brazen serpent, xxi, 4–11); (3) chaps. xxii, 2–xxxvi (mainly P), the sojourn on the steppes of Moab, the incident of Balaam, the second census and the giving of additional laws, together with various other incidents.

The middle section contains important passages from J and E: the 12 spies, the rebellion of Korah and Balaam's mission to Balak (no signs of P). J, E and P can be readily separated in chaps. xi and xii. To E belongs the passage describing the outpouring of the Spirit on Eldad and Medad and the remarkable prayer of Moses in xi, 29, "Would God that all Yahweh's people were prophets that Yahweh would put his Spirit upon them," *cf.* the idea that Christians are "priests unto God" (Rev. i, 6). As usual, the J and E elements possess such a vivid character as to render them familiar to ordinary readers; contrast P's legisla-

tive and statistical style, and his diffuseness (which reaches a climax in chap. vii). The most illuminating example of the difference between JE and P is found in the passage that occurs after the first long section of P describing the order of march of the several tribes and the position of the ark in the very centre of the host, both when encamped and on the march. In x, 30, Moses entreats Hobab, the son of Reuel, his father-in-law, to come with the Israelites to be "eyes" unto them; and in x, 33, it is stated that the ark went before them to seek out a resting place for them. It is clear that these statements directly contradict P's elaborate scheme, according to which the people march mechanically, tribe by tribe, with the ark in the very centre of the square, and guided by the pillar of cloud by day and the pillar of fire by night. Moses, instead of simply following the pillar of cloud, requests Hobab to determine the line of march and select the sites for encampment. No clearer proof could be desired of the nature of early methods of compilation than that the detailed account in chaps. i–x, 28, should be immediately followed by two short paragraphs in palpable contradiction of the whole plan of camp and march so elaborately worked out in the preceding narrative.

Of very great interest is the account of Korah's revolt in chap xvi, which is composed of J, E and P in a most intricate manner Literary analysis has unravelled three stages of development: (1) two *Reubenites,* Dothan and Abiram, rebel against the *civil* authority of Moses; (2) Korah the Levite, with 250 *Israelites,* rebels against the *religious* authority of Moses and Aaron; and (3) Korah at the head of 250 *Levites* protests against the priestly privileges of Aaron (for details *see* the commentaries). The analysis (which is generally accepted) is of extreme value for the difficult study of the history of the Levites (*q.v.*).

Another very important narrative is that of Balaam (*q.v.*). It includes a number of poetical quotations which help to determine its date and also indicate the value of poetry in its bearing on history. Also in xxi, 14, we have a poetical quotation from a lost volume of early poetry entitled "The Book of the Wars of Yahweh." Deborah's song was probably originally in this book; and when we compare its statement as to Israel's full fighting strength, viz., 40,000 men, with the statements in the prose of Numbers as to 600,000 men and more, we at once realize how much closer to actual facts we are brought by early poetry than by the later prose of writers like P. Perhaps it is in chap. xxxi that we have the clearest proof of P's nonhistorical character. There we are told that 12,000 Israelites, without losing a single man, slew every male Midianite, children included, and every Midianite woman that had known a man, and took so much booty that there had to be special legislation as to how it should be divided. But if this were actual fact, how could the Midianites have ever reappeared in history? And yet in Gideon's time they were strong enough to oppress Israel.

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NUMBERS, THEORY OF.—The theory of numbers is concerned, in its elementary parts, with properties of the integers, or whole numbers, $0, \pm 1, \pm 2, \cdots$. Examples of such properties which emerged in ancient times are these: the Chinese knew in 500 B.C. that 2^p-2 is divisible by p, for prime numbers p; Euclid (300 B.C.) proved that there exist infinitely many primes (otherwise, if p could be the greatest prime, then as a contradiction a larger prime would divide $M+1$, where M denotes the product $2\cdot 3\cdot 5\cdots p$ of all primes up to p). While most results of this vast and beautiful subject, dealing with the universally familiar whole numbers, are easy to understand, the proofs of many use the deepest resources of mathematics, and some of the most interesting conjectures are still unproved.

DIVISIBILITY AND PRIMALITY

Elementary Definitions, Factorization Into Primes.—If a and b are integers, and $a=bc$ for some integer c, then b is called a *factor* or *divisor* of a; abbreviated $b|a$, read "b divides a"; thus $1|a$ and $a|a$ for every integer a. A *prime* number is an integer $p(>1)$ such that p has no positive factors except 1 and p; examples are 2, 3, 5, 7, 11. Other integers greater than 1 are called *composite.*

Every integer greater than 1 is either itself a prime or can be expressed as a product of primes in only one way (except for rearrangement of factors). This fact, known as the "fundamental theorem of arithmetic," is usually proved by means of a property given by Euclid, namely, if a prime p divides ab, then p divides a or b. To establish this property Euclid showed that if d is the greatest common divisor (g.c.d.) of a and b, then there exist integers x and y satisfying $ax+by=d$ (*cf.* end of section 2). Assuming this, suppose that $p|ab$ but not a; then since p is a prime, the g.c.d. of p and a is 1, $ax+py=1$, $abx+pby=b$, hence $p|b$.

The symbol (a,b) is frequently used for the g.c.d. of the integers a and b, assumed not both zero. If $(a,b)=1$, a and b are called *relatively prime,* or *coprime,* and a is described as *prime to b.*

Several independent proofs of the fundamental theorem of arithmetic, based on mathematical induction, have appeared (H. Hasse, 1928; E. Zermelo, 1934; Ferdinand Lindemann, 1933). *See* Arithmetic: *Theory of Divisors.*

2. Residue Classes: Euler's Theorem.—Let m denote a given positive integer. Every integer a can be expressed in the form $a=qm+r$, where q is an integer (the *quotient* on division by m) and r, the *remainder,* has one of the m values $0, 1, \cdots, m-1$. Two integers a and b having the same remainder r are said to be *congruent modulo m,* abbreviated $a\equiv b \bmod m$. Clearly this is equivalent to saying that $m|a-b$. All integers congruent modulo m to a given integer are considered as forming a *residue class* modulo m. There are m residue classes.

If $a\equiv b \bmod m$, $(a,m)=(b,m)$. If $(a,m)=1$ we may therefore say that the residue class of a modulo m is prime to m. Those residue classes which are prime to m are said to form a *reduced system* of residue classes mod m. For example, if $m=12$, the reduced system is represented by the four residues 1, 5, 7 and 11.

L. Euler introduced the symbol $\phi(m)$ to denote the number of reduced residue classes mod m, or what is equivalent, the number of positive integers prime to m and not exceeding m. For example, $\phi(1)=1$, $\phi(p)=p-1$ for any prime p. One easily proves that $\phi(mn)=\phi(m)\cdot\phi(n)$ if $(m,n)=1$, and $\phi(p^r)=p^r\left(1-\frac{1}{p}\right)$ for any prime p and positive integer r. This facilitates the evaluation of $\phi(m)$; *e.g.,* $\phi(12)=\phi(2^2)\cdot\phi(3)=2\cdot 2=4$, as noted earlier.

Let a be prime to m. If r_1-r_2 is not divisible by m, the same is true of ar_1-ar_2. It follows that if $r_1, r_2, \cdots, r_h$ (where $h=\phi(m)$) constitute a reduced residue system mod m, then $ar_1, ar_2, \cdots, ar_h$ comprise the same residues in a different order. Hence the difference of the products $ar_1.ar_2\ldots ar_h$ and $r_1r_2\ldots r_h$, which can be written $r_1r_2\ldots r_h(a^h-1)$, is divisible by m. Since $r_1r_2\ldots r_h$ is prime to m, m divides a^h-1.

This result, that $m|a^{\phi(m)}-1$ if a, m are coprime, is known as Euler's theorem (1760). Fermat's theorem (1640) is the special case for a prime p, $a^{p-1}\equiv 1 \bmod p$ if $(a,p)=1$.

By the same argument, the m residues ax $(x=0, 1, \cdots, m-1)$ are incongruent mod m, if $(a,m)=1$; hence the congruence $ax\equiv k \bmod m$ is solvable, for any k. Hence, if $(a,b)=1$, then for any given integer k there exist integers x, y satisfying $ax+by=k$.

2a. Primitive Roots.—It can be shown that if $(a,m)=1$, the least positive e such that $a^e\equiv 1 \bmod m$ must divide $\phi(m)$. If $e=\phi(m)$, a is called a *primitive root of m*; and the powers $1, a, a^2, \cdots, a^{e-1}$ comprise a reduced set of residues mod m. Primitive roots have importance in various applications involving nth powers; *e.g.,* in solving binomial congruences such as $x^n\equiv k \bmod m$. K. F. Gauss proved that primitive roots exist only when $m=2, 4, p^k$, or $2p^k$, where p is an odd prime.

3. Congruences in One Unknown.—If $a\equiv b \bmod m$ and $c\equiv d \bmod m$, it is easily seen that $a+c\equiv b+d$, $a-c\equiv b-d$, and $ac\equiv bd \bmod m$. Hence, if $f(x)$ is a sum of terms $a_0+a_1x+\cdots+a_nx^n$ with integral coefficients, then $f(a)\equiv f(b) \bmod m$, if $a\equiv b \bmod m$. Hence, in searching for solutions (called *roots*) of the congruence $f(x)\equiv 0 \bmod m$, one can confine oneself to incongruent solutions mod m. The *number of roots* is the number of

incongruent solutions mod m: *e.g.*, $x^3 \equiv 1$ mod 7 has precisely three roots, *viz.* $x \equiv 1, 2, 4$.

Let $m_1, m_2, \cdots, m_k$ be k positive integers, coprime in pairs, $m = m_1 \cdots m_k$. A method of solving the k congruences $x \equiv r_1$ mod $m_1, \cdots, x \equiv r_k$ mod m_k, for an integer x, uniquely determined mod m, was known to the Chinese in the first century A.D., and is called the "Chinese remainder theorem." This leads to the result that the number of solutions of $f(x) \equiv 0$ mod m is the product of the numbers of solutions of $f(x) \equiv 0$ mod m_i ($i = 1, \cdots, k$). The search for roots of $f(x) \equiv 0$ mod m can thus always be reduced to the case where m is a power of a prime. In certain cases there is a systematic way of deriving the solutions mod p^{r+1} from those mod p^r.

In the special case $m = p$ there holds an important theorem formulated by J. L. Lagrange (1768). If $(p, a_n) = 1$, the congruence $f(x) \equiv 0$ mod p is said to be of degree n. Lagrange proved that the number of roots of $f(x) \equiv 0$ mod p does not exceed the degree n.

As an application, consider $f(x) = x(x-1)(x-2)\cdots(x-p+1) - (x^p - x)$. This is a polynomial of degree $p-1$ at most, and $f(x) \equiv 0$ mod p for each of $x = 0, 1, \cdots, p-1$ (by Fermat's theorem). This contradicts Lagrange's theorem unless every coefficient is divisible by p. Hence, the sum of the products n at a time of $1, 2, \cdots, p-1$ is divisible by p if $n \leqq p-2$; while (by the coefficient of x),

$$1 \cdot 2 \cdot 3 \cdots (p-1) \equiv -1 \pmod p,$$

a result known as Wilson's theorem.

Since $x^{p-1} - 1 = (x^{\frac{1}{2}(p-1)} - 1)(x^{\frac{1}{2}(p-1)} + 1)$, it follows from Fermat's and Lagrange's theorems that each of the congruences $x^{\frac{1}{2}(p-1)} \equiv 1$ and $x^{\frac{1}{2}(p-1)} \equiv -1 \pmod p$ is satisfied by exactly $\frac{1}{2}(p-1)$ residues x mod p. Anticipating section 4, note that if a is any of the $\frac{1}{2}(p-1)$ quadratic residues of p, then $a \equiv x^2$, $a^{\frac{1}{2}(p-1)} \equiv x^{p-1} \equiv 1$. Accordingly, a is a quadratic residue or nonresidue of p according as $a^{\frac{1}{2}(p-1)} \equiv 1$ or $-1 \pmod p$. Putting $a = -1$ we obtain (*cf.* section 4) that the congruence $x^2 \equiv -1 \pmod p$ is solvable if $p \equiv 1$, but unsolvable if $p \equiv 3 \pmod 4$.

On pairing factors equidistant from the two ends, Wilson's theorem gives $(1.2.3\ldots\frac{1}{2}(p-1))^2 \equiv (-1)^{\frac{1}{2}(p+1)}$ mod p. Hence if p is a prime of the form $4n+3$, $1\ 2.3\ldots\frac{1}{2}(p-1) \equiv \pm 1$ mod p. The sign $+$ or $-$ in the last case was investigated by Dirichlet and others. Since -1 is a quadratic nonresidue of p, and since the product of an even (odd) number of quadratic nonresidues is a quadratic residue (nonresidue), the sign is $(-1)^m$, where m is the number of quadratic nonresidues in the series $1, \ldots, \frac{1}{2}(p-1)$. An interesting expression found for m is $\frac{1}{4}(p+1) - \frac{1}{2}(1 + h(-p))$, where $h(-p)$ denotes the number of classes of positive, primitive binary quadratic forms of discriminant $-4p$ (*cf.* section 6). In particular, it follows that there are more quadratic residues in the first half of the interval from 1 to $p-1$, than in the second half, if p is a prime $4n+3$.

Numerous generalizations of Fermat's and Wilson's theorems have been found. One due to Gauss (1801) is as follows: if P denotes the product of the integers less than and prime to n, then $P \equiv -1$ mod n if n is 4, p^k, or $2p^k$, where p denotes an odd prime; but $P \equiv 1$ mod n otherwise.

4. Quadratic Residues; The Quadratic Reciprocity Law.—A *quadratic residue* of m is an integer a prime to m such that $x^2 \equiv a$ mod m is solvable for x. Other integers a prime to m are called *quadratic nonresidues*. Let m be an odd prime p, and consider the squares $1^2, 2^2, \cdots, (p-1)^2$. Since $p \mid x^2 - y^2$ implies that $p \mid x - y$ or $x + y$, which can hold (if x, y are distinct numbers of the set $1, 2, \cdots, p-1$) only if $y = p - x$, it is plain that there are exactly $\frac{1}{2}(p-1)$ incongruent quadratic residues of p. Example: every square prime to p is of the form $pn + R$, where if $p = 3$, $R = 1$; if $p = 5$, $R = 1$ or 4; if $p = 11$, $R = 1, 4, 9, 5 (\equiv 4^2)$, or $3 (\equiv 5^2)$.

By extensive experiment Euler had found in 1783 a theorem of great simplicity, expressing a deep property of numbers. In 1785 A. M. Legendre rediscovered the same result, which he formulated as follows. Let p and q denote distinct odd primes. Then unless $p \equiv q \equiv 3 \pmod 4$ the two congruences $x^2 \equiv p \pmod q$ and $y^2 \equiv q \pmod p$ are both solvable or both unsolvable; but if $p \equiv q \equiv 3 \pmod 4$, one and only one of the two congruences is solvable.

Legendre introduced the useful symbol $(a \mid p)$, defined to equal $+1$ if a is a quadratic residue of p; -1, if a is a nonresidue; 0, if $p \mid a$. Then the above result takes the form

$$(p \mid q)(q \mid p) = (-1)^{\frac{1}{2}(p-1)\frac{1}{2}(q-1)},$$

for any distinct odd primes p and q. He called this the "reciprocity law." His proof was incomplete. In 1795, Gauss, at the age of 18, discovered the same law, and after a year of strenuous effort found a complete proof. Later he found 6 different proofs; and more than 50 proofs have appeared since.

The result at the end of section 3 can now be expressed by $a^{\frac{1}{2}(p-1)} \equiv (a \mid p)$ mod p, true also if $a \equiv 0$. Hence follow the following properties of the Legendre symbol: (1) $(a \mid p) = (b \mid p)$ if $a \equiv b$ mod p; (2) $(ab \mid p) = (a \mid p)(b \mid p)$; (3) $(-1 \mid p) = (-1)^{\frac{1}{2}(p-1)}$; and by another device, $(2 \mid p) = 1$ if $p \equiv \pm 1$ mod 8, $(2 \mid p) = -1$ if $p \equiv \pm 3$ mod 8.

The usefulness of the Legendre symbol was increased by C. G. J. Jacobi, who, defining $(a \mid p_1 p_2 \cdots p_n) = (a \mid p_1)(a \mid p_2)\cdots(a \mid p_n)$, and $(a \mid -k) = (a \mid k)$ if a is positive, found that the "reciprocity law" still holds for any odd numbers p and q not both negative. Example: determine whether $x^2 \equiv 30 \pmod{71}$ is solvable; $(30 \mid 71) = (2 \mid 71)(15 \mid 71) = (+1)(-)(71 \mid 15) = -(-4 \mid 15) = -(-1 \mid 15) = +1$; the congruence is solvable (with $x = \pm 32$). Example: of what primes is 3 a quadratic residue? $(3 \mid p) = (-1)^{\frac{1}{2}(3-1)\frac{1}{2}(p-1)}(p \mid 3) = +1$ if $p \equiv 1$ (mod 4 and mod 3), and if $p \equiv -1$ (mod 4 and mod 3); *i.e.*, $p \equiv \pm 1$ mod 12.

Other "reciprocity laws" have occurred in various generalizations; *e.g.*, one involving complex integers (section 18) occurred in Gauss's researches on biquadratic congruences.

5. Factorization of Numbers; Mersenne Primes.—The labour involved in factoring a large number of, say, 20 or more digits is still prohibitive. By expressing the number in special forms, it is possible to obtain limitations on the form of possible prime factors; thus, if $N = x^2 + ky^2$, where $(x, y) = 1$, then $-k$ must be a quadratic residue of each prime factor of N. Factor stencils have been developed to facilitate this process. A machine constructed by D. H. Lehmer ("A Photo Electric Number Sieve," *American Mathematical Monthly*, 40, 1933) makes it possible to test numbers of about 17 digits in a few hours. The best table of primes is D. N. Lehmer's *List of Prime Numbers from 1 to 10,006,721* (Carnegie Institution of Washington, D.C., 165, 1914).

"Perfect numbers" owe their origin to the number mysticism of the Pythagoreans (500 B.C.). A *perfect number* is an integer equal to the sum of its divisors less than itself. The five least are: $6 (= 1+2+3)$; 28; 496; 8,128; 33,550,336. Euclid gave the example $2^{p-1}(2^p - 1)$, which is perfect if and only if $2^p - 1$ is a prime. All even perfect numbers are of Euclid's type (Euler). No odd perfect number has ever been found.

Numbers of the form $2^p - 1$ are called *Mersenne numbers*, because in 1644 Father Marin Mersenne made a statement which implied that if $p \leqq 257$, $2^p - 1$ is prime only for $p = 2, 3, 5, 7, 13, 17, 19, 31, 67, 127, 257$. Subsequent work has yielded the following results: $2^p - 1$ is known to be prime for $p = 2, 3, 5, 7, 13, 17, 19, 31, 61, 89, 107, 127$; its factors are completely known for $p = 11, 23, 29, 37, 41, 43, 47, 53, 59, 67, 71, 73, 79, 113$, and partially known for $p = 83, 97, 131, 151, 163, 167, 173, 179, 181, 191, 197, 211, 223, 229, 233, 239, 251$; it has been proved composite for $p = 101, 103, 109, 137, 139, 149, 157, 199, 193$ and 227 (H. S. Uhler, 1948–49), 241 (R. E. Powers, 1934), 257 (M. Kraitchik and D. H. Lehmer, 1932). Several primes larger than $2^{127} - 1$ (E. Lucas, 1876) were found in 1951. The national bureau of standards Western Automatic computer gave, in 1952, the three next Mersenne primes $2^p - 1$ ($p = 521, 607, 1{,}279$).

The ancient Greeks knew that regular polygons of $2^h m$ sides, where $m = 3$ or 5, can be constructed by the Euclidian (straightedge and circle) operations. Gauss, at the age of 17, proved that these constructions are so performable if and only if m is a product of distinct "Fermat primes," *i.e.*, primes of the form $F_n = 2^{2^n} + 1$. If $n = 0, 1, 2, 3, 4$, we get the primes 3, 5, 17, 257,

65,537. But F_n is composite for $n=5$, 6, 7, 8, 9, 11, 12, 18, 23, 36, 38, 73.

REPRESENTATION BY FORMS

6. Binary Quadratic Forms.—Many special quadratic forms, such as $x^2 \pm ay^2$ or $x^2+y^2+z^2$, had been investigated by particular methods, before Lagrange and (especially) Gauss systematized their theory, and established general methods of attack. The guiding general principle was the linear transformation.

Consider for example a form in two variables and of the second degree (*i.e.*, a *binary quadratic form*) $f=ax^2+bxy+cy^2$. A number m is said to be *represented* by the form f if there exists a pair of integers u, v not both zero (called a *representation* of m by f) satisfying $au^2+buv+cv^2=m$. The representation is called *primitive* if the g.c.d. (u, v) is 1. We shall give a version of Gauss's method of finding whether a number m is represented by f.

The basic idea is that we treat not f alone, but an entire class of forms equivalent, for this purpose, to f. If we apply to f a *linear transformation*

$$x=\alpha X+\beta Y,\ y=\gamma X+\delta Y, \tag{1}$$

f is transformed into $F=AX^2+BXY+CY^2$ in new variables X and Y, while $A=a\alpha^2+b\alpha\gamma+c\gamma^2$, etc. On solving equations (1) for X and Y, we find

$$(\alpha\delta-\beta\gamma)X=\delta x-\beta y,\ (\alpha\delta-\beta\gamma)Y=-\gamma x+\alpha y.$$

Hence, in order to ensure that to each pair of integers x and y corresponds one and only one pair of integers X and Y, and conversely, we shall assume that the transformations which we apply are *unimodular*, that is, $\alpha, \beta, \gamma, \delta$ are integers, and $\alpha\delta-\beta\gamma=1$. Clearly the same numbers m are then represented by both forms f and F, and any representation x, y of m in f corresponds uniquely to the representation $X=\delta x-\beta y, Y=-\gamma x+\alpha y$ of m in F.

The forms f and F, related by a unimodular transformation, are termed *equivalent*. The result of applying several unimodular transformations in succession is easily seen to be another unimodular transformation, called their product. All forms equivalent to a given one are equivalent to one another, and are said to constitute a *class* of forms.

If $A=a\alpha^2+b\alpha\gamma+c\gamma^2$ where $(\alpha, \gamma)=1$, then by section 2 we can choose integers β and δ such that $\alpha\delta-\beta\gamma=1$. Consequently, any number A represented primitively by f is the first coefficient of some form $AX^2+BXY+CY^2$ equivalent to f. It can be shown that if β, δ is one solution of $\alpha\delta-\beta\gamma=1$, the most general solution is $\beta+k\alpha$, $\delta+k\gamma$, where k is any integer; and that B is then replaced by $B+2kA$.

The *determinant* of the form f is defined to be the number $d=ac-\frac{1}{4}b^2$. It can be shown that the determinants of equivalent forms are equal. (*See* ALGEBRAIC FORMS.)

The last result holds also for quadratic forms in n variables. We shall later use the terms determinant, class, representation, etc., for such forms, to which these terms can be extended in an obvious way. If a quadratic form f is written in the form $\sum a_{ij}x_ix_j$ (summed for $i, j=1, \cdots, n$), one can always suppose that $a_{ji}=a_{ij}$, and the determinant of f is the determinant $|a_{ij}|$. (*See* DETERMINANT.)

So far, a, b, c may denote any real numbers. We have $af=(ax+\frac{1}{2}by)^2+dy^2$. Hence if $d>0$, $a\neq 0$, and af is positive for any x and y not both zero; accordingly, f represents only numbers of one sign, that of a. But if $d<0$, f represents both positive and negative numbers. If $d>0$, we call f *definite*; specifically, *positive-definite* if also $a>0$; if $d<0$, f is called *indefinite*.

The treatment of definite and indefinite forms now diverges. It is easily shown that any positive-definite form is equivalent to precisely one form $Ax^2+Bxy+Cy^2$ satisfying

$$-A<B\leqq A\leqq C, \text{ with } B\geqq 0 \text{ if } C=A. \tag{2}$$

This form is called the *reduced form* in the class. We illustrate the process of reduction with the form $f=15x^2-44xy+33y^2$ of determinant $495-22^2=11$. Put $x=x_1+ky_1$, $y=y_1$. Then f becomes $15x_1^2+(-44+30k)x_1y_1+(\cdots)y_1^2$; to get $-44+30k$ between -15 and $+15$ take $k=1$, $f_1=15x_1^2-14x_1y_1+c_1y_1^2$; here $c_1=4$ since $15c_1-49=11$. Now treat similarly the smaller coefficient c_1, and replace x_1 by x_2, y_1 by $2x_2+y_2$, obtaining $f_2=3x_2^2+2x_2y_2+4y_2^2$, which is reduced. The result of combining the transformations is $x=3x_2+y_2$, $y=2x_2+y_2$, which transforms f directly into f_2.

Hereafter we assume f integral; *i.e.*, a, b, c are integers. The g.c.d. of a, b, c is called the *divisor* of f. If this g.c.d. is 1, f is called *primitive*. To avoid fractions write $D=-4d=b^2-4ac$, called the *discriminant* of f.

We prove in the case D negative that there are only a finite number of classes of integral, positive-definite, binary quadratic forms of a given discriminant $D=-\Delta$. This number is equal to the number of reduced forms satisfying (2), with $4AC=\Delta+B^2$. By (2), $4A^2\leqq 4AC=\Delta+B^2\leqq\Delta+A^2$, whence $A^2\leqq\frac{\Delta}{3}$, and $B^2\leqq\frac{\Delta}{3}$. To find all the reduced forms of discriminant $-\Delta$ we may therefore proceed as follows. Give B in turn each integer value such that $B^2\leqq\frac{\Delta}{3}$ and $4|\Delta+B^2$; factor $\frac{1}{4}(\Delta+B^2)$ as AC in all ways satisfying $|B|\leqq A\leqq C$. Discard forms such that $B=-A$ or such that $C=A$, $B<0$.

The number of classes of primitive, positive-definite, binary quadratic forms of discriminant D will be denoted by $h(D)$.

Example: Find the reduced forms of discriminant -44. Necessarily $B=2b$, $b^2\leqq\frac{11}{3}$. If $b=0$, $\frac{1}{4}(44+B^2)=11=1\cdot 11$; if $b=\pm 1$, $\frac{1}{4}(44+B^2)=12=2\cdot 6=3\cdot 4$. This yields four reduced forms: x^2+11y^2, $3x^2\pm 2xy+4y^2$, $2x^2+2xy+6y^2$. The last is imprimitive, with divisor 2; hence $h(-44)=3$.

The reader can verify that $h(D)=1$ in the twelve cases

$$-D=3, 4, 7, 8, 11, 12, 19, 27, 28, 43, 67, 163; \tag{3}$$

the reduced form being $x^2+xy+\frac{1}{4}(1-D)y^2$ or $x^2-\frac{1}{4}Dy^2$.

An *automorph* of f is a unimodular transformation carrying f into itself. Every f has the trivial automorph $x=x_1$, $y=y_1$; and its negative $x=-x_1$, $y=-y_1$. The form $a(x^2+y^2)$ has the additional automorphs $x=y_1$, $y=-x_1$; and its negative. The form $a(x^2+xy+y^2)$ has six automorphs, of which $x=x_1+y_1$, $y=-x_1$, is typical. All positive-definite forms not equivalent to these two have only the two trivial automorphs. It is easily proved that all the unimodular transformations carrying f into F are obtained by applying to f any automorph of f, followed by a fixed unimodular transformation of f into F.

We can now solve the problem of finding all primitive representations of A by f in the following manner, which applies equally well to indefinite forms (*cf* section 9). We noted above that to each primitive representation (α, γ) of A by f corresponds a form $Ax^2+Bxy+Cy^2$ equivalent to f, where B is uniquely determined mod $2A$. Equating discriminants, $B^2-4AC=D$.

Hence we start by finding all solutions B of

$$B^2\equiv D(\text{mod } 4A),\ 0\leqq B<2|A|. \tag{4}$$

For each such B construct the form $Ax^2+Bxy+\left(\frac{(B^2-D)}{4A}\right)y^2$, $=F_B$ say. By reducing both f and F_B to reduced forms we determine whether f is equivalent to F_B, and if so can construct all unimodular transformations carrying f into F_B. The coefficients α, γ of these transformations give all the primitive representations of A by f. Different solutions B of (4) cannot yield the same representation.

Example: Find all representations of 15 by $f=3x^2+2xy+4y^2$. The solutions of $B^2\equiv -44$ (mod 60), $0\leqq B<30$, are $B=4$, 14, 16, 26. If $B=4$, $F=15x^2+4xy+y^2$, which is equivalent to $x_1^2+11y_1^2$ under the transformation $x_1=2x+y$, $y_1=-x$; the corresponding representations in $x_1^2+11y_1^2$ are therefore 2, -1 and -2, $+1$. Similarly, $B=26$ yields 2, 1 and -2, -1 in $x_1^2+11y_1^2$. If $B=-14$, $F=15x^2-14xy+4y^2$, and we find the representations 1, -2 and -1, 2 in f; $B=16$ yields similar representations in $3x^2-2xy+4y^2$. Thus there are eight representations of 15 in the system of three reduced forms, two of them in f.

By a set of representations of A in f, we mean the set obtained from a given representation by applying the automorphs of f. This has a meaning even in the indefinite case when the number

of automorphs may be infinite. The preceding process proves the following important result formulated by P. G. L. Dirichlet and equally true when f is indefinite:

Theorem: The number of sets of primitive representations of an integer A by the system (one form from each class) of binary quadratic forms of a given discriminant D is equal to the number of solutions of (4).

In a large number of special cases, this theorem provides immediate information on the number of representations in single forms. This is obviously true in the 12 cases in (3). For example, taking $D=-4$, we obtain the following result: a positive integer A is represented primitively as a sum of two squares if and only if A contains no prime factor of the form $4n+3$ and A is not divisible by 4; and then the number of representations is $4\cdot 2^k$, where k denotes the number of distinct prime factors of A of the form $4n+1$.

By counting the primitive representations of $\frac{A}{s^2}$, for square factors s^2 of A, various formulas are obtainable for the number of sets of all representations by the system of reduced forms of discriminant D; one such formula, in the special case $(A, 2D)=1$, is $\sum_{k|A}(D|k)$; *i.e.*, the sum of the Legendre symbols $(D|k)$ for all the positive divisors k of A. Thus, in particular, the only positive integers A not represented by x^2+y^2 are those containing a prime factor $4n+3$ to an odd power; while, if $A=2^c p_1^{a_1}\cdots p_r^{a_r}t^2$, where the r ($\geqq 0$) distinct primes p_i are of the form $4n+1$, and no prime in t is of that form, then the number of all representations of A as x^2+y^2 is $4(a_1+1)\cdots(a_r+1)$.

7. Genera of Quadratic Forms; Formulas for Number of Representations.—The last theorem provides a general formula for the number of representations of a number by a system of several classes of forms. A smaller system of great importance, of which many general properties are known is the *genus*.

A natural approach to the notion of genus may be derived from the following observations. If an integral form say $f=ax^2+bxy+cy^2$, represents a number A, say $f(u, v)=A$, then obviously the congruence $f\equiv A$ mod m is solvable (with $x=u$, $y=v$) whatever be the modulus m. However, $2x^2+7y^2\equiv 1 \pmod{p^r}$ is solvable for every prime p and positive r, and hence solvable for every m; *e.g.*, with $3x\equiv 1$, $3y\equiv 1$, if $p\neq 3$, with $5x\equiv 3$, $5y\equiv 1$, if $p\neq 5$. But $2x^2+7y^2$ does not represent 1. The situation here is that there is associated with $2x^2+7y^2$ another class of forms, that of x^2+14y^2, which while not equivalent to $2x^2+7y^2$, is "equivalent to it for all congruencial purposes." And x^2+14y^2 does represent 1. The two classes, represented by x^2+14y^2 and $2x^2+7y^2$, happen to constitute a "genus." As another example, x^2+y^2 happens to be in a genus of one class, and x^2+y^2 represents a positive integer A if and only if the congruence $x^2+y^2\equiv A$ mod m is solvable, for all m.

We shall call two integral forms *equivalent in the field of reals* if each is transformable into the other by linear transformations with real coefficients; *e.g.*, if $n=2$, both must be positive-definite, both negative-definite, or both indefinite. Two forms are defined to be in the same *genus* if they have the same determinant d, are equivalent in the field of reals, and if for every modulus m (the modulus $2^n d$ being in fact sufficient) each is equivalent to a form whose coefficients are congruent mod m to the corresponding coefficients of the other.

There are several other sets of properties which distinguish a genus. Two quadratic forms in n variables are in the same genus if and only if they have the same determinant d and there exists a linear transformation, whose coefficients are rational numbers with denominators prime to $2^n d$, transforming one form into the other. For example, $2x^2+7y^2$ is carried into $x_1^2+14y_1^2$ by the transformation $x=\frac{(x_1+7y_1)}{3}$, $y=\frac{(x_1-2y_1)}{3}$. The proof of the necessity of this criterion was completed for $n>3$ only in 1940 by C. L. Siegel. Historically, genera have usually been characterized by means of sets of (more or less) easily computable invariants; Gauss (1801, $n=2$), G. Eisenstein (1847, $n=3$), H. J. S. Smith (1867, $n\geqq 3$), H. Minkowski (1884), B. W. Jones and G. Pall (1944). The most important of these are illustrated in section 8 for $n=3$.

Equivalent forms are in the same genus. A genus consists of a finite number of classes. If $n\geqq 4$, indefinite forms are in genera of one class; this is true also if $n=3$, save in certain exceptional cases. It is probable that there are only finitely many classes of primitive, positive-definite forms in genera of one class; there are none in more than 35 variables (W. Magnus, 1938), and probably none in more than 10 variables. As an example, the three primitive forms of discriminant -44, preceding (3) in section 6, constitute a genus of three classes. The form $x_1^2+\cdots+x_n^2$ is in a genus of one class only if $1\leqq n\leqq 8$.

Some writers prefer to define "class" by means of transformations of determinant ± 1, instead of Gauss's $+1$. Perhaps the main reason for preferring $+1$ is the following theorem formulated by Gauss: every genus of primitive, binary, quadratic forms of discriminant D contains the same number of classes. The situation if $n\geqq 3$ is somewhat different.

Consider a genus of primitive forms in $n(\geqq 2)$ variables. We assume the forms to be positive-definite, while mentioning that C. L. Siegel (1936), with a suitable meaning for sets of representations, has extended the results which follow to indefinite forms. Let h denote the number of classes in the genus, and select one form $f_i (i=1, \cdots, h)$ from each class. Let w_i denote the number of automorphs of f_i. The quantity $\frac{1}{w_1}+\cdots+\frac{1}{w_h}$ is called the *weight of the genus*. A remarkable formula for the weight of a genus was suggested for $n=3$ by Eisenstein, and was proved and generalized to any n by H. J. S. Smith (1867) and Minkowski (1884). Further, under certain restrictions, the total number of primitive representations of an integer m by the system of forms f_i of a genus was shown to be equal to the weights of certain related genera. These results were generalized in 1935 by Siegel, to yield a formula for the numbers of representations (suitably weighted) of forms in k variables by a genus of forms in n variables; the case $k=1$ is that of representation of numbers stated in the following paragraph.

Let $f_i(A)$ equal the number of representations of A by f_i. Then

$$\frac{\frac{f_1(A)}{w_1}+\cdots+\frac{f_h(A)}{w_h}}{\frac{1}{w_1}+\cdots+\frac{1}{w_h}}=\frac{\pi^{\frac{1}{2}n}A^{\frac{1}{2}n-1}S(A)}{\Gamma(\frac{1}{2}n)\cdot d^{\frac{1}{2}}} \tag{1}$$

where d denotes the determinant of f, $\Gamma(\frac{1}{2}n)$ is the well-known gamma-function (for which $\Gamma(m)=1\cdot 2\cdot 3\cdots(m-1)$ if m is a positive integer), $S(A)$ denotes the product extended over all primes p,

$$S(A)=\chi(2)\cdot\chi(3)\cdot\chi(5)\cdot\chi(7)\cdots,$$
$$\text{where } \chi(p)=\lim_{r\to\infty} p^{-(n-1)r}f(A, p^r),$$

while $f(A, p^r)$ (which can be evaluated by various methods) denotes the number of solutions of the congruence $f\equiv A \pmod{p^r}$. This general expression simplifies remarkably when n is even, and provides a neat formula for the number of representations of an integer A by a genus; hence by a form if the genus consists of one class.

We select several examples. Let $r_n(A)$ denote the number of representations of A as a sum of n squares. For example, $r_4(13)=112$, since $13=3^2+2^2+0^2+0^2=2^2+2^2+2^2+1^2$, and we can permute and change signs of 3, 2, 0, 0 in 48 ways, of 2, 2, 2, 1 in 64 ways. Set $A=2^k m$, m odd, $k\geqq 0$. If $n=2, 4, 6, 8$ (when the genus of $x_1^2+\cdots+x_n^2$ consists of one class), $r_n(A)$ has the following expressions in terms of the positive divisors d of m:

$$r_2(A)=4\sum_{d|m}(-1)^{(d-1)/2},$$
$$r_6(A)=4\{(-1)^{(m-1)/2}4^{k+1}-1\}\sum_{d|m}(-1)^{(d-1)/2}d^2,$$
$$r_4(A)=8\{2+(-1)^A\}\sum_{d|m}d,$$
$$r_8(A)=\frac{16}{7}|8^{k+1}-15|\sum_{d|m}d^3.$$

Similar expressions have been obtained for many other forms in genera of one class; and for special forms of A by forms in genera of more than one class. For example, if A is of the form $4r+3$, $r_{10}(A)=12\sum(-1)^{(d+1)/2}d^4$, and if A is even there is a simple expression for $r_{12}(A)$.

The formula for $r_4(A)$ was first obtained in 1828 by C. G. J. Jacobi, by equating coefficients in the expansions of certain eliptic functions. In a series of 18 articles (1858–65), J. Liouville stated without proof several identities and derived from them expressions for the number of representations by numerous quadratic forms. The proofs of these identities are elementary, although as shown by E. T. Bell, many can be paraphrased from elliptic function identities by replacing sine and cosine terms by more general odd and even functions.

As an example we quote one of Uspensky's identities. Let $F(x, y, z)$ denote a function odd with respect to x, and even with respect to y, z; *i.e.*, $F(-x, y, z)=-F(x, y, z)$ and $F(x, -y, -z) =F(x, y, z)$. Then

$$2\sum F(\delta-2i,\ d+i,\ 2d+2i-\delta)=\sum F(d+\delta,\ i,\ d-\delta)+2T-U,$$

where the summations extend over all integral solutions of $n=i^2+d\delta$, with d and δ positive. Both T and U are zero unless $n=s^2(s>0)$, in which case

$$T=\sum_{j=1}^{2s-1} F(2s-j,\ s,\ 2s-j),\quad U=\sum_{j=1}^{2s-1} F(2s,\ j-s,\ 2j-2s).$$

By various specializations of this formula, James Victor Uspensky obtained a large number of expressions for the numbers of representations by quadratic forms in two, four, six, eight, and ten variables; and all the known and certain new relations connecting binary quadratic class-numbers for various determinants.

H. D. Kloosterman and V. Tartakowsky showed, about 1924, that (1) gives an asymptotic formula for the number of representations by a single form f_i, if $n\geqq 4$. (*Cf.* section 12).

8. The Numbers Represented by a Quadratic Form; Universal Forms; Representation of Zero.—We shall make certain observations about the numbers represented by an integral quadratic form. As we implied earlier, a genus has the property that if $f\equiv A \bmod m$ is solvable for every m, and if A has the necessary sign when f is positive- or negative-definite, then some form in the genus of f represents A. For example, the two forms $f=x^2+y^2+10z^2$ and $g=2x^2+2y^2-2yz+3z^2$ are representative of the two classes of a certain genus of determinant 10. It is easily proved that $f\equiv A \bmod p^r$ is solvable for every A and p, except when $p=2$, r is large enough, and A is of the form $4^h(16k+6)$. Hence f and g represent between them all positive integers not of the form $4^h(16k+6)$. It might be supposed that f and g would each represent all large numbers not of the excluded form. It is easily proved that f represents all even numbers not of the excluded form; and Hansraj Gupta (1941) stated the odd numbers up to 20,000 not represented by f: 3, 7, 21, 31, 33, 43, 67, 79, 87, 133, 217, 219, 223, 253, 307, 391, 679, 2,719. But examples exist of two ternary classes in the same genus which do not represent the same large numbers.

In any case, if the genus of f consists of one class, the numbers represented by f can be determined by investigating the solvability of the congruences $f\equiv A \pmod{p^r}$. In this way we find that $x^2+y^2+z^2$ represents all positive integers not of the form $4^h(8k+7)$, and that $x^2+y^2+z^2+t^2$ represents all positive integers.

V. Tartakowsky (1925) showed that each class of positive-definite forms in five or more variables represents all the large numbers represented by its genus. This is not quite always true when $n=4$, but the exceptions are known. It is definitely false (save in the trivial case of "improperly equivalent forms" such as $3x^2\pm 2xy+4y^2$) for binaries.

A quadratic form is called *universal* if it is positive-definite and represents all positive integers, or indefinite and represents all nonzero integers. Every universal binary is equivalent to xy. Every universal ternary with even cross-product coefficients was shown by L. E. Dickson to be equivalent to $2xy-Hz^2$ (H odd) or $2xy+y^2-Hz^2$ ($H\equiv 2 \bmod 4$); if any cross-product coefficient is odd, A. Oppenheim showed it to be equivalent to $xy-Hz^2$.

Srinivasa Ramanujan (1917) examined the forms $ax^2+by^2+cz^2+dt^2$, where a, b, c, d are positive integers, $a\leqq b\leqq c\leqq d$; he found at most 54 such forms which may represent all positive integers. Dickson completed the proof of their universality in 1927. A complete proof, including forms with odd cross-products, that there are only finitely many classes of positive-definite, universal quaternaries, was first given by A. E. Ross. Dickson proved that every universal ternary is a *zero-form.*

A zero-form is a form which represents zero for values of its variables not all zero. The theorem that every indefinite form in five or more variables is a zero-form was formulated by A. Meyer (1884). Trivially, a binary form is a zero-form if and only if its discriminant is a square. We shall suppose a ternary or quaternary to have been transformed into the form $f_3=a_1x_1^2+a_2x_2^2+a_3x_3^2$ or $f_4=a_1x_1^2+a_2x_2^2+a_3x_3^2+a_4x_4^2$, and shall formulate necessary and sufficient conditions for such a form to represent zero. The symbol $(a, b)_p$ may be defined (*cf.* section 4) as follows, by writing $a=p^\alpha m$, $b=p^{\alpha'}m'$, where m and m' are prime to p, and α, α' are integers:

$$\text{if } p>2,\ (a, b)_p=(-1|p)^{\alpha\alpha'}(m|p)^{\alpha'}(m'|p)^{\alpha};$$
$$\text{if } p=2,\ (a, b)_2=(-1)^{(m-1)(m'-1)/4}(2|m)^{\alpha'}(2|m')^{\alpha}.$$

The conditions are expressed in terms of the "characters"

$$c_p(f_3)=(-a_1a_2,\ -a_1a_3)_p,\quad c_p(f_4)=(a_1,\ a_2)_p(-a_3,\ -a_4)_p.$$

The former is an invariant of f_3 under rational linear transformations. The latter is needed for our present purpose only when $a_1a_2a_3a_4$ is of the form s^2k, where k is a quadratic residue mod p^r; *i.e.*, $(k|p)=1$ if $p>2$, $k\equiv 1 \bmod 8$ if $p=2$. Evidently, $c_p(f_3)=1$ unless $p|2a_1a_2a_3$. We state finally: f_3 is a zero-form if and only if $c_p(f_3)=1$ for every p; f_4 is a zero-form if and only if $c_p(f_4)=1$ for every prime p such that $a_1a_2a_3a_4$ is of the above-specified form.

The theory of quadratic forms in rational coefficients, and for rational values of the variables, is much simpler than that in the domain of integers; attention should be drawn to Hasse's elegant development of this theory in the *Journal für Mathematik* for 1923.

9. Automorphs and Reduction of Indefinite Binary Quadratic Forms.—Any real, irrational number θ can be expanded into a continued fraction

$$a_0+\cfrac{1}{a_1+\cfrac{1}{a_2+\cdots}},\ \text{abbreviated } a_0+\frac{1}{a_1+}\ \frac{1}{a_2+}\cdots,$$

where the a_i are integers, and a_1, a_2, $\cdots$ positive. Indeed, we can write $\theta=a_0+\frac{1}{b_1}$, where a_0 is an integer and $b_1>1$; then write $b_1=a_1+\frac{1}{b_2}$, where a_1 is a positive integer and $b_2>1$; and so on. Since θ is irrational, the process cannot terminate. The rational fraction

$$\frac{p_n}{q_n}=a_0+\frac{1}{a_1+}\ \frac{1}{a_2+}\cdots\frac{1}{a_n},(p_n,\ q_n)=1,\ q_n>0.$$

obtained by stopping at a_n, is called the nth *convergent to* θ. It can be proved that $|\theta-\frac{p_n}{q_n}|<\frac{1}{q_n^2}$; and that $\frac{p_n}{q_n}$ is a closer approximation to θ than any other rational fraction with denominator not exceeding q_n.

Lagrange observed that the continued fraction is periodic if and only if θ is a root of a quadratic equation of the type $a-b\theta+c\theta^2=0$, where a, b, c are integers. Here $\theta=\frac{(b+r)}{(2c)}$, where $r^2=D=b^2-4ac$. As a typical example, consider $a=40$, $b=-45$, $c=12$, $D=105$. Then $\theta=\frac{(-45+r)}{24}=-2+\frac{(3+r)}{24}$, $b_1=\frac{24}{(r+3)}=\frac{(r-3)}{4}=1+\frac{(r-7)}{4}$, $b_2=\frac{4}{(r-7)}=\frac{(r+7)}{14}=1+\frac{(r-7)}{14}$, $b_3=\frac{14}{(r-7)}=\frac{(r+7)}{4}=4+\frac{(r-9)}{4}$, $b_4=\frac{4}{(r-9)}=\frac{(r+9)}{6}=3+\frac{(r-9)}{6}$, $b_5=\frac{6}{(r-9)}=\frac{(r+9)}{4}=4+\frac{(r-7)}{4}$, $b_6=\frac{4}{(r-7)}=b_2$. Hereafter, the period b_2,

$\cdots, b_5$ recurs.

The preceding discussion should help to explain Gauss's method of reduction of binary quadratic forms of a positive nonsquare discriminant D. Instead of a single reduced form (as in the case $D<0$), each class contains a chain of reduced forms. In the case of $f=40x^2-45xy+12y^2$ this chain consists of the forms $\phi_1=-2x^2+7xy+7y^2$, $\phi_2=7x^2+7xy-2y^2$, $\phi_3=-2x^2+9xy+3y^2$, $\phi_4=3x^2+9xy-2y^2$. These correspond to the period of the recurring continued fraction above, and can be obtained from f by applying in order the following unimodular transformations: $x\to -y$, $y\to x-2y$, to get $12x^2-3xy-2y^2$ (not yet reduced); to the latter form, $x\to -y$, $y\to x-y$ to get ϕ_1; then, $x\to -y$, $y\to x+y$, ϕ_2; $x\to -y$, $y\to x-4y$, ϕ_3; $x\to -y$, $y\to x+3y$, ϕ_4; $x\to -y$, $y\to x-4y$, giving $\phi_5=\phi_1$; etc. In general, $ax^2+bxy+cy^2$ is reduced if and only if $ac<0$, $b>0$, $0<r-b<2|a|<r+b$, where $r=\sqrt{D}$.

To complete the theory of section 6, we observe that all the automorphs of a primitive form $ax^2+bxy+cy^2$ of discriminant D are given by

$$x=\tfrac{1}{2}(t-bu)X-cuY,\ y=auX+\tfrac{1}{2}(t+bu)Y,$$

where t, u range over all integral solutions of Fermat's equation (usually called Pell's equation), $t^2-Du^2=4$. If D is a positive nonsquare integer, Fermat's equation can be shown to have a least solution T, U in positive integers (which can be found from a single period of the continued fraction for $\sqrt{D}$), and all integral solutions t, u are given by

$$\tfrac{1}{2}(t+u\sqrt{D})=\pm(\tfrac{1}{2}(T\pm U\sqrt{D}))^k,\ k=0,\ 1,\ 2,\ \cdots$$

I. Schur (1918) showed that $\frac{1}{2}(T+U\sqrt{D})<D^e$, with $e=D^{\frac{1}{2}}$.

10. Diophantine Equations.—Diophantus of Alexandria (250 A.D.) was the first to treat systematically the solutions of equations or systems of equations in integral (or sometimes in rational) values of the unknowns. Such problems are called after his name. Infallible methods are available only for a few special cases, such as a system of linear equations, or a single quadratic equation. For a fuller discussion, *see* DIOPHANTINE EQUATIONS; FERMAT'S LAST THEOREM.

We noticed in the preceding section that if D is any positive integer (not a square), then $x^2-Dy^2=1$ has infinitely many integral solutions. An important theorem of A. Thue and C. L. Siegel shows that on the contrary, if $f(x, y)$ is of degree $\geqq 3$ (and is not a power of a linear or quadratic function), and if c is a given nonzero number, then $f(x, y)=c$ has at most a finite number of integral solutions.

TOPICS IN ANALYTIC NUMBER THEORY

11. Gauss's Class-number Conjecture—*The Riemann Zeta Function Conjecture.*—We saw in section 6 that the number $h(D)$ of classes of primitive binary quadratic forms of discriminant D is finite, and noted 12 negative discriminants for which $h(D)=1$. No other negative D satisfying $h(D)=1$ has ever been found. L. E. Dickson showed in 1922 that there are no others up to $-D=15.10^5$, and D. H. Lehmer carried this in 1933 to -5.10^9. In 1934, H. Heilbronn and E. H. Linfoot proved that at most one other negative D exists satisfying $h(D)=1$.

On the other hand, if D is positive, the tables show numerous values of D such that $h(D)=1$, and indeed Dirichlet showed that there are infinitely many positive integers D with this property.

In *Disquisitiones Arithmeticae*, 1801, art. 303, will be found Gauss's conjecture that, as D tends to infinity through negative values, $h(D)$ tends to infinity. This conjecture was first proved by Heilbronn in 1934. Some of the developments preceding and following Heilbronn's proof are of interest. The analytic tools used in proving this and later results to be described began their development in the 19th century. Lejeune Dirichlet, who called his great memoir of 1839, "Diverse Applications of Infinitesimal Calculus to Number Theory," is generally regarded as the founder of analytic number theory. After Dirichlet, it was G. F. B. Riemann who made the most fundamental advance.

The "Riemann Zeta Function" which he introduced, may be defined by means of the series $\zeta(s)=1+\frac{1}{2^s}+\frac{1}{3^s}+\frac{1}{4^s}+\cdots$. Here s is a complex variable, taking values of the type $s=\sigma+it$, where σ and t are real numbers, and $i^2=-1$. The series is convergent only if $\sigma>1$, but determines by a process known as analytic continuation, a function defined and "regular" for all complex values s, except that it has a pole (a kind of infinity) at the point $s=1$. A great deal is known about this function today. Riemann, in 1859, knew that $\zeta(s)=0$ if s is any negative even integer, and that all the remaining zeros of $\zeta(s)$ satisfy $0<\sigma<1$ and lie symmetrically about the straight lines $\sigma=\frac{1}{2}$ and $t=0$. Riemann conjectured that all these "nontrivial" zeros of $\zeta(s)$ lie on the straight line $\sigma=\frac{1}{2}$. Up to 1952 it was not known whether this was true or false. It may be mentioned that G. H. Hardy proved that there are infinitely many zeros on the line $\sigma=\frac{1}{2}$, and that E. C. Titchmarsh has located all zeros up to $t=200$.

The Riemann zeta function conjecture poses one of the most significant unsolved problems of modern mathematics. A conjecture similar to Riemann's can be made for a somewhat more general set of functions,

$$L(s, \chi)=\sum_{n=1}^{\infty}\frac{\chi(n)}{n^s}$$

known as the Dirichlet L-functions. We will not describe the $\chi(n)$, except to say that they are called *characters*, and have values ± 1 or 0 or roots of unity. The conjecture that there are no zeros of the L-functions with real part $\sigma>\frac{1}{2}$ is known as the Generalized Riemann Hypothesis (G.R.H.).

These conjectures are connected with several interesting questions. It seemed to be important to deduce results by assuming the truth of the G.R.H., in the hope that they might throw some light on the subject. For example, Hardy and J. E. Littlewood proved in 1923 on the basis of the G.R.H. slightly modified, that every sufficiently large odd number is equal to the sum of three odd prime numbers (*see* section 15). Again, in 1913, E. Hecke proved that if the G.R.H. holds true for all real-valued characters χ, then Gauss's conjecture about $h(D)$ follows.

These results did not of course prove that every large odd number is the sum of three primes, or that $h(D)$ tends to infinity, but they have an interesting aftermath. In the case of Hecke's result the climax came in 1934. M. Deuring proved in 1933 that if $\zeta(s)$ has at least one zero with real part greater than $\frac{1}{2}$, then $h(D)=1$ for only a finite number of negative discriminants D, and this was soon followed by the theorem of Heilbronn and Linfoot mentioned earlier. Then L. J. Mordell proved in 1934 that if $\zeta(s)$ has at least one zero with real part greater than $\frac{1}{2}$ then $h(D)$ tends to infinity. Finally, Heilbronn proved in 1934 that if there exists at least one real character χ for which $L(s)=0$ for a value s with $\sigma>\frac{1}{2}$, then $h(D)$ tends to infinity. Thus by Hecke's work, Gauss's conjecture is correct if the Riemann hypothesis is true for all real characters χ; and by Heilbronn's work, Gauss's conjecture follows if the Riemann hypothesis for real characters χ is false. It follows that Gauss's conjecture is true, but nothing can be concluded about the truth of the Riemann hypothesis itself. As a sort of anticlimax it should be mentioned that S. Chowla immediately revised Heilbronn's proof to make it independent of Hecke's work.

C. L. Siegel immediately followed with a brief proof that

$$\frac{\log h(D)}{\log|D|}\to\tfrac{1}{2}\text{ as }D\to-\infty.$$

thus giving an actual measure of how rapidly $h(D)$ tends to infinity. Siegel's formula has made possible other developments, such as I. M. Vinogradow's startling achievement of 1937, when he proved (without any unproved hypothesis) that every large odd number is a sum of three odd primes.

12. Distribution of Primes; Asymptotic Formulas.—In 1837 Dirichlet proved that there are infinitely many primes in any arithmetic progression $my+n(y=0,\ 1,\ 2,\ \cdots)$, where m and n are any given coprime integers, m positive. In his article, analytic methods using fairly deep results from the theory of functions were first introduced into the theory of numbers. A number of special cases, notably $my\pm 1$, have been proved by strictly elementary methods. It is not known whether quadratic expressions such as x^2+1 represent infinitely many primes. However,

if $f=au^2+buv+cv^2$ is primitive and not negative-definite, if $(m, n)=1$ and the congruence $f\equiv n \bmod m$ is solvable, then f represents infinitely many primes of the form $my+n$.

Consider two functions $f(x)$ and $g(x)$ which tend to infinity with x. Examples are $\pi(x)$ = the number of primes up to x; and the function $\frac{x}{\log_e x}$. If the ratio $\frac{f(x)}{g(x)}$ tends to 1 as a limit when x tends to infinity, we say that $f(x)$ *is asymptotic to* $g(x)$, abbreviated $f(x)\sim g(x)$. The difference $f(x)-g(x)$, or "error" in approximating $f(x)$ by $g(x)$, may then still become large with x, but will be of smaller order of size than $g(x)$. It is frequently important to estimate the magnitude of this error. The notation used for this purpose is illustrated by the equation $(x+1)^3=x^3+O(x^2)$; which means that there exists a positive constant c such that, for all sufficiently large values of x, $|(x+1)^3-x^3|<cx^2$; here, $|3x^2+3x+1|<7x^2$ if $x>1$. Generally, if F is a positive function of x, $O(F)$ denotes a function of x which, for all sufficiently large x, does not exceed cF in absolute value, where c is a positive constant. Examples: $\sin x=O(1)$, $(\log x)^{10}=O(x)$.

P. L. Tchebychef gave asymptotic formulas for $\sum\frac{1}{p}$ and $\Pi\left(1-\frac{1}{p}\right)$, where p ranges over the primes less than x; and proved Bertrand's postulate on the existence of a prime between x and $2x (x\geqq 2)$. Asymptotic formulas for $\pi(x)$ had been suggested by Legendre and Gauss. The simplest formula is $\pi(x)\sim x/\log x$, proved independently by J. Hadamard and C. de la Vallée Poussin in 1896. A closer approximation is given by

$$\int_2^x \frac{dx}{\log_e x} \qquad (1),$$

the error being proved by Littlewood (1924) to be $o(xe^{-t})$, with $t^2=k\log x\log\log x$ (k a positive constant); and improved by N. Tchudakov (1947) to $t=(\log x)^\delta$, $\delta=0\cdot6-\epsilon$. The Riemann zeta function hypothesis (section 11) is equivalent to the statement that the error in (1) is $O(x^{\frac{1}{2}}\log x)$.

We state a few of the simplest examples of asymptotic formulas for number-theoretic functions. For Euler's function $\phi(n)$ (section 2), $\phi(1)+\phi(2)+\cdots+\phi(n)=\frac{3n^2}{\pi^2}+O(n\log n)$. The number of pairs of integers u, v satisfying $u^2+v^2\leqq x$ is $\pi x+O(x^{1/3})$. This exponent $\frac{1}{3}$ can be lowered, though it must exceed $\frac{1}{4}$, and exceedingly delicate analysis has gone into proving that we can take the exponent as low as $\frac{13}{40}$. If x is a prime, the least primitive root (section 2a) of x is $O(x^{\frac{1}{4}+\epsilon})$, where ϵ is any desired positive number. If $r(x)$ denotes the number of representations of the integer x as a sum of three squares, and x is not of the form $4n$ or $8n+7$, then $\log r(x)\sim\log\sqrt{x}$ (Siegel, 1935).

A recent development of interest is the elementary proof of the fact that $\pi(x)\sim x/\log x$, by Atle Selberg (1949). His method also was applied to prove Dirichlet's theorem on the infinitude of primes in an arithmetic progression. In the same year, an elementary proof of Dirichlet's theorem based on algebraic numbers (*cf.* section 18) was published by H. Zassenhaus.

An interesting, as yet unproved, conjecture states there exist infinitely many pairs of primes differing by two (*e.g.*, 3, 5; 197, 199); such pairs are called twin primes. However, if their number is infinite, they are distributed much more sparsely than the primes themselves, since, as was shown by Viggo Brun in 1921, the sum of the reciprocals of the twin primes is finite, while the sum of the reciprocals of all primes is infinite.

ADDITIVE THEORY OF NUMBERS

A typical problem of the additive theory of numbers may be described as follows. Consider a set S of integers $a_1, a_2, \cdots$; *e.g.*, S might contain the primes, or the cubes of primes, or the squares. Let $r(n)$ denote the number of representations of a positive integer n as a sum of s elements a_i of S. The problem is to find out what we can about $r(n)$; *e.g.*, whether $r(n)$ is always positive; or positive for all sufficiently large n; or to obtain an exact or approximate formula for $r(n)$.

13. Partitions. In particular, if $S=(1, 2, 3, \cdots)$, consists of all positive integers, the number s of summands is unrestricted, repetitions are allowed, and order is irrelevant, we have the problem of "unrestricted partitions"; *i.e.*, of expressing a positive integer n as a sum of positive integers. Thus 4 has five partitions: 4, 3+1, 2+2, 2+1+1, 1+1+1+1.

A number of interesting facts can be proved by elementary methods, such as representing a partition by an array of dots, and collecting these dots in different orders. Thus: the number of partitions of n into m parts is equal to the number of partitions of n into parts the largest of which is m. If $p(n)$ denotes the number of partitions of n, then

$$1+\sum p(n)x^n=\frac{1}{\{(1-x)(1-x^2)(1-x^3)\cdots\}},$$

called a generating function for $p(n)$. Generating functions are constructible for partitions variously restricted; *e.g.*, into odd parts, unequal parts, parts of the form $5n\pm1$, etc. By transformation of generating functions results such as the following appear (those stated being first given by Euler): the number of partitions of n into unequal parts is equal to the number of its partitions into odd parts; if $E(n)$ is the number of partitions of n into an even number of unequal parts, and $U(n)$ the number into an odd number of unequal parts, then $E(n)-U(n)=0$ unless n is of the form $\frac{1}{2}k(3k\pm1)$, when $E(n)-U(n)=(-1)^k$. Again, the number of partitions of n into parts which differ by at least 2 is equal to the number of partitions into parts of the form $5m\pm1$.

Among the most important recent developments, we should mention an asymptotic formula for $p(n)$, developed by Hardy and Ramanujan (1917); and an exact expression for $p(n)$ by an infinite series, presented by H. Rademacher (1937).

14. The Waring Problem, and Related Problems.—Interest in forms capable of representing all positive integers goes back to Diophantus, of the 3rd century, who (according to Bachet de Méziriac, 1621) assumed that every positive integer is a sum of four squares. Fermat (1636) stated that: "every number is either triangular or the sum of two or three triangular numbers; every number is either a square or a sum of two, three, or four squares; either pentagonal, or the sum of two, three, four, or five pentagonal numbers; and so on ad infinitum whether it is a question of hexagonal, heptagonal, or any polygonal numbers." (If billiard balls are stacked into a triangle, the number of balls will be $1+2+\cdots+x=\frac{1}{2}x(x+1)$, called a triangular number. Generally, a *polygonal number* of order m is given by $x+\frac{1}{2}(m-2)(x^2-x)$, where $x=0, 1, 2, \cdots$; the squares are obtained when $m=4$.) Fermat's theorem is that every positive integer is a sum of m polygonal numbers of order m.

This theorem was proved for squares by Lagrange (1772), for triangular numbers by Legendre (1798), for the remaining cases by Cauchy (1813–15).

In 1770 E. Waring stated an extension of the four square theorem in the direction of higher powers: every positive integer is a sum of at most 9 (positive, integral) cubes, also a sum of at most 19 fourth powers, at most 37 fifth powers, and in general of a limited number (whose least value we will denote by $g(k)$) of kth powers. That at least 9 cubes are required follows from the fact that 23 and 239 cannot be represented by sums of fewer cubes. The son of the great Euler noticed an integer which requires at least $2^k-2+\left[\left(\frac{3}{2}\right)^k\right]$ kth powers. Here the symbol $[t]$ denotes the greatest integer in t.

The function $G(k)$ giving the least number of kth powers required to represent all but a finite number of positive integers is of even greater interest. Evidently $G(k)\leqq g(k)$. By Lagrange's result, $G(2)=g(2)=4$.

Starting about the middle of the 19th century, the finiteness of $g(k)$ was gradually proved by means of elementary but complicated methods, first for $k=4$, then for $k=3, 5, 6, 7, 8, 10, 12$ and 14; and finite upper bounds to $g(k)$ (which, except for $k=3$,

were not best possible) were obtained. The problem of finding anything general about $g(k)$ or $G(k)$ seemed hopeless until D. Hilbert, in a famous paper of 1909, proved the fact that $g(k)$ is finite for every k. His proof is not exactly elementary, since it is based on the transformation of a 5-fold integral (in his first presentation, a 25-fold integral). The transcendental character of his proof was gradually eliminated by various writers, but it is still a pure existence proof and gives no method of estimating $g(k)$.

The really great invention which opened up the whole subject was the work (1917 on) of Hardy and Littlewood, and Ramanujan (Hindu, died in 1920). A very important step depended on H. Weyl's previous investigation of exponential sums. By use of A. L. Cauchy's integral formula (*See* FUNCTION), an expression can be constructed for the coefficient c_n in the expansion of

$$(1+x^{1^k}+x^{2^k}+\cdots)^s=\sum_{n=0}^{\infty}c_nx^n.$$

Briefly, the main contribution of Hardy and Littlewood to Waring's problem and similar problems was that they invented a way to prove that if $s\geqq(k-2)2^{k-1}+5$, at most a finite number of coefficients in the above expansion vanish, and hence $G(k)\leqq(k-2)2^{k-1}+5$, and that they found an asymptotic expression for c_n, that is the number of ways n can be expressed as a sum of s kth powers. Later they found smaller bounds for $G(k)$.

Although Hardy and Littlewood proved that every sufficiently large integer is a sum of 19 fourth powers, 41 fifth powers, $\cdots$, 425 eighth powers, etc., they did not compute actual limits beyond which these facts would hold true. Hence their work gave no immediate information about the size of Waring's constant $g(k)$. In the hope of being able to prove Waring's original statement with the best possible values $g(k)$, L. E. Dickson urged certain of his students about 1930 to find lower limits to the constants in the Hardy-Littlewood analysis. R. D. James succeeded in this, and proved $g(6)\leqq183$, $g(7)\leqq322$, $g(8)\leqq595$, in 1934; but the limits given by the Hardy-Littlewood method soon became impracticable.

The next and most important step came from the great Russian mathematician, I. M. Vinogradow. Vinogradow's earlier researches on the Waring problem had appeared in 1924; his methods were similar to those of Hardy and Littlewood, but led more rapidly to certain results. In his later work he made very important improvements, and found results which for large k were much better than those previously obtained. In particular, he ultimately proved $G(k)\leqq k(3\log k+10)$.

With the appearance of Vinogradow's new results, L. E. Dickson in the U.S. and S. S. Pillai in India investigated the possibility of proving the Waring conjecture in the original sense with best possible values $g(k)$, and both arrived independently in 1936 at an "almost complete" solution. Let $q=[(\frac{3}{2})^k]$. They proved that $g(k)=2^k+q-2$ if $k\geqq7$, and

$$(\tfrac{3}{2})^k-q\leqq1-(\tfrac{1}{2})^k\ (q+3). \qquad (1)$$

This condition is satisfied if $k\leqq400$, and possibly for every k. When (1) does not hold, the formula for $g(k)$ is different, but was determined except for those values k (if any) satisfying

$$(\tfrac{3}{2})^k-q=1-(\tfrac{1}{2})^k\ (q+2). \qquad (2)$$

The exceptional case (2) was finally solved in 1944 by I. Niven. Further, (although his proof may require minor corrections) Pillai proved that $g(6)=73$ in 1940. Accordingly, Waring's problem was completed (1944) as regards $g(k)$, except when $k=4$ and 5.

The best results for these cases were those of Dickson (1933) that $19\leqq g(4)\leqq35$, $37\leqq g(5)\leqq54$; and Davenport (1942 and 1939), that $G(5)\leqq23$ and $G(4)=16$. The latter is a best possible result, since the infinitely many numbers $16^h\cdot31$ require 16 fourth powers. It was, up to 1944, the only best possible result known for $G(k)$, $k\geqq3$.

In 1909 (except for an omission supplied by A. Kempner in 1912) A. Wieferich proved that $g(3)=9$. In the same year Edmund Landau showed that $G(3)\leqq8$. In 1944 U. V. Linnik gave a proof (a lacuna being later filled) that $G(3)\leqq7$. Dickson proved in 1939 that every number except 23 and 239 is a sum of eight cubes.

Numerous generalizations of the Waring problem have been investigated, such as sums of kth powers of primes, integral-valued polynomials, etc.

15. The Goldbach Problem. In an exchange of letters (1742) between Euler and C. Goldbach, it was conjectured that every integer is a sum of three primes, and every even integer a sum of two primes. Not considering 1 as prime, and omitting the even prime 2, we may formulate these conjectures for odd integers $\geqq9$ and even integers $\geqq6$.

No essential progress was made in solving this problem until the result (1923) of Hardy and Littlewood (see section 11) based on the G.R.H. In 1930, L. Schnirelmann proved that every positive integer can be represented by a sum of at most 800,000 primes. This number was lowered to 2,208 by N. P. Romanoff in 1935; to 71 by Heilbronn, Landau, and H. F. Scherk in 1936; to 67 by G. Ricci in 1937. Supplementing the analytic methods of Hardy and Littlewood by powerful new methods of his own, Vinogradow proved that every sufficiently large odd number is a sum of three odd primes, in 1937. In the first award of the Stalin prizes in 1941, Vinogradow received a first prize of 100,000 rubles for his work on the Goldbach problem.

DIOPHANTINE APPROXIMATION

16. Geometry of Numbers.—A *lattice* (in the plane) is the configuration formed by two systems of equidistant parallel lines. The points of intersection form a *point-lattice*. A lattice L can be defined analytically by two linear forms with real coefficients and integer variables: if x and y take all integral values, the points with rectangular co-ordinates $(\alpha x+\beta y,\ \gamma x+\delta y)$, where $\alpha,\beta,\gamma,\delta$ are given real numbers, form a point-lattice. The four points $O=(0,0)$, $P=(\alpha,\gamma)$, $Q=(\beta,\delta)$, $R=(\alpha+\beta,\ \gamma+\delta)$ are the vertexes of a "fundamental parallelogram," of area $\Delta=\alpha\delta-\beta\gamma$ (which we assume not zero). In particular, if $\alpha=\delta=1$, $\beta=\gamma=0$, the lattice consists of all points (x, y) with integral co-ordinates. Any linear transformation $x=ax'+by'$, $y=cx'+dy'$, where a, b, c, d are integers and $ad-bc=+1$, produces a different system of parallelograms based on the same point-lattice. The lattices so derived are said to be *equivalent*. The area Δ of a fundamental parallelogram is the same for equivalent lattices.

Consider a parallelogram with centre at O, and with two lattice-points. P_1 and Q_1 of L as midpoints of adjacent sides. Let the area of the parallelogram be $4k$. If $k=\Delta$ (which is least possible), there are at least 8 points of L on the boundary, but none (except O) in the interior of the parallelogram. This fact is a special case of a famous theorem of Minkowski, which asserts that any simple, closed, convex region R symmetrical about O, and of area greater than 4Δ, contains within it points of L other than O. The reader may think of R as the interior either of a parallelogram or ellipse. This theorem can be extended to n dimensions.

Other important theorems of Minkowski (some of the proofs of which use the above theorem on convex bodies) concern sets of n linear forms $\xi_i=\alpha_{i1}x_1+\ldots+\alpha_{in}x_n$ $(i=1,\ \ldots,\ n)$, with real coefficients α_{ij} and n integral variables $x_1,\ \ldots,\ x_n$. Supposing, for simplicity that $n=2$, we have $\xi=\alpha x+\beta y$, $\eta=\gamma x+\delta y$. Let D denote the absolute value of the determinant $\alpha\delta-\beta\gamma$, and assume $D\neq0$. One theorem asserts that there exist integers x and y not both zero, such that $|\xi\eta|\leqq\frac{D}{\sqrt{5}}$. A second theorem states that if b and c are positive numbers such that $bc\geqq D$ (*e.g.*, if $b=c=\sqrt{D}$), then there exist integers x and y not both zero such that $|\xi|\leqq b$ and $|\eta|\leqq c$. Both these theorems extend to n dimensions. A third theorem asserts that if ρ and σ are given real numbers, we can find integers x and y such that

$$|(\alpha x+\beta y-\rho)(\gamma x+\delta y-\sigma)|\leqq\tfrac{1}{4}D.$$

The obvious extension to n linear forms would have $\frac{D}{2^n}$ on the right. The case $n=3$ was proved by R. Remak in 1923, but the cases $n\geqq4$ had up to 1945 defied attempts at proof. The case $n=4$ was proved by F. J. Dyson in 1948.

After 1938, powerful methods of investigating certain non-convex regions were developed by L. J. Mordell, H. Davenport and K. Mahler.

17. Diophantine Approximation.—The literature on the approximation of irrational numbers by rational fractions is very extensive.

We saw, by continued fractions (section 9), that if θ is any irrational number, there are infinitely many rational fractions $\frac{p}{q}$ such that $|\theta-\frac{p}{q}|<\frac{1}{q^2}$. A different proof (based on Dirichlet's principle that if $n+1$ objects are in n boxes, then at least one box contains two or more objects) is worth giving, because it extends easily to n-dimensional problems. Let (x) denote $x-[x]$; *i.e.*, the fractional part of x. The $Q+1$ numbers (0), (θ), (2θ), $\ldots$, $(Q\theta)$ define $Q+1$ points distributed among the Q intervals 0 to $\frac{1}{Q}$, $\frac{1}{Q}$ to $\frac{2}{Q}$, $\ldots$, $\frac{(Q-1)}{Q}$ to 1. At least one interval must contain two numbers, say $(q_1\theta)=q_1\theta-p_1$, $(q_2\theta)=q_2\theta-p_2$, where p_1, p_2, q_1, q_2 are integers, and $0\leqq q_1<q_2\leqq Q$. Hence $p=p_2-p_1$ and $q=q_2-q_1$ satisfy $|q\theta-p|<\frac{1}{Q}$, $|\theta-\frac{p}{q}|<\frac{1}{qQ}\leqq\frac{1}{q^2}$. If θ is irrational, there will be a larger Q_1 such that $|q\theta-p|>\frac{1}{Q_1}$, and new approximations can be determined by means of Q_1. An extension of this argument proves the following result of Dirichlet. If $\theta_1, \theta_2, \cdots, \theta_k$ are any real numbers, then one can find integers $p_1, \cdots, p_k$, and q such that $|\frac{p_i}{q}-\theta_i|<\frac{1}{q^{1+\frac{1}{k}}}$, $(i=1, \cdots, k)$; if at least one θ_i is irrational there are infinitely many solutions p_i and q.

In 1884 L. Kronecker proved that if θ is any irrational number there are integers n such that $(n\theta)$ is as near as we please to any number in the interval 0 to 1; briefly, $(n\theta)$ is dense on the interval $(0, 1)$. Moreover, as proved about 1912, this distribution is uniform over the interval $(0, 1)$; *i.e.*, if I denotes a subinterval of $(0, 1)$ of length I_1, and if n_I of the points (θ), (2θ), $\cdots$, $(n\theta)$ fall in I, then $\frac{n_I}{n}\to I_1$, as $n\to\infty$. In *Mathematische Annalen*, 77(1916), Weyl proved that a necessary and sufficient condition for the uniform distribution of the numbers $(f(n))$, $n=1, 2, 3, \cdots$, is that

$$\frac{1}{n}\sum_{k=1}^{n}e^{2\pi ihf(k)}\to 0 \text{ as } n\to\infty,$$

for every integer h.

17a. Transcendental Numbers.—Any real number which is not algebraic (*cf.* section 18) is called *transcendental*. Interest in transcendental numbers perhaps first arose in connection with the classical problem of "squaring the circle," which could be performed by Euclidean constructions if and only if the number π were expressible by means of square roots and rational operations. The impossibility of this construction was therefore demonstrated when F. Lindemann proved the transcendence of π in 1882.

Liouville proved a theorem which shows how to obtain as many transcendental numbers as we please (1851). It states that if ξ is a real algebraic number of degree n and K is any constant, then there exist at most a finite number of rational fractions $\frac{p}{q}$ such that $|\frac{p}{q}-\xi|<\frac{K}{q^{n+1}}$. Hence a number with a sufficiently rapid sequence of rational approximations is transcendental (*e.g.*, this is true of $.101001000010\cdots$)

Among the numbers known to be transcendental we may mention e, π, $\log_e 2$, $2^{\sqrt{3}}$, e^{π}. In 1900, Hilbert proposed the problem of proving that if α and β are algebraic numbers, α not 0 or 1, and β is irrational, then α^β is transcendental. This was proved in 1934 by Alexis Gelfond and T. Schneider, independently, by different methods.

GENERALIZATIONS OF ARITHMETIC

18. Algebraic Numbers.—Gauss was the first to extend the notions of arithmetic (integrality, divisibility, primality, etc.) to systems other than the ordinary integers. He defined a complex number $a=a_0+a_1i$ (where a_0, a_1 are rational numbers and $i^2=-1$) to be a *complex integer* if a_0 and a_1 are ordinary integers. Ordinary integers will hereafter be called *rational integers*. Divisibility is defined as usual: $b|a$ if $a=bc$ in complex integers. The number a_0-a_1i, called the conjugate of a, may be designated by a'. The product aa' is the rational integer $a_0^2+a_1^2$, and is called the *norm of a*. If $a=bc$, then $a'=b'c'$, $aa'=(bb')(cc')$, so that the norm of b is a factor (in the ordinary sense) of the norm of a. The only complex integers which divide all complex integers are those of norm 1, the *units* ± 1 and $\pm i$. If $b|a$ then the associates ub of b, where u is any unit, are also factors of a. If the complex integer p (not a unit) has no factors other than its associates and units, p is called a *prime*. It turns out that $p=p_0+p_1i$ is a complex prime if the norm of p is a rational prime of the form $4n+1$, or if $p=\pm(1\pm i)$, or if p is the associate of an ordinary prime of the form $4n+3$. One proves that $p|ab$ only if $p|a$ or $p|b$, and deduces the fundamental theorem of arithmetic (section 1) in the system of complex integers. Virtually all the theorems of ordinary theory of numbers have analogues among complex integers.

E. E. Kummer, in studying Fermat's equation $x^n+y^n=z^n$ (*See* FERMAT'S LAST THEOREM), developed the theory of integral elements in the fields generated by nth roots of unity (Gauss's case is $n=4$), and found to his astonishment, about 1847, that the fundamental theorem of arithmetic does not always hold true in such systems.

To illustrate this, consider the system of numbers $a=a_0+a_1\theta$, where $\theta^2=-5$ and the a_i are rational numbers; a is called integral if the a_i are rational integers. The conjugate a' is now $a_0-a_1\theta$ and the norm of a is $aa'=a_0^2+5a_1^2$. As before, if $b|a$, then the norm of b divides the norm of a. Hence the units (of norm 1) are ± 1. The number $1+\theta$ (of norm 6) must be a "prime," since neither 2 nor 3 are norms. This prime $1+\theta$ is a divisor of $(1+\theta)(6+5\theta)=-19+11\theta=(-1+3\theta)(4+\theta)$. But $1+\theta$ is not a divisor of $4+\theta$, since the norm 6 does not divide the norm 21. Hence the fundamental theorem of arithmetic (with many of its consequences) does not hold.

If θ is a real or complex solution of an algebraic equation of the type $a_0x^n+a_1x^{n-1}+\ldots+a_n=0$, where the coefficients a_i are rational numbers, θ is called an *algebraic number*. It is called an *algebraic integer* if it satisfies such an equation with $a_0=1$, and $a_1, \ldots, a_n$ integers. Examples are i and $\sqrt[3]{6}$. One frequently considers the algebraic integers in a given algebraic field, which consists of all numbers of the form $b_0+b_1\theta+b_2\theta^2+\ldots+b_r\theta^r$ with rational coefficients b_i. The sum, difference, and product of two algebraic integers in a field are easily seen to be algebraic integers in the same field.

19. Ideals. Suppose that S is the system of all algebraic integers, denoted by $a, b, \ldots, s, t$ in a given algebraic field. Divisibility, units, associates, etc. are defined much as in the preceding two examples. Factorization into primes may not be unique. However, by adjoining to the system S a set of *ideals*, presently to be defined, the fundamental theorem of arithmetic can be made to hold.

If $a=bc$, then clearly the set of all multiples sa of a (where s ranges over all the integral elements of S) is included in the set of all multiples sb of b. Thus the notion of divisibility of integers can be replaced by the notion of inclusion of one set in another. The set of all multiples sa of a given number a will be called an *ideal*, more specifically, a *principal ideal*. More generally, an *ideal* is a set of numbers in an algebraic field, such that if u and v are any numbers in the set then $su+tv$ are in the set, where s and t range over all the integers of the field. In the case of rational integers, if u and v are any rational integers not both zero, then the set of numbers $su+tv$ is the same as the set of numbers md, where d is the g.c.d. of u and v; hence every ideal is then principal. The same is true in Gauss's case of numbers a_0+a_1i. But the field

generated from $\theta^2=-5$ contains nonprincipal ideals.

The product of two ideals is the ideal obtained by multiplying each element of one by each element of the other, and then constructing all combinations $su+tv$ (s and t integral, u and v in the ideal). The principal ideal consisting of all multiples sa of a will be denoted by (a); the ideal consisting of all combinations $su+tv$ by (u, v). It can be shown that every ideal in an algebraic field can be expressed in this way by one or two terms. The ideal (1) plays the role of the number 1; *i.e.*, for any ideal α, $(1)\ \alpha=\alpha$. An ideal whose elements are algebraic integers is called *integral*. A *prime ideal* is an integral ideal with no divisors except itself and (1). The fundamental theorem of arithmetic can be shown to hold in an algebraic field, if each algebraic integer a is replaced by its principal ideal (a), and the system is enlarged to encompass all the integral ideals of the field: every ideal which is not a prime can be expressed as a product of prime ideals in one and only one way.

This may be illustrated in the above example with $\theta^2=-5$ as follows. Let $\alpha=(1+\theta,\ -1+3\theta)$, $\beta=(1+\theta,\ 4+\theta)$, $\gamma=(6+5\theta,\ -1+3\theta)$, $\delta=(6+5\theta,\ 4+\theta)$. The ideals $\alpha, \beta, \gamma, \delta$ are easily shown to be prime ideals (of respective "norms" 2, 3, 23, and 7), and the factorization of $(-19+11\theta)$ into prime ideals is simply $\alpha\beta\gamma\delta$. The factorizations previously given were $\alpha\beta.\gamma\delta=(-19+11\theta)=\alpha\gamma.\beta\delta$, and it is not surprising that $\alpha\beta|\alpha\gamma.\beta\delta$ without dividing $\alpha\gamma$ or $\beta\delta$.

20. Algebras, and Their Arithmetics. Other generalizations of number are found in the extensive theory of linear algebras, which we will illustrate only very briefly. A simple example is the algebra of quaternions (*see* QUATERNIONS). These are symbols of the form $a=a_0.1+a_1i_1+a_2i_2+a_3i_3$, where we will suppose the a_i to be rational numbers, and the basal elements $1, i_1, i_2, i_3$ satisfy the multiplication table $1.b=b.1=b, i_1^2=i_2^2=i_3^2=-1$, $i_1i_2=i_3=-i_2i_1$, $i_2i_3=i_1=-i_3i_2$, $i_3i_1=i_2=-i_1i_3$. Algebraic operations are performed in the usual way, except that multiplication is in general not commutative (*e.g.*, $i_1i_2\neq i_2i_1$), and the order of multiplication must be preserved. The resulting algebra has many applications, physical and geometrical. The question here is, what shall be meant by an integral quaternion?

In 1886, R. Lipschitz defined a to be integral if the co-ordinates a_i are rational integers, and was able to prove the following result resembling the fundamental theorem of arithmetic. Define a', the *conjugate of* a, to be $a_0-a_1i_1-a_2i_2-a_3i_3$. The product aa' will be found to be $a_0^2+a_1^2+a_2^2+a_3^2$, a rational integer called the *norm of* a, abbreviated $N(a)$. From $a=bc$ follows $a'=c'b'$, and hence $aa'=(bc)(c'b')=b(cc')b'=(bb')(cc')$, or $N(a)=N(b)N(c)$. The units are the eight quaternions $u=\pm 1, \pm i_1, \pm i_2, \pm i_3$ of norm 1. If b is a left-divisor of a(*i.e.*, $a=bc$ in integral quaternions), then the right-associates bu are also left-divisors of a. A *prime quaternion* is an integral quaternion a (not a unit) such that if $a=bc$ in integral quaternions, then b or c is a unit. It is easily proved that a quaternion is prime if and only if its norm is a rational prime number; *e.g.* $1+i_1$ of norm 2, $2+i_1-2i_2+2i_3$ of norm 13. Factorization into primes is in general not unique. For example, $3=(1+i_1+i_2)(1-i_1-i_2)=(1+i_1+i_3)(1-i_1-i_3)$, yet the primes $1+i_1+i_2$ and $1+i_1+i_3$ are not right-associates. However, suppose now that a is primitive, *i.e.* that a_0, a_1, a_2, a_3 are relative-prime, and that $N(a)$ is not divisible by 4. Factor $N(a)=p_1p_2\ldots p_r$ into rational primes, not necessarily distinct, but in a definite order. Lipschitz's result is this: there exist prime quaternions $t_1, t_2, \ldots, t_r$ of respective norms $p_1, p_2, \ldots, p_r$ such that $a=t_1t_2\ldots t_r$; this factorization into primes is unique, for the given order of $p_1, \ldots, p_r$, except that we can introduce unit factors in the trivial way illustrated by $t_1t_2t_3=(t_1i_1)\ (-i_1t_2i_3)\ (-i_3t_3)$. This theorem of Lipschitz yields a large number of arithmetical applications; *e.g.*, he proved thereby the formula for the number of representations of integers as a sum of four squares (section 7).

However, the definition of integral quaternion was somewhat arbitrary. A. Hurwitz was led by natural considerations to define a to be integral if the a_i are either all integers, or all halves of odd integers. For example, $\frac{1}{2}(1+i_1-i_2+i_3)$ is integral, of norm 1. The resulting arithmetic is better behaved with respect to the prime 2 (it being unnecessary to restrict $N(a)$ to be not divisible by 4,—but still necessary to assume a primitive.)

We owe, finally, to L. E. Dickson an adequate and unique characterization of a system of integral elements in any linear algebra (*Algebras and Their Arithmetics* [1923]). This includes Hurwitz's system and the theory of algebraic integers as special cases, and has formed the basis of much subsequent work.

The first half of the 20th century saw many extensions of the theory of numbers to various algebraic systems. Not all theorems extend easily, and some lead to rather surprising results. The prospects for original research were, by mid-20th century, by no means exhausted.

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NUMBER SEQUENCES. A number sequence is a set of numbers arranged in some order so that for each pair of numbers of the set it is determined which one of the pair precedes the other. The simplest kind of example is a finite sequence, such as 9, 15, 7, 2, $\frac{3}{2}$, where the order of precedence is from left to right. A different sequence is obtained from the same set of numbers by rearrangement, as, for example, 15, 2, 7, 9, $\frac{3}{2}$. The term infinite sequence usually refers to an unending succession of numbers, such that after each one appears a next following, as, for example, $1, 4, 9, 16, \ldots, n^2, \ldots$. Such an infinite sequence is a function of a variable ranging over the positive integers and is sometimes called a simple infinite sequence. It is frequently convenient to allow repetitions in such a sequence. Other types of sequences are sometimes useful in mathematics, as, for example, the rational numbers in their usual order. (*See* also NUMBER: *Infinite Ordinal Numbers*.) A double infinite sequence is a function of two variables each ranging over the positive integers. It may be thought of as a set of numbers arranged in a rectangular array instead of in a line. Thus, a double sequence is not an instance of the definition given at the beginning of this article but requires an extension of that definition.

Types of Simple Sequences.—These include arithmetic progressions, harmonic progressions and geometric progressions. An

arithmetic progression is a sequence such that the difference of two successive terms of the sequence is always the same number, d. If the first term is a, then an arithmetic progression may be written in the form

$$a,\ a+d,\ a+2d,\ a+3d,\ \cdots.$$

It may be shown by mathematical induction that the nth term of the sequence is given by the formula $a+d(n-1)$, and the sum of the first n terms by the formula

$$\tfrac{1}{2}n[2a+(n-1)d].$$

A harmonic progression is a sequence the reciprocals of whose terms form an arithmetic progression. A geometric progression is a sequence such that the ratio of two successive terms is always the same number $r(\neq 1)$. If the first term is a, then a geometric progression may be written in the form

$$a,\ ar,\ ar^2,\ ar^3,\ \cdots.$$

The nth term is ar^{n-1}, and the sum of the first n terms is given by the formula

$$\frac{a(1-r^n)}{1-r}.$$

These formulas are readily proved by mathematical induction. If r is numerically less than one, the expression for the sum of the first n terms approaches $\dfrac{a}{(1-r)}$ when n increases without limit. In this case $\dfrac{a}{(1-r)}$ is called the sum of the infinite geometric progression or geometric series

$$a+ar+ar^2+\cdots+ar^{n-1}+\cdots.$$

Definition of Irrational Numbers.—Simple infinite sequences of rational numbers may be used to define irrational numbers. For example, $\sqrt{2}$ may be defined by the decimal sequence 1, 1.4, 1.41, 1.414, $\cdots$, whose successive terms may be determined by any one of the customary methods of computing square roots. A sequence $a_1, a_2, a_3, \cdots, a_n, \cdots$ to be used in defining a number must be a regular sequence, in the sense that to every positive number ϵ there corresponds an integer n such that the numerical value of $a_m - a_n$ is less than ϵ whenever m is greater than n. Two regular sequences $a_1, a_2, a_3, \cdots$ and $b_1, b_2, b_3, \cdots$ define the same number when $a_n - b_n$ approaches zero as n becomes infinite. Algebraic operations on regular sequences are readily defined. This method of constructing the real-number system by the use of regular sequences of rational numbers is due to G. Cantor (*Math. Annalen*, vol. v [1872] and vol. xxi [1883].) It is found that regular sequences of real numbers always have real numbers as limits so that no further extension of the number system in this direction is necessary.

Solutions of Equations.—Infinite sequences appear in Sir Isaac Newton's method of finding solutions of numerical equations. Thus, if a_1 is sufficiently close to a root of an equation $f(x)=0$, the formula

$$a_2 = a_1 - \frac{f(a_1)}{f'(a_1)},$$

where $f'(x)$ is the derivative of $f(x)$, gives a closer approximation. Repeated use of this formula gives a sequence $a_1, a_2, a_3, \cdots$, of closer and closer approximations to the desired root. This sequence may be proved to be regular in accordance with the definition given above. A similar method may be employed to approximate solutions of differential equations (*q.v.*), but in this case sequences of functions appear in place of number sequences.

Summability of Infinite Series.—The term infinite series is frequently applied to the indicated sum of the terms of an infinite sequence $a_1, a_2, a_3, \cdots$ when one wishes to consider the existence and value of the limit as n approaches infinity of the related sequence $s_1=a_1$, $s_2=a_1+a_2$, $s_3=a_1+a_2+a_3$, $\cdots$. When this limit exists and is finite, the infinite series is said to converge. In the consideration of infinite series which do not converge, various methods of summation have been invented which associate with the series other sequences than the sequence $s_1, s_2, s_3, \cdots$ defined above. For example, E. Cesàro considered the sequence $t_1=s_1$, $t_2=\dfrac{(s_1+s_2)}{2}$; $t_3=\dfrac{(s_1+s_2+s_3)}{3}\cdots$. This sequence may have a limit when the sequence $s_1, s_2, s_3, \cdots$ does not; but when the latter does have a limit, the former always has the same limit.

In the study of functions by the use of associated infinite series of functions, the series may fail to converge for some values of the independent variable. In some cases of this sort the value of the function may still be recovered from the series by use of a suitable method of summation.

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NUMENIUS, a Greek philosopher, of Apamea in Syria, Neopythagorean and forerunner of the Neoplatonists, flourished during the latter half of the 2nd century A.D. His chief divergence from Plato is the distinction between the "first god" and the "demiurge." This is probably because of the influence of the Valentinian Gnostics and the Jewish-Alexandrian philosophers (especially Philo and his theory of the Logos). His works were valued by the Neoplatonists, and it is said Amelius wrote about 100 books of commentaries on them.

Fragments of his treatises on the points of divergence between the Academicians and Plato, on the Good (in which according to Origen, *Contra Celsum*, iv, 51, he makes allusion to Christ) and on the mystical sayings in Plato are preserved in the *Praeparatio Evangelica* of Eusebius.

The fragments are collected in F. G. Mullach, *Frag. phil. Graec.*, iii; *see* also F Thedinga, *De Numenio philosopho Platonico* (Bonn, 1875); Ritter and Preller, *Hist. Phil. Graecae*, ed. by E. Wellmann (1898), T. Whittaker, *The Neo-Platonists* (1901; 2nd ed., 1918) and Überweg, *Grundriss der Gesch. der Philosophie*, Bd. I (1926).

NUMERALS. Just as the first attempts at writing came long after the development of speech, so the first efforts at the graphical representation of numbers came long after people had learned to count. Judging by the habits of primitive tribes of the present as well as by the oldest trace that we have of written or sculptured records, the earliest numerals were simple notches in a stick, scratches on a stone, marks on a piece of pottery or the like.

Having no fixed units of measure, no coins, no commerce beyond the rudest barter, no system of taxation and no needs beyond those of a savage, there was no necessity for written numerals until about the beginning of what we call historical times.

Early Forms.—The earliest numerals of which we have definite record were simply straight marks for the small numbers, with some special form for ten. These symbols appear in Egypt as early as the 1st dynasty (*c.* 3400 B.C.), and in Mesopotamia as early as *c.* 3000 B.C. These dates long precede the first known inscriptions containing numerals in India (*c.* 3rd century B.C.), in China (3rd century B.C.) and in Crete (*c.* 1200 B.C.).

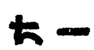
Egyptian hieroglyphic, *c.* 3400 B.C. . . . . 

Egyptian hieratic, *c.* 3400 B.C. . . . . 

Cretan inscriptions, *c.* 1200 B.C. . . . . 

Sumerian and later, *c.* 3000 B.C. . . . . 

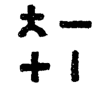
Somewhat later it is not uncommon to find a group mark before ten is reached. For example, four has a special symbol in certain Hindu types, as follows:

Asoka's time, 3rd century B.C. . . . . . . 

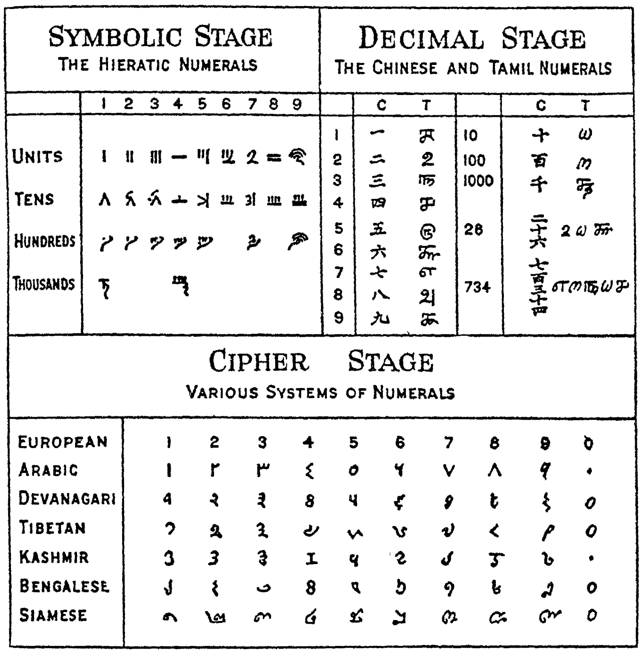
Nānā Ghāt, 2nd century B.C. . . . . 

Saka, *c.* 1st century B.C. . . . . 

Nasik, 1st or 2nd century . . . .
Kuṣana, *c.* 150 . . . .



Early Hindu Symbols for 1 and 4.—Even to-day a Chinese merchant may write one and four in the forms I and X respectively, instead of using the classical symbol. This use of a symbol for four may, in fact, have preceded the Western habit of taking



THE DEVELOPMENT OF NUMERALS THROUGH THE SYMBOLIC, DECIMAL AND CIPHER STAGES

ten as the first group number, and the Etruscan and Roman use of V or Λ for five may have been a hand symbol in use before the X was taken for ten.

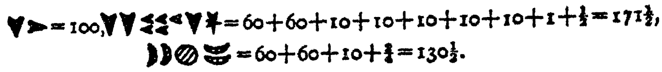
The vertical marks, I, II, III, etc., may possibly be representations of the fingers held as used in counting and computing, a linguistic trace of which is found in the word *digit*. The horizontal marks may be representations of computing rods as they lie on a table. The vertical symbols were preferred in Mesopotamia and the Mediterranean region, and the horizontal ones in the Far East, where —, =, and ≡ were commonly used for one, two, and three, = and ≡ being cursively written to give us our present 2 and 3.

It therefore appears that the primitive numerals were I, II, III, IIII, and so on, as we find in Egypt and the Grecian lands, or —, =, ≡, and probably so on as we usually find in the East, each going as far as the simple needs of people required. The idea of a group figure would naturally have occurred to merchants as soon as there developed a need for numbers beyond 10 or 12 (as was the case in Egypt and Babylon). Once the idea was suggested, probably influenced by the ten fingers, symbols were invented for smaller units, as in the case of those used for four and five as stated above. These naturally suggested special symbols for each of the numbers from one to ten or even farther, and the use of the additive principle to build up larger numbers, as in the Roman XXII. The idea of special symbols for larger groups, as for 20, 30, and so on, was a natural extension.

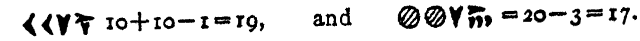
Cuneiform Numerals.—Around Babylon, clay was abundant; and in the damp clay tablets they impressed their symbols, then baking these tablets in the sun or in a kiln, thus forming historical documents that were practically as permanent as stone. Since the pressure of the stylus gave a wedge-shaped symbol, the writings are known as cuneiform (Lat. *cuneus*, a wedge, +*forma*, a shape) inscriptions.

For our purposes some leading principles will suffice. The symbol for 1 served also for 60, 3,600, and in general for 1×60^n; similarly the symbol for 10 served for 10×60^n, the context telling what particular value was indicated. The symbols could be made either with the pointed or the circular end of the stylus, as follows:

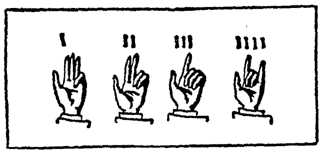
There was also a symbol for 100, but in general the scribe preferred to make use of the symbol for 60, thus:



Following the general custom of the race to use small numbers instead of large ones, the Babylonians employed a subtractive principle, as we do in saying "a quarter to three" instead of "three quarters past two," and "three minutes to six" instead of "57 minutes after five." This appears in such numerals as

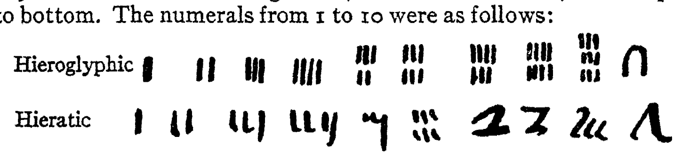


A similar custom is seen in Hebrew number names, in the occasional use of IV. for four and IX. for nine in the Roman inscriptions. The Romans also used *unus de viginti* for 19, and *duo de viginti* for 18, occasionally writing these numbers as XIX. (or IXX.) and IIXX., respectively. On the whole, however, the subtractive principle was little used in the numerals of the classical period.

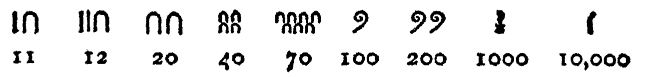


FROM SMITH, "HISTORY OF MATHEMATICS"
THIRTEENTH CENTURY FINGER SYMBOLISM
From the *Codex Alcobatiensis*, in the Biblioteca Nacional, Madrid

Egyptian Hieroglyphics.—The Egyptian numerals in hieroglyphic writing differed somewhat from those in the hieratic and demotic, but the last two were degenerate forms of the first, with certain additions. It will suffice to call attention to the principles of the first and second. In doing so, however, it should be observed that the Egyptians generally wrote from right to left, as in the Semitic script, but the hieroglyphics were occasionally written from left to right or (as also the Hieratic) from top to bottom. The numerals from 1 to 10 were as follows:

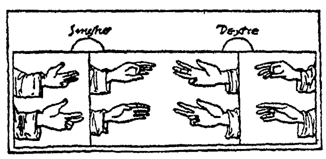


The hieroglyphic symbols for certain larger numbers were as follows:



It will therefore be seen that the general plan of the hieroglyphic notation was to have special symbols for powers of 10, and to repeat these as necessary. The Hieratic had special symbols for 5, 7, 8, and 9—a step toward the later Hindu system. The Hieroglyphic was similar in principle to the Etrusco-Roman, except that the latter introduced special numerals for 5, 50, and 500.

Greek Numerals.—The Greeks had two important systems of numerals, besides the primitive plan of repeating single strokes, as in III III for six. Their predecessors in culture—the Babylonians, Egyptians, and Phoenicians—had generally repeated the units up to nine, with a special symbol for ten, and so on. The early Greeks also repeated the units to nine, and probably had various symbols for ten. In Crete, whose early civilization was so much influenced by that of Phoenicia and Egypt, the symbol for ten was —, a circle was used for 100, and a rhombus for 1,000. Cyprus also used the horizontal bar for ten, but the precise forms



FROM SMITH, "HISTORY OF MATHEMATICS"
FIFTEENTH CENTURY FINGER SYMBOLISM
From *Sūma* of Pacioli, Venice, 1494

are not of so much significance as that the grouping by tens, with special symbols for certain powers of ten, was characteristic of the early systems of the Near East.

The Greeks, entering the field much later, and influenced as to their alphabet by the Phoenicians, based their first elaborate system chiefly on the initial letters of the numeral names. This was a natural thing for all early civilizations, since the custom of writing out the names for large numbers was at first quite general, and the use of an initial by way of abbreviation of a word is universal. These initial numerals, in modern characters, were

Π, *pi*, for ΠΕΝΤΕ (*pente*), five;
Δ, *delta*, for ΔΕΚΑ (*deká*), ten; often written like O;
H, an old Attic breathing, like our *h*, later represented by a special symbol like ', for HEKATON (*hekaton*), hundred;
X, chi, for ΧΙΛΙΟΙ (*chil'ioi*), thousand;
M, *mu*, for ΜΥΡΙΟΙ (*myr'ioi*, *mur'ioi*), ten thousand.

These numerals were frequently combined, thus:

𐅄 or 𐅄, *pente-deka*, for 5×10, or 50;
𐅅, *pente-hekaton*, for 5×100, or 500;
𐅇, *pente-murioi*, for $5 \times 10{,}000$ or 50,000.

This system appears in records of the 3rd century B.C. but was probably used much earlier. In the 2nd century of our era it was described by the grammarian Herodianus, and hence characters are often spoken of as Herodianic numerals. They are more properly called Attic numerals, being the ones always found in the Attic inscriptions.

As early as the 3rd century B.C. another system came into use, running parallel to the initial-letter one, being better adapted to the theory of numbers, and being more difficult of comprehension by the trading class. It consisted in assigning nine letters of the alphabet to the numbers 1–9, nine letters to the numbers 10, 20, 30,..., 90, and nine letters to the numbers 100, 200, 300, ..., 900. Since, however, there were only 24 letters in the Greek alphabet, three were added, namely the Phoenician *vau* (shaped like our letter **F**), *koph* or *qoph* (shaped somewhat like our letter **Q**, which indeed is derived from the same source, and represented below as **Q**), and a character known in modern times as *sampi* (and then shaped somewhat like the Greek π, but tipped about 45° to the right and represented below as **&**). An earlier form of this last symbol was ͳ. The numerical values of the letters were therefore as follows:

Units . .	A	B	Γ	Δ	E	[F]	Z	H	Θ
	1	2	3	4	5	6	7	8	9
Tens . .	I	K	Λ	M	N	Ξ	O	Π	[Q]
	10	20	30	40	50	60	70	80	90
Hundreds .	P	Σ	T	Υ	Φ	X	Ψ	Ω	[&]
	100	200	300	400	500	600	700	800	900

The thousands were often indicated by placing a bar to the left of the numeral, thus:

/A = 1,000 /B = 2,000 /I = 10,000 /Σ = 200,000

The myriads (ΜΥΡΙΟΙ, *myrioi*, ten thousands) were represented by such symbols as

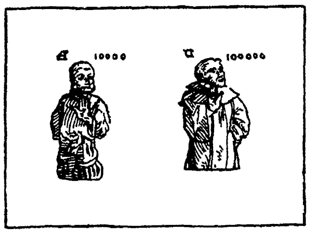
M or $\overset{\Upsilon}{\text{M}}$, for 10,000, $\overset{\Delta}{\text{M}}$ for $4 \times 10{,}000$, or 40,000, etc.

Such numeral forms were not particularly difficult for computing purposes, once the operator was able automatically to recall the meaning of each. To be able to express 10,407 by MΥZ would have seemed to a Greek considerably simpler than by our system. The capital letters were used by the Greeks, the small letters being a relatively modern invention.

Hebrew Numerals.—By the 2nd century B.C. at the latest, the Hebrews had established a system of alphabetic numerals similar to the one used by the Greeks. The alphabet being exhausted when the symbol for 400 was reached, the letters for 400 and 100 were combined by early writers to represent 500, and similarly up to 900. Later scholars used the final forms of the letters for 20, 40, 50, 80 and 90 (that is, the form of the letter that would be used at the end of a word) to represent 500, 600, ..., 900. The scheme then appeared as follows:

Units . . .	א	ב	ג	ד	ה	ו	ז	ח	ט
	1	2	3	4	5	6	7	8	9
Tens . .	י	כ	ל	מ	נ	ס	ע	פ	צ
	10	20	30	40	50	60	70	80	90
Hundreds . .	ק	ר	ש	ת	ך	ם	ן	ף	ץ
	100	200	300	400	500	600	700	800	900

Roman Numerals.—The direct influence of Rome for such a long period, the superiority of her numeral system over any other simple one that had been known in Europe before about the 10th century, and the compelling force of tradition explain the strong position that the system maintained for nearly 2,000 years in commerce, in scientific and theological literature, and in *belles lettres*. It had the great advantage that, for the mass of users, the memorizing of the values of only four letters was necessary—V, X, L, and C. Moreover, it was easier to see three in **III** than in 3, and to see nine in **VIIII** than in 9, and correspondingly easier to add numbers—the simplest of all the operations.



FROM SMITH, "HISTORY OF MATHEMATICS"
SIXTEENTH CENTURY FINGER SYMBOLISM
From the *Abacvs* of Johannes Aventinus, Nurnberg, 1522

As in all such matters, the origin of these numerals is obscure, although the changes in their forms since the 3rd century B.C. are well known. Of the various theories that of Mommsen (1850) has had the widest acceptance. This was that the use of **V** for 5 is due to the fact that it is a kind of hieroglyphic representing the open hand with its five fingers. Two of these gave the **X** for ten. Three of the other symbols, he asserted, were modifications of Greek letters not needed in the Etruscan and early Latin alphabet. These were *chi*, which appears in inscriptions not only as **X** but also in such forms as ⊥, ↓, and which later became the **L** that was arbitrarily chosen for 50; *theta*, Θ, which was selected for 100, being finally changed to C under the influence of the word *centum* (hundred); and *phi*, Φ, to which was assigned the value 1,000, and which finally took the forms (I), and **M**, the last being chosen because of the word *mille* (thousand). There is considerable epigraphical evidence in support of these contentions made by Mommsen. (*See* the bibliography for other theories.)

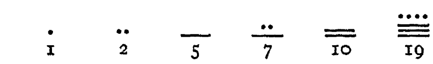
The oldest noteworthy inscription containing numerals representing very large numbers is on the *columna rostrata*, a monument erected in the Roman forum to commemorate the victory of 260 B.C. over the Carthaginians. In this a symbol for 100,000, which was an early form of (((I))), was repeated 23 times, making 2,300,000. This illustrates not only the early Roman use of repeated symbols, but also a custom which extended to modern times—that of using (I) for 1,000, ((I)) for 10,000, (((I))) for 100,000, and ((((I)))) for 1,000,000. The symbol (I) for 1,000 frequently appears in various other forms, including the cursive ∞. All these symbols persisted until long after printing became common. In the middle ages a bar (*vinculum*, *titulus*) was placed over a number to multiply it by 1,000, but this use is not found in the Roman inscriptions. When the bar appears in early manuscripts it was merely for the purpose of distinguishing numerals from nouns, as in the case ĪĪVIR for *duumviri*. We also find in the middle ages such forms as $\overline{|X|}$ or **|X|** for ten hundred thousand and $\overline{|M|}$ for one thousand hundred thousand.

Of the later use of the numerals, a few of the special types are as follows:

(1) $\bar{c}$ · $\overline{\text{lxiiij}}$ · ccc · l · i, for 164,351, Adelard of Bath (*c.* 1120).
(2) II.DCCC.XIIII, for 2,814, Jordanus Nemorarius (*c.* 1125).
(3) MƆCLVI, for 1,656, in San Marco, Venice.
(4) cIↃ.IↃ.Ic, for 1,599, Leyden ed. of Capella, 1599.
(5) IIIIxxet huit, for 88, a Paris treaty of 1388.
(6) four Cli.M, for 451,000, Baker's arithmetic (1568).
(7) vj.C for 600 and CCC.M for 300,000, Recorde (*c.* 1542).

The first represents the use of the vinculum; (2) represents the place value as it occasionally appears in Roman numerals; (3) illustrates the not infrequent use of ɑ (like D, originally half of (I), the symbol for 1,000); (4) illustrates the persistence of the old Roman form for 1,000 and 500, and the subtractive principle so rarely used by the Romans for a number like 99; (5) shows the use of *quatre vingt* for 80, commonly found in French manuscripts until the 17th century, and occasionally later, the numbers often being written like iiij^{xx}, vij^{xx}, and so on; (6) represents the coefficient method, "four C" meaning 400, a method often leading to forms like ijM or **IIM** for 2,000, as shown in (7).

The Maya Use of Place Value.—Evidence of some appreciation of place value is found in various systems of notation. For example, the cuneiform inscriptions contain frequent examples like ɪtʇɪ (using ɪ to represent the vertical wedge and *t* to represent the tens symbol), in which the first ɪ stands for 60 and the last ɪ for one, the number being 81. Similarly the later Roman forms occasionally contain cases like II · CX for 2,110, although these are not examples of the systematic use of place value as we understand it. In Yucatan, however, the highly developed Maya civilization used, for calendar purposes, a system of numerals based upon a scale which has elements of both 5 and 20, the horizontal bar (—) representing 5 and the dot (·) representing unity. The following are examples:



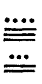
The Mayas also had a symbol for 0 in connection with which the place value clearly appears, as follows:

, 1 twenty and no units

, 15 twenties and no units

, 17×20 and no units (our 340)

The next number after 17×20+19 is 360, which then became a kind of super-radix, as follows:



, 19×360+13×20+13=7,113.

The Maya numerals seem to have been used for writing numbers rather than for calculation.

Chinese Numerals.—The Chinese have three general systems of numerals—the ancient national, the modern national, and the mercantile. These are respectively as follows:

一	二	三	四	五	六	七	八	九	十	百	千
一	二	三	四	五	六	七	八	九	十	百	千
〡	〢	〣	〤	〥	〦	〧	〨	〩	十	百	千

The second differs from the first in that the place value is used, the circle ○ being used for our zero. The date 1937 is here shown in the two systems, the numbers being written downwards, as usual.

Modern	Traditional
一 九 三 七	千 九 百 三 十 七

Sanskrit and Arabic Numerals.—By way of comparison of the modern Sanskrit and Arabic forms, the two are here shown:

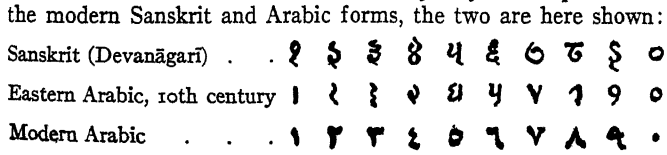
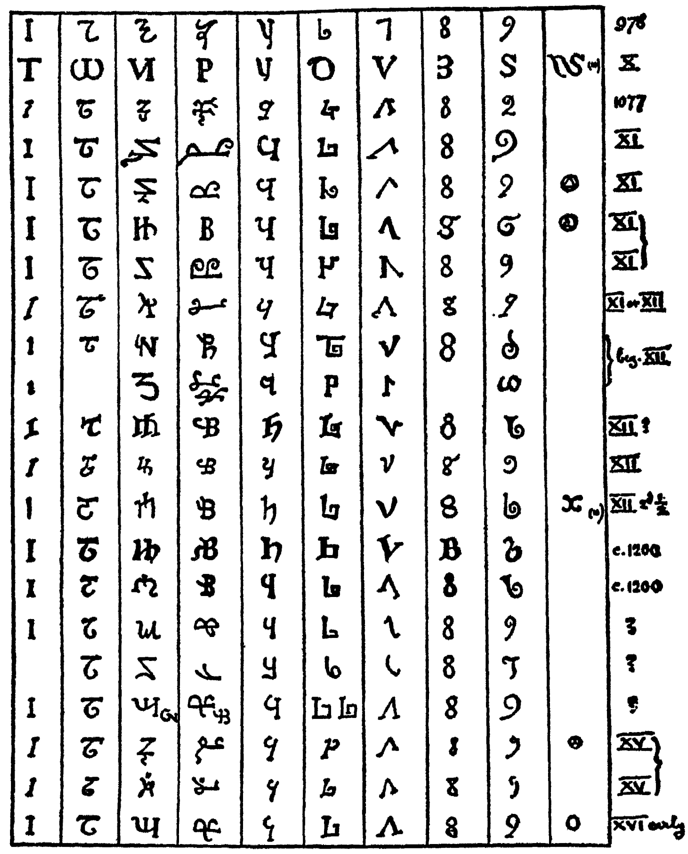


Table of Changes of the Hindu-Arabic Numerals in Europe
From G. F. Hill's *The Development of Numerals in Europe*, Oxford, 1915
Reproduced by permission of the author and the Oxford University Press



Our Common Numerals.—Several different claims, each having a certain amount of justification, have been made with respect to the origin of our present numerals, commonly spoken of as Arabic but preferably as Hindu-Arabic. These include the assertion that the origin is to be found among the Arabs, the Persians, the Egyptians, and the Hindus. It is not improbable that the intercourse between traders served to carry such symbols from country to country, so that our numerals may be a conglomeration from different sources. The country, however, which first used, so far as we know, the largest number of our numeral forms is India. The 1, 4, and 6 are found in the Aśoka inscriptions (3rd century B.C.); the 2, 4, 6, 7, and 9 appear in the Nānā Ghāt inscriptions about a century later; and the 2, 3, 4, 5, 6, 7, and 9, in the Nasik caves of the 1st or 2nd century of our era—all in forms that have considerable resemblance to our own, our 2 and 3 being well-recognized cursive derivations from the ancient = and ≡. None of these early Indian inscriptions gives any evidence of place value, or of a zero that would make our place value possible. Hindu literature gives some evidence that the zero may have been known before our era, but we have no actual inscription containing such a symbol before the 9th century.

The first definite external reference to the Hindu numerals is in a note by Severus Sebokht, a bishop who lived in Mesopotamia *c.* 650. Since he speaks of "nine signs," the zero seems not to have been known to him. By the close of the 8th century, however, some astronomical tables of India are said to have been translated into Arabic at Baghdad, and in any case the numerals became known to Arabic scholars about this time. About 825 al-Khowârizmî wrote a small book upon the subject, and this was translated into Latin by Adelard of Bath (*c.* 1120) under the title of *Liber Algorismi de numero Indorum*. There is some reason for believing that the numerals found their way into Europe even earlier than into Baghdad, but the earliest European

manuscript that is known to contain them was written in Spain in 976. The table on preceding page shows their subsequent development until the time of printing.

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NUMERAL SYSTEMS. There is no language without some numerals; the notion of unity and plurality is expressed at least in the formation of "one" and "two," though "two" is often equal to "much," thus concluding a numeration that has just only started. It is doubtful whether even systemless numeration really exists, as it is mostly reported of peoples who are but vaguely known. The eastern languages of Australia, in spite of the occurrence of numerals for "three" and even "four," and in a less degree the western languages, Yuin-Kuri, Wiradhuri, Kamilaroi, and the southern central languages have been suspected of it. It remains doubtful whether Tasmania practised systemless or pair numeration. The Pygmies of the Andaman islands and Malacca form numerals for "one" and "two," yet sum up only with units, not with pairs. So with the Chiquito in South America.

The Pair System.—The pair system has numerals for "one" and "two" and forms the following numerals by addition to the "pair": $3=2+1$, $4=2+2$, $5=2+2+1$, etc. It is found in Australia among tribes ethnologically the oldest—the Kulin-Kurnai of the south-east, the Narrinyeri of the south; several of them count up to "ten" in this manner. A pure pair system still occurs in many Papuan languages of Torres straits and the adjacent coast of New Guinea. In Africa it is practised by the Bushmen. In South America it is found among the ethnologically oldest tribes—the Fuegian tribes: Yamana and Halakwulup, the Guayaki and Shipaya, and the Ges-Tapuya tribes.

The pair system starts from the parts of the human body that exist in pairs, like eyes, ears, hands, feet. The pair system is also found in various associations with later numeration systems. The formation of a dual with the personal pronoun (and substantive) can be traced back to those times.

The Quaternary System.—The quaternary system forms the numerals above "four" by composition: $5=4+1$, $7=4+3$, $8=4+4$ (or 2×4), $9=(2\times4)+1$, $16=4\times4$. In this consequent type, however, it is but seldom met, *e.g.,* in California with the Salina and traces of it with the Chumash. In California the four quarters of the sky play an important part in religion, mythology and custom.

The Hexad System (Senary System).—When further developed to a duodecimal system this is the most useful of all as it permits of more divisions without fractional numbers than any other system, and in later stages it has been repeatedly introduced especially for astronomy or in metrical or monetary systems. In primitive numeration it has a rather limited dispersion in north-west Africa, *e.g.,* in the Huka, the Bulanda, the Apko; traces of it are to be met with among the Bube on Fernando Po.

The Quinary System.—The quinary system in its pure form, where for instance $10=2$ hands, $25=5$ hands, is found only in Saraweka, a South American Arowak language. Everywhere else it is combined either with the decimal or the vigesimal system.

The Vigesimal System.—The vigesimal system takes 20 as a basis, so as to make 20×20 the numeral next in height, if the numeration goes as far as that. It may combine either with the quinary system forming a quinary vigesimal system or more rarely and only in younger forms with the decimal system, and then becomes a decimal vigesimal system. The quinary vigesimal system is frequently combined with the pair system, so that the numbers 3 and 4, often also 6, 7, 8, 9, and further 12 and 13, are formed according to the pair system.

These systems start with the fingers and the toes. Therefore "five" often means "hand," "ten" means "the two hands," 11 "one at the foot." 20 "both the feet (and hands)" or "the whole man."

The quinary vigesimal system is found sporadically in almost all the Australian linguistic groups; in nearly all the Papuan languages of the (north) east coast and exterior of New Guinea, in the oldest Melanesian languages of New Caledonia, the Loyalty islands, etc. In Asia-Europe it occurs in the border languages: Ainu, Chukchi, Koryak, in Burushaski (*q.v.*), and in the Himalaya group of the Tibeto-Burman languages.

The decimal vigesimal system is found in the Munda languages of India and in Tibeto-Chinese groups of the Himalayas, in Nicobarese, in the north (and south) Caucasian languages. With the Indo-European and the Semitic languages the dual form for 20 seems to point to a former vigesimal system. The Sumerian, too, shows traces of it. Basque practises a full (decimal) vigesimal system, so that forms like soixante-dix, quatre-vingt, quatre-vingt-dix in French are to be explained.

In Africa the vigesimal system occurs in upper Guinea, and its hinterland, from the Senegal to the Cross river, in a series of Bantu, Mande, Togo and Niger languages, and in some east Bantu languages, in the Hamitic Kunama (and Barea) and in the Bantu languages Konde and Sango.

In North America it is found in Eskimo and in the north-west in Bellacoola and Haida and several languages of California, together with Pawnee (Caddo). This system mostly as decimal vigesimal is dominant in Mexico, Central America, even in the languages of the high civilization of the Aztecs and Maya. In South America the vigesimal system is found both in the progressive civilization of the Chibchas and with a great many primitive tribes belonging to nearly every linguistic group save the Gez-Tapuya and the tribes south of the Gran Chaco.

The quinary vigesimal system, especially its older form combined with the pair system, appears to have originated in the culture cycle (*Kulturkreis,* culture area) of the totemistic-patriarchal progressive hunters; a culture type in which the human body in art (sculpture), clothing and adornment has gained greatest importance and is most cared for. According to that the vigesimal system, too, agrees up to 20 with the parts of the body.

In north-western Africa on the coast of upper Guinea a quadragesimal system has developed, derived from a vigesimal system. Its origin is due to commercial reasons, as the monetary standard in this region is a set of 40 cowries.

The Decimal Systems.—The decimal systems are superior to the vigesimal systems in taking as a basis a smaller numeric unity more easily applied, and render possible shorter forms of the numbers. Two forms are known, the quinary decimal system and the pure decimal system. In the quinary decimal system the numbers of the second pentad are formed by composition with "five" ($6=5+1$, $7=5+2$, etc.) or by the pair system (especially $6=3\times2$, $8=4\times2$) or by subtraction (especially $9=10-1$). It seems to have originated in the matriarchal soil-tilling culture. The great quantity of agricultural products which had to be counted, arranged, stored, and brought to market required to be frequently repeated and counted quickly, and thus led to this system. In the languages of this culture numeral unities have developed which spring from the special grouping of certain products: a dozen, a brace, score (three score), etc.

In Australia and in the Papuan languages it is found isolated and in rudimentary form; with the Melanesians it is fully displayed. In Asia it originally dominated the two great families of the Austroasiatic and the Tibeto-Chinese languages. Whether a quinary or a pure decimal system was the original numeration in the Ural-Altaic languages cannot be ascertained. In Africa the great majority of the languages show originally a quinary decimal system, especially the Bantu and the semi-Bantu languages and the majority of the Nilotic, Wule, Ngo-Nke and Manfu languages. So too, in North America; but neither in Mexico, Central America, nor in South America has the system spread widely.

With the pure decimal system there is no partition of the decad into two pentads and therefore the compound character of the numerals from five to ten is not met with. The whole system

becomes simpler and its forms are better fitted for general application. The pure decimal system seems to have originated in the culture-cycle of the nomadic herders, who, in counting their large flocks of horses, cows, camels, sheep, etc., needed to employ high numbers with more facility. From the aristocracies of the nomadic herders it has spread everywhere, and it is now found in all nations of high culture on the whole globe, except those of Mexico and Central America, where the number 20 was used in astronomy, and thus was safe from competition. (W. Sc.)

NUMERATION: *see* NUMERALS; ARITHMETIC.

NUMIDIA, the classical name of a territory in the northern part of Africa. When the Romans first came into conflict with Carthage in the 3rd century B.C., the name was applied to the whole country from the river Mulucha (now the Muluya), to the frontier of the Carthaginian territory. Numidians were divided into two great tribes, the Massyli on the east, and the Massaesyli on the west, the limit between the two being the river Ampsaga. At the time of the second Punic war, the eastern tribe was governed by Massinissa, who took the side of the Romans, while Syphax, king of the Massaesyli, led the Carthaginians. At the end of the war, the Romans confiscated the dominions of Syphax, and gave them to Massinissa, whose sway extended from the frontier of Mauretania to the boundary of the Carthaginian territory, also south and east to the Cyrenaica, so that the Numidian kingdom surrounded Carthage except towards the sea. Massinissa, who reached a great age, retained the whole of these dominions till his death in 148 B.C. and was succeeded in them by his son Micipsa, who died in 118. For the war with Rome which followed the death of Micipsa, *see* JUGURTHA.

After the death of Jugurtha, the western part of his dominions was added to those of Bocchus, king of Mauretania, while the remainder continued to be governed by native princes until the civil war between Caesar and Pompey, in which Juba I. was defeated by Caesar. Numidia in the more restricted sense became for a short time a Roman province under the title of Africa Nova, but after the battle of Actium it was restored to Juba II., who had acquired the favour of Augustus. In 25 B.C., Juba was transferred to the throne of Mauretania, including the whole western portion of the ancient Numidian monarchy as far as the river Ampsaga, while Africa Nova was rejoined to the province of Africa; together with Africa Vetus it was governed by a proconsul, and was the only senatorial province in which a legion was permanently stationed. In A.D. 37 the Emperor Gaius sent a legatus of his own to take over the command of the legion (*see* AFRICA, ROMAN). Under Septimius Severus (A.D. 193–211) Numidia was separated from Africa Vetus and governed by an imperial procurator (*procurator per Numidiam*); finally, under Diocletian, Numidia became one of the seven provinces of the diocese of Africa, being known as Numidia Cirtensis, and after Constantine as Numidia Constantina. During this period it reached a high degree of civilization, and was studded with numerous towns, the importance of which is attested by inscriptions and by the massive remains of public buildings.

The invasion of the Vandals in A.D. 428 reduced it to a condition of decay; and the invasion of the Arabs in the 8th century again brought desolation on the land, which was aggravated by misgovernment till the conquest of Algeria by the French in 1833.

Chief towns of Numidia under the Romans were: in the north, Cirta, the capital, which still retains the name Constantine given by Constantine, and Hippo Regius, the see of St. Augustine; to the south, Theveste (Tebessa) and Lambaesis (Lambessa), connected by military roads with Cirta and Hippo respectively. Lambaesis was the seat of the legion III. Augusta, and the most important strategic centre.

For account of Roman remains, *see* AFRICA, ROMAN.

NUMIDINAE: *see* GUINEA FOWL.

NUMISMATICS (from the Latin *numisma,* a coin) is the study of coins and medals. Coins were first issued in the east and west in the 8th century B.C., and since then their use has spread over the whole civilized world. Unlike many objects in everyday use, they have always been highly prized by their owners, and were therefore frequently hoarded. As is still the custom in the east, it was usual to bury treasure for safety, with the result that the contents of such ancient and mediaeval savings banks are frequently turned up by the spade to-day. Coins are themselves the most imperishable of antiquities. The result is that they still exist in vast numbers of forgotten generations out of all proportion to other remains of the culture with which they were contemporary. The study of coins may therefore be expected to yield a considerable amount of information about the past, although we must be careful not to exaggerate their importance. Coins give us some idea of the wealth and importance of ancient states and cities. A study of the find-spots of coins gives an idea of their circulation in ancient times, and it is sometimes possible to make deductions about the extent of the dominion of a particular state from this; chronological analyses of finds, by reasoning from known dates to pieces of which the dates are hitherto unknown, has often given valuable results. The argument from find-spots has to be used with care, as commercial reasons frequently explain the finding of coins far from their original mints. Thus, the frequent finds of Roman gold of the early empire in India do not show that the Romans ruled there, but corroborate Pliny's reference to the tremendous drain on Rome for gold to pay for Indian luxuries; to go to the other end of the world, the huge finds of Arab silver coins in Scandinavia were brought there to pay for furs for the wealthy Abbasids and Samanids. At all times certain currencies have acquired especial popularity and have wandered far; such were in ancient times the tetradrachms of Athens and the staters of Philip II.; in mediaeval times, the dinars of the early caliphs and the ducats of Venice, and in modern times the Mexican and Maria Theresa dollar and the English sovereign.

Commercial and economic history can thus learn much from coins; their depreciation reveals times of economic stress; the base Roman antoniniani of the third century tell their tale as readily as the inflated paper currency of Germany in 1919. The imitation of the Edward I. penny on the Continent shows how welcome a really good coin was in those days of base deniers.

Coins and medals have preserved a series of portraits which throw light on the characters of their issuers. Of particular value is the light thrown by coins on ancient religion and mythology.

As datable objects they are above all valuable as the grammar of art. Not only do they throw light on local forgotten schools and preserve representations of long-lost masterpieces, but it is from them that the chronology of ancient art has been fixed. A long series of coins of a Greek town, ranging from the archaic period to the decline of art, sets a standard of comparison which enables sculpture and other objects to be dated.

The principal metals in which coins are struck are electrum, gold, silver, copper and bronze.

Electrum is a natural mixture of gold and silver which was used for the earliest Greek coins struck in Asia Minor (Lydia) until Croesus replaced it by pure gold. Electrum was the metal of the great 5th century coinage of Cyzicus. An artificial electrum was used in the 5th and 4th centuries in Carthage and Sicily.

Gold was the great currency of Asia, of the later Lydian kings, of the Achaemenids, of the Kushans and most Indian dynasties till the 12th, and again in the 17th century. In Europe it is not found till the great coinages of Philip II., Alexander III. and Lysimachus of Macedon; in Europe we find it in the Roman and Byzantine empires and their successors till the 8th century; it was revived in the 12th century with the great commercial currencies of the Italian republics and from the middle of the 14th century became the standard of the northern countries of Europe also.

In the ancient world silver was the currency of early Greece and of Republican Rome, and of the 9th to the 14th century in Europe generally; it was the currency of the Parthians, and on the whole of the Sassanians, and of the Asiatic state of the middle ages.

Bronze or copper was the early currency of Rome and Northern Italy and of China till modern times: it first appears in Greece towards the end of the fifth century, and here as usual in its later numismatic history throughout the world was used only for small change.

Lead has only been occasionally used for coins; the only lead currencies of any note are those of the Andhras of ancient India and the modern coinages of the Malay States. Iron was occasionally used in the ancient world and during World War I in Germany. Nickel was used in Bactria, 3rd century B.C., and has been extensively used in modern currencies since the middle of the 19th century. The only prewar aluminum coinage was that for British East Africa in 1908, but it was not a success. Aluminum and aluminum-bronze were used for a number of the post-World War I currencies of modern Europe.

GREEK COINS

A coin may be defined as a piece of precious metal stamped with some mark or type or inscription showing that it is issued by some authority which guarantees its weight and purity. Coins as we know them are not older than the 8th century B.C. Traces of more primitive currencies which preceded them survived into historic times. Passing over the stage of barter, when a superfluity of one necessity of life was exchanged by its owner for another necessity of which he was in want but could not so easily supply, it is found that certain things, notably oxen and instruments of husbandry, early became standards of value and were used as mediums of exchange. Among the Romans, for example, fines were exacted in cattle down to the end of the 5th century B.C. and the etymology of *pecunia* from *pecus* shows that coined money took the place of cattle. With the passing of a pastoral civilization and the transition to an agricultural community with its multiplicity of products, a demand for some more convenient medium and for small change was felt. There is abundant evidence of the use of agricultural implements and household utensils as currency in the ancient world. In China for example the earliest coins of the 8th century B.C. are models of the spades and bill-hooks which preceded them, with the addition of a proper coin-inscription showing they were issued by authority. In pre-historic Europe there were in Gaul hoards of small bronze celts which seem to have been used for currency. The most certain survival of this coin in the Mediterranean world is the iron or bronze spit (*obeliskos*—whence the name *obol* for a small coin). Hoards of these spits have actually been found in circumstances which show that they were currency. The most remarkable of these hoards of spits is that found in the Heraeum in Argos, dedicated by Pheidon himself—whether as specimens of demonetized currency or as standards set up in connection with Pheidon's reforms or simply dedicated specimens of the usual currency is disputed; similar bundles of spits in bronze and iron have been found in Etruria. In Homer basins, tripods and axes were used as gifts and prizes in a way which shows that they were a recognized standard of wealth. With the invention of the scales these more or less clumsy currencies disappeared and the metal itself is used; a definite weight takes the place of a particular shape. In all countries from the 10th to the 5th centuries B.C. existed hoards of broken bronze or silver, sometimes shapeless, sometimes cast in the form of bricks or plates; later it is regularly in the form of bars which could be broken and weighed. There are finds of silver of this kind from Assyria of the 8th century B.C. and from Egypt and south Italy of a little later. The Egyptian finds frequently contain Greek silver coins chopped in a way which shows they were considered only as bullion. In Italy in particular rude chunks of copper (*aes rude*) were regular currency from early times to the 3rd century B.C. as is known from literary references and from finds. Caesar wrote that the ancient Britons used iron bars of a definite weight, and specimens still survive; excavations have also confirmed the accuracy of Plutarch's reference to the iron money of the Spartans.

The large oblong Roman bronze pieces with a type on either side form a kind of transition from metal bars to coins although they are not earlier than some Roman coins. In any case it is a short step from the use of metal by weight to its use in pieces of definite weights with a stamp of some kind guaranteeing it is what it professes to be, so that it can be paid without weighing; at this stage it becomes a coin. It is in this form that coinage first appears in Greece and India.

Period I. 750–480 B.C.—Ancient writers—Xenophanes in the 6th and Herodotus in the 5th century—ascribe the invention of coinage to the Lydians; the latter says they were the first to strike coins of gold and silver. This definite statement probably refers to a period after the beginnings of coinage when Croesus of Lydia struck coins of pure gold and pure silver. There is, however, evidence of an earlier coinage of Lydia and Ionia of electrum, a natural mixture of gold and silver, the "white" gold of the Greeks; these early pieces, as the finds at Ephesus show, belong to the 8th century B.C. They are little globules with a variety of stamps which suggests that they are private issues and not issues of a state authority; this early coinage is irregular in weight and quality and unsystematic in character and it is not until the issues of Croesus that there is in Asia Minor an undoubted coinage by a state authority. The types on his gold and silver coins are the same, the heads of lion and bull facing one another and reverse a double incuse square caused by the anvil in striking.

In contrast to this early electrum coinage, irregular, alike in quality, types and shape, is the almost contemporary earliest coinage of Greece proper, even the oldest specimens of which, unlike the electrum, are at once recognizable as coins to the least trained eye. These coins are of silver and capable of definite attribution. The oldest are those of Aegina, and if the not early but persistent ancient tradition which says that coinage was invented by Pheidon, king of Argos, is correct, these would be his coins. The type of Aegina is a turtle—an animal associated with Aphrodite—on the obverse, an incuse square on the reverse. That the coins of Aegina are the earliest is supported by the fact that the Aeginetic standard is the most common on the earlier coins of the islands, the Peloponnese and Greece proper. It was later supplanted by the Euboic-Attic standard, the adoption of which by Solon for Athens led to its wide dissemination. By the end of the 6th century the practice of striking coins was well established in many centres. Corinth with its *pegasi*—from their type of a pegasus—struck staters on its own standard, a variant of the Attic and began to strike not long after Aegina. It is not improbable that Periander was the institutor of the Corinthian coinage which became one of the great commercial currencies of the Greek world. The date of origin of the coinage of Athens is still uncertain; the well known types of the head of Athena on the obverse and her attribute the owl on the reverse date from the middle 6th century and are the earliest coins with a type on both sides and the earliest also to bear a human head. The exact attribution to Athens of its Solonian and pre-Solonian coins is still disputed. By the institution of the "owls," a type of coin, obverse deity and reverse an attribute of the deity, was developed which had a far-reaching effect on the development of coin-types. The head of the king on an English penny goes back to the head of Athena through the deified head of Alexander and the Britannia on the reverse similarly can be traced back to the owl. Other important towns like Thebes and trading centres like Corcyra began to issue coins about this time but a number of important towns seem to have still been content to use the currency of their neighbours. In the 6th century also are the earliest coins of Africa in the issues of the Spartan colony of Cyrene with its badge the silphium plant, the cultivation of which was its great source of revenue. Coinage was also begun by the Greek colonies in south Italy and Sicily; these latter are of a characteristic fabric. Instead of the thick dumpy piece with a type on the obverse only and an incuse square on the reverse which are common to the cities and islands of Greece, these are broad thin pieces with the type struck on both sides, in relief on the obverse, incuse on the reverse. There still exist many coins of this type of Tarentum, Metapontum, Croton, Rhegium, Zankle (Messana), etc. By the time of the Persian Wars coinage was a familiar feature of everyday life in the cities of the Greek world. Traders and colonists had carried the art to Cyrene in North Africa from Sparta, to south Italy from Corinth, and to Sicily from Athens and the Peloponnese. In Asia Minor also coinage spread southward and had reached Cyprus but not yet Crete. The Phoenicians and Egyptians were already familiar with Greek coins but did not

attempt to copy the invention; in the north however the silver mints of Thrace and Macedon were beginning to be worked vigorously and not only the Greek cities but the barbarian tribes, also, who employed Greek legends on their coins, were actively striking.

The various coinages of this early period (down to 480 B.C.) have a number of features in common. One of the most remarkable to the modern eye is the absence of inscriptions; these are either non-existent or consist only of the initial letter or letters of the town issuing the coin. The device of the town was originally sufficient for local circulation but as coins began to go further afield it became necessary to add some indication of its name. The earliest coin legends are therefore very brief: a *koppa* for the initial of Corinth, a Φ (*phi*) for Phocaea, Σ Γ (*Su*) for Sybaris, ΑΘΕ for Athens, and so on. The earliest inscriptions of any length are still written from right to left. Long inscriptions like "I am the badge of Phanes" above a stag on an archaic coin of Ephesus or "the stamp of Gortyna" on an early coin of the Cretan mint of Gortyna are remarkable exceptions and important as showing the original nature of inscriptions and of the types themselves. They show that the genitive, which is the usual form of the name when written in full, although nominatives are not very rare, is explanatory of the type.

Types.—The types in the early period are mainly taken from the animal world; they include domestic—particularly the bull—wild animals, birds and insects (the bee at Ephesus); fabulous creatures are also common like the griffin at Abdera, the pegasus at Corinth, the Chimaera, etc.; the vegetable world is also represented, notably by the silphium plant at Cyrene. Representations of the human figure are rarer and later than other types to appear, but once the human head became established as a coin-type, its use spread rapidly and widely and with the disappearance of the incuse square and coming of the double typed coin a head began to be regularly used as one of the types. Complete human figures are rare and are represented either kneeling or standing, both very stiffly like the Poseidon at Poseidonia; the nymph and satyr or centaur common in Thrace hardly deserves the name of a group; elaborate compositions like the Hercules and Hesperides at Cyrene and the flight of Aeneas at Aeneia are quite unique.

With the coming of legends on coins it was no longer necessary that the main type should be the badge of the town, which is frequently relegated to the reverse or becomes merely a symbol or disappears altogether to give the artist a subject more worthy of his talents. Except in the doubtful case of the earliest electrum, coinage was always a matter for the ruling authority whether civic or regal and the earliest types are chosen to show who these are. That coinage was early recognized as too important a right for private ownership is seen from the traditions which associate all the great lawgivers, Pheidon, Solon and Lycurgus, with the institution or improvement of coinage. The sanctity of the republic's right of coinage is seen in the coinage of cities ruled by tyrants, who never put their name or other indication of their existence on the coins, although they occasionally made alterations in the types, as when Peisistratos added the head of Athena to the Athenian coins or when Anaxilos of Rhegium introduced the mule-chariot type in memory of his Olympic victory.

The early types are generally chosen from simple motives. Many of them are a punning allusion to the name of the town like the lion at Leontini, the seal at Phocaea, the goat at Aegae or the quince at Melos, or the sickle-shaped harbour at Zancle. Sometimes it is chosen from the history of a town like the figure of the mythical founder Taras at Tarentum or the Minotaur and Labyrinth at Cnossos. Types like the ear of corn at Metapontum allude to the fertility of the country about. Thrace and Macedon are notable for their huge silver octodrachms with the type of a local hero in a chariot drawn by two bulls. In Italy, Croton takes as its type the tripod of Apollo like its mother city Zacynthus. Poseidonia has a statue of Poseidon brandishing his trident. Naxos in Sicily, whose founders came from Naxos in the Aegean, has a head of Dionysos who was born in the Aegean island. Himera has a cock, a punning allusion to the name of their town for the cock proclaims the dawning of day (*hêmera*). Selinus has another punning type, the wild parsley leaf (*selinon*). Toward the end of the 6th century B.C., Syracuse introduces the celebrated type of the head of Arethusa, the nymph of a spring in Ortygia, which was in the next century to become the most famous of Greek coin types. The reverse, a victorious chariot, became a popular one in other towns. The finest specimen of this type of late archaic style is the *Demareteion* commemorating the victory over Carthage in 480. The head of Arethusa on the obverse wears the laurel wreath of the victorious and beneath the chariot on the reverse is a lion, the emblem of conquered Africa. This type of obverse spread throughout Sicily; the main types of Sicilian towns in the 5th century are local nymphs and river gods. At Catania we have the river god Amenanos; Gela has a manheaded bull swimming, a personification of the river Gelas.

Period II. 480–336 B.C.—The finest period in Greek coinage begins after the Persian Wars and runs to the accession of Alexander the Great in 336 B.C. The first half of this period is transitional and is marked by a great advance in technical skill, an increased delicacy in the treatment of details and greater freedom of movement in the treatment of the human figure. In the last eighty years of this period the art of engraving coins reached the highest standard it has ever attained: the head of a divinity is now established as the obverse type and is usually represented in very high relief—many of the finest are shown facing; the engravers sign their coins which show that they were artists of note and not mere artificers: the names of great artists otherwise unknown have been thus preserved. The types are very varied and almost entirely based on local mythology, although latterly the fine bigae and quadrigae types became popular in allusion to Olympic victories. The type first introduced in Athens—obverse head of a deity and reverse badge of the city—grows increasingly popular and towards the end of the period is almost regular. Inscriptions become general although still frequently contracted. The period is marked by a geographical extension of coining and an increase in its quantity; with the decline of the Persian empire, the cities of Asia Minor, Phoenicia and Syria show an increasing activity; the opening of the mints of Emporiae in Spain and Messalia in Gaul bring the art of coinage to the other end of the known world. Towards the end of the period the rise of Macedon under Philip II. led to the closing of many mints in northern Greece, and his coinage foreshadows the great imperial coinages of Alexander the Great. The second half of the 5th century witnesses a great expansion of the monetary influence of Athens at the expense of her allies.

The coinage of the period is mainly silver; the Aeginetic standard gradually yields to the Attic: electrum disappears except at Lampsacus and Cyzicus and sporadically at Syracuse and Carthage. Gold is continued in the darics of the Persian kings in the east and in the fine series of Lampsacene staters; with the decline of Persian power the Great King's monopoly of gold was usurped by various rulers in Cyprus and Caria. The late 5th and 4th century gold coinages of Syracuse, Tarentum and Cyrene are extensive. Toward the end of the period we have the institution of Philip II's gold stater, the first great gold coinage of the world. In the latter part of the 5th century the first copper coins were issued and soon replaced the infinitesimal small silver coins which had hitherto served as small change.

The greatest commercial currency of the 5th century was the silver coinage of Athens, as contemporary references and the huge finds still made all around the Mediterranean show. It was imitated in Central Asia and Arabia which shows the extent of its penetration. The Corinthian stater continued to be an important coinage although its circulation was more limited. The same is true of Cyzicene staters: these great currencies remain more conservative than their contemporaries which are not affected by the same commercial considerations; care is taken to avoid the slightest change, hence the long survival of the now obsolete *koppa* on the coins of Corinth or the archaic use of E for H at Athens.

The feature of the period is the development of the general type—head of a deity on obverse and reverse, the badge of the city—which usually has some reference to the deity also. We find

the latter prevailing in time so that when the old type has no reference to the deity chosen, it is dropped. The gradual abandonment of these old types gave a freer choice to the artist and the simple figures of animals, plants, fabulous animals, etc., give way to mythological groups. Symbols begin to appear on coins and are usually the marks of magistrates or otherwise mark the issues and change constantly. Occasionally we find the old badge of the town relegated to a subordinate position, like the tunny fish at Cyzicus. Names of towns and magistrates are written at greater length and those of artists begin to appear. Types are occasionally labelled like the Zeus at Locri Epizephyrii or the Ajax at Locri Opuntii.

Predominance of Athens.—The causes of the predominance of Athenian currency were firstly the development of rich silver mines in Laurium in the beginning of the 6th century, which provided the money to build the ships which defeated the Persians at Salamis in 480 and secondly the prosecution of her policy of prohibiting silver issues by any city or state that came within her power, whether as tributary or as a member of the alliance in which she was the predominant partner. The members of the Confederacy of Delos while nominally retaining their monetary rights bowed to the practical advantages of a common coinage—which was that of Athens. The fine quality of its silver, the accuracy of its weights and its numerous subdivisions made the Athenian tetradrachm welcome everywhere so that Athens gained the monetary hegemony in addition to the political. In 453 Aegina became tributary to Athens, which at once put a stop to the issue of the "tortoises" and the stater of Aegina practically disappeared from the international market where it had so long competed with the "owls." Eretrea on its conquest in 445 lost its right of coinage as did its neighbour Carystus. Tenos, Naxos and other Aegean islands also ceased coining. In Asia Minor, Miletus, Cnidos and other tributaries of the Confederacy issued only small change.

One notable exception is that of Melos, which had refused to enter the League and therefore could still continue its staters. Samos and Lesbos kept up their issues but they were allies of equal status to Athens; Ephesus which entered the Confederacy in 469 continued to coin silver till 460, but there was seemingly some special arrangement in this case. Aeolis, Mysia, and Troas only struck small change. Several towns of the south coast of Thrace, like Abdera, continued their coins but these with their different standards did not compete with those of Athens in the markets of the Aegean. Phocaea, Mytilene and Cyzicus continued their electrum in the 5th century but their silver ceases. The Athenian tetradrachms thus became predominant in the Aegean and beyond, completely ousting local currencies. If we occasionally find autonomous staters, it is a sign of rebellion or shows that the town in question entered the League with special reservations. With the first news of the disasters in Sicily a general defection began and the days of the economic supremacy of Athens were soon over. The Spartans seized the mines of Laurium in 413 and cut off the supply of silver. In 407 Athens was reduced to such financial straits that the gold statues of Victory from the Parthenon were melted down for an emergency coinage; in the next year she had to have recourse to a coinage of bronze which had an unfavourable reception as it could not, like the infinitesimal silver pieces, be carried in the mouth. After being almost extinct, Athenian coinage revived after Conon's successes in 394. On the formation of the second League against Sparta, her allies however struck coins on equality with Athens and used a common type of the infant Hercules with their own reverses and their own standards. Such staters are known of Ephesus, Cnidus, Rhodes, Samos, Cyzicus and other islands and towns of Asia. This diversity of standard in the League shows that there was no monetary convention. Among the rising coinages of this period one of the chief was that of Rhodes founded in 408. Its silver and gold coins have the punning type of the rose and head of Helios. Rhodes had its own standard and its rapidly increasing commerce spread its coinage and standard quickly in the Mediterranean. In 376 Athens regained its hegemony over the islands but for a generation only. Its coinage again became abundant but never regained a predominance over the numerous local coinages which had sprung up since the end of the 5th century. In addition to Rhodes the important mints of Amphipolis and Larissa begin to issue their beautiful coins and many smaller towns open their numismatic history. The ancient coinages of Samos and Chios disappear before Athenian vengeance in the middle of the 4th century but other towns of Asia and the islands, Cnidos, Ephesus, Tenedos, and notably Cyzicus, testify in their coins to the great prosperity which their autonomy brought them. Corinth and its colonies continued to issue their staters of the old types uninterruptedly up to their conquest by Philip II. and even then did not lose the right of coinage. With this exception however the great revival of autonomous coinage in the early 4th century was short-lived. Philip II. became politically supreme, and economically his gold and silver mines enabled him to drive the gold of Cyzicus and the silver of Athens from the market, but the Attic standard was to survive in the tetradrachm of Alexander. In 404 the people of Aegina after half a century of exile returned to their homes to resume the issue of their celebrated staters but replaced the turtle of the obverse by a tortoise.

The 5th century saw the beginning of one of the finest and most interesting series of silver coins, that of Elis. From about 471 when Elis became a city to its conquest by Macedon in 322 the staters form a continuous series. The whole land was sacred to the Olympian Zeus and his symbols, the thunderbolt or eagle clutching its prey, are usual types along with a Victory in various attitudes—running to crown a victor, standing or seated with outspread wings—the latter type was copied by Pistrucci for the Waterloo medal in 1815. At a later period the head of Zeus appears as does that of Hera and also the fine head of the nymph Olympia. The legend is always FA for (F)*aleion* and the long obsolete digamma survived to the end of the coinage in the middle of the 1st century B.C. The types and the additional legend *Olympikon* occasionally found show a close connection with the Olympic games which the Eleians claimed to control. There is an interesting numismatic record at Pisa of the successful effort on the occasion of the 104th Olympiad by the Pisatans to regain their ancient right of controlling the games which they had lost when the Eleians destroyed their city in 572 B.C.

Italy and Sicily.—It is in the west in Italy and Sicily that work of the finest period is seen in greatest profusion. In Italy, Tarentum, the capital of Calabria, continued its type of Taras on a dolphin on its silver. In the middle of the 5th century the agonistic type of a horseman appears and Taras is relegated to the reverse; the celebrated Tarentine cavalry are thus commemorated down to the middle of the 4th century. About 340 Tarentum issued a series of very beautiful gold coins with a head of Persephone and, reverse, the infant Taras appealing to Zeus enthroned. These gold coins, like sudden issues of gold elsewhere, were really a money of necessity.

In Lucania, Heraclea, founded in the middle of the 5th century, issues fine staters with a helmeted Athena and Heracles seated, strangling, or wrestling with a lion. Metapontum interrupts the monotony of its ear of corn type with a most striking head of its founder Leucippus. Other mints of the time are Neapolis, with its types the siren Parthenope and her father, the manheaded bull Archelous; Velia, with its head of a nymph and reverse the eastern type of a lion attacking a bull; Thurium, with its unusually fine head of Athena and the powerful bull on the reverse, and Terina, remarkable for its beautiful treatment of the Victory type.

It is in Sicily, particularly in Syracuse, that the engraver's art reaches a perfection never attained elsewhere before or since; from the middle of the 5th to the middle of the 4th century every coin is the work of an artist. In the 5th century Syracuse began to dominate the politics of Sicily as Athens was doing in the Aegean, and her artists spread the influence of her coin-types everywhere. The coins of Syracuse showed many varieties of the heads of Arethusa and Persephone and the chariot of the reverse was found capable of very varied treatment. After the middle of the 5th century her artists began to sign their work and we

can thus prove, what is frequently obvious, that other towns borrowed engravers from Syracuse. The Syracusan coinage is mainly silver. During the siege by the Athenians, beautiful little gold coins were struck with reverse Hercules strangling a lion. With the prosperity following the enemy's defeat, Syracusan art reaches its zenith. As the *Demareteion* commemorates the defeat of the Carthaginians, so the great series of decadrachms perpetuates the victory of 412. The agonistic types and word *athla* on some of them show that they were distributed at the games held to celebrate the victory; their types were widely copied and their engravers, Kimon and Euainetos—otherwise quite unknown—have gained a place among the world's greatest artists. In the 4th century the coinage becomes somewhat stereotyped and has no longer any originality. We may note the issues of electrum by Dion in 357–353 and of gold by Timoleon, who introduced the Pegasus type from Corinth on his coinage.

Among other cities of Sicily we may note the fine series of Agrigentum of the 5th century with its beautiful double eagle type and the Camarina type of the river god Hipparis and the nymph Camarina on a swan. Himera before its destruction in 408 issued some very interesting types, such as the nymph Himera sacrificing while Silenus beside her bathes at the thermal spring for which Himera was noted; or Pelops in his chariot, referring to a victory of a Himeran at the Olympic games which Pelops is said to have founded. Segesta, Eryx and other cities already Carthaginian use Greek types and artists but have Punic legends. The nymph Segesta and the river god Crimissos are the best types of Segesta while Selinus abandons its parsley leaf and issues a number of very remarkable types, notably that of Apollo and Artemis in their quadriga with reverse the god Silenus sacrificing at an altar, a type which refers to the cessation of the plague as a result of appeals to Apollo as healer. In conclusion we may mention the wonderfully realistic Silenus with his wine cup at Naxos.

Period III. c. 336–c. 100 B.C.—Alexander's conquest considerably extended the sphere of Greek influence and in this period there is a further extension of coinage. Egypt, hitherto coinless, now produces the richest series of the Hellenistic period. Bactria and Parthia, too, strike Greek coins. Spain and Mauretania begin to issue coins; in the north the Gauls, Britons and Germans begin early in the 2nd century to imitate Greek coins and soon learn to strike more independent issues. The influence of Alexander's coins is decisive in the coinages of his successors in their different kingdoms. Only a few free towns strike their own silver and even they tend to use Alexandrian types. The period produced a number of coins of alliances like the Achaean and Thessalian leagues. In the west the gradual advance of Rome is reflected in the coinages; local silver ceases earlier in Italy and Sicily than in Greece and Asia.

The accession of Alexander the Great in 336 inaugurates a new epoch in coin types. The main feature of the period from his accession to the conquest of Greece by Rome is the final establishment of the portrait coin as the regular type of a currency and the great preponderance of regal issues.

The portrait of a living monarch took nearly a century to establish itself on a coin. Philip II and Alexander the Great issued vast coinages throughout the ancient world but were content to put their names alone on the coin—latterly Alexander added the title "Basileus." After his death his deified portrait appeared on the coins of Lysimachus in Thrace and on the early coins of Ptolemy I in Egypt. It is not till 306 that we have a portrait of a living king on his coins when Ptolemy I appears, still as god with the aegis of Zeus. Seleucus I similarly puts himself on his coins as Dionysos; in time the divine attribute is dropped and the ruler appears as a mortal wearing only the royal diadem. In Macedon Arrhidaeus, Cassander and Antigonos still follow the types of Alexander, and the early coins of Demetrius Poliorcetes (306–283) are without a portrait. Soon, however, his own portrait appears, still with the horns that deify him. His successors have only types of deities. Pyrrhus does not appear on any of his extensive coinages but the last two kings of Macedon, Perseus and Philip V, have left very fine portraits. The kings of Pontus, notably Mithridates VI, have a magnificent series of portraits. The kings of Pergamon use the same portrait throughout, that of the founder of the dynasty, Philetairos I, and the Ptolemies in Egypt throughout their long series use only the head and legend of Ptolemy I, except on certain special issues. Among the early Seleucids Antiochus I was reluctant to drop the portrait of Seleucus I, but the portrait of the reigning monarch becomes the rule in this series; farther east we have the long series of portraits of the Arsacids and the unparalleled series of Bactrian and Indian kings. The smaller series of Persis gives some portraits, but they rapidly become stereotyped as do the coins of Elymais and Oman. The Jews, with that strict interpretation of the second commandment as is later the case among the Arabs, have no portraits, but the Nabathaean kings have.

The reverse types also show the influence of Alexander; seated deities become common and go back to the Zeus on the tetradrachms of Alexander, or standing deities which go back to the Nike on his gold. The Seleucids have commonly a seated Zeus or Apollo. The Parthian series is unusual—the reverse shows the king seated, (perhaps) Arsakes I, the founder of the dynasty, treated with the respect due to a deity. The king's name remains on the reverse in keeping with its development as the successor to a town name and does not yet appear alongside of the portrait. The ancient world did not know the custom of numbering kings of the same name; they are as a rule sufficiently distinguished by their epithets.

After the vast issues of gold by Philip II, Alexander and Lysimachus, gold is but rarely struck, except in Egypt. Silver is the general metal of coinage and the Attic standard, which Alexander had adopted for his tetradrachms, became the monetary standard of the world, except in Egypt; there is a great increase in the bronze coinage, the local issue of which does not seem to have been seriously restricted by sovereigns and suzerains.

As the greater part of the Greek world was now ruled by the Diadochi, their various coinages naturally formed the main currencies of commerce. A number of civic and other coinages still survived however. Third-century Athenian coinages are scarce except in bronze; occasionally as in 296 the issue of gold shows the straits to which the once wealthy city was come. In 229 when Macedon lost its supremacy over Athens and friendly relations were established with Rome a new era begins with the abundant issue of tetradrachms of the "new style" which went on for two centuries. The Athena of these coins is not the old one but a copy of the head of the Parthenos of Phidias and the owl on the reverse is now perched on a Panathenaic amphora. The ΑΘΕ still remains but a number of new legends and symbols are added to the reverse chronicling a long series of magistrates. Much light is thrown on the organization of the Greek civic mints from these names and symbols. The other great coin issuing city, Corinth, went on striking its stater till 229 when by its surrender to Doson the long series came to an end.

Rise of Rome.—The Roman conquest of Greece is reflected in the coinages. When the Romans overthrew Philip V in 197 or Perseus in 168 they professed to be restoring the liberties of the Greeks and it is clear from the resumed activity of the mints that the Greek cities were autonomous in one respect at least. After the defeat of Philip V the Thessalians formed a confederation with silver coins of the type of Zeus and Athena and the legend *Thessalōn;* a similar coinage was issued by the Boeotians. With the final overthrow of Macedon at Pydra in 168 begins the extensive issue of tetradrachms of Maronea and Thasos which became a great commercial currency for trade across the Danube with the barbarians, who continued to imitate them. Macedon itself as a Roman province issued tetradrachms bearing the names of Roman governors. In Asia after the defeat of Antiochus III at Magnesia we have an outburst of tetradrachms of Attic weight and local types at towns like Lampsacus, Smyrna, Magnesia and many others. Other cities similarly resumed the issue of Alexander tetradrachms, adding a small symbol to mark the town of issue—Miletus, Samos, Rhodes and many other Asiatic cities. These Alexander types continued down

to the middle of the 2nd century when the Roman province of Asia was set up and the *cistophori* replaced them. The first *cistophori*, so called from the Dionysiac chest which formed the principal type, were first struck at Ephesus at the end of the 3rd century; the reverse is a bow in quiver between two serpents. The Pergamene kings popularized them and the Romans thus found it easy to substitute them for the Alexandrine tetradrachms with their undesirable associations. *Cistophori* were now struck in many Asiatic mints and bear the monogram of the town of issue. The last stage in the Roman conquest of the east was the defeat of Mithridates and those towns that had assisted him had their coins replaced by *cistophori* with the exception of Athens which obtained favoured treatment. The fact that Rhodes resisted Mithridates and assisted Sulla enabled its autonomous silver coinage to survive down to the Civil War:—it was the last autonomous coinage of Greece.

In the west the rise of Rome in the 3rd century introduced a new factor into the history of Greek coinage. The first coinage to disappear was the Etrurian after a life of two centuries. Rome's early intercourse with the Greek cities of Italy is reflected in the Romano-Campanian coinage. In the south the Italian campaign of Pyrrhus left its mark on various coinages, notably at Tarentum which also has some exceptional numismatic records of Hannibal's occupation. The towns of Magna Graecia gradually lost their silver coinage under Roman influence although their bronze lasted till the 1st century.

In Sicily in the 3rd century Syracuse began to dominate the whole island in coinage as well as politically; the types are mainly imitations of those of the 5th and 4th centuries; the coins of the other towns have little claim to originality. The Punic Wars brought the Romans to Sicily where the Carthaginians had been established since the end of the 5th century and had struck coins of Syracusan and other Sicilian types with Punic legends and later with their own types. When Syracuse fell to Rome in 210, Sicily became a Roman province; henceforth only bronze was struck in it; these local coins continued into the first century, when the last trace of Greek coinage in the west disappears.

Period IV. c. 100 B.C.–A.D. 268.—Under the Romans many Greek cities and districts continued to issue their own bronze coins but the geographical area over which this was done became considerably restricted under the empire. In the west—Italy, Gaul, Spain and North Africa—the right of coinage was abolished quite early in the empire, the latest local issue of these regions being a coin of Babba in Mauretania of the reign of Galba. In the east, particularly in Asia, these local bronze coinages went on down to the time of Gallienus in 268, when the complete depreciation of the Imperial silver coinage, now bronze washed with silver, made the issue of bronze for small change pointless. The language of the inscriptions is Latin in the west and Greek in the east—with a few exceptions in the latter case. The Imperial gold (solidus) and silver (denarius) became the main currencies throughout the Roman empire.

Before dealing in general with the bronze of the Greek cities, we may note one or two local subsidiary silver coinages issued by the Roman emperors in continuation of important pre-conquest coinages. The largest series of these was the Egyptian or Alexandrian series which runs from Augustus to Diocletian. In addition to bronze, this series at first included tetradrachms of billon of gradually decreasing fineness, which continued the tetradachms of the Ptolemies; later it is of bronze only. The legends are always in Greek; the coins bear the emperor's head on the obverse and the reverse types are at first usual Roman types but after the end of the first century begin to include native Egyptian types in increasing numbers, often of peculiar interest. The reverses are dated in regnal years in Greek numerals. From the reign of Claudius II. there is only one denomination, a small thick bronze piece originally coated with silver, which is probably still the commonest of all ancient coins. The earlier bronze which occasionally, although not generally, rival the work of the Roman mint have in the 2nd century a characteristic bevelled edge.

In Syria silver tetradrachms continued to be struck, mainlv at Antioch but also at Tyre and a few other mints. These gradually became baser in the course of the early third century. Copper was also struck by the Romans at these mints and frequently bears the letters S C showing that this issue, as in Rome, was the prerogative of the Senate. Of several other local silver coinages the large series of drachms struck at Caesarea in Cappadocia from Tiberius to Commodus is the most important. The usual type is a local one of Mount Argaeus but common denarii reverses are also found.

A number of vassal states and protectorates continued to issue their own coinages in the precious metals until they became Roman provinces. The only gold coinage of this kind is that of the kings of the Bosporus who struck coins from the time of Augustus to the beginning of the 4th century with the Roman Emperor's head on one side and the local dynast's on the other. This coinage becomes gradually debased, passing from gold to electrum then to silver and billon and ultimately to copper in the 3rd century A.D. At the other end of the world, the kings of Mauretania continued to strike their own gold and silver until it became a Roman province in A.D. 40.

Bronze Coinage.—We now come to the regular series of Imperial Greek bronze coins which close the thousand years of Greece's numismatic history. They have no claim to artistic merit and are of local workmanship; therein they form a contrast to the regular Roman coins of the time which frequently attain a very high level. If they are devoid of artistic interest they have a very high historical and archaeological value.

The right of coinage is sometimes continuous and sometimes intermittently permitted by the Emperor or governor. Sometimes the right is held alternately by pairs of towns as in Moesia by Marcianopolis and Nicopolis. Coins are struck not only by single towns but jointly by alliances of towns (*homonoia*).

The general type is everywhere the same; obverse a bust and reverse a type of local interest. Under the Republic the Greek cities usually placed on the obverses of their coins an allegorical bust,—that of some local hero or of the "people" the "Senate" or the local city-goddess. The People (*Demos*) in Asia Minor is usually personified as a young male bust; the municipal council (*Boule*) and the Senate (*Sunkletos*) appear as young veiled females. The Tyche of the city appears as a female bust wearing a mural crown. The goddess Roma is found as a helmeted female, *e.g.*, at Smyrna. Pergamon and other towns of Asia Minor have Poseidon. Athena, Apollo and other well-known divinities are also found on the obverses.

Under the empire the usual obverse type is the head of the Emperor as on the regular Roman series. There are some notable exceptions. Macedonia for example had the head of Alexander the Great. Athens was privileged by Hadrian to use the head of Athena in place of the Emperor's. These are exceptions; the usual type is the bust of the Emperor and the obverse legend gives his name and titles in Greek, usually transcriptions or translations of his Latin titles, with occasionally some local allusion. The reverse type is reserved for the town of issue and the date when given is in a local era. The name of the town is in the genitive plural of the ethnic, very frequently with the addition of some proud epithet, of more or less significance. These epithets are of various kinds; many refer to the emperor either to flatter him or in memory of some benefit received. Some recall the origin of the inhabitants; Blaundus in Lydia, for example, calls itself Macedonian because it was originally a colony of Macedonian soldiers. Very favourite adjectives are "autonomous" and "free" but the most highly prized is that of *Neokoros*, which in Imperial times signified that the town had built a temple in honour of the Emperor. Ephesus for example proclaims in the reign of Caracalla that it had built 3 imperial temples. Capitals of provinces call themselves *Metropolis;* the title "first city" of the province is also highly prized and occasionally disputed, as we see from the coin-legends of Nicomedia and Nicaea in Bithynia or of Smyrna and Ephesus in the province of Asia. Towns in Phoenicia and Syria which had a temple with the right of asylum call themselves *ἱερά καὶ ἄσυλος*; a number of maritime towns bear the title *ναυαρχίς* officially granted them by the emperor in recognition

of their naval importance. Damascus calls itself "illustrious," Syedra "brilliant," Nicaea "greatest and best" and there are many such empty titles.

Besides the ethnic these coins very often bear the names of magistrates and other officials; in the early years of the empire these include a few governors and other officials sent from Rome, some of whom even have their portraits on their coins, like the younger Cicero at Magnesia. But throughout the series the names and titles of local magistrates are vastly more common. These throw a good deal of light on local life and administration.

It is the reverse types of this series of coins that give them their importance. The coins of Athens preserve representations of many statues famous in antiquity which have long since perished such as the Athena Parthenos of Phidias, the great Athena Promachos on the Acropolis visible far out at sea, or the Dionysos of Alcamenes. A coin of Elis preserves for us the Olympian Zeus of Phidias and Lacedaemon the Apollo of Amyclees. Local cults are everywhere illustrated and incidents in the lives of all the divinities of Greek mythology are common types. Not only do we have gods and goddesses but also all kinds of local deities like river gods and nymphs. Local celebrities are also recorded; thus we have Homer at several of the various towns that claimed him as a native notably Smyrna, Anacreon at Teos, Sappho at Eresos in Lesbos, Herodotus at Halicarnassus, Alcaeus at Mytilene which records on its coins a whole series of its famous men, the majority of whom are not otherwise known. Not only are famous Greeks commemorated; the travels of Hadrian in the provinces led to the issue of many specially fine coins, some of which bear the portrait of his favourite Antinous.

Agonistic types are very numerous on account of the great part played by games and festivals in the life of the time. Their celebration is frequently recorded on coins; sometimes we learn that the town was not able to bear the expense and that officials or private individuals were ready to bear the expense in return for the honour of presiding and this is duly chronicled. In addition to the four great Hellenic Games we find many of more recent origin instituted in honour of the Emperor, like the Actian games in honour of the victory of Augustus at Actium, celebrated at Tyre and other towns, the Philadelphian in honour of Caracalla and Geta at Nicaea, etc., or in honour of local deities like the Panathenaic at Athens, or the Heraclean at Perinthus commemorated by a series giving the labours of Hercules. When two or more cities combined to have a joint festival, this is commemorated by a joint issue of coins. In conclusion we may mention a notable example of the preservation of a local tradition on a Greek imperial coin. On a coin of Septimius at Apameia in Phrygia we have as reverse type a man and woman in a chest or ark floating on water with a raven on the top and a dove flying above with a branch in her beak; to remove any doubt as to what scene is represented the ark is labelled NΩϵ and the coin is evidence of the local tradition that the ark rested on the mountain behind Apameia.

ROMAN COINS

It was comparatively late in her history that Rome emerged from obscurity and became a great city. The adoption of a coinage was one of the most significant signs of the change. In very early times Rome had reckoned values in oxen and sheep, hence the word *pecunia* (money), from the same root as *pecus* (head of cattle). Later she began to use bronze as a means of payment,—but as yet only in rough, unstamped lumps (*Aes rude*), not as coins. The later tradition represents her as ridiculously poor in the precious metals, and the little that we know confirms it.

The exact date at which Rome passed on to the use of metallic currency is subject to some doubt. It is certainly not earlier than 338 B.C. (the date proposed by E. J. Haeberlin), and a strong case can be made for a date rather later. The Roman authors, who attributed the innovation to the king Servius Tullius, had no real knowledge of the facts. The first pieces issued were heavy cast coins of bronze (*Aes Grave*) representing the As, the unit, a pound of bronze and its subdivisions—semis, ($\frac{1}{2}$), triens ($\frac{1}{3}$), quadrans ($\frac{1}{4}$), sextans ($\frac{1}{6}$), uncia ($\frac{1}{12}$)—a cumbrous coinage that needed wagons to transport it. It seems to be a clumsy attempt to apply the Greek institution of coinage to the bronze system of Italy. But very soon afterwards silver also was issued in the Roman name; its superior convenience was soon felt and, after the First Punic War at latest, it ranked as the chief metal in the Roman market.

The earliest Roman silver coins were didrachms struck on a standard familiar in Campania and issued in part at least in that district. They are coins of a normal Greek pattern and with the small token bronze that accompanies them, were clearly meant to circulate in districts accustomed to Greek coins—that is to say in Campania and its neighbourhood, Lucania and Bruttium and to some extent Samnium and Apulia. The coinage, whether we regard it as primarily military or commercial, certainly arose in the course of the great wars, which ended in making Rome supreme in Italy by about 270 B.C. It represents one result of the closer contact of Rome with the Greek south.

The *Aes Grave,* to a large extent, runs in series parallel to the silver, but can hardly have circulated in the same districts. It is simplest to regard it as the counterpart of the silver coinage, issued for Rome and her Italian allies, in North Italy, Latium, the Sabine country and, to some extent, Samnium and Apulia. As Haeberlin has demonstrated, Rome's first system of coinage is a dual one: it is only unified, when the more cumbrous Italic system yields to the Greek. Our knowledge of details is as yet very imperfect. There are variations in the weight of the *As* or pound, which do not answer to any obvious explanation; there is a reduction in the weight of the didrachm, which may or may not be due to inflation in the Pyrrhic War. We do not know how the didrachm and the As were related. Fortunately, the historical meaning of the coinage is clear. Rome began to open her doors to Greek ways and she was soon followed by her colonies in the South—Cales, Suessa, Teanum, which struck didrachms like hers—and by other colonies, in districts less Greek, which cast *Aes Grave*—Hatria in Picenum, for example, and Luceria in Apulia, or by independent cities such as Iguvium and Tuder in Umbria.

It was under the strain of the Punic Wars that Roman Republican coinage assumed the form in which we know it best. The denarius, traditionally assigned to 269–268 B.C., replaced the didrachm as the main Roman silver piece; it was equal in value to 10 asses, while its half, the quinarius, equalled 5, its fourth, the sestertius 2½. The As, originally a pound in weight, was reduced to about 5 oz.; then by slow descent to little more than 3 oz., again to 2 oz. and finally to 1 oz. Gold was issued on two separate occasions, as an emergency coinage—once in 217 B.C., once perhaps earlier. One fact, which has been obscured by modern writers, is the issue of *Aes Grave,* with the reverse type, in great masses during the First Punic War; Rome was short of silver and fell back upon her native Italian bronze and the strain of the war led to inflation, expressed in the reduction of the weight of the bronze unit, the As.

By the end of the Second Punic War Roman coinage had assumed its lasting form. The denarius was without question the master coin. Second to it in importance came a second silver piece, three-fourths of it in weight, the "Victoriate" or "Victory coin," struck for foreign trade in the Western Mediterranean, South Italy and the Adriatic. It may only have been introduced just before or during, the Second Punic War. The As, now reduced to one ounce, was a tenth of the denarius in value. Pliny has recorded a change of tariff to sixteen to the denarius in the Second Punic War, while admitting that the value of ten to one still held in the pay of the soldiers. As the coins themselves only show the new value much later, we are uncertain how far Pliny can be trusted. There was no gold coinage except in case of emergency.

The political supremacy of Rome in Italy afterward found expression in the supersession of all other Italian coinages, except a few of token copper in the South, by the Romans. This change did not take place very early or all at once—and favoured allies, such as Naples or Velia, probably coined in their own name longer than the Latin allies, with their closer bond with Rome: it was

probably hardly complete before the end of the Second Punic War.

In the great period of expansion after 200 B.C., denarius and victoriate went out to conquer the markets of the world. In the West progress was rapid, but the East, with its abundance of coinage, offered a successful resistance. Rome in her Eastern wars learned to use Eastern currencies, gold staters of Macedon and silver tetradrachms of Athens or Asia, and brought them into her own service: it was thus that she could dispense with any gold coinage and be content with a silver piece of less value than a shilling. About 135–130 B.C. the value of the denarius was raised to 16 asses, in place of 10, and, after a period in which the two values conflicted, that of 16 won the day (*c.* 100 B.C.). The great Social War of 91–89 B.C., when the Italian allies almost overthrew Rome in their eagerness to share her citizenship, led to confusion and inflation. The policy of the Gracchi, with its demands for land settlement and foreign colonies, had necessitated great issues of money, and, as early as 122 B.C. the senate had begun to inflate, by issuing base, plated denarii among the good ones. This policy was now vastly extended: the silver became so mixed and impure, that no one could tell what he really possessed. To add to the confusion the As was reduced from 1 oz. to ½ oz.; and, finally, in 87 B.C., the state declared itself bankrupt by ordering that all debts should be cleared at five shillings in the pound (*quadrans* for *As*). A praetor, M. Marius Gratidianus, attempted to find a remedy by sorting out the good denarii from the bad: at the same time, a new coinage of pure silver (theoretically pure, at least) was issued. Sulla, however, on his return and triumph, butchered M. Marius and annulled his policy, insisting that the money of the state must be accepted at its issue value: but, in future, the senate used its powers with strict moderation. The bronze coinage was allowed to sink into the background. The only further development of the Republic was the introduction of a permanent gold coinage by Julius Caesar, after previous experiments by Sulla.

The control of the coinage was in the hands of the senate, acting for the sovereign people; major changes had to be sanctioned by the passing of special laws. The responsibility for the striking of coins was normally entrusted to a special commission of three, "tresviri aere argento auro flando feriundo," but also, if less commonly, to other officials, such as quaestors or curule aediles. Roman coins were issued not only at Rome, but also at other mints in Italy and, later, in the provinces. But it is probable that these outside coinages were not at first administered in any way differently from the home and that issues outside Italy occur but rarely until the time of Sulla. In the period after Sulla these provincial issues became more and more important and less and less dependent on the senate. The generals abroad assumed the right to issue money to their troops in their own name and the senate raised no objection. In the end this military coinage of the provinces gave birth to the imperial coinage.

Roman coinage was historical in a sense in which modern coinage is not, but it is only late in the Republic that this element becomes strong. Rome began by placing on the obverse of her denarius the helmeted head of Roma, the protectress of the city and on the reverse, the Heavenly Twins, Castor and Pollux, who "fought so well for Rome" at the battle of Lake Regillus in 494 B.C. These types, with their somewhat general reference to Rome's divine protectors, remained in vogue for more than a hundred years. Variety first began in the reverse types, when figures of deities driving chariots began to replace the Dioscuri—Diana or Victory driving a biga or Jupiter or Apollo driving a quadriga. From about the time of the Gracchi an even greater freedom begins to prevail, and, extends to the obverse as well. In the succeeding period the types vary from issue to issue, with rare and passing revivals of traditional types. The choice is dictated by two considerations (1) the family pride of the moneyer, who selected incidents of interest from his family history (2) a natural interest in current politics, which leads the moneyer to select such types as can be brought into relation with current events.

A few examples will illustrate these tendencies. Sex. Pompeius Fostlus strikes a reverse, showing his ancestor Faustulus, the shepherd, finding the twins, Romulus and Remus, with the she-wolf; he probably strikes in the days of Tiberius Gracchus, when the thought of Roma Renascens, the "re-birth of Rome" was in men's minds—hence an appropriateness in the reference to her origins.

A group of moneyers of the year 118 B.C. issuing coins for the new colony of Narbo in Gaul, put on their reverses a Gallic warrior, probably Bituitus, king of the Arverni, in his war-chariot: in this case the public interest in Gaul has displaced any personal references. L. Tiburius Sabinus, striking *c.* 87 B.C., refers to the legendary Sabine king, Talicus, and to the rape of the Sabine women: the parallel between Rome's troubles with her neighbours in the past and in the present was obvious to all. Sulla, in the East, struck gold coins, with obverse types of Venus, whose favourite he claimed to be: later, in Rome itself, he commemorates his own triumph. Pompey the Great, perhaps in 61 B.C., struck a similar coin in honour of his Eastern victories, with a glance too at Africa, where his career of triumph had begun. The twenty years from 70 to 50 B.C. yield a host of references to history. M. Lepidus, probably the man who was afterwards triumvir with Octavian and Antony, has a gallery of family types, celebrating an earlier Lepidus, who at the age of 15 killed an enemy and saved a fellow-countryman in battle; the Marius Lepidus, who was sent to Alexandria to be tutor to King Ptolemy V. of Egypt in 200; the vestal virgin Aemilia, for whom Vesta miraculously rekindled the sacred fire; the Lepidus who restored the Basilica Aemilia and hung it with shields in 78 B.C. A. P. Hypsicus goes back still further to Neptune and his daughter, Leucronoe, the origin of his line.

With the outbreak of the great Civil War, the personal element burst out into full prominence. The coinage of Julius Caesar from the first bears the stamp of his personality and in the last year of his life the senate authorized him to place his portrait on the coins. Hitherto, the obverse of the coins had been considered the prerogative of a god or goddess: at the most, room might be made there for a hero of early days, such as Scipio Africanus. Caesar's own generation had begun to engrave the portraits of its fathers and now, at last, the portrait of the living man appears. Rome had come back to the monarchy, by whatever name she might call it. From this point to the end of the Republic, we have no true Republican coinage but only the preparations for the Imperial. Even the murderers of the tyrant Caesar in their last struggle for the Republic in the East, placed their own portraits on their coins. Brutus, on one famous reverse, set the daggers that had stabbed Caesar, with the comment EID. MAR. (the fatal Ides of March). Antony strikes in the East associating with himself first his wife in Rome, Octavia, later his Egyptian enchantress, Cleopatra. For his army and navy before the battle of Actium, he strikes denarii with the eagle and standards and prow on the reverse. Sextus Pompey, the pirate son of Pompey the Great, celebrates his chief naval victory over Octavian by a coin showing him as "son of Neptune"—proud title of a successful admiral.

The Roman bronze coinage never outgrew its conventional types. It grew to importance in the First Punic War, when the reverse represented the prow, the sign of sea power, the obverses the great gods of the state. These types it kept throughout: the ordinary Latin word for the "tail" of a coin is "navis" (ship).

Augustus.—The Empire, founded by Augustus, has a dual aspect; on the one side it is a monarchy, based on the support of the troops; on the other it is simply an exalted magistracy of the Roman Republic, created with special powers to deal with special problems. The imperial coinage faithfully mirrors this duality. The Emperor, as paymaster of the soldiers, keeps in his own hands the issue of the precious metals; but he leaves to the senate, now the one representative of the Roman people, the right of issuing the token coinage of brass and copper. The mint of the senate is naturally in Rome itself. The imperial mint is early centralised in the same place, but it is important to note that Augustus began by striking his money for the troops in the provinces, continuing the practice of the generals of the late Republic. His mint was not the successor of the senatorial, but

a new creation of his own. It was probably Caligula who opened the first mint in the capital. Henceforth gold and silver was normally struck in Rome. Provincial issues occur freely in times of civil war, but hardly to any extent otherwise. It was only in the 3rd century that a number of provincial mints came into being, to meet the needs of the chief armies, Antioch in Syria among the first. The example once given soon spread. By the time of Gallienus, imperial coins were struck in Viminacium, Siscia, Lugdunum, Mediolanum—perhaps at other mints too—as well as at Rome and Antioch; and from Aurelian on, the principle of the local issue of imperial coins is dominant. The senate struck mainly in Rome—at first only for Rome and Italy. The mark S.C., "senatus consulto," attests its authority. Antioch in the East and Lugdunum in Gaul also issue coins with this mark, which we must regard as also issued under senatorial authority. After the first two Emperors this coinage was probably current over the whole Empire; but it never played any large part in the East.

The commission of "tresviri" of the mint continued to exist as late as the 3rd century; but the names of these magistrates cease to appear on the coins before the death of Augustus. They may still have played a part in the senatorial issues; the imperial coinage fell within the range of the chief imperial officer of finance, the "a rationibus," and, under him, were administered by imperial procurators. The actual striking was entrusted to a staff of imperial freedmen and slaves. From an early date the Emperor began to exercise a controlling influence over the bronze token coinage also. The two mints may after a time even have been housed in the same building; at any rate the authority of the senate came to be more and more an empty form.

The Roman Republic had only known gold as an emergency or as a foreign coinage. Augustus from the first made his standard gold piece, the "aureus," the head of his system. The denarius however continued to be struck pure and of unimpaired weight; the coinage rested on a bi-metallic basis. The aureus weighed the forty-second part of a pound, the denarius the eighty-fourth; twenty denarii went to the aureus. The token coinage consisted of the sestertius and the dupondius, struck in brass, the fourth and the eighth part of the denarius respectively. The as, the fourth of the sestertius, and the quadrans, the fourth of the as, were struck in copper. Gold and silver were both struck almost pure. Base, plated denarii were not uncommon, but were the work of forgers. Under Caligula and Claudius, however, there is reason to think that the government abandoned its sound principles and condescended to make an unlawful profit by this device itself.

Later Imperial Changes.—Nero reformed the coinage, reducing the weight of the aureus to the forty-fifth part, that of the denarius to the ninety-sixth part of a pound. More important still, he added ten per cent of alloy to the hitherto pure silver. The relations of the coins to one another remained unchanged. Various more or less respectable motives for this reform have been suggested; and, so far as concerns the reduction of weight, there may have been justification for this measure of inflation. It is impossible to judge the debasement of the silver so charitably. It can be nothing but a device of a spendthrift government for meeting its obligations cheaply.

The evil consequences of Nero's debasement were slow to make themselves felt; but they were nevertheless disastrous. Again and again under stress of circumstances the government resorted to the same expedient. The percentage of alloy in the silver rose to as much as forty per cent under Septimius Severus.

Caracalla took the next step. He reduced the weight of the aureus to a fiftieth part of the pound and issued a new silver coin, the "antoninianus" or double denarius at the weight of about a denarius and a half. In the following period the aureus continued to decline in weight and the denarius, after a struggle, succumbed to the less honest double piece.

A final debasement of the silver by Gallienus at the crisis of his reign, when Valerian was a Persian captive and the West cut loose under an Emperor of its own, overtaxed the patience of a long-enduring public. The Antoninianus was no longer taken at its nominal value; confusion reigned and prices rose to absurd heights.

It was Aurelian, the "restorer of the world," who stabilized the coinage. The details of his work are obscure; what is certain is that his stabilization was so unpopular that it led to a riot, on the scale of a miniature civil war in Rome. A coin like the antoninianus was struck, but its value was reduced far below par. Gold was not restored on a reliable basis and the process of inflation began again. Diocletian had no choice but to deal summarily with this problem, before he could restore a coinage that deserved confidence.

Non-imperial Coinages.—In the West, local coinage in South Italy, Sicily, Gaul, Spain and Africa is found commonly under Augustus and Tiberius and sporadically, down to Galba. When this local coinage ceased, the duty of supplying the whole of the West fell on the mints of Rome, sometimes assisted by branches at Lugdunum (Lyons). In the East the case was very different. Coinage had been known there for so long, that the Romans found it expedient to leave a large part of the issues to local mints. Provincial silver or billon was struck in Asia, at Caesarea in Cappadocia, at Antioch in Syria, and at Alexandria in Egypt. Small change was issued freely not only in a number of provincial issues, but also at a vast number of city mints. It may fairly be said that the right to issue such small change was freely granted to almost every urban community. Under these circumstances the part assigned to imperial coinage was a restricted one. The aureus, indeed, had hardly a rival, the denarius circulated beside the provincial silver; but the token coinage in use was almost exclusively of local make. Not till late in the 3rd century did this local coinage succumb before the debasement of the imperial silver and the opening of provincial mints for imperial coin. The provincial coinage was, in its degree, a concern of the imperial government; the local coinage, however, was in theory independent. Its types are largely taken up with local interests; and, although reference to the Emperor or senate or people of Rome, is common, it is by no means universal and expresses a compliment rather than a definite acknowledgment of sovereignty.

Portraiture.—We have seen how under Julius Caesar interest in the living individual found expression on the coins in the form of portraiture. This tendency was developed to an immense degree under the Empire; but, as was only natural, interest was now focussed on the Emperor himself and the members of his family. Beside them there was no room for individual distinction. The Emperor, as head of the state, enjoys the right of portraiture on the obverse—a right which extended, at first sparingly, later more freely, to living Empresses or princes or to deceased members of the line. The reverse types, too, are full of his personality and his prowess. His victories, his triumphs, his distributions to the poor of Rome, his public shows, his measures for the welfare of Italy or the provinces, his arrivals and departures, his marriages, the birth of his heirs, his provision for the succession—these and many more, find constant reference on the coins. It is significant of the growth of imperial influence over the senatorial coinages, that, after a time, such reference is found as freely on the bronze coinage as on the gold and silver.

Religion still plays a large part. But even the great gods of the state are freely brought into connection with the Emperor and his protectors or as types of his qualities; and what is true of them is even more true of the minor deities, or virtues, who were so widely worshipped by the Romans. The virtues of the Emperor provide a symbolism fit to cover the whole of the imperial administration; his valour and victorious power, his care for the corn-supply of Rome, his spirit of constitutionalism, his liberality, his justice and his mercy. The coinage has throughout a strongly propagandist character. It serves to make known the achievements and to advertise the policies of the government.

The imperial system produced its own cult, the worship of those Emperors who, after death, were adjudged worthy of the honour of consecration. The worship of the "divi," as these deified Emperors were called, bulks large on the coins. They wear the radiate crown of the Sun-god as the symbol of their divinity;

while on the reverses appears the eagle, the symbol of the soul flown heavenwards, the pyre, the temple, or types of "Aeternitas," that world beyond time, conceived of as in the starry heavens, to which the soul of the good depart.

Diocletian.—Diocletian refounded the Roman Empire, but in a form that Augustus would hardly have recognized. The Emperor is now a monarch of the Eastern pattern, even in his lifetime receiving something like divine worship.

The mints formed a section of the department of the chancellor of the exchequer and, under him, were administered by "rationales." The moneyers, like so many other professions of the age of Diocletian, were organized as a rigid caste, from which escape was barely possible. They were subject to severe discipline and terrible penalties for abuses: but, despite this, false coinage was immensely prevalent and flourished in the face of repression.

Diocletian in A.D. 296 completed the task which Aurelian had begun. He finally cleared away the depreciated coinages of the 3rd century and issued a new coinage, based on sound gold and silver coins. His gold piece was struck at sixty to the pound of gold, his silver at ninety-six to the pound of silver. His successors continued his policy in the main lines unchanged. Constantine substituted the *solidus*, a piece of $\frac{1}{72}$nd of the pound, for Diocletian's sixtieth; this standard found general acceptance and passed on to the famous "besant" of the Byzantine Empire. In the first thirty-five years of the 4th century silver was very sparingly struck. When its free issue was resumed, new denominations, the *miliarense* ($\frac{1}{1,000}$ of the gold pound) and *siliqua* ($\frac{1}{1,728}$ of the gold pound) soon replaced Diocletian's ninety-sixth. The silver came more and more to be struck below standard weight—that is to say, to become a subordinate token coinage. The basis of the system was the steady supply of a standard gold coin.

Whether Diocletian and his successors issued a regular coinage in bronze or copper is very doubtful. They certainly continued to issue the very base billon, which represented the last stage of the debasement of the double denarius.

Diocletian's reform must have brought some improvement on the chaos of the great anarchy of the third century. But one great evil persisted—the cost of living remained high and would not come down. Diocletian's edict of A.D. 301 fixing maximum prices, was undoubtedly only one of a series of blows aimed at a recurrent social evil.

Influence of Christianity.—The spirit of the coinage undergoes a change, similar to that of its form. The divine Emperor dominates the entire coinage: even the gods hardly appear except as patrons of the new dynasty—Jupiter for Diocletian, Hercules for Maximian, Mars for Galerius, Sol for Constantius I. When Christianity, surviving the great persecution, received full tolerance and increasingly marked favours from Constantine, the pagan element in the coinage declined. Little of Christianity, however, took its place. For many years types and legends of a neutral character were preferred, though Christian signs and emblems—cross, monogram of Jesus Christ, *labarum* (Christian standard) begin to appear. There was in fact an unavowed truce between old and new. After Julian—who revived pagan types on his coins—notably the Apis bull of Egypt—the Christian element becomes stronger. The Emperor appears more and more as the defender of the faith, the imperial Victory shades off into the Christian angel. But the full development of the Christian tradition in coinage was reserved for Byzantium.

The Roman coinage of the East passes on without interruption into that of Byzantium. In the West, the Empire, succumbing to the barbarians in the late 5th century, left them its coinage as part of its legacy.

MEDIAEVAL AND LATER EUROPEAN COINS

With the fall of the Western empire, the coinage of the Byzantine empire became the great influence in European currency. The Byzantine period in coinage may be considered to begin in the reign of Anastasius. The coins are in the three metals, but the silver is rare, and was probably struck in small quantities. At first the gold and silver are fine, but, towards the close of the empire, much alloyed. The gold coin is the solidus of Constantine, with its half and its third (semissis and tremissis). The Byzantine solidus (besant) throughout the middle ages was the gold coin of European trade until the introduction of Italian gold in the 13th century. The chief silver coin was the miliarision, and a smaller coin, the siliqua or keration.

In 498 Anastasius introduced a new copper coinage, bearing on the reverse, the following marks of value in place of a type: M, K, I and E, 40 nummi, 20, 10 and 5. These coins bear beneath the values the abbreviated name of the place of issue. Justinian I. added the regnal year in A.D. 538, his twelfth year; this is the first appearance of annual dating on European coinage. The money of this class shows extraordinary variations of weight, which reflect the state of the imperial finances. Under Basil I. the bronze money to all appearances was reformed, but the absence of marks of value makes the whole later history of the coinage in this metal very difficult. There was one curious change in the shape of the money. Early in the eleventh century the solidus begins to assume a cup-shaped form, and this subsequently became the shape of the whole coinage except the smaller-bronze pieces. These coins are called *nummi scyphati.* The types, except when they refer simply to the sovereign, are of a religious and Christian character.

On the reverse of the oldest coins we have such types as a Victory holding a cross (other personifications all but disappear), but on those of later ones a representation of Christ or the Virgin Mary. Christ first appears on a coin of about A.D. 450, where He is represented marrying Pulcheria to Marcian. He does not appear again until the end of the 7th century, when His bust is introduced by Justinian II. From the 9th century Christ appears in various forms on the coins; about 900 we find the Virgin; a few years later saints, St. George, St. Michael, St. Theodore, etc., begin to appear. A remarkable type was introduced by Michael VIII. Palaeologus, who recovered Constantinople from the Latins in 1261, and issued coins with the Virgin standing in the midst of the walls of the city. Another notable type is the adoration of the Magi. The principal inscriptions for a long period almost invariably relate to the sovereign, and give his name and titles. The secondary inscriptions of the earlier coins indicate the town at which the piece was struck, and in the case of the larger bronze pieces, the year of the Emperor's reign is given. From about the 10th century there are generally two principal inscriptions, the one relating to the emperor and the other to the sacred figure of the reverse, in the form of a prayer. The secondary inscriptions at the same time are descriptive, and are merely abbreviations of the names or titles of the sacred personages beside the representations of whom they are placed. From the time of Alexius I. (Comnenus) the principal inscriptions practically disappear, and descriptive ones alone are given. These are nearly always abbreviations, like the secondary ones of the earlier period. The language of the inscriptions was at first Latin with a partial use of Greek; about the time of Heraclius Greek began to take its place on a rude class of coins, probably local; in the 8th century *Basileus* and *despotes* replace *Augustus;* by the 9th century Greek inscriptions occur in the regular coinage; and by the time of Alexius I. Latin has wholly disappeared. The Greek inscriptions are remarkable for their orthography, which indicates the changes of the language. In the 11th century we have a few metrical inscriptions, a practice commoner in Asia than in Europe. From the time of Justinian (6th century) onwards the profile which has been usual for centuries practically disappears from the coinage, and is replaced by a facing bust. The last Byzantine gold coin (a piece of John V., 1341–91) shows a figure of John the Baptist imitated from the Florentine coinage.

Cognate Groups.—Besides the regular series of the Byzantine empire, there are several groups connected with it, either because of their similarity, or because the sovereigns were of the imperial houses. These are the coinages of various barbarians, and the money of the emperors of Nicaea, of Thessalonica, and of Trebizond. The last groups consist of small silver pieces, which were prized for their purity; they were called Comnenian white-money (ἄσπρα κομνήνατα), the princes of Trebizond hav-

ing sprung from the illustrious family of the Comneni.

The coinage of the other states of the West falls into well-defined periods which have been distinguished as (1) transitional period, from Roman to true mediaeval coinage, *i.e.*, from the fall of Rome (476) to the accession of Charlemagne (768); (2) true mediaeval period, during which Carolingian money was the currency of Western Europe; this covers the period from Charlemagne to the end of the Swabian house in 1286; (3) early Renaissance from the first issue of the florin at Florence in 1252 to the beginning of the classical Renaissance in the middle of the 15th century; (4) the Renaissance and (5) modern period.

Mediaeval.—The main feature of the mediaeval period is the disappearance of gold and rise of silver and the return of gold from the 15th century onwards. The inconvenience of gold money when it represents a very large value in the necessaries of life must have caused its abandonment and the substitution of silver by the Carlovingians. The denier (denarius) or penny of about 24 grains was at first practically the sole coin. The solidus in gold was struck but very rarely, perhaps as a kind of proof of the right of coining. The Byzantine solidus or bezant was used and probably the equivalent Arab gold. The new coinage spread from France, where it was first royal and then royal and feudal, to Germany, Italy, where the Byzantine types did not wholly disappear, England, Scandinavia, Castile and Aragon. In Germany and France feudal money was soon issued, and in Italy towns and ecclesiastical foundations largely acquired from the empire the right of coinage, which was elsewhere rare. The consequence of the extended right of coinage was a depreciation in weight, and in the middle of the 12th century the one-sided deniers called bracteates appeared in Germany, which were so thin that they could only be stamped on one side. The types of this whole second coinage are new, except when the bust of the emperor is engraved. The most usual are the cross; and the church as a temple also appears, ultimately taking the form of a Gothic building. There are also sacred figures, and more rarely busts in the later age.

The great precursor of the Renaissance was the emperor Frederick II. (1215–50). In his restoration of the gold coinage he had already been preceded by the Norman Duke of Apulia, who for the convenience of these Arab subjects and for commercial reasons also had continued the gold coinage of the Fatimids, the great currency at that time of all the western Muslims. Roger II. (1130–54) also struck Latin coins of his own as DVX APVLIAE, the first ducats. Frederick II., continuing the gold standard, also struck his own Roman gold money, solidi and half solidi, with his bust as emperor of the Romans, Caesar Augustus, and on the reverse the imperial eagle, in keeping with the obverse title. In workmanship these were the finest coins produced in the middle ages. It is not till the great Swabian that we get the final establishment of a worthy coinage, a necessity of their large commercial schemes. The famous gold florin was first issued in 1252 and at once became popular. The obverse type is the standing figure of St. John the Baptist, the reverse bears the lily of Florence. The weight was about 54 grains, but the breadth of the coin and the beauty of the work gave it dignity. The commercial greatness of Florence and the purity of the florin caused the issue of smaller coins in almost all parts of Europe. Venice was not long in striking (in 1248) a gold coin of the same weight as the florin, but with the types of a standing figure of Christ, and the doge receiving the gonfalon at the hands of St. Mark, a type suggested by Byzantium. It was first called the ducat, the name it always bears in its inscription; later it is known as the zecchino or sequin. Though not so largely imitated in type as the florin, the extreme purity of the sequin made it a world currency down to the 19th century. Genoa likewise had a great gold currency, and the other Italian states struck in this metal. Many varieties of gold money appear in course of time in France, England and to a less extent in other countries. The need for heavier silver coinage caused the issue of the large denier (grossus denarius, gros or groat). This coin appears early in the 14th century. The types from the 14th century onwards are many and distinctly worthy of the art of the time, which as yet is purely decorative and conventional, so that portraits are not possible. The religious intention also is gradually giving way to the desire to produce a beautiful result, and the symbol of the cross is varied to suit the decorative needs of the coin. Heraldic subjects also appear, and in the shield, which is frequently a reverse type, we see the origin of the usual modern reverse of the most important coins.

With the classical Renaissance we find ourselves in the presence of modern ideas. It is a period of innumerable small states and kingdoms with no uniformity of coinage yet most modern series can be traced back to it. Its most remarkable characteristic is the revival of portraiture and from the 16th century with the opening of the new world the enormous increase in output of coins in gold and silver. With the institution of the German thaler in 1518, it speedily became the chief European piece in its metal, and to its popularity is no doubt due the large silver pieces of other countries—crowns, ecus and scudos.

In the west a number of coins carry on the Roman tradition. They cover the period from the 5th to the 8th centuries, and are of considerable historical significance. The types throughout are monotonous: the bust of a Roman emperor or local ruler, a cross of some kind, a Victory, etc. The style is quite barbarous. The classification of the earliest servile imitations of Roman and Byzantine money rests only on origin and is uncertain.

The following general series are distinguished: (A) The Vandals (Africa, 428–534) issued gold (?), silver and bronze from Hunneric (477–84) to Gelamir (530–34); the gold is anonymous. (B) The Suevians (Spain, 409–585) had little but imitations of Byzantine gold; but Richiar (448–456) issued a denarius in his own name. (C) The Ostrogoths (Italy, 489–553) were preceded by the Herulian Odoacer (476–94), who coined silver and bronze; their kings (including Theodoric, 493–526, and Totila or Badulla, 541–52) issued gold, silver and bronze in their own names, from Rome, Ravenna, Milan, etc. (D) The Lombards (Italy, 568–774) had no coins in their own names before Grimoald, duke of Beneventum (662–71); later there are gold solidi and thirds and silver from many mints. Gold was issued for the duchy of Beneventum in the 8th century. (E) The Burgundians (Gaul, to 534) first issued recognizable coins under Gondebald (473–516). (F) The Visigoths (South Gaul and Spain) had imitative gold thirds in the 5th and 6th centuries; the kings' names appear from Leovigild (573–586) to Roderic (710–11). Sixty-one mints were in operation. (G) The Meroving Franks first issued under Clovis I. (481–511) coins recognizably Frankish (solidi and thirds). Royal names first appear on silver and copper under Theoderic of Austrasia (511–34) and Childebert I. of Paris (511–58). The chief Frankish inscribed coinage is, however, of gold solidi and thirds, from Theodebert I. (534–48), who broke down the Roman imperial prerogative and issued gold with his own name in full, to the beginning of the 8th century. The last Merovingians issued no coins in their own names, being mere puppets. From the middle of the 6th century the coins with kings' names are far less numerous than those bearing the names only of mints and moneyers; some 800 places (not only in what is now France, but in Germany, the Low Countries and Switzerland) are thus named. This coinage seems to have been intimately connected with the fiscal organization, though the generally accepted theory that the taxes collected in each place were there and then converted into money is by no means proved. Certain religious establishments also possessed the right of coining in their own name. The close of the Merovingian dynasty saw a revival of silver in the *saiga,* which heralded the introduction of the denier. (H) In England the Anglo-Saxons began with an imitative coinage similar to the Merovingian, viz., gold, *solidi* and *thirds,* and silver *sceattas* of about 20 grains troy, and *stycas,* first of silver, then of copper. The gold is rare and confined to the south; only two *solidi* are known, imitations of Honorius, with Runic legends on the reverse.

Portugal.—The coinages of the various countries of Europe from the end of Roman coinage and its imitations can be briefly mentioned in geographical order from west to east. The money of Portugal begins, after the expulsion of the Moors, with Alphonso I. (1112); it is exclusively regal, and not of great interest except as affording indications of the wealth and commercial activity of the state in the early part of the 18th century.

The early golds are of interest as by the arrangement of their type and inscription they try to look as like Moorish coins as possible.

Spain.—The coinage of Spain, after the reconquest from the Moors, is almost without exception regal. The Kingdom of Navarre had a coinage from the time of Sancho III. (1000–35). The series of Castile and Leon begins with Alphonso VI. (1053) with deniers and obols. Aragon first has coins under Sancho Ramirez I. (1063). Gold (as in Portugal imitated from Moorish money) is introduced in the middle of the 12th century. A plentiful coinage was issued after the union of the crowns in 1479. The Spanish dollar of the 17th and 18th centuries was one of the most widely circulating currencies in the West.

France.—In France in 755 Pepin the Short abolished the gold coinage of his Merovingian predecessors and introduced the silver denier (denarius=penny); the coinage became a royal prerogative once more and confined to a few mints. The denier, which at first weighed *c.* 1·28 gramme (19¾ grains), was for centuries the chief of European silver coins. Under Charlemagne the weight was slightly raised; the Caroline monogram appears and there are other modifications in the types. Charlemagne also issued money from various Italian, German and Spanish mints. He also introduced the obol, and struck gold (chiefly at Italian mints). Among his types must be noted the temple with the inscription XPISTIANA RELIGIO. Louis le Debonnaire (814–840) was the last Carolingian to strike gold. In the 9th century are perceptible the first traces of the movement which led to the extensive feudal coinage. The advent of the house of Capet made no great change in the system, but the feudal issues now become important. The most widespread denier was that of the abbey of St. Martin at Tours (*denier tournois*); the royal coinage was known as the *monnaie parisis*. Louis IX. (1226–70) effected a great reform late in his reign, making the sou (hitherto a money of account) into a real coin as the *gros* and introducing a gold coinage. Henceforward the coinage increases in complexity; in the 14th century it has great artistic merit, especially the gold; from the end of the 16th century it becomes conventional.

Belgium.—Passing on to Belgium, its coinage, which, except for the few mints operating under the Merovingians and Carolingians, does not begin until the 11th century, comprises many pieces struck by foreign rulers, and has little of an independent character in either the regal or the seignorial class. The most important coinages are those of the house of Burgundy and Charles V. and his son, and of the bishops of Liége. The coinage of Belgium approaches the French on the one side, the German on the other.

Switzerland.—The multitudinous coinage of Switzerland illustrates the varying fortunes of this central state, and its gradual growth and consolidation. First we have the gold money of the Frankish kings, among whose mints Basel, Lausanne, St. Maurice-en-Valais and Sitten (Sion) already appear. The silver deniers, which Charlemagne made the coinage of the empire, are issued by fewer mints; the dukes of Swabia began to strike at Zürich in the 10th century, and the empire granted during the 10th and down to the 13th century the right of coinage to various ecclesiastical foundations, bishoprics and abbeys. Bern was allowed a mint by the emperor Frederick II. in 1218, and other towns and seigneurs subsequently gained the same right. The demi-bracteate appears about the middle of the 11th century, and about 1125 is superseded by the true bracteate, which lasts until about 1300. The 14th century witnessed the rise of the Swiss confederation, and by degrees the cantons struck their own money. These, together with the coins of some few sees and abbacies, form the bulk of Swiss money of the mediaeval and modern periods. The separate cantonal coinage, interrupted by the French occupation, was finally suppressed in 1848, when a uniform currency was adopted.

Italy.—Italy, with Sicily, has special features. Here the barbaric coinages were mixed with the Byzantine issues which marked the recovery of the Eastern empire, and left a lasting influence in the north at Venice, and in the south at Beneventum. Later the Arab occupation of Sicily and the predominance of Arab coins left their mark in the curious Oriental coinages with Arabic inscriptions of the Normans of Sicily and of the Emperor Frederick II., mixed after his fashion with Latin coinage. The earliest money is that of the barbarian Ostrogoths and Lombards, and local Byzantine issues in Sicily. This is followed by the deniers of Charlemagne and his successors, succeeded by the gold currencies of the Normans and Frederick II. The age of the free cities is marked by the great coinages of Florence, Venice and Genoa, while the Angevin and Aragonese princes coined in the south, and the popes began to issue a regular currency of their own at Rome. The Italian princes of the next period coined in Savoy, and at Florence, Modena, Mantua and other cities, while Rome and the foreign rulers of the south continued their mintages, Venice and Genoa of the republics alone surviving.

The money of Florence, as may be observed, is disappointing in its art, for the great commercial currencies have to be conservative. The silver florin was first struck in 1189. It is heavier than the denier, weighing about 27 grains, and bears the lily of Florence and the bust of St. John the Baptist. These are thenceforward the leading types, the flower never changing, but the representation of the saint being varied. On the gold florin, first issued in 1252, the Baptist is represented standing, while in the contemporary silver florins he is seated. The latter have a rhyming legend, "Det tibi florere Christus, Florentia vere."

Venice as a mint rivals Florence in conservatism, and the early style is distinctly Byzantine; commercial reasons had to prevail in keeping coin types unchanged even in a great artistic city. The famous Venetian zechino or sequin, the rival of the florin of Florence, appears to have been first issued under Giovanni Dandolo (1284). On the obverse St. Mark gives the gonfalon to the kneeling doge, and on the reverse is a standing figure of the Saviour within an oval nimbus and a rhyming legend, "Sit tibi, Christe, datus Quem tu regis, iste ductus."

The series of the coins of Rome is rather of historical than of artistic merit. The popes begin to strike money under Adrian I. (A.D. 772–795), whose deniers are in a Byzantino-Lombard style. The coins of his successors, excepting few, down to Leo IX (1049) associate the names of pope and emperor. From Leo IX to Urban V (1362) there is no papal coinage. The Roman senate strikes from 1188 onward. We then see on the silver the style of the senate and Roman people, and ROMA CAPUT MUNDI. Some coins have the figures of St. Paul and St. Peter, others Rome seated and a lion. Charles of Anjou, King of Sicily (1263–85), strikes as a senator, and Cola di' Rienzo (1347–48) as tribune. The gold ducat of about 1300 imitates the types of the Venetian sequin. St. Peter there gives the gonfalon to a kneeling senator. The arms of the moneying senator next appear in the field. The papal coinage is resumed at Avignon; and Urban V, on his return to Rome, takes the sole right of the mint. From Martin V (1417) to Pius IX there is a continuous papal coinage. The later coins, though they have an interest from their bearing on the history of art, are disappointing in style. We have beautiful gold coins of Giovanni Bentivoglio, lord of Bologna, who employed Francia at his mint, and we know that the artist remained at his post after Julius II had taken the city. There are also pieces of Clement VII by Cellini, vigorous in design but careless in execution. There were papal mints at Ancona, Bologna, Piacenza, Parma, Ferrara and other Italian towns; and coins were also struck at Avignon from 1342 to 1700. When the Vatican City state was created in 1929 it was accorded the right of issuing its own coinage.

The coinage of Sicily, afterward that of the Two Sicilies, or Naples and Sicily, begins with the Normans. Theirs is a curiously mixed series. It begins with Robert Guiscard as duke of Apulia (1075) and Roger I of Sicily (1072). The gold money is almost wholly Arabic though Roger II struck the Latin ducat, the earliest of its class; the silver is Arabic, except the great Latin scyphati of Roger II with Roger III; the copper is Latin and Arabic. The gold series (*Augustales*) of the emperor Frederick II (1198–1250) shows the first sentiment of reviving classical art, its work far in advance of the age. These are Latin coins; he also struck small Arabic pieces in gold.

Under Conrad and Manfred there is little coinage, copper only, but with Charles I of Anjou (1266–85) the gold money in purely mediaeval style is beautiful, quite equal to that of his brother,

St. Louis of France.

After this time there is a great issue of gigliati, silver coins with, for reverse, a cross fleurdelisée cantoned with fleur-de-lis.

Germany.—The money of Germany, with which we include Austria and Hungary is, like that of Italy, far too varied for it to be possible here to do more than sketch some of its main features. In the Frankish period mints were in operation at cities in the west, such as Mainz, Strassburg, Speyer, Treves, Worms, Cologne. Pepin issued denarii from Strassburg and Mainz; under his successors denarii and obols were also coined at other mints, as Bonn, Cologne, Spires, Treves. After the reign of Louis the Child (910–11) the Carolingian system was continued until the advent of the Swabians with Conrad III. (1138–52). In the succeeding period which ends with the introduction of the grossus and the gold coinage under Louis of Bavaria (1314–47), the uniformity of the currency disappears. In the west (in Lotharingia, including the southern Low Countries, the Moselle and Rhine-lands, in Frisia, Bavaria, parts of Franconia and Swabia) the denier continues; but elsewhere we find the bracteate. The right of coinage is acquired in an increasing measure by the feudatories of the empire. With the introduction of the regular gold coinage (consisting for the most part of florins) and the grossus in the 14th century, Germany enters on the modern period. From the 16th century the thaler (so called from Joachimsthal in Bohemia, where the counts of Schlick first struck the coin in 1518) dominates the silver currency. The thalers and other large coins of the 16th and 17th centuries are often good and always vigorous in workmanship. By the convention of 1857 the thaler was recognized as the unit for Berlin and the north, the florin of 100 kreuzers for Austria, the florin of 60 kr. for the south. A uniform system, based on the gold reichsmark of 100 pfennigs, was established all over the German empire in 1876. Of particular currencies in Germany we must be content with the mention of some of the more important. Among the great rulers we note the dukes of Bavaria, who coined from Henry I. (948–55), and issued fine thalers in the 16th century. The Counts Palatine of the Rhine coined from 1294, their mints being at Heidelberg, Frankfort, etc. The Saxon coinage begins with Duke Bernard (973) and includes a large series of bracteates and thalers, the latter being especially famous. The Brunswick coinage begins in the 11th century; besides its bracteates we note the large mining-thalers of the 16th and 17th centuries (up to ten thaler-pieces). There are good bracteates and thalers of the margraves of Brandenburg; from 1701 they coin as kings of Prussia. In Austria there is a ducal coinage from the 12th century; the gold florin of Florentine character appears under Albert II. (1330–1358). The marriage-coin of Maximilian and Maria of Burgundy (a 16th-century reproduction of a medal made by the Italian, Candida in 1479) is a striking piece, and in the 16th century there is a large series of fine thalers. The thalers of Maria Theresa became popular on either side of the Red Sea, and those of the date 1780 are still recoined for trade there. In Bohemia there is a ducal coinage from the early 10th century to 1192; then came the regal bracteates. Wenceslas II. (1278–1305) struck the first German grossus at Prague. The gold florin made its appearance under John of Luxemburg (1310–47). In Hungary the regal coinage begins with St. Stephen (1000). Charles I. of Anjou (1310–42) introduced the florin and grossus. Of historical interest is the money of John Hunyadi as regent (1441–52). The abundance of gold about this time and later shows the metallic wealth of the land. The same is true of the rich gold coinage of the Transylvanian princes in the 16th and 17th centuries. Of ecclesiastical coinages the most important are at Münster, Cologne, Mainz, Treves, Augsburg, Magdeburg, Spires, Würzburg, Salzburg. The Cologne series of coins is almost continuous from the Frankish period; the archbishops first received the right from Otto I., Brune (953–65) being the first to coin; from Pilgrim (1021–36) the series, issued at various mints in the Rhineland, is very complete down to 1802. The series of Treves ranges from Theodoric I. (965–75) to Clement Wenceslas (1794). The archiepiscopal coinage of Mainz begins with Willigis (975) and lasts until 1802; its mints included Erfurt, Bingen and many other places. The Salzburg series (beginning 996) is remarkable for its fine thalers (especially of Mathias Lang, 1519–1540). The patriarchs of Aquileia, who may be mentioned here, acquired the right of coinage from Louis II. in the 9th century, but the first who can be identified on the coins is Godfrey (1184); thence onwards there is an interesting series of denarii and smaller coins down to the early 15th century. Of cities with large coinages it is sufficient to mention Aix-la-Chapelle (from the time of Frederick I. to 1795), Frankfort-on-the-Main, Hamburg (with great gold pieces of the 16th and 17th centuries, up to 10 ducats) and Nuremburg.

Scandinavian Countries.—The origin of the coinage of the Scandinavian states: Norway, Denmark and Sweden, is clearly English and due to the Danish conquest of England. The Runic alphabet is employed, though not by any means exclusively, on many of the early coins of Denmark and Norway. The Norwegian series begins with Hakon Jarl (989–96), who copies the pennies of Aethelred II. In the second half of the 11th century begins a coinage of small, thin pennies, which develop into bracteates. Magnus IV. (1263–80) restores the coinage, more or less imitating the English sterlings of the time. Norway and Denmark were united under Eric of Pomerania in 1396. The money of Denmark begins with pennies of Sweyn (985–1014) which are copied from the coinage of Aethelred II.; the coins of Canute the Great (1014–1035) and Hardicanute (1036–42) are mainly English in character. With Magnus (1042–47) other influences, especially Byzantine, appear, and the latter is very strong under Sweyn Aestrithson (1047–76). Bracteates come in in the second half of the 12th century. The coinage is very difficult of classification until the time of Eric of Pomerania (1396). There are important episcopal coinages at Roskilde and Lund in the 12th and 13th centuries. Sweden has very few early coins, beginning with imitations of Olaf Skötkonug (995) of English pennies and showing the usual bracteate coinage. The money was restored by Albert of Mecklenburg (1363–87). The thaler is introduced by Sten Sture the younger (1512–20). The money of Gustavus Adolphus is historically interesting. Under Charles XII. there is highly curious money of necessity. The daler is struck as a small copper coin, sometimes plated. The types include the Roman divinities. At the same time and later there was a large issue of enormous plates of copper, stamped with their full value in silver money as a countermark.

Russia.—The earliest Russian coinage begins with the princes of Kiev as early as the end of the 10th century; it shows strong Byzantine influence. The grand princes from the early 15th century struck curious little silver pieces. The coinage was modernized by Peter the Great, who introduced a regular gold coinage. The large silver and copper coins of his successors are very plentiful. Nicholas I. (1825–55) introduced a platinum coinage of about two-fifths the value of gold.

Other Countries.—The Christian coinages of the northern Balkan States are of great morphological interest. They are chiefly silver grossi, showing a mixture of Byzantine and Venetian influences. The Bulgarians had a regular silver coinage from Asien I. (1186–96) to John Sismana (1371–95). The Serbian coinage lasts from Vladislas I. (1234–40) to the middle of the 15th centurv. There is also a coinage of the Bans of Bosnia (late 13th to 15th century). The modern coinages of the Balkan States are of the 19th century only. The independent city of Ragusa is remarkable for the bold style of its early copper (13th century, inspired by Roman models of the 4th century) and the richness and variety of its later issues.

BRITISH COINS

The earliest coins struck in Britain were rude uninscribed imitations of the stater of Philip II. of Macedon (359–336 B.C.), one of the great currencies of the ancient world; they reached Britain through Gaul where they had been imitated by the various tribes there. The exact distribution of the earliest coins of this type found in Britain between British and Gaulish mints is still uncertain. These coins are of gold of gradually diminishing purity and are at first uninscribed. Under Roman influence we have the introduction of silver and copper coins toward the end

of the last century B.C.; inscriptions also now appear on the coins so that we can identify the coinage of Tincommius and Cunobelinus (Cymbeline) and others known and unknown to history. With the Roman conquest native coinage disappears and if we except the Roman coins from the mint of London in the 3rd and 4th centuries A.D., we have no British coinage again till the departure of the Romans. Gradually degenerating copies of Roman types formed the currency of Britain from the 5th to the 7th century, when we are once more able to attribute the coins to definite rulers. In the 7th century we have the extensive coinage of little silver pieces known as "sceats" with a considerable variety of types and legends in Runic letters, which enable some to be attributed, for example, to Peada, king of Mercia (655–57 A.D.).

About the same time in the kingdom of Northumbria we have the small copper coins known as "stycas," which record a long series of kings from Ecgfrith (670–85) onward. But it is from the reign of Offa (757–96) who introduced the silver "penny" that English coinage may be said to date. In its broad flat fabric, contrasted with the thick fabric of its predecessors, it shows the influence of its Carolingian prototype but the designs are thoroughly Anglo-Saxon and the portrait of Offa, a remarkable piece of work, reaches a level not equalled again in English coinage till the reign of Henry VII. The inscriptions, obverse name of the king and reverse that of the moneyer, were to remain unchanged in form till the reign of Edward I; for the same period also the silver penny was the only English coin. A remarkable coin struck by Offa is his imitation of an Arab dinar of the Caliph al-Manṣūr with the additional legend OFFA REX, one of the few and exceptional gold coins of the Anglo-Saxon period. About the same time we find the Archbishops of Canterbury beginning to issue coins, the earliest being those of Jaenberht (766–90) bearing the names of the suzerain Offa also.

The kings of Kent and the kings of East Anglia also began to strike pennies: the rise of Wessex after the battle of Ellandune in 825 can be traced in the coinage; the earliest coins of Wessex were those struck at Canterbury by Ecgberht and his conquest of Kent, and the mints of Alfred's reign reveal how West Saxon power had expanded. The Danish invaders have also left extensive numismatic records, some of exceptional historical interest like the London coinage of Halfdan. The troubled state of the country is reflected in the many barbarous and hurriedly struck coins of this period. The peace and prosperity which returned after the peace of Wedmore (878) is seen in the improved workmanship of the coinage, with a more careful treatment of the portrait and a great variety of original work in the reverse types, a feature which was not long maintained. In the 10th century it became the regular practice to add the name of the mint as well as that of the moneyer on the reverse. In the edicts of the Council of Greatley (928) we have the earliest surviving mint ordinances. Coins were only to be struck at certain towns and each town was to have only one moneyer with certain specified exceptions (*e.g.*, eight for London). The number of mints increased till in the reign of Aethelred II we have more than 70; from about his time also the king's portrait, which had only been occasionally used, became the regular obverse type on the coinage, while the reverse type also became stereotyped to some form of cross.

The Norman conquest made no change in the coinage or mint system and we even find that preconquest moneyers stayed in office and struck coins for William I. But the coin-types were now regularly changed partly as a source of revenue, for the moneyers had to make a payment when new dies were issued, partly as a check on forgery. The dies were made in London and sent to the country mints. The pennies of William II have nothing in their legend to distinguish them from his father's issues but students have been able to allot eight types to William I and five to his son. Forgers gave Henry I much trouble and one step he took to prevent it was to issue his later coins with a snick in the edge to show that the silver was good. The civil wars of Stephen's reign produced many interesting coins such as those struck in Matilda's name and the pennies of Eustace Fitzjohn and other barons.

Henry II ceased the practice of regularly changing the types which had been the custom since William I's reign and struck one type till 1180. In this type the work of the English mints reached its lowest level; the coins frequently have only a letter or two of the legends and fragments of the type. His second type, the "short-cross," so called from its reverse design, first issued in 1180, remained unchanged—including the name Henricus—not only by Henry II but also by Richard and John and Henry III till 1247. In 1247 Henry III coined the "long-cross" penny with the arms of the cross extended to the edge of the coin with a view to preventing clipping. He also reduced considerably the number of mints. In 1279 Edward I introduced a new type of penny obverse: bust of the king and reverse: long cross with three pellets in each angle, a type which was much imitated abroad and persisted in the silver coinage till the reign of Henry VII. The moneyer's name disappeared from the reverse legend and its place was taken by the name of the mint CIVITAS LONDON, etc. He also struck halfpennies and farthings to replace the cut pennies which had hitherto done duty for small change. He also introduced a groat or fourpenny piece (groat=gros=*grossus*, large *denarius*-penny) but the time was not yet ripe for this larger coin and it did not establish itself till Edward III's reign. The coins of Edward I, II and III cannot be distinguished by their legends; a minute study of them has, however, enabled them to be attributed satisfactorily.

Henry III had attempted to issue a gold coinage by striking the gold penny of the value of 20 pence silver, later raised to 24, but the difficulty of rating gold to silver proved insuperable and the coinage was withdrawn. In 1344 Edward III with the issue of his fine series, the florin, leopard and helm ($\frac{1}{2}$ and $\frac{1}{4}$ florin) again attempted without success to introduce a gold currency: the attempt was renewed with the noble and after various experiments with its weights a gold coinage was finally established in currency in 1351 with a noble of 120 gr. of gold and its subdivisions the half- and quarter-noble. The silver penny was reduced to 18 gr. and the groat first issued in the same year. The noble was valued at 6*s.* 8*d.* The obverse type of the noble, the king in a ship, is supposed to allude to the naval victory of Sluys. The reverse type is a floreate cross with considerable ornamentation. Edward IV distinguished his noble by a rose on the ship (rose-noble or ryal) and raised its value to 10*s.*, while a new gold coin, the "angel," was introduced to replace the old value of the noble at 6*s.* 8*d.*; the penny was reduced to 12 gr.

The angel is so called from its type of St. Michael and Lucifer. The reverse is a ship with a cross in front of the mast. The angel in the 16th century became the piece given to those touched for king's evil; it was struck for this purpose down to the reign of Charles I; it was not again issued as legal tender but small copies of it were struck by the later Stuarts and pretenders for presentation at the ceremony of touching for king's evil. The next important change in the coinage was not till the reign of Henry VII. This was the introduction of the sovereign, a large gold coin of 240 gr. current for 20*s.*; the obverse type was the king seated in an elaborate throne and the reverse a Tudor rose with a shield of arms in the centre. The same ruler also issued the first English shilling or testoon, a handsome coin with a fine portrait, in 1583, but this did not attain much currency. Henry VIII altered the types of the smaller silver coins by replacing the three-centuries-old cross and pellets by a long cross and shield while the inscription POSUI DEUM ADJUTOREM MEUM took the place of the mint legend; the stereotyped bust was replaced by an excellent profile portrait on the groat and the seated king on the penny; Henry VIII debased the gold and reduced the weight of the sovereign, the reverse type of which was now the royal arms supported by a lion and dragon. He introduced the gold crown of 5*s.* and half-crown and raised the angel to 7*s.* 6*d.*, introduced the George noble to take its old value of 6*s.* 8*d.*—so called from its type of St. George and Dragon. In 1544 he issued the base shilling or testoon of 12 pence and debased the silver coinage. It was in his reign that the archiepiscopal mints of Canterbury, York and Durham were abolished, the former having exercised its privilege for

ANCIENT GREEK COINS

1. Electrum stater of Lydia. 2. Electrum stater of Ephesus. 3. Gold stater of Croesus. 4. Daric of Persia. 5. Alliance of Siris and Pyxus. 6. Knossos with Minotaur and Labyrinth. 7. Stater of Thasos. 8. Tetradrachm of Athens. 9. Stater of Corinth. 10. Gold stater of Lampsacus. 11. Stater of Aegina. 12. Stater of Philip II. 13. Stater of Alexander the Great. 14. Decadrachm of Syracuse. 15. Stater of Rhodes. 16. Stater of Lysimachus. 17. Tetradrachm of Alexander the Great. 18. Tetradrachm of Antiochus Hierax. 19. Late tetradrachm of Athens. 20. Tetradrachm of Ptolemy I. 21. Tetradrachm of Cleopatra. 22. Gold 100 litrae of Syracuse

NUMISMATICS

GREEK, ROMAN AND EARLY MEDIAEVAL COINS

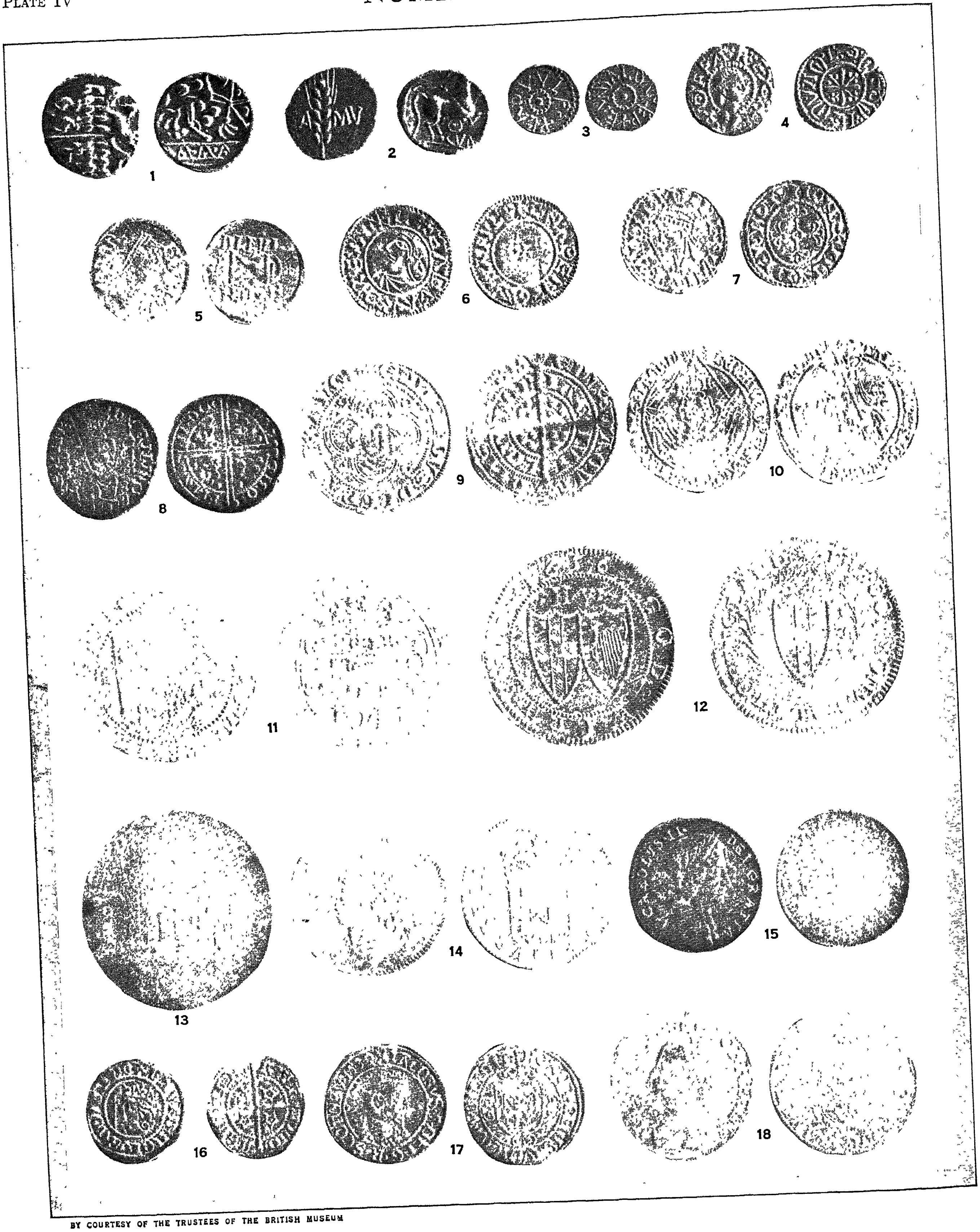
1. Delphi, *c.* 480 B.C. 2. Istrus, 4th century B.C. 3. Syracuse, *c.* 410 B.C. 4. Egypt, 271–46 B.C. 5. Magnesia, *c.* 190 B.C. 6. Nero and Agrippina, A.D. 54–55. 7. Constantine Jun., 317–37. 8. Constans, 337–50. 9. Honorius, 395–423. 10. Tiberius Constantine, 578–582. 11. Offa of Britain, 757–796. 12. Coenwulf of Britain, 796–822. 13. Conrad II., 1024–39. 14. Edward the Confessor, 1042–66. 15. Thuringia (Germany), 1190–1200. 16. Frederick II., 1226–50. 17. Florin (gold) of Florence, 1252–1300. 18. Ducat (gold) of Venice, 1280–89. 19. Henry III. of England, 1257. 20, 21. Louis IX. of France, 1226. 22. Philip II. of France, 1270–85

NUMISMATICS

MEDIAEVAL AND LATER EUROPEAN AND ASIATIC COINS

1. Byzantine cup-shaped coin of Andronicus II. (1282–1328). Byzantine. 2. Philip VI. of France (1328–50). 3. Florin (gold) of Edward III. of England (1344). 4. Noble (gold) of Edward III. 5. The Black Prince (1368). 6. John II. (The Good) of France (1350–64). 7. Visconti family of Milan (1354–85). 8. Edward IV. of England (before 1471). 9. Milan (1479–94). 10. Austria (1486). 11, 12. Henry VII. of England. 13. The Great Mogul Jahangir (1610) India. 14. Charles II. "Petition" crown made by Thomas Simon

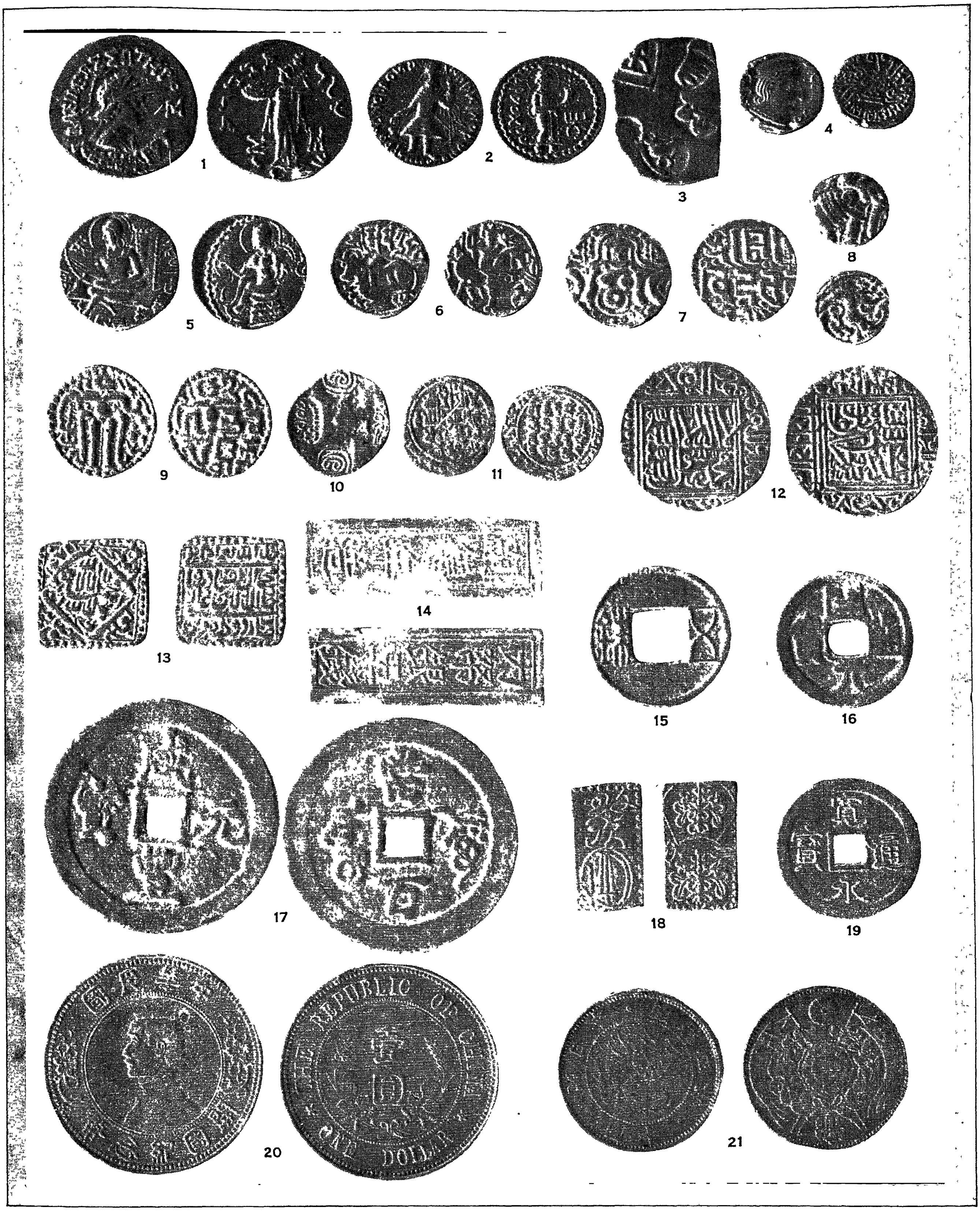
NUMISMATICS



BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

BRITISH COINS

1. Ancient British stater. 2. Stater of Cunobelinus (Cymbeline) 1st century A.D. 3. Northumbrian styca (copper). 7th century A.D. 4. Penny of Offa. 8th century. 5. Penny of Alfred. 6. Penny of Edward the Martyr. 7. Penny of William I. 8. Gold penny of Henry III. 9. Groat (fourpenny piece) of Edward I. 10. George noble (6s.8d.) of Henry VIII. 11. Unite or sovereign (gold) of Charles I. 12. Half-crown of the Commonwealth. 13. Colchester siege-piece. 14. Broad of Oliver Cromwell. 15. Guinea of Charles II. 16. Penny of David II. of Scotland. 17. Bonnet-piece of James V. of Scotland. 18. Ryal of Mary Queen of Scots

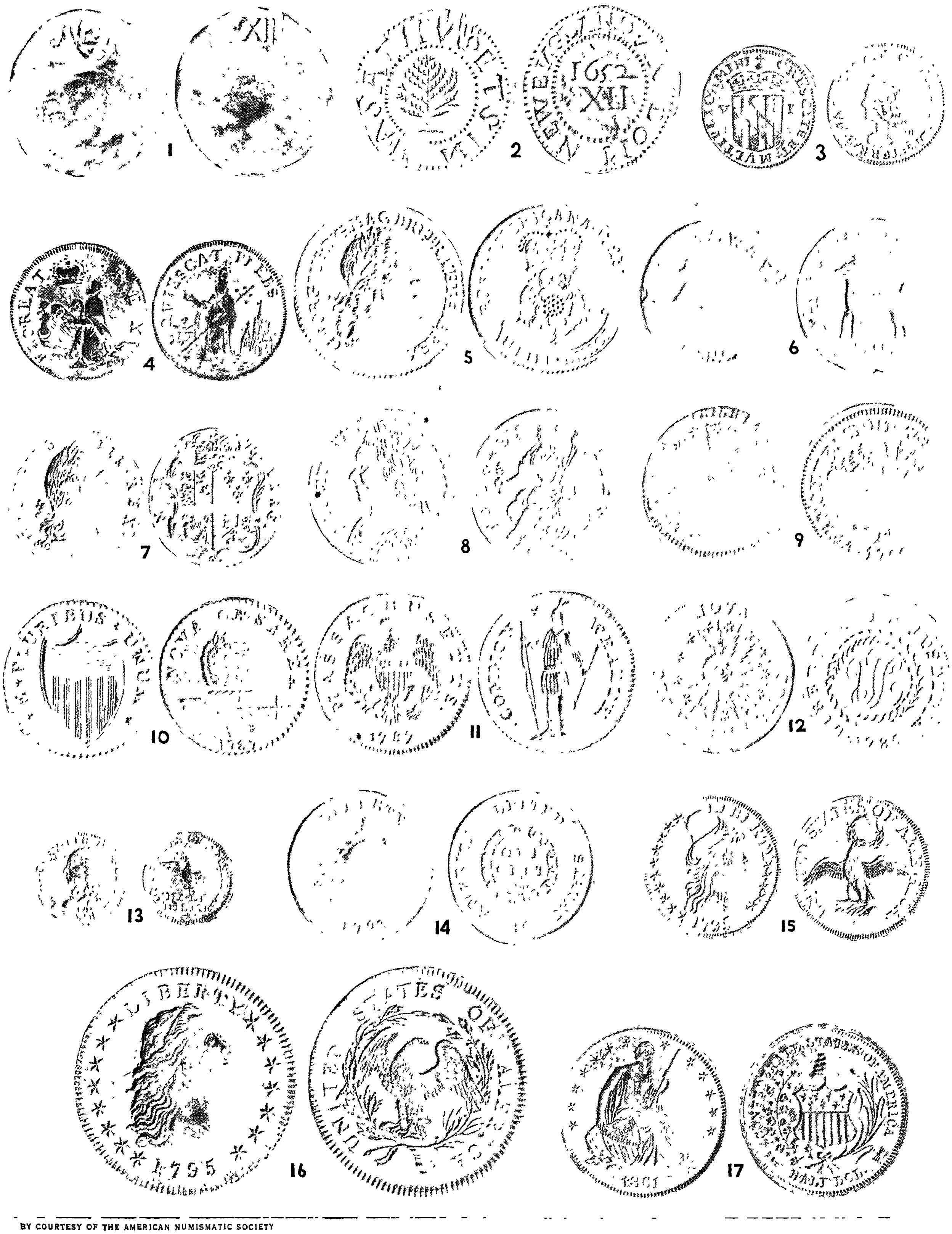


BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

ANCIENT AND MODERN ORIENTAL COINS

1–13. INDIAN. 1. Tetradrachm of Menander. Graeco-Indian, *c.* 2nd–1st century B.C. 2. Stater of Kanishka. 3. Punch-marked, *c.* 3rd century B.C. 4. Western satrap. Silver, 1st century B.C.–4th century A.D. 5. Samudragupta, 4th century. 6. Samantadeva. 7. Govindachandra. 8. Chera, mediaeval. 9. Massa of Ceylon, *c.* 1200. 10, 11. Mahmud of Ghazna, 11th and 12th century. 12. Sher Shah rupee. 13. Mohur (gold) of Akbar. 14. ANNAM. Tu Duc, 1847–83. 15–17, 20. CHINESE. 15. Five-chu piece (copper), *c.* A.D. 500–550. 16. Kai Yuan, A.D. 618–627. 17. Hsien Feng, struck for Chinese Turkistan. 20. Republic. 18–19, 21. JAPANESE. 18. 2 *bu* piece (gold). 19. Sen. 21. Modern gold 10-yen piece

NUMISMATICS



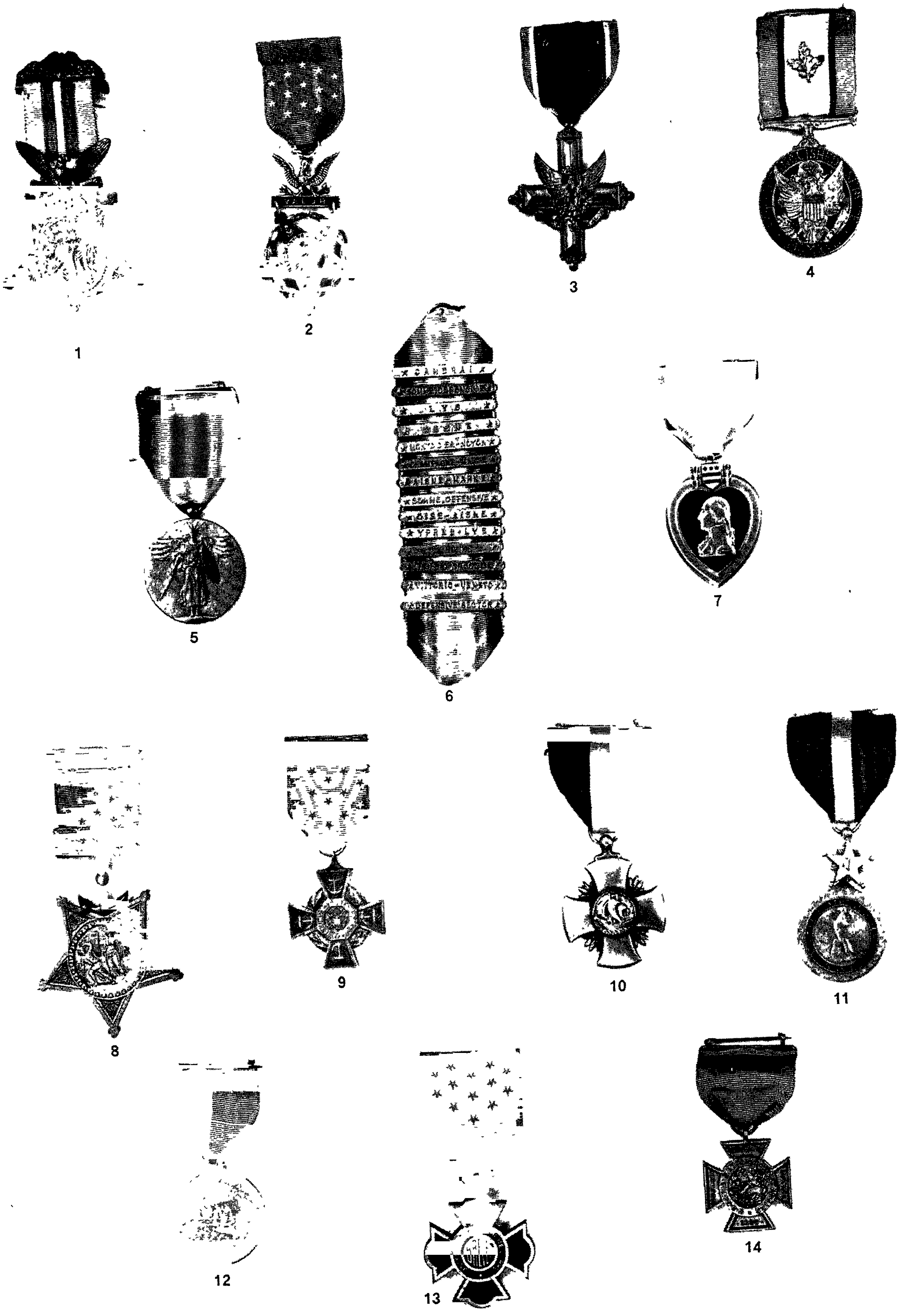
BY COURTESY OF THE AMERICAN NUMISMATIC SOCIETY

EARLY AMERICAN COLONIAL AND UNITED STATES COINS

1. The New England shilling, the first coin made by the colonists. Struck in Massachusetts. 2. The Pine Tree shilling, 1652. Made by John Hull in Boston. 3. The Lord Baltimore sixpence. Made in England for Maryland about 1659. 4. The St. Patrick farthing brought from Ireland by Mark Newby in 1681 and used in New Jersey. 5. The Rosa Americana twopence made in England for the American Colonies in 1722 and 1723. 6. A copper token made about 1737 by John Higley at Granby, Connecticut, to pass for threepence. 7. A halfpenny made in England for Virginia in 1773. 8. A cent made by the State of Connecticut from 1785 to 1788. 9. A cent made by Vermont in 1785 and 1786. 10. A cent made by New Jersey from 1786 to 1788. 11. A cent made by Massachusetts in 1787 and 1788. 12. The Nova Constellatio cent made for the United States in 1785 before the Mint was established. 13. The half disme, 1792. One of the first coins made in the Mint, and said to have been made from silver furnished by George Washington. 14. The first type of cent, 1793. 15. The first type of half eagle (five dollar gold piece). 16. The first type of the silver dollar. 17. The Confederate half dollar. Four only were made at the New Orleans Mint

FIFTEENTH, SIXTEENTH AND SEVENTEENTH CENTURY MEDALS

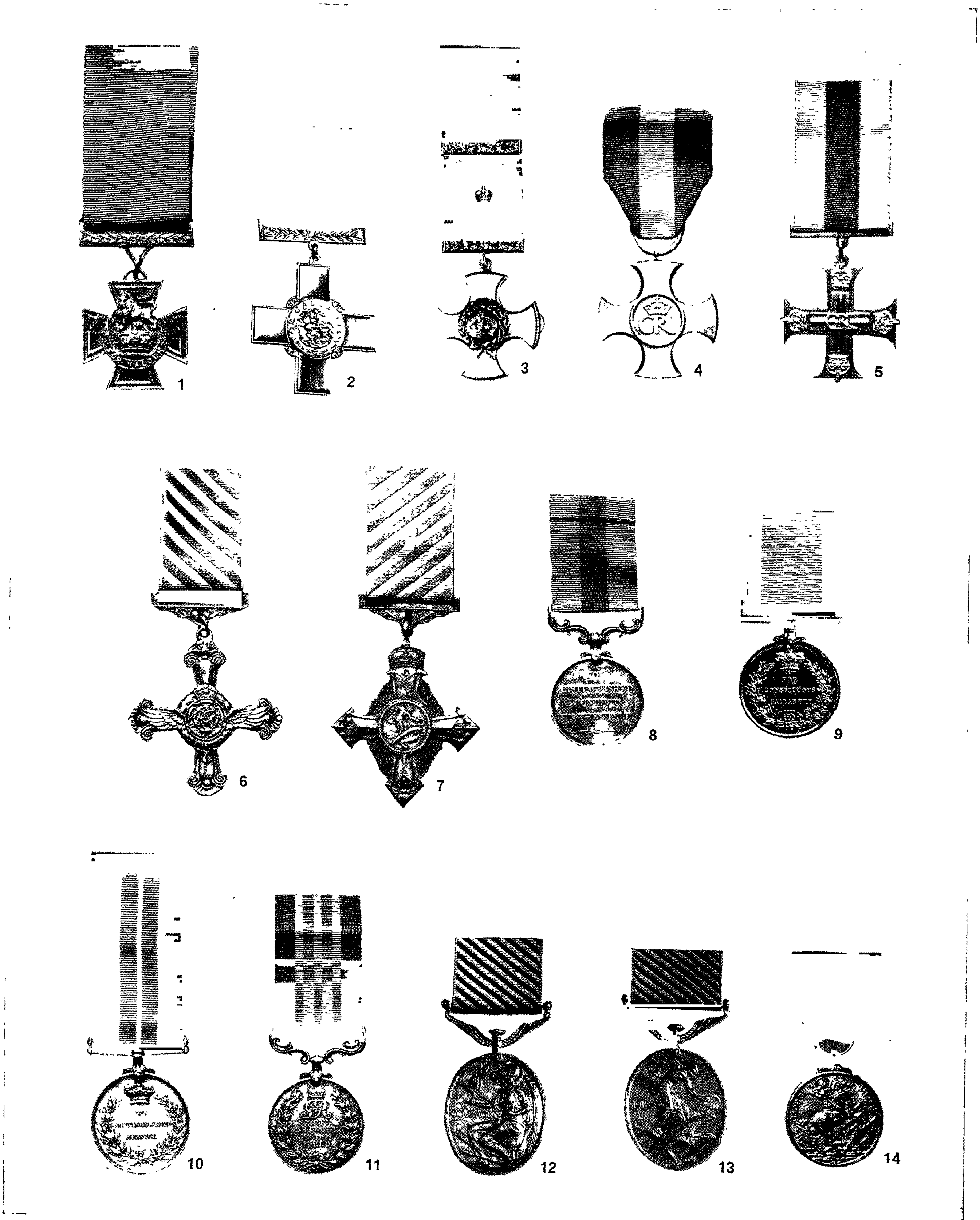
1. John VII., by Pisanello, 1438
2. Christoph Tetzel, by M. Gebel, 1528
3. Vittorio Gambello, by himself, 1508
4. Giovanni Toscani, by Lysippus
5. Edwara Courtney, by Pastorino, 1556
6. Marie de Médicis, by G. Dupré
7. George Monck, by Thomas Simon, 1660



BY COURTESY OF THE SMITHSONIAN INSTITUTION, U.S. NATIONAL MUSEUM

U.S. MILITARY AND NAVAL MEDALS AND DECORATIONS

ARMY MEDALS: 1. Medal of honour, 1st design. 2. Medal of honour, 2nd design. 3. Distinguished service cross. 4. Distinguished service medal. 5. Victory medal. 6. Victory medal clasps. ALL SERVICES: 7. Purple Heart. NAVY MEDALS: 8. Medal of honour, 1st design. 9. Medal of honour, 2nd design. 10. Navy cross. 11. Distinguished service medal. 12. Civil War service medal. 13. Marine Corps brevet medal. 14. Meritorious service medal



BRITISH ORDERS, CROSSES AND MEDALS

1. Victoria cross
2. George cross
3. Distinguished service order and bar
4. Distinguished service cross
5. Military cross
6. Distinguished flying cross
7. Air force cross
8. Distinguished conduct medal
9. Conspicuous gallantry medal
10. Distinguished service medal
11. Military medal
12. Distinguished flying medal
13. Air force medal
14. George medal

nearly eight centuries. When Edward VI again restored a coinage of fine silver he introduced the silver crown of five shillings, which took the name of the gold piece of the same value introduced a few years earlier. The reign of Mary is notable for the appearance of the portrait of her husband, Philip II of Spain, on the shilling.

Elizabeth continued her father's denominations and restored the purity of the silver coinage. By introducing the sixpence and threepence of silver she gave the groat its deathblow, although it and the twopence continued to be struck. She also introduced coinage by machinery (mill and screw) although it was not really established until after the Restoration. James I introduced a number of new gold coins, the most important being the "unite" or sovereign (20*s.*), so called from its legend (*Faciam eos in gentem unam*) alluding to the union of the crowns. In his reign the number of denominations in use reached its maximum. Charles I made no changes in the coinage of the last years of his father, but the Civil War and the king's financial difficulties added many new coins to the English series. These were 20*s.* and 10*s.* pieces in silver and the large gold pieces, *e.g.*, £3 pieces of Oxford and Shrewsbury, the fine Oxford silver crown by Rawlins with a view of Oxford behind the usual type of the king on horseback; the siege pieces rudely struck on pieces of silver plate at various Royalist strongholds show to what straits the king's party was reduced. Under James I and Charles I are found the first English copper coins, the "Harrington" farthings; they were not struck by the king but by contract. The coinage of the commonwealth is remarkable for the simplicity of its types and this is the only period of English coinage when the legends have been in English. A series of coins was struck with Cromwell's bust and superscription but, although not uncommon, they never seem to have been put into currency.

The modern coinage dates from the reign of Charles II. After issuing the old denomination of hammered money in the first two years of his reign, he replaced the unite or broad in 1662 by the guinea, so called from the provenance of its gold, still a 20*s.* piece. It was not until 1717 after various oscillations that its value was fixed at 21*s.* His silver coins were the crown, half crown, shilling, etc., all regularly and beautifully struck by Jan Roettier with the new mill which was then established at the mint. In 1672 he introduced the bronze halfpenny and farthing with the Britannia type. The finest coin of his reign is not a regular issue. It was the "Petition" crown made by Thomas Simon, engraver at the mint under the commonwealth, and bears on the edge a petition to the king that he might be given the same office under the new regime. The coinage of the 18th century calls for no remark; one may just mention the practice of recording the provenance of the metal of particular issues as in the VIGO issues of Anne struck from captured Spanish bullion in 1702, the Welsh Copper company shillings of George I and LIMA coinage of George II made of bullion brought by Anson from his voyage around the word. Toward the end of the century the scarcity of government silver was largely made good by Spanish dollars, with or without a bust of George III countermarked upon them, and by tokens issued by the Bank of England while the deficiency in copper was made up by the private issue of vast numbers of tokens. In 1816 the great recoinage took place with the introduction of the sovereign and silver coins each with Benedetto Pistrucci's design, St. George and the Dragon. In 1848 in the reign of Queen Victoria the 2*s.* piece (florin) was issued and proved a most popular coin. The double florin which was first issued in 1887 did not take the public fancy and the practical disappearance of the crown piece also from circulation reflects the public prejudice against large coins. The gold sovereign was last struck in 1917 but it had disappeared from currency in 1914 soon after the outbreak of World War I, after a career of 300 years as sovereign, unite, guinea and again sovereign.

Wales has never had a regular coinage but there exist two unique coins of Welsh kings, a penny of Howel Dda (*c.* 910–40) and another of Llewellyn (1075–79).

Scotland.—The coinage of Scotland followed similar lines to that of England in regard to types and weights: the earliest coins are silver pennies resembling the contemporary coins of England. The silver coins are baser and of inferior work but the more rare gold coins present several remarkably fine pieces of workmanship. The Scots coinage decreased in quantity after the union of the crowns in 1603 and ceased in 1709 after the union of the parliaments. The only extensive and varied coinage is that of Mary Queen of Scots.

Ireland.—Ireland had an extensive silver coinage in the 10th century, mainly copies of the Anglo-Saxon coinage by Danish kings, Sihtric III and his successors. The Anglo-Irish coinage began in 1177 with pennies and halfpennies of John, the only coins to bear his name which does not occur on the English coins. The quality of the coinage became more and more debased, reaching its final degradation under the Tudors. Gold was never struck by the government but copper was introduced quite early. The Civil War, as in England, produced a number of siege-pieces, notably the Inchiquin and Ormonde money. James II in his campaign in Ireland issued vast numbers of gun-metal coins ranging from the 2/6 downward. These were to be cashed for silver when he regained the throne. They are unusual as they bear the date in months. Irish coinage under the British regime did not actually come to an end until the reign of George IV, the last issue being in 1822. In 1928 coinage by the Irish Free State was introduced.

We may note that the Isle of Man had its own coinage from 1709 under the Earls of Derby to 1864 under Victoria and that the Channel Islands of Jersey and Guernsey have had their own bronze coinage for over a century.

ASIATIC COINS

Achaemenids.—The ancient kingdoms of the nearer east, Sumerian, Assyrian, Babylonian and Hittite, had no coined money, nor had the earlier Achaemenids of Persia. Not till after Cyrus conquered Lydia in 546 B.C. did the Persians learn the art of coinage. It is not certain which Achaemenid ruler first struck coins but it was likely Darius Hystaspes (521–486) as Herodotus suggests. The coins of the dynasty were the daric (*i.e.*, the coin of Darius) of gold of very pure quality and the siglos in silver. Thus early we have the relationship of sovereign and shilling anticipated, for 20 sigloi (shekels) made a daric which weighed a little more than an English sovereign. The types of both coins were the same: obverse the Persian king in a kneeling position holding a bow in his left hand and a spear in his right; the reverse bears no type but only a rough irregular incuse caused in the striking. In shape they are roughly oval being struck from round or rather egg-shaped globules of metal. These pieces were uninscribed and remained in issue unaltered in type until the fall of the empire. The issue of gold was the royal prerogative, but the conquered Greek and other cities and states were allowed to issue silver and copper while a number of Persian satraps struck silver in their own names; to this latter class we owe a number of the earliest and finest portraits on coins. On the fall of the empire, various satraps, such as Mazaeus who ruled Babylon for his new master Alexander the Great, struck silver coins of their own.

Parthians.—In the middle of the 3rd century the Parthians rebelled and cast off the Greek (Seleucid) yoke and soon became a great power in Persia. They had an extensive but monotonous coinage in silver (tetradrachms and drachms) and copper. The tetradrachms and drachms bear the bust of the king and Arsakes, the founder of the dynasty, seated holding the Parthian bow on the reverse of the drachms. The usual reverse on the tetradrachms is the king seated receiving a wreath from a Victory or a city goddess. The coins do not bear the name of the issuer but that of Arsakes, the founder of the dynasty, and the inscriptions range in length from the simple (coin of) "king Arsakes" to legends such as (coin of) "the great king of kings, Arsakes, the just, the illustrious, the divine, the friend of the Greeks." After Phraates IV the coins are dated in the Seleucid era; on the later coins the Greek becomes corrupt and broken and is joined by an inscription in Pehlevi, a language then more intelligible to those who used the coins.

The kings of Persis, who became independent about the same

time as Parthia, began their series with very fine portrait tetradrachms but the coins rapidly degenerated; their reverse type, a fire altar with or without attendant priests, was revived by the Sassanians so that it had a life of nearly 1,000 years; numerous debased silver, almost copper, tetradrachms of the rulers of Characene and of the Omani on the lower Tigris down to the sea still exist to record the names of forgotten rulers.

Sassanians.—In the beginning of the 3rd century A.D. Ardashir, a native Persian prince, overthrew the last remnants of Parthian power and founded the great Sassanian empire which ruled all western Asia. The Sassanian coinage was very extensive in silver and the early emperors regularly coined gold although the latter was rare. The copper coinage also seems to have been small. The coin types throughout the dynasty are the same for all metals; on the obverse is a bust of the king with a long legend of the form (Ardashir, etc.) "worshipper of Ahura Mazda, divine king of kings of Iran," and on the reverse a fire altar usually with two attendant priests and the legend "the fire of (Ardashir or other emperor)"; from the time of Kobad the reverse legend gives the mint and the regnal year of issue. The standard of the gold coins is derived from that of the Roman solidi; the silver coins are drachms following the Parthian standard and are remarkable for their broad thin fabric which was copied by the Arabs for their silver coins. The execution of the portraits especially in the 3rd and 4th centuries is remarkably fine.

Caliphates.—The early Arabs were unacquainted with the art of coinage which had died out in Arabia with the extinction of the Himyarite kingdom in the south; it was not till the conquering armies of Islam had wrested Syria from the Byzantines in the east and overthrown the Sassanian empire of Persia in the west that they became acquainted with regular currencies and with the sudden accession of wealth found the need of one. At first they issued gold and bronze pieces imitated from contemporary Byzantine coins, modifying the cross on the reverse of the latter somewhat to suit Moslem susceptibilities; the earliest silver coins were copies of late Sassanian coins with the addition of *bismillah* (in the name of God) on the margin. The need for a purely Arab coinage worthy of the now vast Arab empire was soon felt and toward the end of the 7th century the fifth Omayyad caliph, 'Abd al-Malik (A.D. 685–705), instituted a coinage more in keeping with the principles of Islam. This coinage was of gold, silver and copper and the names *dinar* (denarius aureus), *dirhem* (drachm) and *falus* (follis) were borrowed from the Byzantines, as were also the weights of the gold and bronze. It is interesting that the gold and bronze kept the thick fabric of the Byzantine originals while the silver retained the thin fabric of the Sassanian drachms; it was some centuries before this distinction of fabric disappeared. The strict interpretation of some sayings of Mohammed on image-making had removed a vast field of activity from the Moslem mint engraver by limiting him to legends instead of types. This, however, gave Arab coins a historical value which the coinage of no other race possesses. From the earliest times they bear the mint and date and in time the ruler's name and title often with valuable genealogical data and titles of historical interest. Every Moslem claimant to sovereign power took the earliest opportunity of striking coins and we possess coins of rulers and pretenders known to have had the briefest reigns and in some cases their coins still testify to the existence of rulers unrecorded by history.

The dirhem of 'Abd al-Malik bears on the obverse the Moslem profession of faith: "There is no god but God: he has no associate" and around is the marginal legend: "In the name of God this dinar was struck at —— in the year ——." The reverse area has a quotation from Koran cxii, "God is alone; God is eternal: He begets not and is not begotten nor is there any one like unto Him." Around is Koran ix, 33: "Mohammed is the Prophet of God sent with guidance and the religion of truth to make it prevail over all other religions averse though the idolators may be." This type of coin, issued from Spain and Morocco to the borders of China, gave Moslem coinage the character which it held for centuries. In mid-8th century the 'Abbāsids overthrew the Omayyad caliphate but at first made little change in the coinage. The long reverse formula was replaced by the simple statement "Mohammed is the Prophet of God" and in time the caliph's name was added and at the provincial mints that of the local governor and in the 9th century a second marginal inscription was added: "To God belongs the order before and after and in that day believers shall rejoice in the help of God" (Koran xxxi, 3–4). Among the more remarkable coins of this series are those of Hārūn al-Rashid (786–809) which bear the name of his vizier and boon companion the ill-fated Barmecide Ja 'afar, whose fame, like that of his master, has been spread by the *Arabian Nights*. The extensive gold coinage of the 'Abbāsids became one of the great currencies of the mediaeval world and Offa in his efforts to found an English coinage imitated a dinar of al-Manṣūr (A.D. 754–775).

The 'Abbāsid caliphate broke up in the 9th and 10th centuries and the succeeding independent governors regularly put their own names on the coins although they retained that of the caliph of Baghdad whose spiritual authority was still recognized. Among such dynasties were the Omayyads of Spain, who issued an extensive coinage mainly in silver from the middle of the 8th till the end of the 11th century, the Idrīsids, Tūlūnids, 'Aghlabids and Ibhshīdids, all short-lived dynasties in North Africa and Egypt, coining mainly in gold. In central Asia there was the extensive coinage of the Sāmānids of the days when Samarkand and Bukhara were great centres of culture and poured their wealth into northern Europe to buy costly furs, as the great finds of Arab coins around the Baltic show. The 'Abbāsid coinage continued down to the 13th century but Baghdad was almost its only mint in its latter days; its last coins were very handsome large gold pieces. Minor dynasties mainly of Persian origin were the Ṭā'hirids, Saffarids and Būyids whose silver coins are still valuable historical documents.

In the 10th century the Fāṭimid caliphate, of Shī'a origin, arose in western Africa and in time conquered Egypt. Its extensive currency of gold introduced a new type of dinar with legends of the usual type but arranged in three concentric circles; they held Sicily for a time and the coins struck were imitated by their Norman successors. A little later the Turks arose in the west, swept before them the smaller dynasties and ultimately ruled all western Asia. As the Ghaznevids, they ruled in Afghanistan and part of India; Mahmud of Ghazni struck coins with inscriptions in Arabic and Sanskrit, the latter for his Indian dominions. His regular gold coinage and those of the great Seljuk Tughril Bey are among the last issues of the old type and in the 13th century we have a series of remarkable innovations. The descendants of the original Seljuk conquerors divided their conquests in western Asia into numerous small states. Their scarce gold coinage follows orthodox lines, while giving a wealth of historical information, but the most remarkable of their issues was an extensive series of large copper coins bearing a remarkable number of different types borrowed from all sources, ancient Greek and Roman and Byzantine. They seem to have taken a childish delight in reproducing any coin type or even picture that took their fancy. Such are the coins of Karā Arslān (1168–1174) with reverse the familiar Byzantine type of Christ seated or of Alpī (1152–1176) with the virgin crowning a Byzantine emperor. Their silver coins were directly influenced by the aspers of the Byzantine emperors and more particularly by those of the empire of Trebizond. From the latter comes the type of a horseman with a mace over his shoulder, popular with the Seljuks of Asia Minor. Notable among the silver coins of this period are those of Kai Khusru II (1236–45) with the Lion and Sun type, the horoscope of his beautiful Georgian wife whose portrait he even wished to put on his coins. It is these Turks, Seljuk, Ortukid and Ayyubid, who were the "Saracen" opponents of the Crusaders, the best known of them being Saladin, the Ayyubid sultan of Egypt and Syria; his silver coins and those of his family give their titles at great length to the exclusion of religious legends. During this period and a little later some of the most beautiful coins the Moslem world has produced were being struck by the Almohads and Almoravids in western Africa. These large thin pieces of fine gold bear long genealogical

and religious legends written in a beautiful, often elaborate script. Ibn Baṭṭūṭa, the Moorish traveller, remarked that nowhere were the dinars so large and beautiful as in his native land.

In the 13th century the Mongols swept through all Asia except India until checked on the Egyptian frontiers. Of the Mongol lines, the Khans of the Golden Horde in the north issued an extensive series of small silver coins; the greater and wealthier line of the Ilkhans of Persia struck large and handsome coins in all three metals, with the Khan's titles in Mongol on the reverse and the Mohammedan creed in the Shī'a form on the obverse. In Egypt the Bahrī and later the Burjī Mamluks struck a series of large gold coins down to the 16th century; their silver coins are more rare. In the 14th century the great Tamerlane (A.D. 1369–1404), a distant descendant of Jenghiz Khan, revived the power of the Mongols; the majority of his coins (silver and copper) bear the name of his nominal sovereigns Suyurghatmish and Mahmud on the reverse and the Kelima on the obverse. His son and ultimate successor, Shāh Rukh, introduced a new type of dirhem, obverse Kelima with the names of the first four caliphs on the margin and his titles on the reverse, which remained popular throughout the 15th, 16th and early 18th centuries; gold was not struck in Asia during this period. In the meanwhile the eastern half of the Moslem world was passing to the Ottoman Turks. Their coinage of gold and silver, which became gradually more and more base, and bronze is monotonous in its legends of stereotyped titles and mints only. Their wealth of mints gives their coins a certain historical interest as they trace the expansion and decline of Ottoman power in Europe, Asia and North-Africa. A notable feature of the Turkish coinage is the tughra, an elaborate monogram formed of the sultan's name and titles which occupies one side of the coin from the 16th century onward. Latterly Constantinople and Egypt were the only Turkish mints of importance. The coinage of Morocco rapidly degenerated in every way from the 16th century onward, though its most recent issues struck in Paris, Berlin and Birmingham show an improvement.

Persia.—The earlier coins of the shahs of Persia are descended through the Shaibanids from those of Shāh Rukh; at first they are large thin silver pieces of Central Asian style but in the 18th century the fabric changes and the coins become smaller and thicker as in India. The coins, especially the larger pieces, are remarkable for their fine calligraphy; the legends are usually in the form of rhyming couplets; gold is not common till the 18th century. Copper was not a regal but a local issue and each city issued its own. The coins are remarkable from the the fact that each city's has some type, usually an animal. Some of the products of the Persian mint are of huge size (for example, a gold piece of 80 tumans weighing over a pound) and were pieces struck for presentation to distinguished officials. In the latter part of the 19th century Nasr-ed-Din (1829–1896) abolished the provincial mints and instituted a coinage from a central mint in Tehran with European machinery. Henceforth the coins of Persia bear the portrait of the shah on the obverse and the "lion and sun" on the reverse.

Afghanistan.—The emirs of Afghanistan who became independent of Persia in the 18th century and carved out a kingdom at the expense of their neighbours in Persia, central Asia and India, struck coins in gold and silver on the standards of the Mogul emperors whose poetical legends they also copied. At the end of the 19th century a mint on European lines was established in Kabul and the high-flown distichs were replaced by a representation of a durbar hall. The Afghan coinage of the 19th century was mainly silver, although earlier gold also was common.

Of the various smaller modern dynasties which ruled central Asia till the Russian conquest, the emirs of Bukhara and of Khokand are notable for their extensive issues of gold pieces, to the practical exclusion of other metals.

India.—There is no reason to doubt the independent origin of coinage in India although it was soon so much modified by Greek influence that the question was long disputed. The earliest coins are pieces of silver, very commonly square, and of copper punched with various symbols on both sides. Of about the same date are the square and round cast copper pieces with similar but less varied symbols. These pieces circulated all over India and belong to at least the 4th century B.C. although they circulated after this date and may be somewhat earlier. Contemporaneously from the 3rd century onward are the copper coinages of numerous states and dynasties which show increasing Greek influence and whose few silver coins are directly influenced by the hemidrachms of the Greek rulers of northwest India of the 2nd century B.C. The types of these are of considerable mythological and religious interest. Technically they are interesting as showing the evolution of a type from a series of separate punches to the grouping of the punches on a die.

Early in the 2nd century B.C. the Greeks of Bactria began to invade India and their coinage is remarkable for its fine series of portraits and for the number of names it records of rulers otherwise unknown. Prakrit legends begin to appear alongside of corrupt Greek; the Greek in time becomes more and more corrupt as the Greek rulers were replaced by Scythian and Kushan invaders who copied their types. The Greek deities gradually give place to Indian ones on the coins.

In the middle of the 1st century A.D. the Kushans founded a great empire in northwest India; they have left a wealth of gold and copper coins with legends in an Iranian language in a corrupt Greek character. During this period Roman gold in enormous sums went to India every year and was recoined there. The Kushan coins bear on the obverse the king sacrificing and on the reverse deities of all the religions of the time, Greek, Roman, Zoroastrian, Hindu and Buddhist. This type of king on obverse and deity on reverse became the general type of north Indian coinage for the next 1,000 years; the Kushan coinage continued, rapidly degenerating till the 4th or 5th century, over a much more limited area; the type was continued by the kings of Kashmir down to the 10th century and adopted and modified by the great Gupta emperors in the 4th century. The latter struck an extensive gold coinage with long legends in poetical Sanskrit and many interesting types, often medallic in nature, but, on their coins for general currency at least, always betraying the Kushan prototype. Among the more notable Gupta coins are those that commemorate Sandragupta's horse-sacrifice, or those that record his skill as a lyrist, to which he also testifies in his inscriptions. The art and correct Sanskrit legends of these coins are in keeping with the great Hindu revival of the period.

In western India a dynasty of western Satraps of Persian origin had been ruling since the 1st century B.C. Their extensive coinage of silver only is dated and therefore of a historical value unusual in Indian or any early coinage. They look modern in that they bear on the obverse a bust of the ruler; they resemble Roman denarii and may have been influenced by them but their prototype is rather to be sought in the hemidrachms of the later Greek kings of India. This kingdom was overthrown by the Guptas at the end of the 4th century and they at once began to imitate this silver coinage not only locally but also in their own territory which seems previously to have had no silver coins. The barbarian Huns who destroyed the Gupta and other civilizations in the 6th century have left numerous coins, imitated from Sassanian, Gupta or Kushan prototypes. Degenerate copies of these seem to have been the coinages of northern India until the revival of various Hindu dynasties from the 10th century onward. A notable innovation was the neat silver coinage of the Shahis of Gandhara of the "bull and horseman" type in the 9th and 10th centuries, extensively imitated by the Mohammedan conquerors of India and the contemporary minor Hindu dynasties. The other type favoured by the mediaeval Hindu dynasties for their gold coinage was that of a seated goddess—going back to a Gupta reverse—and an inscription with the king's name on the other side.

The coinages of southern India form a class by themselves. In the later centuries B.C. and early A.D. the Andras ruled a great kingdom in central south India; their coinage is mainly of lead and has types of the usual indigenous character.

The later mediaeval dynasties of south India struck coinages mainly of gold, the type of which is usually the badge of the dynasty; the Cheras of Malabar for example had an elephant and

the Chalukyas of the Deccan a boar, the Pandyas a fish and the cup-shaped pieces of the Kadambas bear a lotus. The Chola dynasty introduced under northern influence the type of a king standing on obverse and on the reverse the king seated, which spread through south India and was taken to Ceylon by the Chola conquest and adopted by the local rajahs there. The great Hindu kingdom of Vijayanagar (Mysore) left a large series of small gold and copper coins with the types of various deities which had considerable influence on the modern coinages of southern India including those of the various foreign companies.

The earliest Arab invaders had reached India in the 8th century and founded a dynasty in Sind which has left numerous very small silver coins of the Omayyad type. Not till the 11th century was India seriously affected by Moslem invasions when Mahmud of Ghazna conquered the Punjab. His empire was short-lived. In 1193 the Ghorid Mohammed bin Sam defeated the allied Hindu forces and became lord of India. His descendants ruled northern India from Delhi till the Mogul conquest. Their coinage is varied and extensive, mainly gold and silver tankas (or rupees) of 178 grains. They are large thick pieces with the profession of faith on one side and the name of the king, mint and date on the other. A feature of this coinage is the unsuccessful attempt made by Mohammed III b. Tughlak (A.D. 1324–1357) to replace gold and silver coinage by brass tokens. Gold was hardly issued at all in the 15th and 16th centuries and for a time the coinage was mainly billon. Sher Shah (1539–45), one of the ablest of the line, issued a large silver currency of a type, carrying the Kelima and names of the four caliphs, which was imitated by the Mogul successor of the Suris.

During the latter half of the period of the sultans of Delhi, various dynasties made themselves independent; such were the rulers of Bengal, Gujarat, Jaunpur, Malwa, etc., whose coins all follow the standards of the central power. Those of Bengal are mainly silver rupees with rare gold; the currency of Jaunpur, gold and billon. Malwa and Kashmir gold and silver coins were square.

The coinage of Bāber and Humāyūn, the first two of the Mogul conquerors of India, are not extensive and are of central Asian types. With the next two, the Great Moguls Akbar and Jahāngīr, is found a series unrivalled for variety and, within their limitations, beauty—the gold coins of Jahāngīr are noble examples of Moslem calligraphy, an art evidently cultivated as much as painting at his court. The mints of the Mogul coins reflect dynastic fortune—even Shāh Jahān's brief occupation of Balkh is at once recorded on a gold mohur. The close association in the Moslem mind between sovereignty and the right of the coinage is exemplified in the existence of the coins of many pretenders to the imperial throne, some of whom we know from history to have had the briefest spell of power. The general type throughout is the same. In the 16th century the type that goes back to Sher Shah prevails, the Kelima with the names of the first four caliphs and the emperor's titles on the other side; Aurangzib replaced the confession of faith by the mint and date and this remained the usual type till the end of the dynasty. The emperor's name is usually enshrined in a Persian couplet to the effect that the metal of the coins acquires added lustre from bearing the emperor's name. Nearly 50 such verses are found on Jahāngīr's coins. The latter's reign is also remarkable for the series of coins bearing the sign of the zodiac and the set of portrait mohurs, one of which represents him holding a wine cup. He also allowed his wife, Nūr Jahān, to strike coins in her own name, and she is also said to have inspired the issue of the zodiacal series. From the beginning of the 18th century the coins become stereotyped and the epigraphy loses its beauty. Numerous native states began to arise and throw off the Mogul yoke, but to the middle of the 19th century they continued to coin on Mogul lines. The English and French East India companies for years copied the native types from the coinages and did not strike on European lines till the 19th century. The right of native states to mint their own coinage was gradually curtailed by the British government until there were very few independent coinages. The most important native state mint at present is Hyderabad, which several years ago instituted a mint with European machinery. Before leaving India mention should be made of the extensive coinage in gold and silver with Sanskrit legends of Nepal, which is still being issued, the long series of octagonal gold and silver coins of Assam struck down to the British conquest, and the brief coinage of Burma in the 19th century.

Chinese.—In spite of the very early references to money in Chinese literature, there is no reason to believe that the earliest coins are much older than the 7th century B.C.; that is to say that coinage originated independently in the far east about the same time as it did in the west. The earliest Chinese coins are small bronze spades and knives, copies of the spades and bill-hooks and other small articles of husbandry that had been used for barter. The knives are about six inches long and bear the value and name of authority issuing it; *pu* money, a modified form of the spades, circulated widely in the 5th and 4th centuries B.C. Small change was supplied by cowrie shells in this period, as it had been long before the invention of a coinage. There was an issue of bronze cowries in the 7th century B.C. Round money with a hole in the centre was issued as early as the 4th century but it was not till 221 B.C. that the reforming Shah Huang Ti (221–210 B.C.) superseded all other currencies by the issue of round coins of half an ounce (*pan-liang*), which were continued by the Han dynasty. This coin became gradually reduced and debased and was replaced in 118 B.C. by the emperor Wu Ti's five-chu piece which remained the coin of China for the next eight centuries; a break in the monotony of the regular coinage is formed by the archaistic innovations of the usurper Wang Mang (A.D. 9–22) who issued a modified form of the *pu* and knife currency and a new round coin (*ho tsien*). The history of Chinese coins is the history of a series of gradual debasement of the government currency until it is overwhelmed by the increasing activity of forgers and a new coin is instituted. On one occasion at least the most skilful of the forgers were given work at the government mints. The five-chu piece lasted till the rise of the T'ang dynasty when the emperor Kau Tsu in 618 issued the *Kai-yuan* coin which gave the coinage of all the far east its form till the end of the 19th century—a round coin with a square hole and a four character legend of the form "current money of (regnal period)." The southern Sung dynasty (A.D. 1137–1278) dated their coins on the reverse in regnal years and the Ming dynasty (A.D. 1368–1628) put the mint name on the reverse as did the Ching dynasty (A.D. 1628–1911), the latter giving it in Manchu characters. Paper money has been in use in China since the 9th century and was current almost to the exclusion of regular coins under certain of the Mongol emperors, for example Kublai Khan, whose paper money is described by Marco Polo. For over 2,000 years the copper cash with occasional multiples of it was the only coinage of China; gold and silver were current by weight only, the latter in the form of boat-shaped ingots. The monotony of the series is only rarely broken as for example by the nail-mark of the emperor Wen-Teh on the Kai-yuan pieces, an issue of lead coins in the 12th century and the issue of large token pieces going up to 1,000 cash in value during the Tai Ping rebellion when the rebels held the copper mines. With the increasing popularity of Spanish colonial and Mexican dollars as a silver currency in China, several attempts were made to institute a silver coinage in the 19th century; not till the very end of the 19th century were mints established to strike silver and copper coins of European style in all the provinces. One of the last of these, a rupee of Szechwan, was the only coin of the Chinese empire to bear the head of an emperor. This was because it was intended to compete for Tibetan trade with the Indian rupee. Under the republic, coins were at once struck with the portraits of Sun Yat Sen and Yuan Shih Kai, and the various generals who have since been fighting for China have issued their own coins with their portraits. A feature of the issues of the latter has been the number of gold coins they have issued, for the first time in Chinese history. The very extensive series of talismans, coinlike in shape but usually larger should be noted. Many are Taoist and Buddhist in their legends and types; others are simply lucky pieces.

Japan.—The art of coinage was borrowed from China by Japan whose first bronze coins were issued in A.D. 708. Twelve

different issues were made down to the middle of the 10th century, each of a different reign. For the next 600 years, however, no government coins were issued and the currency was supplied by imitations of contemporary Chinese coins made by the great nobles. In the 17th century the copper *kwan-ei* was first issued in 1624 and remained in vast variety the usual issue for over two centuries. The *ei-raku* and *bun-kyu* sen of the 19th century were the only other regular copper coins. Unlike China, Japan has had a gold and silver currency since the 16th century. The gold coins are large flat pieces in the shape of rectangles with circular corners, the largest size being *obans* and the smaller *kobans;* these bear various small official stamps and a large signature in ink of a mint official. They range in length from 6 in. to ½ in. Other gold pieces are the small rectangular pieces of 1 and 2 *bu* issued from time to time; round gold is rare and usually of provincial mints. There have not been many issues of silver, usually in small rectangular pieces; the so-called bean money with the figure of Daikoku is not a currency but was made to add to the large, long silver presentation pieces to bring them up to a certain weight. A notable Japanese coin is the oblong silver piece struck in 1765 out of confiscated silver ornaments by an official named Taruna.

In 1869 a mint on European lines was established in Tokyo and gold, silver (yen or dollar) and copper have since been regularly issued from it. The *e* sen of Japan are not coins but amulets and bear figures of Daikoku, the god of wealth, Itsibu fishing, etc.

Korea.—Korea has had a bronze coinage of the Chinese style since the 12th century, but it is only with the institution of *Shang Ping* cash at numerous mints, with an elaborate system of dating or rather numbering the issues between 1790 and 1881, that its coinage becomes common. Attempts were made to establish a silver currency during the last years of its independence. Annam began by imitating Chinese coins and had a regular bronze coinage of its own on the Chinese model from the 10th to the 19th century. Silver became common in the 19th century in the form of narrow oblong bars. Annam also has its amulets or rather presentation pieces. These are in gold, silver, and copper with a variety of designs bearing auspicious inscriptions, quotations from the Chinese classics, etc., in addition to the king's name. The native coinage ceased when Annam became a French possession.

Siam.—Siam down to the middle of the 19th century struck gold and silver in the form of balls formed by doubling in the ends of a short thick bar of silver, and bearing the stamp of the reigning monarch. Since 1850 it has had a coinage on European lines with portraits and issues in gold, silver and copper and more recently in nickel.

The native kingdoms of the Malay Straits used lead for their coinage, these are usually round with Malay or rarely with Chinese inscriptions; an exception is found in the "hat money" of Pahang in the form of a hollow square with truncated pyramids and a Malay inscription along the bottom. The spear money of the Nagas, the canoe-shaped and willow leaf money of the Shan States and the "snail shells" in silver of the more primitive parts of Burma can only be mentioned here.

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TECHNIQUE AND ART

The technique of production of coins and medals has remained in principle the same from the earliest period of coinage to the present day; the gradual introduction of more complicated machinery, while lessening the part played by human hand and eye in the later stages of the process, has never, unless the so-called photosculpture be acknowledged as an art, eliminated the part of the artist in producing in one form or other the actual relief of the coin or medal type.

Casting and Striking are the two sharply distinguished methods of production. The former, although it was little employed in antiquity save for large coins, may be described first, since it was the method that metal-workers used on a larger scale for the solid casting of statues, statuettes and decorative work, etc. A model was first built up in wax or clay. The process of carving the model out of a mass of wax was occasionally employed, sometimes partly combined with the building up process, but there is no evidence of this before the days of the Renaissance. Another method of producing the model, that of carving it in boxwood or pearwood or in fine stone, such as Solnhofen stone or slate, was brought to a high degree of perfection by the Germans of the Renaissance; it was almost unknown in Italy. The model once made was impressed in a mould of fine sand or other material, and a cast was made. Some of the German medallists of the Renaissance seem to have carved the design in reverse in clay (just as if they were carving a matrix in hard material) which was then baked and used as mould. In the case of small coins a number of moulds were often combined, with channels leading from one to the other. Tree-like sets of coins produced in the Far East by such casting *en chapelet* are still extant.

The coins produced by this process are seldom of precious metals and almost entirely negligible as works of art, being of the roughest kind. But the method was employed by all the greatest medallists, from the founder Pisanello, in the 15th century, onwards, in preference to the more mechanical process of striking. Casting was carried to a high degree of excellence (especially by the Germans), the ideal being to reproduce the wax model without subsequent chasing. The Italian medallists were sometimes content with the roughest representation of their work. Others depended on chasing with the burin or graver to remove the irregularities of the cast; and often the chasing was by an alien hand. Any coin or medal could be used as a model, for impressing

in moulding material, so that a new cast could be made. The vast majority of the extant medals supposed to be of the 15th or 16th century are after-casts to the nth degree. Detail has disappeared and the actual diameter has decreased since metal contracts in cooling.

The Repousse Process (*q.v.*) can of course also be used in making medals, in shells, of which the two halves are worked separately. This process was especially favoured in Holland in the 17th century. The process of pressure-casting has also, it is said, been used in recent times. Plaquettes (which are small metallic reliefs, differing from medals in being primarily decorative, not commemorative, usually one-sided and more frequently rectangular than circular) are produced like medals.

Striking of coins or medals is done by means of dies, engraved in intaglio, and impressed on the metal by blows or pressure. It is the method of impressing a signet on wax applied to a hard material, the type of a coin being, indeed, in origin and principle the signet of the issuing authority. The die had first to be engraved in a hard material. Not until Roman times was iron and occasionally steel used for this purpose. The Greeks used bronze, and analysis of two of the extremely few Greek dies that have survived shows a proportion of from 18 to 22% of tin, the rest being copper with negligible impurities. Such proportions mean a very hard quality of bronze. Modern dies are all of steel.

Hubbing and Cutting.—The die can be cut direct in reverse as an intaglio gem is cut. Or a positive punch or hub can be carved in relief in hard metal, and hammered into a piece of softer metal, which can then be hardened for use as a die. Details which cannot be produced by hubbing in this way can be finished by direct cutting. Both methods were known to the ancients; though no ancient hubs, and very few ancient dies are preserved, examination of the struck coins reveals certain details which can only be due to hubbing. The amount of time and labour saved by hubbing is immense; with one hub many dies can be made, whereas if the design is represented by a die alone, when that breaks or wears out all the work has to be done again. The instruments used in antiquity by die-engravers were the graver or scauper and the dotting-punch. There is no evidence that they used the drill, although that instrument was in the hands of every gem-engraver. The fineness of the work, the almost microscopic detail, must have necessitated the use of magnifying glasses, and there is evidence, literary and material, that these were known to the ancients. (*See* ENGRAVING.)

The Reducing Machine.—The second way of obtaining a die was invented in the 19th century and, greatly to the detriment of the art, ousted the method of cutting by hand. It involves the use of the reducing machine, which dates in origin from about 1839 (*see* MINT). The artist first makes a model in wax or plaster at least four times the size of the piece to be produced. This, reproduced in a nickel-faced copper electrotype, is placed in the machine, which works on the familiar principle of the pantograph. A tracer at one end of the proportional arm moves over the whole surface of the model. At the other end a cutting point, revolving rapidly, cuts an exact, mathematically reduced reproduction of the model. Thus is produced a punch which, when driven into another piece of soft steel, afterwards hardened, gives the die which can be used to strike the coin or medal. It is obvious that the die so produced is at least three stages removed from the artist's original model which may not be suitable for a small scale relief, however exact.

The result of the introduction of this machine has been that artists have ceased to trouble themselves about the final metallic product. Not having to cut the metal themselves, they have lost the sense of material. They model in wax or plaster, and the coins or medals which are struck from the dies produced without their intervention appear as if they were made of wax or plaster coloured to look like metal.

Preparing the Blanks.—In ancient times dies were cast, sometimes actually in globular form, more usually in a form approximating to that of the final product, with sufficient convexity to allow the metal to penetrate to the deepest recesses of the die. They could also be cut from bars. The thin blanks of the middle ages were clipped out of a sheet of metal; in modern times they are punched out of a rolled bar. In antiquity, the lower die, which produced the obverse, was let into an anvil. The upper (for the reverse) was on the end of a cylindrical bar. The blank being placed on the anvil die, the reverse die was placed above it, and a sledge-hammer brought down on the upper end of the bar. How far the blank was heated before being struck we do not know. Such a primitive method of striking, without a collar to keep the blank in shape, produced great irregularities, splitting of the edge, double-striking and the like. The Greeks were indifferent to such things. The methodical Roman was more careful, and his coins are less irregular in shape. The sledge-hammer blows of course placed great strain on the dies. The first invention to obviate that disadvantage consisted in placing the dies in a frame and hammering wedges in between frame and dies, thus forcing the latter on to the blank between them. In the reign of Julius II. (1503–17) Bramante began experimenting with a press for papal leaden seals; and Leonardo da Vinci also made experiments with a coining press, and more particularly in the process of drawing strips of metal to the right thickness and punching out blanks. Out of such experiments grew the screw-press, the essential advantage of which was that the upper die was brought down on the blank not with a blow, but with a gradual pressure.

Relief and Lettering.—Those qualities which make a coin most serviceable as currency are not necessarily favourable to its beauty as a work in relief. The Greeks, for instance, being pre-eminently sculptors, made their coins in high relief. They thus suffered in circulation. It was only in the 4th century of our era that the relief of coins began to become flat, making way for the flat pattern-like treatment which is characteristic of the middle ages. That was not due to a recognition of the suitability of such treatment so much as to the decay of technique. In the use of lettering the Byzantines made an effort at decoration, but the finest development of lettering as an art on coins was left to the Moslems. In the 16th century printing wrought disaster on medal lettering.

The 13th Century.—Frederick II attempted to revive the older Roman style; his gold augustale has a head in medium relief, inspired by the Roman gold of the Constantinian period. But this was a false start. The beautiful Gothic coinages of the 14th century in France, England, the Low Countries, Italy, etc., show the high-water mark of the flat pattern style, which is by far the most suitable for a coinage which has to be packed in rouleaux and circulates widely. The facing head ousted the profile under the Lower empire. In obedience to a Roman principle, the frontal pose was alone proper to the imperial majesty.

Toward the end of the 15th century the influence of the medal, for which the profile was alone suitable, made itself felt on the coinage and the facing head thus practically disappeared. The early testoons of the Sforzas at Milan are the supreme example of profile treatment in very low relief, the finest combination of portraiture with decorative treatment that coinage can show. So far as mere engraving was concerned the highest excellence was probably reached in the 17th century by artists like Nicholas Briot and Thomas Simon; and, so far as mere finish is concerned, Benedetto Pistrucci, William Wyon or Bertrand Andrieu leave nothing to be desired.

The problem of composing within a circular field was solved by the ancients. The posing of a head, the combining of two or more heads in a group, whether they are jugate or addorsed or opposed, were the main problems of the obverse. The jugate or accollate position was not attempted until the 3rd century B.C. and did not become common until Roman times. The confronted pose offers no difficulty, and pleased the Roman taste for symmetry; but the Greeks disliked it and it is not found on their coins before Roman times.

The Greeks liked symmetry, but it had to be dynamic and full of movement; while they knew all that need be known about what is called heraldic opposition, and occasionally used it, it never played much part in their designs.

The remarkable outburst of artistic effort in England in the middle of the 8th century, when a real profile portrait head of

Offa appears on his coins at a time when the designs of all other parts of Europe were entirely without merit, had no duration or repercussion. Not even the excellent ornamental designs on the Anglo-Saxon coinage of this time, due perhaps to Irish influence, inspired continental contemporaries to efforts for better coins. Equally without effect was such an innovation as the type of the sovereign seated in majesty on Edward the Confessor's penny, as on the great seal. France had to wait two centuries until Philip II (1270–85) ventured to introduce the majesty-type. The Norman Conquest caused a definite setback in English art.

Germany.—In the next period we must turn to German lands to find the first signs of relief from the degradation of the engraver's art. About 1125 the curious pieces known as bracteates, extremely thin and bearing on one side only a type which shows through on the reverse, began to be produced in Thuringia and Lower Saxony. The designs—the figure of the king seated facing, the half-figures of king and queen side by side, the emperor on horseback, the figures of saints, often in an architectural setting, and the like—are a not unworthy reflection of the greater art of the Romanesque period. The style reaches its zenith in the second half of the 12th century under Frederick Barbarossa and Henry VI, when the coins sometimes attain a diameter of 50 mm. It was, however, in the middle of the 13th century that the real revival began.

A similar effort was made by the little republic of Ragusa in the same century. But other states, though they wisely did not attempt to attain high relief, did begin to play with the idea of making their coins interesting or significant. Florence placed on the gold coins, which were to become world-famous as florins, its graceful lily and the figure of St. John the Baptist (in 1252). Venice started its equally famous gold sequins or ducats in 1280 with the interesting types of the figure of Christ blessing in a border of stars, and of the doge receiving the gonfalon from St. Mark. These types were not entirely new; they had been already used in a less elaborate form on silver.

It must have been the florin that suggested to Henry III, that enlightened patron of art, the introduction of his beautiful gold "penny" in 1257. His example was followed by St. Louis in his *denier d'or* in 1266—an admirably executed coin of heraldic design. St. Louis must also be credited with a far-reaching innovation in the shape of the large silver piece or gros of 12 deniers, the forerunner of the English groat or fourpence, though that coin did not come into regular use until 1351. The enlarged size eventually made possible the introduction of more interesting designs, though France continued to cling to conventional patterns, and England to the conventional facing head and cross.

In the grossi of Wenceslas II of Bohemia (1278–1305) the opportunity afforded by the larger flan was seized for a fine heraldic design.

The 14th Century.—But the time of Edward III and his contemporaries is the golden age of European coinage. There is no distinction in style between the Anglo-French coins and those of the French kings, and foreign workmen were employed at the English mint. At this period there is no evidence of an independent English art. The fine period of the Anglo-French coinage closes about 1368; the gold coin of the Black Prince issued at that time is a distinct attempt at portraiture on a small scale. In England we have the beautiful, but abortive first issue by Edward III in 1343 of the gold florin and smaller denominations: the most beautiful coins in the whole English series, but demonstrably the work of two Florentines, Giorgio Chierichino and Lotto Nicolini. These coins are followed by the gold noble, the obverse bearing the king in his ship as type. In 1465 Edward IV introduced a type of rude strength, the angel, in which there is something peculiarly English, especially in contrast with the St. Michael on the French coins of a century and a quarter earlier (Philip VI) and the angelot of Louis XI.

Toward the end of the 15th century the Tudor coinage makes its appearance with a flourish; the sumptuous "sovereign" of Henry VII, first struck in 1489, is still Gothic, but effete: it mistakes restlessness and over-decoration for strength. As in England, the art of coinage in the Low Countries in the 14th and 15th centuries presents no essential difference from what is to be seen in France; Germany during the same period lags far behind the west, its coinage being monotonous and crude.

Italian Influence.—It was from Italy that the new revival was to come; and the splendour of its coinage in the last quarter of the 15th century was directly due to the sister art of the medal.

The portrait-medal founded by Vittore Pisano, with his incomparable series of portraits made between 1438 and 1449, showed the possibilities of the profile relief. After a few artists, like Enzola of Parma, had in the '60s and '70s made groping experiments in die-cut portraits on small medals, others, notably in Milan—though the attribution of the Sforza series to the Milanese Caradosso may be baseless—succeeded toward the end of the century in producing pieces which, as we have said, reached the high-water mark of portraiture in coinage. Early in the 16th century the influence made itself felt outside Italy.

It was a German, Alexander of Bruchsal in Baden, who was employed by Henry VII from 1494 to 1509, but the beautiful profile portraits by which, from 1503 onward, he left his mark on the English coinage are obviously inspired by the Italian fashion. His work sealed the doom of the facing-head on English coins although examples lingered on to the reign of Edward VI.

The Thaler.—Meanwhile Germany had taken an important step in the invention of the thaler, again the size giving greater scope to the designer. The Tyrolese guldengroschen of 1484—the earliest of the class afterward generally known as thalers—was evidently inspired, clumsy though it be, by an Italian model. It was the ancestor of all the large silver coins, thalers, dalers, dollars, scudi and crowns, of the 16th and 17th centuries. It did not add greatly to the art of coinage, which attains its highest perfection on a field of not more than an inch and a quarter. For a larger field, the medallic art, unrestricted in relief by its nonuse as currency, is proper.

Portraiture.—The development of portraiture on coins, as seen in the second half of the 15th century, must be traced to the Italian medal. Pisano's first medal, representing the emperor John VII Palaeologus, was made in 1438. It revealed the possibilities of profile portraiture on a small scale, suitable for coinage. What the medallists showed was that modern portraits, and not mere imitations of the antique, could find a place on modern coinage.

In the '60s and '70s engravers in Milan, Parma and Venice were producing both small medals and portrait-coins from dies. By the beginning of the 16th century the technical difficulties had been overcome; and soon the facility afforded by striking for the mass production of medals began to have a reaction on the medallic art. The art of coinage had reached its culmination; all future developments added nothing to its artistic content, and were due merely to increased technical dexterity.

But the medal had still a course to run. The best medallists continued throughout the 16th century to use the casting process for their most important work, even when they were also die-engravers by profession. But official patronage favoured the struck medal, satisfied with number rather than quality. The technical dexterity of the modeller continued nevertheless to increase.

In Germany especially, where the art of the medal culminated in the period from 1520 to 1540, a series of portraits was produced unsurpassed in the realism of their presentation and technique of casting. In Italy after about 1530 the cast medal continued to develop as an art that had lost its inspiration; facile, graceful but superficial, the elegant portraits of Pastorino of Siena are typical of the school.

The modeller begins to lose the sense of material; the original wax model is all he cares about and the final product in metal is merely a means of perpetuating it. By the end of the 16th century the Italian vein was worked out. Italian influence, however, had passed across the Alps. German lands, especially Austria, France and Flanders had all felt it, though none of them in the 16th century produced medallists who marked an epoch. It

remained for France in the first half of the 17th century to do for the art of the medal what Italy through Bernini did for sculpture. As masters of the baroque portrait Guillaume Dupré Jean and Claude Warin should be mentioned beside Bernini, though they too had his excessive virtuosity, as well as his brilliance. In England Thomas and Abraham Simon are almost on the same level. In Holland a native school is distinguished by hardy vigour. These developments are the last flowering of the medallic art before the dead period of the 18th century.

The 19th Century.—In the last quarter of the 19th century the monotonous academic tradition which had reigned for nearly two centuries began to break down. The French revival took its rise in F. J. H. Ponscarme (1827–1903). By the study of character in portraiture, the search for a dignified realism, and for a harmonious relation of type to background, and by such external reforms as the abolition of the raised border which had so long been the fashion, he inaugurated a return to the true principles of the art. The French school reached its zenith under J. C. Chaplain (1839–1909), but unfortunately, thanks to modern machinery, exploited with immense skill by Oscar Roly and his school, the medal in French hands became a merely pretty art, lacking virility and sincerity.

In Germany native vigour interposed, and the portraiture by such artists as the Viennese Anton Scharff (1845–1903) is of a fine seriousness.

In England Alphonse Legros (1837–1911), with a true instinct rejecting the machine-made medal, produced a remarkable series of cast portraits; but he found no successor.

Later developments are not sufficiently important to require detailed mention. We are still in the age of experiment. The immense output of medals, especially in Germany, during World War I should have revealed original artists if there were any, but the only one to rise above a journalistic level was Ludwig Gies and he often trespassed beyond the limits of his art.

There is at the present moment no lack of fine and accomplished portraiture, and although for the purposes of mass production the use of machinery is unavoidable, the better medallists, such as Theodore Spicer-Simpson, are content to produce their works by the nobler method of casting in limited editions of two or three specimens. (See METAL WORK; SEALS; GREEK ART; ROMAN ART.)

BIBLIOGRAPHY.—On the technique of making coins and medals *see* G. F. Hill, "Ancient Methods of Coining," *Numismatic Chronicle* (1922) and *Medals of the Renaissance* (1920). On the place of coins in art, the literature is confined to ancient coins: B. V. Head, *Guide to the Coins of the Ancients* (4th ed., 1895); P. Gardner, *Types of Greek Coins* (1882); K. Regling, *Die Antike Münze als Kuntstwerk* (1924); G. F. Hill, *Select Greek Coins* (1927). (G. F. H.)

TOKENS FOR WAR SERVICE

From the earliest times service of all kinds has been rewarded by honours and distinctions. We learn from Josephus ("Antiquities of the Jews") that in the 3rd century B.C. Jonathan, the high priest, successfully led the Jews in battle thereby aiding Alexander, who "sent to Jonathan, and gave testimony of his worth, and gave him *honorary rewards*, as a *golden button*, which it is the custom to give King's kinsmen." Later Jonathan received another golden button for similar service. These honorary rewards of golden buttons are the earliest form of medal to commemorate war service.

BRITISH MEDALS

War Medals.—The earliest medal in existence struck for an Englishman for war service is that awarded to John Kendal in 1480. Kendal was prior of the English Knights of St. John of Jerusalem and in 1480, relieved Rhodes. His medal is now in the British Museum.

Although decorative medals were common before her reign, Queen Elizabeth appears to have been the first sovereign to bestow a medal for particular military service to the Crown, this being the "ark in flood" medal (so called from its design) to commemorate the victory over the Armada in 1588. James I. (1603–1625) issued a medal "in reward for naval achievements" on which the design was repeated.

Under a royal warrant, dated May 18, 1643, Charles I. authorized the issue of "Badges of silver, containing our Royal image and that of our dearest son, to be achieved to wear on the breast of *every man* who shall be certified under the hands of their Commander-in-Chief to have done us faithful service in the Forlorn-Hope" (*i.e.*, the tactical advanced guard of those days and not a hopeless adventure).

During the Commonwealth, statutory provision was made for the bestowal of medals as naval awards under a minute of the council of State, Nov. 15, 1649. There was also a "Medal of the Parliament" for land service, one being awarded to Col. Mackworth, governor of Shrewsbury, as a mark of the parliament's favour. This medal was given with "a chain of gold to the value of one hundred pounds." The first English campaign medal is that issued by the Commonwealth to commemorate Dunbar, Sept. 3, 1650. A week after the battle the House of Commons authorized the medal "both for officers and men." Cromwell protested against his effigy appearing on the medal, but this was overruled, and his effigy placed thereon. The finest medals of this period are those granted to Blake, Monk, Penn and Lawson for their victory over Van Tromp, July 31, 1653. The medals are in gold, with gold chains.

One interesting medal granted by James II. was to Bishop Mew, for his services as commander of the king's artillery at Sedgemoor, 1685. Before entering the church Mew had been an able soldier, and his ecclesiastical duties had not interfered with his continued study of the military art. Almost all writers on the subject classify the "Cumberland" medal (sometimes called the "Culloden" medal) as a commemorative war medal. This is incorrect. The battle was fought on April 16, 1746, the English being commanded by the young duke of Cumberland. To commemorate his success a number of admirers formed the Cumberland Society, a rule of which was that each member on joining was to be presented with a medal. No evidence has been found to show that the victory was *officially* commemorated by the grant of a medal.

Only one medal was issued for the American War of Independence, this being awarded to a Captain Ewing who distinguished himself at Bunker Hill.

Credit is due to the Honourable East India Company for instituting the regular practice of making the grant of medals a "general distribution" and not solely to officers. Some of their early grants include the "Deccan" medal for service during 1778–84, the "Mysore" medal (1791–92) and the "Seringapatam" medal (1799), and they continued this practice until the Crown assumed the Government of India after the Indian Mutiny. The lack of medallic recognition to the rank and file prompted Davison, Nelson's prize agent, to present a medal to every man who took part in the battle of the Nile (1798). His example was followed in 1805 by Boulton, of the Soho Mint, Birmingham, who presented medals to all ranks who had taken part in the battle of Trafalgar (1805). But, it is stated, that as the medals for the men were only made of pewter they deemed them of no value and the majority threw them away. These are the only instances of medals being awarded to service men by private individuals.

British war medals enter upon a new era with those awarded to admirals and captains for Lord Howe's victory over the French on "the Glorious 1st of June" (1794), generally known as the *Navy Gold Medals*, in that the first official reference is made to *medal ribbon* in connection with them.

The Peninsula Campaign was two years old before any medals were authorized to commemorate the successful major operations therein. The battles of *Roleia* (Roliça), *Vimiera, Corunna* and *Talavera* had all been fought before the *Army Gold Medals* were instituted under general order, Sept. 9, 1810. In addition to the foregoing the *Army Gold Medal* was authorized for officers, not below the rank of battalion commander, for the following operations: *Sahagun, Benevente, Busaco, Barossa, Fuentes d'Onor, Albuhera, Ciudad Rodrigo, Badajoz, Salamanca, Vittoria, Pyrenees, St. Sebastian, Nivelle, Nive, Orthes* and *Toulouse.* Originally a separate medal was awarded for each separate operation and many officers became entitled to several medals. This,

however, caused inconvenience to the recipients and a new system was instituted in 1813 under which only one medal was to be borne by each officer entitled thereto. For the second and third occasions gold clasps, the first ever sanctioned, were added to the medal ribbon, and on becoming entitled to a fourth mark of distinction the medal was surrendered and a *Gold Cross* issued in its place, on the four arms of which were inscribed the four battles for which marks of distinction had been awarded. On becoming entitled to a fifth or further marks of distinction, gold bars inscribed with the name of each battle were added to the *Gold Cross* ribbon. The substitution of a cross for a medal was never repeated.

Of the 20 operations in the Peninsula Campaign for which medals, crosses and clasps were awarded, the Duke of Wellington had distinctions for 14, viz. (*a*) inscribed on the *Gold Cross:—Roleia* and *Vimiera, Talavera, Busaco, Fuentes d'Onor,* (*b*) clasps to the *Gold Cross: Ciudad Rodrigo, Badajoz, Salamanca, Vittoria, Pyrenees, Nivelle, Nive, Orthes* and *Toulouse.*

The first war medal to be issued to all ranks, alike in all respects, was the *Waterloo Medal*—this, at the suggestion of the Duke of Wellington.

The fact that the *Waterloo Medal,* the *China Medal* (1840–42) and the *Jellalabad Medal* (1842) were given to all ranks alike without discrimination, appears to have started an agitation amongst those who had taken part in operations for which the *Army Gold Medal* and *Gold Cross* had been awarded but for which they were not eligible, owing to their rank. In this case, the Duke of Wellington opposed granting such a medal but it was adopted as the *Army General Service Medal.* The *Military Ribband* was worn with the medal. It was usually referred to as the *Peninsula Medal,* colour being lent to the idea by Wellington's figure appearing thereon, but it included campaigns in which Wellington had no military concern. Clasps were added.

The grant of the Army G.S.M. naturally led to a similar medal being authorized for the Navy, the *Navy General Service Medal* which covered operations from 1793 to those off the coast of Syria in 1840. Clasps included: *Howe's Victory* (June 1, 1794), *Camperdown* (Oct. 11, 1797), *Nile* (Aug. 1, 1798), *Copenhagen* (April 2, 1801), *Trafalgar* (Oct. 21, 1805), *Navarino* (Oct. 20, 1827).

Later medals commemorate service in the Crimea, the Indian Mutiny, New Zealand campaigns and those in Egypt.

The Honourable East India Company followed the example of the home Government and instituted the "India 1851" medal. Four further India general service medals have been granted to cover operations from 1849–95, 1895–98, 1901–02, and from 1908 to 1928. For the late Lord Roberts' march from Kabul to Kandahar in 1880 there is a bronze, known as *Roberts' Star.* For minor campaigns, the *General Service Medal* is granted.

Gallantry Medals, Crosses or Orders.—The most famous of this class is the *Victoria Cross* instituted in 1856. All ranks and civilians are eligible for the award, to qualify for which the recipient must have performed some conspicuous act of bravery in the presence of the enemy. The ribbon now is red (claret) for all recipients, but was previously blue for the Royal Navy. Recipients who are granted a second distinction are awarded a bar. The award carries a pension. The V.C. takes precedence of all other orders and medals.

Other awards of lesser degree in this class are: *Distinguished Service Order,* instituted in 1886 and the *Military Cross* (1914); only officers are eligible for the award. *Distinguished Conduct Medal* instituted in 1854, also the *Military Medal* (1916); only "other ranks" are eligible for the award. *Meritorious Service Medal,* instituted in 1845, awarded to sergeants as a reward for distinguished or meritorious service; it carries a gratuity. *Conspicuous Gallantry Medal,* originally sanctioned for Crimean War only, reinstituted 1874 and now available for any war; only "other ranks" of Royal Navy and Royal Marines are eligible for the award. *Indian Distinguished Service Medal,* instituted 1907, only Indian officers and "other ranks" are eligible. The Royal Air Force has medals, etc., comparable to the foregoing. See also on next page under *Other Medals and Decorations.*

Good Conduct Medals.—There are a number of medals granted for good conduct combined with a prescribed number of years' service, the conditions of eligibility varying according to the service, and whether Regular, Auxiliary, Colonial, etc. The first of these medals was the *Long Service and Good Conduct Medal* instituted in 1830.

UNITED STATES MEDALS

The premier decoration of the United States is the *Medal of Honor* which is comparable to the *Victoria Cross.* It was instituted in 1862 as a reward for conspicuous acts of bravery during the Civil War. In the course of time the details of the design have changed; the present description of the Army medal is a five-pointed star superimposed on a wreath, in the centre of the star he head of *Minerva,* surrounding which is a circle inscribed "UNITED STATES OF AMERICA." The star is suspended from a bar attached to the two top points, and on the bar is inscribed "VALOR," above which is the American Eagle. Attached to the eagle's head is a ring through which passes the ribbon. The ribbon is light blue with stars embroidered thereon, and the medal is worn round the neck. The Navy medal differs in a few details from the Army pattern. This medal takes precedence of all other United States decorations. "Medal of Honor" lapel buttons are optional for wear in civilian clothes; they are hexagonal rosettes made of light blue silk with 13 white stars. There was a *Merit Medal,* awarded with the "Certificate of Merit" for which only enlisted men were eligible, but this was abolished in 1918.

War commemorative medals follow the British practice. An interesting example is the *Civil War Medal,* on the obverse of which is a portrait of Lincoln, surrounded by an inscription taken from his famous Second Inaugural: "WITH MALICE TOWARDS NONE, WITH CHARITY FOR ALL." On the reverse is inscribed "THE CIVIL WAR, 1861–1865." The "Indian Wars" Medal is also interesting from the fact that the reverse was copied for reverses of many other campaign medals.

MEDALS OF OTHER COUNTRIES

France.—Before 1802 gallantry in the field was awarded by grants of swords of honour, muskets of honour and other weapons but in that year Napoleon instituted the *Legion d'Honour.* The original cross of the Legion of Honour was a white enamel gold badge, with five rays of double points, each point tipped with a silver ball, the whole on a wreath of oak and laurel: in the centre of the obverse, Napoleon's effigy with "NAPOLEON" inscribed around it. The present badge is much the same in appearance but instead of Napoleon's effigy on the obverse there is a female head, and inscribed round it, "REPUBLIQUE FRANÇAISE, 1870." The order is divided into five grades: Grands Croix, Grands Officiers, Commandeurs, Officiers and Chevaliers. The Legion of Honour is the premier order of France and is only conferred for gallantry in action or for 20 years' distinguished military or civil service in peace. The *Médaille Militaire,* instituted in 1852, is comparable with the British D.C.M. It is only conferred upon general officers in command of armies and to N.C.Os. and men of the Navy and Army for distinguished service in action. It was awarded to the late Field-Marshal Lord French. As regards commemorative war medals the first is interesting, viz., *St. Helena Medal,* instituted in 1857 for operations between 1792 and 1815. The medal is bronze and bears on one side the effigy of Napoleon, and on the other, in French, "Campaigns of 1792 to 1815. To his comrades in glory, his last thought. St. Helena, May 5, 1821." Another interesting war medal is the *Pontifical Cross,* instituted in 1867, by Pope Pius IX., and granted to all members of the French forces who took part in the defence of Rome in 1867.

Germany.—A renowned German decoration was the *Iron Cross,* instituted in 1813, as a reward for distinguished service in the War of Liberation. It was revived for the Franco-Prussian War of 1870 and was again issued for service in the World War. The cross is a Maltese Cross of cast iron edged with silver. On the upper link is a crown, on the lower link the date of the campaign, that for the World War being "1914," in the centre the initial or initials of the sovereign at the date of issue. There are three classes of the Order of the *Iron Cross.* The Grand Cross, dou-

ble the size of the ordinary cross, is worn round the neck, and is awarded solely for the winning of an important battle, or equivalent exploit. With the rank and file the cross carries with it a gratuity. *The Order of Military Merit* (*Prussia*), founded in 1665, was bestowed for conspicuous war service.

Belgium.—The *Order of Leopold II.* was instituted in 1900. There are six classes. It is awarded to N.C.Os. and men and "ranker" officers for exemplary service after a number of years (20–30). The *Ordre de la Couronne*, instituted in 1897, was originally the premier order of the Independent Congo State but was transferred to the Ministry of Foreign Affairs in 1910. It is awarded to officers after a number of years' exemplary service (20–32) and to N.C.Os. after 38 years' exemplary service. The *Military Medal*, instituted in 1902, is comparable with the British Military Medal.

Japan.—The *Order of the Rising Sun*, instituted in 1875, is awarded to all ranks of Army and Navy for gallant service in war or distinguished service in peace. The *Order of the Sacred Treasure*, instituted in 1888, is awarded to both military and naval officers for meritorious service. The *Order of the Golden Kite* was instituted in 1891. There are several classes, the higher for officers and the lower for N.C.Os. and men. It therefore corresponds approximately to the British D.S.O., D.S.C., M.C. and D.C.M. The medal to commemorate the Russo-Japanese War of 1904–05 is made of light bronze.

Italy.—The *Order of Saint Maurice and Saint Lazarus* was founded in 1434, and revised in 1831, 1837 and 1855. The *Military Order of Savoy*, founded in 1815, is awarded for special distinguished war service. Medals for military valour are awarded for acts of bravery in much the same manner as British gallantry medals. The *Messina Medal* was awarded by the King of Italy to officers and men of the British men-of-war and to certain others who assisted in succouring the injured after the terrible earthquake at Messina and Reggio in Dec. 1908. The ribbon is green with white edges.

Serbia.—The *Order of the White Eagle*, instituted in 1883, consists of five classes. The badge consists of a double-headed eagle in gold, ensigned with a crown. The *Star of Kara George*, instituted in 1904, consists of four classes.

WORLD WAR MEDALS AND DECORATIONS

By resolutions passed by a committee of the Peace Conference in Paris in March 1919, it was decided that the victorious Allies and associated Powers (*i.e.*, Great Britain and her dominions, France, Belgium, Italy, Spain, United States of America, Japan, etc.) should have a medal common to the Powers in general design. The medal was to be called the *Victory Medal* and was to be round, made in bronze (36mm. wide), the colour, surface, thickness and attachment to be similar to the French Medal of the 1870 war, on the obverse a winged figure of Victory full length in the middle, on reverse the inscription, "The Great War for Civilization," in the language of the country granting the medal, the rim plain. The ribbon to be identical for all countries and to consist of two rainbows joined by the red in the centre.

One of the objects of issuing a medal similar in design in all countries was to obviate the interchange of Allied commemorative war medals. No clasps have been issued with the medal except in the U.S. The exact conditions under which the medal was awarded varied in each country, but generally it was issued to all who went into a theatre of war in any capacity between the first declaration of war in 1914 and the date of the Armistice, Nov. 11, 1918. In the British service it was also granted for post-Armistice operations in North Russia and Siberia, ending on Oct. 12, 1919, and in Trans-Caspia, concluding on April 17, 1919. Also in the British service an emblem in the form of an oak leaf in bronze was placed on the Victory Medal to indicate that the recipient had been mentioned in despatches during the World War.

OTHER MEDALS AND DECORATIONS

Great Britain.—(*a*) *1914 Star* (commonly known as the Mons Star), instituted in 1917, and awarded to all ranks, including nursing staffs, who actually served in France or Belgium on the establishment of a unit between Aug. 5, 1914, and Nov. 22–23, 1914. (*b*) *1914–15 Star*, instituted in 1918, similar in design to the *1914 Star*. (*c*) *British War Medal*, instituted in 1919. In general terms it was granted to all personnel of the Army who served overseas in a theatre of operations in any capacity during the war, and to the Navy for one month's service during the war. (*d*) *Mercantile Marine War Medal*, granted to members of the Mercantile Marine for service during the World War; (*e*) *Territorial Force War Medal*, instituted in 1920, granted to members of the T.F. and T.F. nursing service for service outside the United Kingdom during the war subject to certain conditions (those awarded the *1914 Star* or *1914–15 Star* were ineligible for the T.F.W.M.); (*f*) *Military Cross*, instituted in 1914, an army decoration for which only captains, junior officers and warrant officers are eligible; (*g*) *Distinguished Service Cross* (established as Conspicuous Service Cross in 1901) re-named in 1914 and its award extended to all naval and marine officers below the relative rank of lieutenant-commander; (*h*) *Distinguished Service Medal*, instituted in Oct. 1914 for other ranks of Royal Navy and Royal Marines; (*i*) *Order of the British Empire*, instituted in June 1917, as a reward for war service in any capacity; (*j*) *Military Medal*, instituted in 1916; all other ranks are eligible for the award; (*k*) *Silver War Badge*, instituted in 1916, issued to all ranks who served at home or abroad during the World War and who on account of age, or physical infirmity arising from wounds or sickness caused by military service, had been compelled to leave the forces; (*l*) *Royal Air Force*. The following decorations were instituted under a royal warrant dated June 3, 1919, and have been awarded: *Distinguished Flying Cross, Air Force Cross, Distinguished Flying Medal* and *Air Force Medal*.

United States of America.—(*a*) *Distinguished Service Cross, Army*, instituted Jan. 12, 1918, awarded to those who since April 6, 1917, have distinguished themselves in connection with military operations in circumstances which do not justify the award of the Medal of Honour. (*b*) *Distinguished Service Medal, Army and Navy*, instituted Jan. 12, 1918, awarded for exceptionally meritorious service. (*c*) *Navy Cross*, terms of award similar to *Distinguished Service Cross, Army*. The United States *Victory Medal* has battle clasps.

France.—*Médaille de la Reconnaissance Française*, instituted in 1917, is awarded to persons who performed acts of devotion in the public service. The following war medals were also issued: *Médaille Commémorative d'Orient* and *Médaille Commémorative Française de la Grande Guerre*.

Turkey.—For the Gallipoli campaign Turkey issued a white metal five-pointed star, in the centre of which is the Sultan's cypher, and the characters representing "El Ghazi" (The Victorious), below the date "333" (*i.e.*, 1915). The ribbon is scarlet moire with a white stripe towards the edges.

Japan.—This medal is similar to that granted for the Russo-Japanese War. The ribbon is dark blue with a broad white stripe.

Egypt.—*The Military Star of the Sultan Fouad* was instituted in 1919 for officers of the Egyptian Army who are mentioned in despatches for post-Armistice operations.

Belgium.—*Croix de Guerre*, instituted in 1915, awarded for exceptional acts of bravery. Medal *De la Reine Elisabeth*, instituted in 1916, and awarded to ladies, without distinction of rank, who assisted Belgians during the war. Other medals are *Médaille du Roi Albert; Croix Militaire; Décoration Militaire; Médaille de l'Yser*. Three medals for the general campaigns on the Continent and in Africa were also struck: *Médaille Commémorative de la Campagne 1914–1918, Médaille Commémorative de la Campagne d'Afrique 1914–18*, and *Étoile de Service du Congo*.

Rumania.—*Order of St. Michael The Brave*, instituted in 1916, solely for service in the field.

Portugal.—*Victory Medal* and *Medalha commemorativa das campanhas do Exercito Portugues* (to which were added clasps) were issued for the general campaign.

Germany.—Several medals were issued in Germany of which the following are the most important: (*a*) a silver medal was struck for the *March on Paris*. On the obverse is the bust of Gen. von Kluck and "1914–1915"; reverse, a naked fury on horse-

back carrying two blazing torches and "Nach Paris, 1914"; (*b*) a bronze medal was struck for the anticipated German entry into Paris. Obverse the Arc de Triomphe; among rays spreading from the top "1871–1914"; in the background the Eiffel Tower, and inscribed round the whole, "Entry of the German Troops into Paris." Reverse, the 1914 Iron Cross and "Nach aussen entschlossen. Nach innen geschlossen" (Resolute in the face of the enemy, united on the home front). An attempt was made to suppress it when the German hopes were not realized, but a few specimens are in existence, one being in the British Museum; (*c*) the Failure Before Paris is commemorated by a cast-iron medal. Von Kluck's bust with "1914–1915" on the obverse, with an eagle perched on a gun-emplacement, gazing at distant "Paris" on the reverse; (*d*) the new Triple Alliance is commemorated by a bronze medal, bearing on the obverse the busts of Kaiser Wilhelm II., Kaiser Franz Josef and the sultan of Turkey, and the inscription "Glory to God alone." Reverse, eagle perched on an oak branch, with the inscription "Brotherhood in arms, 1915, Germany, Austria-Hungary, Turkey"; (*e*) Russian defeat at Tannenberg: medal cast in iron and bronze. Obverse, bust of Hindenburg; reverse, "Tannenberg–Ortelsburg 1914" and "Queller of the Russians, liberator of East Prussia"; (*f*) the battle of the Falkland isles, Dec. 8, 1914, is commemorated by a bronze medal; (*g*) the Submarine War medal is cast in bronze. Obverse, bust of Admiral von Tirpitz. Reverse, Neptune with trident, seated on conning-tower of a submarine, shaking his fist at the distance where are two British sailing ships, one sinking; in middle distance, another submarine, inscription, "Gott strafe England, 18 Februar, 1915"; (*h*) the sinking of the "Lusitania." Obverse, ticket office of the Cunard company in New York, with Death issuing tickets to a crowd of passengers, motto "Business First." Reverse, the Lusitania (showing guns, aeroplanes, etc., on board) sinking. Inscription, "No contraband" and "The liner Lusitania sunk by a German Submarine, May 5, 1915." The liner was sunk on May 7 not May 5. "The authenticity of this medal has sometimes been denied, but the fact that it was issued has been frequently admitted by responsible German authorities as well as by the artist (K. Goetz) himself" (vide *Historical Medals in the British Museum*); (*i*) the Zeppelin attack on London on the night Aug. 17–18, 1915, was commemorated by a medal cast in iron; (*j*) the failure of the Allies Dardanelles Expedition was commemorated by a satirical medal in bronze. (T. J. E.)

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NUMMULITE: *see* PROTOZOA.

NUN, a member of a community of women, living under vows a life of religious observance (*see* MONASTICISM; MONK).

NUNATAK, a name applied in Greenland to a hill or mountain peak appearing above the surface of a glacier. Greenland is for the most part covered by an ice-cap of a certain thickness which moves slowly downwards to the sea. It will rise upwards and pass over a barrier if there is no outlet, but it will flow between and around mountain peaks leaving them standing as hills (nunataks) above the general surface of the ice-cap.

NUNCIO, a representative of the pope sent on diplomatic mission, sometimes called *Nuntius apostolicus*. The nuncios are of lower rank than the *legati a latere*, but have practically superseded them as ambassadors of the papacy. Nuncios were permanently established during the 16th century.

NUNCOMAR or NANDA KUMAR (d. 1775), Indian official, best known for his connection with Warren Hastings (*q.v.*), was governor of Hugli in 1756, and in 1764 he was appointed collector of Burdwan in place of Hastings, which resulted in a long-standing enmity. In 1775, when Hastings was governor-general, Nuncomar brought accusations of peculation against him, which were entertained by Francis and the other members of council inimical to Hastings. While the matter was still pending Nuncomar was indicted for forgery, condemned and executed. Warren Hastings and Sir Elijah Impey, the chief justice, were both impeached, and were accused by Burke and afterwards by Macaulay of committing a judicial murder; but Sir James Stephen, after investigation, reached an opposite conclusion.

See Sir James Stephen, *The Story of Nuncomar* (2 vols., 1885); and H. Beveridge, *The Trial of Nanda Kumar* (Calcutta, 1886).

NUNEATON, a municipal borough in the Nuneaton parliamentary division of Warwickshire, England, 9.7 mi. N.W. from London by the L.M.S.R. It is on the river Anker and the Coventry canal. Pop. (1951) 54,408. Area, 18.4 sq.mi. The prefix of the name of the town is derived from a priory of nuns founded there in 1150. In the reign of Henry III a weekly market was granted to the prioress. Nuneaton was incorporated in 1907 and the boundaries were later extended. The church of St. Nicholas consists of nave, chancel and aisles, with a square embattled tower having pinnacles at the angles. The grammar school was founded in 1552. The ribbon industry is of less importance than formerly. The weaving of worsted goods is carried on, and there is a considerable industry in the making of bricks, tiles and drain pipes. Local mines of coal and ironstone employ many hands.

NUNEZ, PEDRO (PETRUS NONIUS) (1492–1577), Portuguese mathematician and geographer, was born at Alcacer do Sal, and died at Coimbra, where he was professor of mathematics. He published a translation of portions of Ptolemy (1537), and a treatise in two books, *De arte atque ratione navigandi* (1546). His clear statement of the scientific equipment of the early Portuguese explorers has become famous. A complete edition of all his writings appeared at Basel in 1592.

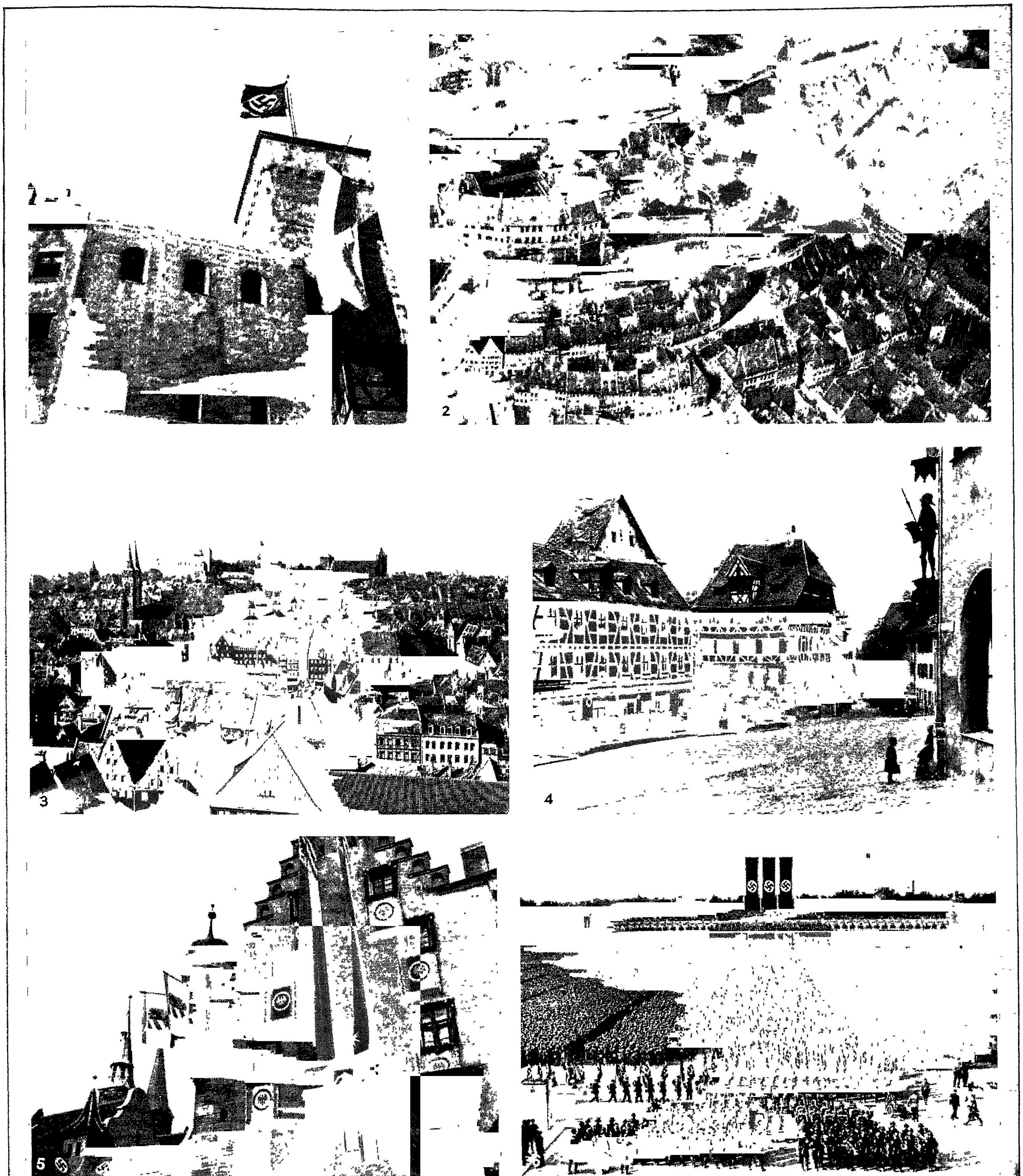
See F. de B. Garcão-Stockler, *Ensaio historico sobre a origem e progressos das mathematicas em Portugal* (Paris, 1819); R. H. Major, *Prince Henry the Navigator* (London, 1868, p. 55).

NUÑEZ CABEZA DE VACA, ALVARO (*c.* 1490–*c.* 1564), Spanish explorer, was the lieutenant of Pamfilo de Narvaez in the expedition which sailed from Spain in 1527; when Narvaez was lost in the Gulf of Mexico, Cabeza de Vaca succeeded in reaching the mainland to the west of the Mississippi, and, striking inland with three companions, reached the city of Mexico in 1536. Returning to Spain in 1537, he was appointed "adelantado" or administrator of the province of Rio de la Plata in 1540. Sailing from Cadiz in the end of that year, after touching at Cananea (Brazil), he landed at the island of St. Catharine in March 1541. Leaving his ships to proceed to Buenos Aires, he set out in November with about 150 men to find his way overland and reached Ascension (Asunción) for the relief of his countrymen there the next year. Though successful, he was sent home under arrest in 1544, and in 1551 was banished to Africa by the council of the Indies for eight years. He was recalled and appointed judge in Seville, where he died not later than 1564.

The *Naufragios* ("Shipwrecks") of Cabeza de Vaca, which relate to the Florida expedition and his journey to the city of Mexico, appeared at Zamora in 1542; the work has frequently been reprinted, and an annotated English translation was published by T. Buckingham Smith in 1851. His *Comentarios* (1555) chronicle the events of the South American expedition. *See* Fanny Bandelier, *Journey of A. Nuñez Cabeza de Vaca* (ed. A. F. Bandelier, New York, 1905).

NUÑEZ DE ARCE, GASPAR (1834–1903), Spanish poet, dramatist and statesman. Deputy for Valladolid in 1865, he was imprisoned at Cáceres for his violent attacks on the reactionary ministry of Narvaez, acted as secretary to the revolutionary Junta of Catalonia, and wrote the "Manifesto to the Nation" (Oct. 26, 1868). He served under Sagasta as minister for the colonies, the interior, the exchequer and education; but ill-health compelled him to resign in 1890.

Nuñez de Arce first came into notice as a dramatist with such plays as *La Cuenta del Zapatero* (1859), and *El haz de leña* (1872). But his talent was more lyrical than dramatic, and his celebrity dates from the appearance of *Gritos del combate* (1875), a collection of poems exhorting Spaniards to save the country from anarchy and lay aside domestic controversies. He was maintained in popular esteem as the only possible rival of Campoamor by a series of philosophic, elegiac and symbolic poems: *Raimundo Lulio*, *Ultima lamentación de Lord Byron* (1879), *Un Idilio y una Elegía* (1879), *La Selva oscura* (1879) and *La Visión de Fray Martín* (1880). The old brilliance sets off the naturalistic observa-



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SCENES OF INTEREST IN THE OLD CITY OF NÜRNBERG

1. The old fortress castle, on the north side of the city
2. Aerial view of Nürnberg looking down on Castle hill (centre, left) and its mediaeval fortifications around which the town developed. At the left is the imperial castle, and in the centre the Vestner-Turn (round tower), built 1561. Behind it in a diagonal line is the Five-Cornered tower, in which was the torture device known as the "Iron Maiden"
3. Looking across the roofs of Nürnberg to Castle hill. St. Sebald's church (1230–73), with twin towers, is on the left
4. House (centre) of Albrecht Dürer. It has been owned by the city since 1826, and has been restored
5. Detail of an old house on Adolf Hitler Platz, with characteristic gable
6. The Luitpold arena during a nazi party congress prior to World War II

tion of *La Pesca* (1884) and *La Maruja* (1886). The list of his works is completed by *Poemas cortos* (1895) and *¡Sursum corda!* (1900); *Hernán el lobo*, published in *El Liberal* (Jan. 23, 1881), and *Luzbel* remain unfinished. Gracious in his vision, sincere and patriotic, his weakness was sentiment and rhetorical sympathies. (J. F.-K.)

NÜRNBERG [NUREMBERG], second town in Bavaria, Germany, in size, and first in commercial importance. It lies in the district of Middle Franconia in a sandy, well-cultivated plain, 124 mi. by rail N.N.W. from Munich. The city stands on the Pegnitz, which is here crossed by 14 bridges.

History.—The first authentic mention of the town of Nürnberg, which seems to have been called into existence by the foundation of the castle, occurs in a document of 1050; and about the same period it received from the emperor Henry III permission to establish a mint and a market. It is said to have been destroyed by the emperor Henry V. in 1105, but in 1127 the emperor Lothair took it from the duke of Swabia and assigned it to the duke of Bavaria. An imperial officer, styled the burggrave of Nürnberg, became prominent in the 12th century. This office came into the hands of the counts of Hohenzollern at the beginning of the 13th century. The town was ruled by patrician families. German monarchs frequently resided and held diets here, and in 1219 Frederick II. conferred upon it the rights of a free imperial town.

Like Augsburg, Nürnberg attained great wealth as an intermediary between Italy and the East on the one hand, and northern Europe on the other. Its manufactures were well known. The town gradually extended its sway over a territory nearly 500 sq.mi. in extent, and was able to furnish the emperor Maximilian with a contingent of 6,000 troops. But perhaps the great glory of Nürnberg lies in its claim to be the principal fount of German art. Adam Krafft, Veit Stoss and Peter Vischer are famed as sculptors. In painting Nürnberg claims Wohlgemuth and Dürer. A large proportion of the old German furniture, silver-plate and stoves was made in Nürnberg workshops. Its place in literary history it owes to Hans Sachs and the other meistersänger.

Nürnberg was the first imperial town to embrace Protestantism (about 1525). The first blow to its prosperity was the discovery of the sea-route to India in 1497; and the second was inflicted by the Thirty Years' War, during which Gustavus Adolphus was besieged here for ten weeks by Wallenstein. The downfall of the town was accelerated by the illiberal policy of its patrician rulers. In 1803 Nürnberg was allowed to maintain its nominal position as a free city, but in 1806 it was annexed to Bavaria.

After 1933 Hitler's National Socialist party held its annual September convention at Nürnberg with great displays of fervent oratory and parades of troops, Hitler Youth and other nazi organizations. Here were decreed in 1935 the "Nürnberg laws" which divided the people of Germany into three classes: (1) German (Aryan) citizens enjoying full rights; (2) Jews, who had two or more Jewish grandparents and who were excluded from the ordinary rights of citizenship, could not marry Germans and were virtually condemned to a ghetto existence; and (3) "mixed" or "hybrid" persons, who had one or two Jewish grandparents, were not of Jewish faith or married to a Jew, and who might marry Germans and become assimilated into the German people. For the party conventions Hitler began the construction of a gigantic stadium, to be the largest in the world, in the Zeppelin field near Nürnberg.

During World War II several severe British air raids destroyed or damaged many of Nürnberg's famous buildings, including the Dürer house.

Population and Industries.—The population of Nürnberg was, in (1939) 430,851, more than two-thirds of whom are Protestant. The city is a garrison town. The manufactures are toys and fancy articles in metal, carved wood and ivory, which are collectively known as Nürnberg wares. It is also famous for pencils, needles, electric apparatus, chromo-lithography and motors. Nürnberg is ordinarily the chief market in Europe for hops. It is an important junction for railways and is served by the Ludwig canal, connecting the Danube and the Main.

Buildings.—Considerable sections of the ancient walls and moat still remain; of the 365 bastions which formerly strengthened the walls, nearly 100 are still *in situ*, and a few of the old gateways have also been preserved. Most of the streets are narrow and crooked, and the majority of the houses have their gables turned towards the street. The general type of architecture is Gothic, but the rich details, which are lavished with especial freedom in the interior courts, are usually borrowed from the Renaissance. Most of the private dwellings date from the 16th century, and there are practically none of earlier date than the 15th century. The roofs are of red tile.

The old castle (Kaiserschloss), on a rock on the north side of the town, dates from the early 11th century, but received its present form about 150 years later. It was restored in 1854–56.

Nürnberg contains several churches, the finest of which are those of St. Lorenz, of St. Sebald and of Our Lady. All three are Gothic edifices and are notable for their elaborately carved doorways, in which free play has been given to the exuberant fancy of the Gothic style. The church of St. Lorenz, the largest of the three, was built in the 13th and 14th centuries and has recently been restored. In it is the masterpiece of the sculptor, Adam Krafft, consisting of a ciborium, or receptacle for the host, in the form of a florid Gothic spire 65 ft. high; the carving of this work is exquisitely minute and delicate. The shrine of St. Sebald, consisting of a bronze sarcophagus and canopy, in the richest Gothic style, adorned with numerous statues and reliefs, is looked upon as one of the greatest achievements of German art. It was executed by Peter Vischer, the celebrated artist, in bronze, who was occupied on the work for 13 years (1506–19). The church of Our Lady has some fine old stained-glass windows and paintings by Michael Wohlgemuth. The Tuchersche altar, with its winged picture, is one of the finest works of the Nürnberg school about the middle of the 15th century.

The town hall (Rathaus), erected in the Italian style in 1616–19, contains frescoes by Dürer, and a curious stucco relief of a tournament held at Nürnberg in 1446. The building incorporated an older one of the 14th century, of which the great hall, with its timber roof, is part. The most interesting secular buildings are the houses of the old patrician families. A special interest attaches to the dwellings of Albert Dürer and Hans Sachs, the cobbler-poet. The streets are embellished with several fountains, the most noteworthy of which are the Schöne Brunnen, 1385–96, in the form of a large Gothic pyramid, adorned with statues, and the Gänsemännchen or goose-mannikin.

The Germanic national museum, established in an old Carthusian monastery includes masterpieces by Holbein, Dürer, Wohlgemuth and others. The municipal library contains many thousands of manuscripts and books, some of which are of great rarity.

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NURSERIES, NURSERY TREES: *see* ARBORICULTURE.

NURSERY EQUIPMENT. A baby should room alone, if possible, and must always sleep alone. Nursery equipment should be simple and all furniture and fittings of a type that may be readily washed. Painted walls are preferable but fresh clean wall paper is permissible. The best floors are well oiled or waxed hard wood or linoleum with a few small, washable, cotton rugs. Muslin curtains and dark window shades permit of good ventilation and subdued lighting. The necessary furniture consists of: A table of plain wood about two by three feet in size and low enough so that the mother may reach anything on it from her chair. Two low chairs without arms; one may be a rocker. A screen with removable washable panels to be used for protection from draughts and as a rack for airing the clothing. Two accessible shelves on the wall for the toilet articles. A closet with shelves or a bureau to hold the clothing. A wall thermometer and a covered pail to hold soiled diapers.

The Bed.—A crib or bassinet may be used. The latter is advised for the first two months; the best kind is the ordinary clothes basket with handles at either end. This affords free ventilation, is easily cleaned, may be placed upon two chairs or a bench and is moved about readily. For a mattress an ordinary hair pillow

is best; a feather pillow must not be used but one of felt or kapoc is a good substitute. Large pillow cases are preferable to sheets; one to hold the mattress and so serve as a lower sheet; the other to hold the blankets and serve as an upper sheet and bed spread. A small blanket rolled tightly may be placed at the foot of the bed before the upper sheet and blankets are tucked in; this will hold the upper bedding away from the baby's feet and permit free movement of the legs. A pillow for the head is not needed.

Care of the Nursery.—The bed should be placed in a corner of the room well protected from a direct draught and too strong a light. The wall thermometer should be placed on the wall above the head of the bed. The temperature of the nursery should not be above 68° F nor below 66° during the daytime. For the first three months the proper night temperature is from 62 to 64° and later this may be reduced to from 50 to 54 degrees. In winter the proper ventilation may be secured by the use of a window board and in summer the windows, thoroughly screened, may be left open during the cooler part of the day and at night. The room should be well cleaned and aired every day and the baby in his basket taken out of the room while this is done. Soap and hot water with sunshine are the best cleaners and disinfectants to use.

The Bath.—Tub baths may be given as soon as the umbilical cord drops off, usually about the tenth day after birth. Until that time sponge baths only are permitted. The equipment needed for the bath consists of: A portable bathtub of rubber or enamel ware. Rubber apron for the mother. Small soft blanket. Supply of soft and absorbent towels. Two wash cloths; one for the face and head and the other for the body. A tray holding a cake of castile or other pure white soap, a tube or jar of baby cream, plain unscented talcum powder, a few covered glass jars to hold small squares of sterile gauze, cotton pledgets and liquids needed, safety pins of assorted sizes, a bottle of boric acid solution and a bath thermometer. These articles should be replaced on the tray after use and covered with a clean towel until needed again. When all the equipment is in place, undress the baby and lay him on the bed wrapped in the soft blanket. Put on the rubber apron and pour the water into the tub. The temperature of the water must be tested with the bath thermometer at the last moment before the bath is given. For the first few weeks this should be 100° F. From the second to the sixth month the right temperature is 98 degrees. For the remainder of the first year, 95° is proper. During the second year the temperature of the bath water may be lowered to from 85 to 90° F. When the water is at the right temperature, take the baby in your lap and place the towel about him in place of the blanket. Before placing the baby in the tub use one of the wash cloths to bathe his face with plain water. Then soap the cloth well and gently wash the head, neck and back of the ears. Be careful not to get any of the soap in the baby's eyes. Rinse the wash cloth and wash off the soap from the head and neck. Now lift the baby by placing your right hand and arm under his buttocks and your left arm under his back with the forearm supporting his head. Set him gently in the tub keeping his back and head well supported, leaving your right arm and hand free for giving the bath. Soap the second wash cloth and rub the body, arms and legs all over, gently but thoroughly. Then rinse the cloth and wash off the soapy lather. The bath should not take more than a few moments during the first few weeks, later it may be given more leisurely. Now lift the baby from the tub and wrap him in the bath towel on your lap. The drying process consists of a series of gentle pattings; do not irritate the baby's delicate skin by rubbing. The head and face should be dried first and then the arms, legs and body. Do not wash out the baby's mouth, ears or nostrils unless so advised by your doctor. If the eyes need special care they may be wiped gently with a pledget of sterile cotton wet with sterile water or boric acid solution. When this is done, the baby should be turned on his right side while the right eye is washed and on the left side for the left eye; this turning is necessary to prevent the solution used for one eye from running into the other eye. After the baby is well dried it is a good plan to smear all of the folds of the skin in the groin, under the arms and about the neck with a little of the baby cream or with olive oil. Then comes a light dusting of the body with talcum powder and the baby is ready for his clothing, his feeding and his nap. Diapers must be changed as soon as soiled, placed in a pailful of cold water and once each day thoroughly scrubbed with soap and hot water, rinsed in hot water and then boiled for five minutes. If possible, dry the diapers in the sunlight.

Clothing.—Three points to remember about the baby's clothing are that it must be loose, light in weight and of materials that will not irritate the skin. The same weight clothing should be worn indoors both summer and winter. On very hot days the shirt, diaper and dress are sufficient. In cold weather, a light weight knitted shawl or blanket may be used for added warmth. For out of doors in cold weather, a warm cloak, hood and bootees are necessary. Socks may be worn if needed for warmth but their use is rarely desirable except in very cold weather. (*See* INFANCY.)

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(S. J. B.)

NURSERY SCHOOLS. The nursery school is a comparatively modern section of education designed to provide a suitable environment for the education and physical development of children aged from two to five years.

Great Britain.—The age of compulsory school attendance is five years, but education authorities may admit children at three years and in the 19th century frequently did so in urban areas in England (in Scotland there was no general demand for the admission of children under five).

By the beginning of the 20th century conditions essential to right development of young children were more fully understood, and doctors and educationists alike attacked the prevailing school education of the "under fives" in crowded classrooms, deprived of fresh air and exercise and subjected to formal instruction.

In 1908, because of an adverse report made by five women inspectors, the board of education appointed a consultative committee to report on school attendance of children below the age of five. The committee's report (Cmd. 4,259; H.M.S.O., London) recommended that children under five should remain at home but that those from homes in which their mental and physical development could not be properly secured should be sent to places specially intended for their training, the best place for this purpose being a nursery school, providing air and sunshine, open space, hygienic structures, opportunity for physical activity, for forming good habits and for sleep, and education on kindergarten lines by enlightened teachers. The board took no action, however, to establish such schools, and local authorities increasingly excluded the "under fives."

Voluntary effort had already opened day nurseries for "under threes" and a few free kindergartens on Froebelian lines for children from two to five years of age. Nursery schools on these lines, though small in number, became centres of light and healing in slum areas. The majority were held in adapted houses, with small gardens, but all sought to provide conditions for healthy development of body and mind; formal lessons were replaced by training of the senses and of speech and movement; independence and self-control were encouraged; happy activity and comradeship in a friendly community fostered social virtues. Meetings were held for parents, so that methods of child care became more widely understood in the community. Co-operation was established with infant-welfare clinics and public medical services. In 1914 a notable advance was made by Rachel and Margaret Macmillan, who in a riverside slum area in Deptford, London, established a large open-air nursery school.

In 1918 the president of the board of education, H. A. L. Fisher, included in his Education act regulations giving local authorities power to supply or aid nursery schools or nursery classes for children from two to five years of age. Economy nipped the new growth. Few new schools were established, but grants helped to maintain those in existence. Nursery classes for children aged

from three to five, in infant schools, however, increased and were influenced by nursery school principles.

During the interval between 1918 and the Education act of 1944, nursery schools increased in numbers and developed fresh principles and methods. "Didactic apparatus" gave way to more spontaneous play. Greater flexibility of procedure to suit individual needs replaced formal techniques of physical care and habit training. Increased psychological studies and especially the work of Susan Isaacs, emphasizing the far-reaching influence of early childhood, changed not only the methods but also the conception of the nursery school as being solely designed to compensate for imperfect homes; nursery schools are now recognized as a valuable extension of the good home, providing an environment where, during the busy hours of the mother's day, small children may receive education suited to their needs.

The care of children for long hours when mothers go out to work has passed, in many areas, to day nurseries organized by the ministry of health. After World War II when many wartime nurseries were established, the principle of educating, as well as caring for the child, spread to the day nurseries. The Education act of 1944 made it the duty of local education authorities to provide nursery schools wherever there was a need, but progress was again checked by national economy. In 1953 there were 473 nursery schools in England and Wales and 71 in Scotland (excluding private nursery schools); and nursery classes numbered 1,965 in England and Wales and 133 in Scotland.

Other European Countries.—Institutions analogous to nursery schools are to be found on the continent of Europe. In France they are called *écoles maternelles;* in Belgium *écoles gardiennes* or *jardins d'enfants;* in Austria and in the Scandinavian countries *Kindergarten;* and in Germany and in Switzerland *Kindergarten, Krippen* and *Kleinkinderbewahranstalten.*

See L. de Lissa, *Life in the Nursery School and in Early Babyhood* (New York, London, 1949); D. E. M. Gardner, *Education Under Eight* (London, 1949). (E. St.; D. E. M. G.)

United States.—Research in biological and social sciences and conclusions from clinical medicine and psychiatry emphasize the importance of the years immediately following infancy. At that time every person, for reasons of his own bodily structure and the nature of the social world into which he is born, faces two major adjustments: he needs to depend less upon others and he discovers a confusing world of persons, objects and their activities which he must try to understand and with which he must live. His personality results from the interaction of these organically and environmentally determined forces. By his fifth or sixth year the child has acquired the attitudes and behaviour, that is, the individuality which will thereafter identify and support him. The best guidance during this period in which he is most rapidly growing physically and acquiring social, intellectual, language and motor skills is not a simple matter of universally providing certain situations or certain techniques. It is, rather, an interweaving process in which, knowing each child's development, opportunities to learn are skilfully timed. For children $2\frac{1}{2}$ to 5 years old, the nursery school (or preschool) provides such guidance. Its professional standards, emphasizing specifically trained teachers, are based on a philosophy which includes the child's parents as active participants.

Early nursery schools (Bureau of Educational Experiments, New York, 1919, University of Iowa, Iowa City, 1921, Merrill-Palmer school, Detroit, 1922) were established to study young children and to provide observation and training opportunities for parents and teachers. Subsequent development, including widespread use of similar facilities in universities, colleges and high schools, extended the professional training function to family service related fields such as medicine and social work. However, many groups operate solely for the benefit of the children and families involved. Between 1933 and 1945 two federally supported programs in connection with public education furthered the understanding and acceptance of this educational institution. A 1951 survey listed 3,377 preschools under governmental, private, religious and secular sponsorships. Co-operative nursery schools, parent-initiated, financed and administered, employ trained teachers to ensure standards.

Programs for training teachers emphasize studying this particular age and understanding personality development; they require supervised participation in work with children and their parents.

It is accepted that the nursery school was not designed as a home substitute but that the child's potentialities can be more completely realized as the school works with him and his parents; it is a desirable supplement. The incompletely functioning home may receive substitutive services in the school; this is not its purpose, however. All organizers of groups for young children must recognize the educational implications and, therefore, responsibilities; allied professional workers and parents must demand more than promotion of physical safety, health and entertainment.

Although such essentials as attractive, clean rooms, sanitary facilities, protected outdoor space and maximum child-teacher ratio (1 to 8) are easily described, the subtler, less tangible attributes of any school are more critically discriminating. The clinical and scientific knowledge of the teachers and their personalities are the significant mediating instruments which, with suitable equipment for play, make for a child a constructive group, individually dimensioned.

The educational program for preschool children presupposes participation in play and real-life situations as basic experience within which the child develops. He needs space for being vigorous, being awkward, being alone, being part of an active group, for his happiness and for his concerns. He needs materials appropriate to his skills, his size, his ideas, his feelings, and he needs an understanding teacher to help him help himself explore verbally and manually and learn from both people and things. He needs children and adults outside his family, for as he rubs elbows with them, disagrees with them, shares with them and sometimes ignores them, he learns not to be threatened by them or to exploit them or to follow them blindly but instead achieves constructive attitudes for living with others.

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(R. Uf.)

NURSING. Because of basic differences in eastern and western cultures, the evolution of nursing has been extremely uneven. Historically it may be said to fall into five fairly well-defined periods. These are (1) pre-Nightingale; (2) the pioneer Nightingale period 1860–1900; (3) the period of professional self-development 1900–20; (4) the period of rising internationalism between the two World Wars; and (5) nursing in the Atomic Age.

To 1860.—From the time of Phoebe (A.D. 60), nursing has been recognized as one of the works of mercy of the Christian church. With the rise of monasticism, the care of the sick became a function of many religious orders. It was one of the services performed by communities organized under the rule laid down by St. Benedict in the 6th century. The mother house, an organizational pattern developed by the orders, was adopted by later Catholic and Protestant nursing orders and, in parts of Europe, by the Red Cross. Among the earliest nursing records are those of the Hôtel-Dieu, Paris (A.D. 606), where, since the 12th century, Augustinian sisters have been in charge. From the military nursing orders, such as the Knights Hospitaller of St. John of Jerusalem, nursing inherited a tradition of rigorous discipline. A trend toward the modernization of nursing began when Mlle. de Gras (Louise de Marillac) took a vow in 1634 to work under the direction of St. Vincent de Paul. The principles he laid down for the guidance of the Sisters of Charity, now one of the largest and most widely distributed nursing orders in the world, had lasting influence. Pastor Theodor Fliedner and his wife, whose work influenced the later development of nursing, laid the foundations of the modern deaconess movement at Kaiserswerth, Ger., in 1836. The Sisters of Mercy and the Sisters of Charity, established in Ireland at about the same time, began the reform of nursing in that

country. The Reformation left England without a system of hospital nursing. Nursing, therefore, had no distinctive part in the colonial development of the United States.

Hospitals built by the Spaniards in Latin America antedated public hospitals in the United States by about 300 years. Publication in France of the Jesuit "Relations," the reports of missionaries to "New France," aroused interest in the needs of Canada's colonists. Augustinian Hospitallers from Dieppe, the first nursing sisters to cross the Atlantic, established the Hôtel-Dieu, Quebec, in 1639. Jeanne Mance (1606–73), the first white woman to arrive at Montreal, there established the Hôtel-Dieu (1664) and secured the assistance of the Sisters of St. Joseph—the Hospitallers of La Fleche—while herself remaining outside the order. Visiting nursing was introduced into Canada by Mme. d'Youville, who organized the Soeurs Grises or Grey nuns of Montreal (1755). Charity hospital in New Orleans was staffed by Ursuline sisters from 1737 until Louisiana became part of the U.S. Beginning in 1834, Sisters of Charity conducted the nursing service.

The earliest indigenous order in the U.S. was organized by Elizabeth Ann Seton in 1809 and incorporated in 1917 as the Sisters of Charity of St. Vincent de Paul. These sisters undertook hospital nursing at the Baltimore infirmary (later University of Maryland hospital) in 1923. By 1870, 17 sisterhoods and the Alexian brothers were providing the nursing service in 70 Catholic hospitals.

Four German deaconesses (Lutheran) arrived in Pittsburgh in 1849. By 1880, mother houses under Lutheran, Evangelical and Methodist auspices had been established in Philadelphia, Pittsburgh, Chicago, Milwaukee and other middlewestern cities. Anglican sisterhoods, similar to the new orders in England, provided nursing service for St. Luke's hospital, New York city (1858); St. Mary's Free Hospital for Children, also in New York (1870); and the Children's hospital, Boston, Mass. (1871).

Florence Nightingale.—Miss Nightingale made outstanding contributions to the fields of sanitation, statistics, military medicine and hospital administration but is most widely known as the founder of modern nursing. Born to luxury but dissatisfied with a life of leisure, she was endowed with the intelligence of a scientist and the emotional drive of a reformer. She observed and studied nursing as practised by the Augustinians and numerous other orders. She spent three months with the Fliedners at Kaiserswerth where she found the spirit more impressive than the practice of nursing. Convinced of the need for reform in nursing, she had just opened an institution for the care of the sick in London when, in 1854, England's secretary at war asked her to undertake the nursing of soldiers in the Crimea. The staff she recruited was made up of Catholic and Anglican sisters and practical or "experienced" nurses. The effect of her energetic and well-directed attack on the shocking results of disinterest and military red tape was spectacular. The death rate dropped from more than 400 to 22 per 1,000. The fame of that achievement spread throughout the civilized world.

Miss Nightingale used the fund raised by popular subscription in her honour to establish and endow a school of nursing at St. Thomas' hospital in London. With the admission of 15 probationers, June 15, 1860, the modern era in nursing was begun. The primary characteristics of what came to be known as the Nightingale system of nursing education, although never adopted in its entirety by any country, were (1) a qualified nurse in command of the school; (2) a planned course of instruction; (3) careful selection of students; (4) a home for students with provision for recreational and cultural activities; (5) access to the wards of a well-organized hospital where students could be given direct instruction in the care of patients; and (6) funds for the educational program. The aims of the Nightingale school were to train (1) hospital nurses; (2) nurses (instructors) to train others; and (3) nurses to care for the sick poor (visiting nursing). A supplementary period of three months was required for the third objective. Miss Nightingale insisted that health nursing is as important as sick nursing and incorporated her ideas about hygiene in her widely read *Notes on Nursing*. The new profession (Miss Nightingale preferred the term "calling") was rooted in Christian ideals and imbued with a crusading spirit. It inherited the traditions of military discipline and mother house subservience. It opened a door to opportunity for educated women.

By the latter part of the 19th century the general principles laid down by Miss Nightingale had been adopted by schools connected with both voluntary and tax-supported hospitals in the English-speaking countries and were having some influence in continental Europe. The demonstrable value to hospitals of nursing service by students plus lack of endowments for the schools led to a type of apprenticeship which prepared nurses for institutional service but seriously limited their preparation for community services. Graduates of pioneer schools in the British empire and the U.S. began at an early date to establish mission schools in China, Japan and India and, a little later, in the middle east. The deaconess movement gained momentum in northern and central Europe and the mother-house idea was also adopted by Red Cross nursing schools, especially in Sweden, Germany and Austria. District nursing, the pioneer type of public health nursing by lay nurses, was inaugurated in England in 1859. In 1875, the Metropolitan and National Nursing association in London established the principle, later adopted and expanded in the U.S., that district nurses should have hospital training followed by special experience under supervision. Midwifery was developed as a separate service for which nurses might, or might not, prepare. In the U.S. two hospitals which were established for the primary purpose of providing facilities for the practice of medicine by women physicians set up courses for nurses in 1869 and 1872 at the Women's hospital in Philadelphia, Pa., and the New England Hospital for Women and Children in Boston. The first "Nightingale" school of nursing in the U.S. was established, with advice from Miss Nightingale, at Bellevue hospital, New York city, in May 1873. By the end of that year two other schools which were destined to become famous had been established at the Massachusetts General hospital in Boston and in New Haven, Conn., and Dr. Mack's school at St. Catherines, Ont., had engaged three graduate nurses from England. The schools brought order out of the chaotic and debasing conditions surrounding hospitalized patients. The first schools under religious auspices were established in the mid-1880s; the earliest visiting nurse associations were organized in the same decade.

By 1900, 422 schools with widely varying educational standards and resources had been established. Modern nursing was facilitating the advancement of surgery and a wave of hospital construction swept across the country. Many of them established schools for the sole purpose of securing student service for the care of patients.

Period of Self-organization, 1900–20.—The evolution of modern nursing can most readily be traced by following the history of the national nursing organizations. In its struggles to overcome inertia, antifeminism, political and other opposition, the nursing profession had developed a marked trend toward self-organization before the end of the 19th century. Leaders in this movement believed that legal standards of education and practice were needed for the dual purpose of protecting those in need of nursing care and those who endeavoured to secure adequate preparation for practice. When Mrs. Bedford Fenwick effected the establishment of the British Nurses association in 1887, a few alumnae associations had been established in the United States. Mrs. Fenwick became the founder of the International Council of Nurses (I.C.N.) in 1899 which antedated the international organization of other health professions by a quarter of a century. Nurses from Great Britain, Canada, the U.S., Australia, New Zealand, South Africa and Denmark, in all of which the Nightingale influence was at work, attended the preliminary conference.

Miss Nightingale opposed the movement for state registration believing it to be premature. As a result British nurses were divided and did not secure a nurse practice act until after World War I. But the movement quickly gained momentum in other countries. In North America two organizations composed of American and Canadian nurses had been organized before 1900. With the British association they provided a nucleus for the Inter-

national Council of Nurses. Later (1908) Canadian nurses formed their own association. The American Nurses' association (organized 1896) became the I.C.N.'s official affiliate in the U.S. The organizations of the Finnish (1896) and Danish (1899) nurses, which were to become notably efficient in elevating the standards of nursing in their respective countries, became influential members of the I.C.N. at a somewhat later date. The Australasian Nurses association (1899) for some years included the nurses of New Zealand who, in 1901, with remarkable farsightedness secured the first nurse practice act in the world and established a firm co-operative relationship with the national government. The official publications of the national organizations became effective instruments for promoting the development of nursing. The pioneers were the *British Journal of Nursing* (1887) and the *American Journal of Nursing* (1900).

The second nurse practice act was secured in Cuba (1902) when nurses from the U.S. had an extraordinary opportunity to modernize nursing under the military government following the Spanish-American War. In the U.S., four state legislatures passed such acts in 1903—North Carolina, New Jersey, New York and Virginia. When the U.S. entered World War I the initial task was virtually complete; 47 nurse practice acts were in effect.

Other early organizations which made notable contributions to the advancement of nursing in the U.S. were the National League of Nursing Education (N.L.N.E.; 1893) and the National Organization for Public Health Nursing (1912). In Great Britain the College of Nursing (after 1939 entitled to the prefix Royal), which was later established in London (1916), quickly became the dominant force in British nursing. In the U.S. the N.L.N.E. continued to work for the improvement of basic nursing education after it had persuaded Teachers college, Columbia university (1899) to undertake a program for the preparation of graduate nurses for teaching in schools of nursing. This famous division of nursing education began modestly with funds laboriously raised by the nursing organizations and an enrolment of two students. M. Adelaide Nutting, appointed to direct the expanding program in 1907, was the first nurse to hold professorial rank in any university. She retired in 1925. An endowment in 1909 ensured stability and adaptation of programs to changing social and health needs. From its earliest days the division was a Mecca for international leaders of nursing thought.

Nurses of the British empire became interested in postdiploma education at a later date. When the Royal College of Nursing, a membership organization, received its charter, its department of education was empowered to institute and conduct examinations in all branches of women's work conducive to the efficient conduct of the nursing profession and to grant certificates and diplomas to those who pass prescribed examinations. As in the U.S., the first courses offered were for the preparation of nurse teachers.

By 1912, in the U.S., Great Britain, New Zealand and a few other countries, visiting nurses, organized originally to give nursing care in homes, were participating in a variety of specialized health programs such as child welfare, tuberculosis and school nursing. The direction of nursing services by governmental health agencies was still in its infancy. In the U.S. the National Organization for Public Health Nursing (N.O.P.H.N.; 1912) was organized by members of the older organizations to provide standards of preparation and practice and consultative services in connection with the public health movement and the development of public health nursing services. The N.O.P.H.N. began at once to urge those responsible for the basic education of nurses to provide a sound foundation for all types of nursing and to establish the requirement of one year of collegiate postdiploma preparation for public health nursing.

Wars expedite the evolution of nursing. Military needs, by depleting civilian services, force adaptations. The evolution of military services follows a fairly definite pattern. In the U.S. hospital conditions during the American Civil War were quite as shocking as those encountered by Miss Nightingale in the Crimea. The appointment of Dorothea Dix as superintendent of nurses for the federal military establishment did little to ameliorate the situation. The army nurse corps (1902) was not organized until the Spanish-American War had again demonstrated need for a permanently organized service. The navy nurse corps was organized in 1908.

In Great Britain, Queen Alexandra's imperial military nursing service superseded less formally organized services after the South African War (1899–1901). The territorial army nursing service was organized in 1907. Members of these corps were commissioned in 1941. The officers of Queen Alexandra's royal naval nursing service (organized 1902) have relative rank. Canada, however, was the first country (1904) to make provision for commissions for nurses in military service. In the U.S., army nurses were granted relative rank after World War I; both army and navy nurses were given temporary commissions in World War II. In the military reorganization of 1947, members of both corps were permanently commissioned as were those of the new air force nurse corps organized in 1949. The chiefs of the army and air corps have the rank of colonel; the highest ranking navy nurse is a captain. Members of all three corps served in the Korean war, 1950–1953, as did nurses of Australia, Canada, Denmark, France, Great Britain, the Netherlands, Norway, Sweden and Thailand.

After World Wars I and II.—Relationships between the Red Cross and military nursing require explanation. The International Red Cross was organized, in accordance with the principles laid down by the Treaty of Geneva (1864), as a politically neutral agency which would provide needed voluntary services in time of war. The League of Red Cross Societies (L.O.R.C.S.; 1919) was an outcome of experience in meeting civilian needs during World War I. Both work through the national Red Cross societies.

The preparation of nonprofessional volunteers for nursing service in wartime was actively promoted by the older organization; and a few national Red Cross societies, especially those of Japan, Germany, Austria and Scandinavia, established nursing schools. The division of nursing of the L.O.R.C.S. was helpful in clarifying issues in relation to the preparation, assignment and interrelationship of professional nurses and of nonprofessional volunteers such as nurses' aides. It actively promoted the teaching, by professional nurses, of courses for nurses' aides and also in home nursing and related subjects for use by nonprofessionals in their own homes.

From 1909 to 1947 the relationship between the American Red Cross (A.R.C.) and professional nursing had no counterpart. The nursing service of the A.R.C., in addition to providing nurses for disaster service and for teaching home nursing and other courses, provided a reserve of "enrolled Red Cross nurses" for the army and navy nurse corps. It spearheaded the recruitment of the 25,000 nurses who entered military service in World War I and the 59,000 who served in World War II.

The health section of the League of Nations (1922), which gave powerful impetus to the development of health programs by national governments, had no division of nursing. But the Rockefeller foundation, through its international health program, was already promoting the organization of nursing schools which would graduate nurses equipped to participate in health programs. Its influence has been felt throughout the world. The earliest of the foundation-assisted schools were that of the Pekin Union Medical college, Pekin, China, and the Ana Nery school in Rio de Janeiro, Braz. (1922). In the U.S., the Yale school, established with foundation support in 1923 as an educational experiment, was subsequently endowed by it. The foundation sponsored and assisted with the organization of the first university school of nursing in Europe, established in connection with the University of Brussels, Belg. (1936). By mid-century it had sponsored or given developmental aid to schools in other European countries, in South America, the far east, South Asia and in the South Pacific. The A.R.C. followed up its work for civilians in Europe by sponsoring the organization of modern schools in Prague, Czech.; Posnan and Warsaw, Pol.; Sofia, Bulg.; and Constantinople, Turk.

The League of Red Cross Societies established a postdiploma program in public health nursing in connection with the College of Nursing (London) at Bedford college. The scope of the program had been broadened when, in 1934, the L.O.R.C.S., in co-operation with the International Council of Nursing (I.C.N.),

transferred its program to the jurisdiction of the newly organized Florence Nightingale International foundation as the nucleus of an educational memorial to the founder of modern nursing.

In countries where nursing was already well established, the period between World Wars I and II was characterized by continuous effort to adapt the basic preparation of nurses to changing social and health demands upon the profession. As a basis for action objective studies of nursing were made, under a variety of auspices, in the U.S., Canada and Great Britain. The first of them, *Nursing and Nursing Education in the United States* (1922), was followed by the experiment at Yale and the subsequent endowment of that school. Concurrently the Frances Payne Bolton school was endowed and established at Western Reserve university, Cleveland, O. The organization on a collegiate level and endowment of the Vanderbilt University school, Nashville, Tenn., followed a few years later. Reports from these schools stimulated interest in efforts to utilize the resources of institutions of higher education for the education of nurses. Other state universities began to accept responsibility for educating nurses as the University of Minnesota had been doing since 1909. The organization of the Association of Collegiate Schools of Nursing in 1932 accelerated this movement. Between 1928 and 1934 the Committee on the Grading of Nursing Schools issued a series of reports which encouraged the upgrading of many hospital schools and hastened the closing of feeble ones.

In Canada, the University of British Columbia, Vancouver, was the first (1919) in the British empire to offer a basic program leading to a degree. Other Canadian universities followed its example. The University of Toronto, Ont. (1933), developed a basic collegiate program which prepared nurses for positions in all types of nursing, including public health nursing. This program and the postgraduate offerings of the university attracted nurses from many countries. The *Survey of Nursing in Canada* (1932), sponsored by the national medical and nursing organizations, provided a well-balanced guide to further developments. In Great Britain the report of the Lancet Commission on Nursing (1932) revealed the sharp conflict which had arisen between those who clung to the methods of the past and those who were concerned with current problems and future needs. The report was the forerunner of more searching investigations sponsored by the College of Nursing and philanthropic and health agencies. As in the U.S. and Canada, the control of nursing schools by hospitals in the interest of their own, rather than community service, obscured the basic issue—the need for independence and financial support for nursing schools.

Internationally, the most important publication of the period was the *Educational Program for Schools of Nursing,* published in three languages by the I.C.N. and promptly adopted by the L.O.R.C.S.

In World War II every country which called on nurses for military service was confronted with the fundamental problems of equitable adjustment of nursing resources to military and civilian needs, and need to develop methods for augmenting the peacetime supply of nursing service. The problem was effectively handled in Great Britain where all types of nursing personnel were required to register. Data thus obtained provided a sound basis for the recruitment of student nurses, the distribution of graduate nurses and the provision of supplementary services. War accelerated action in relation to a need which was already apparent in many countries, *i.e.,* preparation of workers to supplement the services of professional nurses. In Great Britain legislation (1943) set standards for the preparation of assistant nurses and provided for a register of them. In the U.S. the preparation of practical nurses was retarded by uneven progress in securing state legislation.

In the U.S., one-fourth of all active professional nurses volunteered for military service. The profession resisted a proposed draft but the American Nurses' association later went on record as favouring a draft of nurses which would ensure a register of all nursing personnel should there again be massive military need for nursing service.

Prior to World War II, in countries where modern nursing had been longest established, national governments had shown little evidence of continuous interest in the preparation of nurses in relation to total national need. In the U.S. the Army School of Nursing (1919–1931) was organized and controlled by the military establishment. Social legislation in the '30s had made provision for the preparation of graduate nurses for public health nursing but nursing schools had never received governmental assistance.

With the beginning of World War II nursing leadership in the U.S. was delegated by the several national nursing organizations to a National Nursing Council for War Service which undertook the co-ordination of the programs of the voluntary agencies and provided liaison with the American Red Cross and the several federal agencies concerned with the supply of military and civilian nursing service. The council initiated a modest program of federal aid to nursing education for which congress appropriated $4,700,000 during the period 1941–43. The few thousand additional students enrolled in nursing schools fell far short of the growing need. Concurrently with the withdrawal of nurses for military service, civilian use of hospital facilities increased at a phenomenal rate, and industries also required unprecedented numbers of nurses. An extensive program of assistance was provided by the Nurse Practice act of 1943 under which the U.S. public health service (PHS) set up a department of nursing education to administer the U.S. cadet nurse corps (July 1, 1943). When enrolment was discontinued Oct. 15, 1945, 84.5% of the 139,000 students in the schools had received federal assistance, *i.e.,* they were members of the U.S. cadet nurse corps. In contrast, there had been only 87,500 students in all schools in 1941, the year before federal aid was made available. The cadet corps effectively met the wartime emergency. Its methods also contributed to the advancement of nursing education. Following the war the essentiality of nursing as a national resource was recognized by the appointment of Lucile Petry Leone, who had directed the corps program, as chief nurse officer of the PHS with the rank of assistant surgeon general (equivalent to army rank of brigadier general). A division of nursing resources was created which conducts and promotes research and disseminates information about nursing.

The termination of World War II brought no end to the demand for nurses, so swiftly did social forces already in action create new or expanded demands for nursing services. Among them were the continuing growth of various types of hospital and health insurance, the adaptation of nursing to rapid changes in medical practice due to chemotherapy, advances in surgical procedure, anaesthesia and the like and to the broadening functions of medicine, especially in relation to prevention, rehabilitation and psychiatry, and the expansion of national health programs. The World Health organization became a stimulating and co-ordinating agency.

In the U.S. the Hospital Construction and Survey act (1947) set in motion a program which is rapidly expanding the capacity of hospitals and health centres but there is no federal program which helps to finance the preparation of the additional nurses and other personnel required by these facilities.

Publication of *Nursing for the Future,* the report of a study it had sponsored to facilitate the postwar adjustment of nursing, terminated the program of the National Nursing council. Out of a study of the structure and functions of the national nursing organizations, emerged in 1952 the new National League for Nursing (N.L.N.) and an expanded American Nurses' association (A.N.A.). The N.L.N., which superseded the National League of Nursing Education, National Organization for Public Health Nursing, and Association of Collegiate Schools of Nursing, set up an accreditation program as recommended by the study of nursing education. In Great Britain the passage of the National Health Service act (1946) was followed by a comprehensive nationally sponsored study of recruitment in preparation for nursing. The recommendations, directed toward improving the conditions which were causing serious "wastage" of students during training, were similar to policies generally accepted in the U.S. and Canada. Chief among them was recognition of student nurses as enrollees in schools as distinguished from service personnel. The study was followed by a

job analysis (1953). An earlier study had called attention to the preparation of nurses, including midwifery training, for work in the colonies.

Need for experimentation and studies of nursing functions, in order that the services of professionally prepared personnel be utilized at the highest level of efficiency, was everywhere apparent. The Canadian Nurses association courageously led off with a major research project. With financial support from the Canadian Red Cross, it set up an experimental school which attracted international attention and stimulated further experimentation in Canada. In a period of sharp competition for the services of young women it was believed that shortening the basic period of education would tend to attract larger numbers of desirable candidates to nursing schools. At the end of the four-year experiment it was concluded that when a school has complete control of students' time, nurses can be prepared at least as well in two years as in three (the 50-year-old standard) but their education must be paid for in money and not in service.

Number of Active Graduate Nurses per 100,000 Population, Selected Years (U.S.A.) 1900–51

Year	Number of active graduate nurses	Population (thousands)	Graduate nurses per 100,000 population
1900	11,804	76,094	16
1910	82,327	92,407	89
1920	103,878	106,466	98
1930	214,292	123,077	174
1940	284,159	131,936	215
1951	366,134	154,360	237

In the U.S. individuals and both official and voluntary agencies were increasingly interested in research. The A.N.A. in 1950 set up a five-year research program in the functions of nursing and a clearing bureau by means of which work in progress might be co-ordinated.

The World Health organization became the directing and co-ordinating agency in the health field. Missionary groups had been at work constructively in some of the underdeveloped areas for generations. By 1950 Catholic and Protestant groups had each established more than 1,100 hospitals and at least double that number of dispensaries. The total number of nurses employed by these agencies is not known. Emphasis by both groups has usually been on remedial therapy.

In addition to participation in W.H.O. programs, U.S. nurses were also assigned to the health missions included in the programs of the Technical Cooperation administration (Point Four) and the Mutual Security agency of the U.S. Nurses were sent to such countries as Iran, Thailand, Burma and Lebanon.

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See also Monasticism.

NUSKU, personification of the new moon, the name of the light and fire god in Sumer, Babylonia and Assyria, who is hardly to be distinguished from a god Gibil. Nusku-Gibil is the symbol of the heavenly as well as of the terrestrial fire. As the former he is the son of Anu, the god of heaven, but he is likewise associated with Enlil of Nippur, the earth god, and regarded as his messenger. A centre of his cult in Assyria was in Harran, where, because of the predominating character of the moon cult, he is viewed as the son of the moon god Sin (*q.v.*). He is often called upon to cleanse the sick and suffering in the magic fire rituals.

The fire god is also viewed as the patron of the arts and the god of civilization in general, because of the natural association of all human progress with the discovery and use of fire, and as the protector of the family. He becomes the mediator between humanity and the gods, since it is through the fire on the altar that the offering is brought into the presence of the gods.

While temples and sanctuaries to Nusku-Gibil are found in Babylonia and Assyria, he is worshipped more in symbolism than the other gods. Nusku and Gibil are symbolized by the lamp.

See A. Deimel, *Pantheon Babylonicum*, Nos. 598 and 2367. H. Zimmern, *Keilinschriften und das Alte Testament*, 416–420.

NUT, a term applied to that class of fruit which consists generally of a single kernel enclosed in a hard shell. Botanically speaking, nuts are one-celled fruits with hardened endocarps, sometimes enveloped in a cupule or cup, formed by the aggregation of bracts as in the hazel and acorn. A great number of nuts enter commerce for various purposes, principally as articles of food or sources of oil and for several ornamental and otherwise useful purposes. Certain of the edible species such as pecan, hickorynut, Brazilnut, sapucaianut, butternut, Persian walnut, coconut, pistachionut, and others are especially rich in fat, while such others as the lychee, chestnut, chufanut and the waterchestnut are notably rich in carbohydrates. Some nuts yield oils hardly fit for human consumption, yet very valuable in soapmaking, while still others furnish oils used in making paints, varnishes and many other products. Some nuts are used only in making buttons, cigarette holders and other similar products of turnery.

While most nuts of leading importance are discussed separately elsewhere in alphabetical order, there is here included a list of many plant products commonly known under this name, together with an indication of their original source and the principal uses of either the nut or the plant, or both. Following are brief comments concerning a few that are of special interest.

The sweet almond is one of the world's best-known and best-liked nuts of the market. While of greatest importance as a crop in the Mediterranean basin, it is also of great importance in California and Australia. The bitter almond is grown chiefly in northern Africa. It is an important source of almond flavouring extract and prussic (hydrocyanic) acid.

Beechnuts are of little importance for human food, although in parts of Europe they are used as the source of a pleasing salad oil. The trees are of chief value for timber and ornamental planting.

The betelnut is chewed in the Philippines and other eastern tropics in much the same manner as tobacco.

Brazilnuts and sapucaianuts are close relatives from the Amazon region and elsewhere in northern South America. The former are well-known and much prized. The latter are not well known but are among the choicest nuts obtainable from any source.

The breadnut, a relative of the true breadfruit (*Artocarpus altilis*) is about an inch in diameter and contains a single seed, which when roasted or boiled is pleasant and nutritious.

The true butternut is the seed of a member of the walnut family which grows in northeastern United States and Canada. It is considerably hardier than is the Eastern black walnut but of less value for timber. Its kernels are preferred by some to those of any other *Juglans*.

The cashewnut is a native of the American tropics but is grown to greatest extent in southern India, Ceylon and East Africa. Marketed little except in the shelled and roasted condition, it is one of the cheapest and most pleasing of the world's nuts.

The castanopsis is a warm-country evergreen which produces a nut resembling the chestnut in bur and an oak in seed. It is eaten to a considerable extent although in flavour it is intermediate between an acorn and a chestnut.

The chestnuts were originally important as food and timber producers in Europe, Asia and North America. Between 1900 and 1940, the American and European trees, which were abundant in the eastern part of the United States, were practically destroyed there by chestnut blight. By 1943, much headway had been made toward reestablishing orchards with resistant strains and varieties of Chinese origin.

Common names in order of preference	Latin name	Original source	Principal use of nut or plant
Allegany oilnut; Elknut; Buffalonut	*Pyrularia pubera*	Eastern U. S.	Botanical interest
Almond (sweet)	*Prunus amygdalus*	Mediterranean basin	Food
Almond (bitter)	*P. amygdalus*, var. *amara*	Mediterranean basin	Flavouring extract; Prussic acid
Araucarian pinenut; Piñon; Pinyonie	*Araucaria araucana*	Chile	Food; Ornamental tree
Arnut; Yer-nut; Earth chestnut; Hawknut; Lousy-nut	*Bunium* spp.	Western Europe to Caucasus	Food
Babassu nut	*Orbignya oleifera*	Brazil	Food; Fuel oil; etc.
Bambarra-nut; Groundnut	*Voandzeia subterranea*	Tropical Africa	Food
Barbadosnut; Physic nut	*Jatropha curcas*	Tropical America	Medicine
Beechnut, American	*Fagus grandifolia*	Eastern U. S.	Mast; Timber
Beechnut, European	*Fagus sylvatica*	Central Europe; S.W. Asia	Salad-oil; Mast and timber
Ben-nut	*Moringa oleifera*	India and West Indies	Artists' oil
Betelnut; Arecanut; Pinang	*Areca catechu*	Eastern Pacific islands	Masticatory
Bladdernut, American	*Staphylea trifolia*	Temperate North America	Ornamental plant
Bladdernut, European	*Staphylea pinnata*	Southern Europe; S. Asia	Necklaces
Bomah-nut; Bome N.; Boomah N.	*Pycnocoma macrophylla*	Africa	Tanning; Poison plant
Bonduc nut	*Caesalpinia bonduc*	Tropics	Medicine; Beads
Brazilnut; Castanea; Creamnut; Paranut; Butternut; Niggertoe; Castana	*Bertholletia excelsa*	Northern South America	Food; Timber. *See* BRAZILNUT
Breadnut	*Brosimum alicastrum*	Tropical America	Food
Butternut; Long or White walnut	*Juglans cinerea*	Eastern U.S.; S.E. Canada	Food; Timber. *See* BUTTERNUT
Candlenut; Lumbang; Kukui; Varnish tree	*Aleurites moluccana*	Tropical Pacific islands	Manufacturing oil. *See* ALEURITES
Capechestnut	*Calodendrum capense*	Southern Africa	Ornamental plant
Cashewnut; Acajou; Caja; Cajou	*Anacardium occidentale*	West Indies and Tropical America	Food. *See* CASHEW
Castanopsis nut	*Castanopsis* spp.	S.E. Asia; California	Food; Ornamental evergreens
Chestnut, American	*Castanea dentata*	Eastern U. S.	Food; Timber; Tannin. *See* CHESTNUT
Chestnut, Chinese	*Castanea mollissima*	Northern China; Chosen	Food; Timber
Chestnut, European; Spanish, French, Italian C.; Marron	*Castanea sativa*	Southern Europe; N.Africa; S.W. Asia	Food; Timber
Chestnut, Japanese	*Castanea crenata*	Japan; Chosen	Food; Timber
Chilehazel	*Gevuina avellana*	Chile	Food; Ornamental plant
Chinkapin, Alabama	*Castanea alabamensis*	Southeastern U. S.	Food; Timber. *See* CHESTNUT
Chinkapin, Allegany; Dwarf chestnut	*Castanea pumila*	Southeastern U. S.	Food
Chinkapin, Ashe	*Castanea ashei*	Southeastern U. S.	Food; Tannin
Chinkapin, Florida	*Castanea floridana*	Southeastern U. S.	Food; Tannin
Chinkapin, Henry	*Castanea henryi*	China	Food; Timber
Chinkapin, Ozark	*Castanea ozarkensis*	Arkansas	Food; Timber
Chinkapin, Trailing; Creeping Chinkapin	*Castanea alnifolia*	Southeastern U. S.	Botanical interest
Chocolate nut; Cacao (Cocoa)	*Theobroma cacao*	Central and South America	Food and beverage
Chufa; Rush nut; Earthnut; Ground almond	*Cyperus esculentus*	Southern Europe	Food
Cobnut. See *Hazelnut* and *Filbert*, below			
Cobnut of Jamaica	*Ophalea triandra*	West Indies and Tropical America	Food
Coconut; Cocoanut	*Cocos nucifera*	Tropics generally	Food
Cohunenut; Cahoun nut	*Attalea cohune*	Honduras	Soap oil
Colanut; Kolanut; Ombene; Temperance nut; Bissy-bissy nut; Guru nut	*Cola acuminata*	West Africa	Food; Beverage
Coquilla nut	*Attalea funifera*	Brazil	Turnery
Coquita-nut; Monkey's coconut; Dwarf coco-nut; Coker-nut	*Jubaea spectabilis*	Chile	Soap oil
Cumaranut (Tonka or Tonquin bean)	*Dipteryx odorata*	Tropical South America	Perfume
Dika-nut	*Irvingia gabonensis*	West Africa	Food; Oil
Filbert, American (Hazelnut)	*Corylus americana*	Eastern North America	Food. *See* FILBERT
Filbert, Beaked	*Corylus cornuta*	Eastern North America	Food
Filbert, California	*Corylus californica*	West Coast of U. S.	Food
Filbert, Chinese	*Corylus chinensis*	Central and West China	Food; Timber
Filbert, European; Cobnut; Hazelnut	*Corylus avellana*	Europe	Food
Filbert, Giant	*Corylus maxima*	Europe	Food
Filbert, Himalaya	*Corylus ferox*	Himalayas	Food
Filbert, Japanese	*Corylus sieboldiana*	Japan	Food
Filbert, Mildred	*C. americana* x *avellana*	United States	Food
Filbert, Siberian	*C. heterophylla*	China; Siberia; Japan	Food
Filbert, Turkish; Constantinople hazel	*Corylus colurna*	Turkey; Southern U.S.S.R.; Himalayas	Food; Timber; Ornamental tree
Ginkgonut	*Ginkgo biloba*	China; Japan	Food; Timber; Ornamental tree
Goatnut. See *Jojoba*, below.			
Grugru nut; Corozo nut	*Acrocomia aculeata*	Tropical South America	Beads
Hazelnut. Synonym for Filbert			*See* FILBERT
Heartnut; Japanese walnut; Cordate W.	*Juglans sieboldiana cordiformis*	Japan	Food. *See* WALNUT
Hican (Pecan x shellbark hybrid)	*Carya illinoensis* x *laciniosa*	Indiana; Illinois; Iowa	Novelty trees and nuts. *See* HICKORY
Hickorynut, Bitter	*Carya cordiformis*	Eastern U.S.; Ontario	Timber; Nut inedible
Hickorynut, Black; Buckley hickory	*Carya texana*	Texas; Okla.; Arkansas	Food; Fuel
Hickorynut, Carolina; Southern Shag	*Carya carolinae-septentrionalis*	Southeastern U.S.	Food; Timber
Hickorynut, Cathay	*Carya cathayensis*	China	Food; Timber
Hickorynut, Fernow	*Carya fernowiana*	Southwestern U.S.	Food; Timber
Hickorynut, Hammock	*Carya ashei*	Southeastern U.S.	Timber; Fuel
Hickorynut, Mockernut; Bigbud H.; Bullnut	*Carya tomentosa*	Eastern U.S.; Ontario	Food; Timber
Hickorynut, Nutmeg	*Carya myristicaeformis*	Southwestern U.S.	Food; Timber
Hickorynut, Pig or Hognut	*Carya glabra*	Eastern U.S.; Ontario	Mast; Timber

Common names in order of preference	Latin name	Original source	Principal use of nut or plant
Hickorynut, Red; False shagbark	*Carya ovalis*	Eastern U.S.; Ontario	Food; Timber
Hickorynut, Sand; Paleleaf hickory	*Carya pallida*	Southeastern U.S.	Mast; Timber
Hickorynut, Scrub; Florida hickory	*Carya floridana*	Florida	Fuel
Hickorynut, Shagbark; Little scalybark; Tuscatine	*Carya ovata*	Eastern U.S.; S.E. Canada	Food; Timber
Hickorynut, Shellbark; Bigleaf H.; Bottom H.; Big scalybark	*Carya laciniosa*	Central, Eastern U.S.	Food; Timber
Hickorynut, Swamp	*Carya leiodermis*	Louisiana; Mississippi	Food; Fuel
Hickorynut, Tonkin	*Carya tonkinensis*	Southern China; Indo-China	Food; Timber
Hickorynut, Water; Bitter Pecan	*Carya aquatica*	Southern U.S.	Fuel; Inedible
Horsechestnut	*Aesculus hippocastanum*	Europe	Starch; Ornamental tree
Hyphaene-nut; Doum-nut; Dom-nut	*Hyphaene crinita*	South Africa	Turnery
Indiannut. Synonym for various North American edible pinenuts			
Javaalmond; Luzon-nut; Philippine N.	*Canarium commune*	Pacific Tropics	Food
Jojoba nut; Goatnut	*Simmondsia chinensis (californica)*	California and Mexico	Food and hair oil
Lychee; Chinese nut	*Litchi chinensis*	South China.	Food
Macadamia. Synonym for Queenslandnut			
Markingnut; Marany; Marsh nut	*Semecarpus anacardium*	India	Ink; Varnish
Marron. French name for large chestnuts			
Moretonbaychestnut; Black Bean	*Castanospermum australe*	Australia	Food
Mu-yu-oil-nut; Mu-yu-shu	*Aleurites montana*	South China.	Manufacturing oil. *See* ALEURITES
Nittanut; Nuttanut	*Parkia africana*	Africana	Food
Nutmeg	*Myristica fragrans*	East Indies	Spice
Nut Pine. Synonym for North American edible pinenut			
Olive-nut	*Elaeocarpus ganitrus*	India	Beads and turnery
Oysternut; Tabui	*Telfairia occidentalis*	Africa	Food
Palm nut	*Elaeis guineensis*	W. Africa	Oil. *See* PALM
Pascualito nut; Pinonchillo	*Garcia nutans*	Mexico to Venezuela	Hard, quick-drying oil
Peanut; Goober; Pindar; Groundnut	*Arachis hypogaea*	Brazil	Food. *See* PEANUT
Pecan; Illinois-nut	*Carya illinoensis*	Southern U.S.	Food; Ornamental tree. *See* HICKORY
Pekeanut. Synonym for Sawarrinut			
Pilinut	*Canarium ovatum*	Pacific tropics	Food
Pinenut; Indiannut	*Pinus* spp.		
Pinenut, Aleppo	*Pinus halepensis*	Southern Europe; W. Asia	Food
Pinenut, Colorado Pinyon	*Pinus cembroides edulis*	Southern Wyoming; Colo.; N. Mex.; Ariz..	Food
Pinenut, Coulter	*Pinus coulteri*	California	Food
Pinenut, Digger	*Pinus sabiniana*	California	Food
Pinenut, Italian Stone (Pignolia)	*Pinus pinea*	Mediterranean region	Food
Pinenut, Jeffrey	*Pinus jeffreyi*	California; Oregon	Food
Pinenut, Korean	*Pinus koraiensis*	Chosen; Japan	Food
Pinenut, Lacebark	*Pinus bungeana*	Northwestern China	Food
Pinenut, Limber	*Pinus flexilis*	Alberta to Texas	Food
Pinenut, Mexican Pinyon	*Pinus cembroides*	Southwestern U.S., Mexico	Food
Pinenut, Parry Pinyon	*Pinus cembroides parryana*	California	Food
Pinenut, Ponderosa	*Pinus ponderosa*	Western U.S.	Food
Pinenut, Singleleaf Pinyon	*Pinus cembroides monophylla*	Southwestern U.S.	Food
Pinenut, Sugar	*Pinus lambertiana*	Oregon to Lower California	Food
Pinenut, Swiss Stone (Pignolia)	*Pinus cembra*	Central Europe to Siberia	Food
Pinenut, Torrey; Soledad Pinenut	*Pinus torreyana*	Southern California	Food
Pinenut, Western White	*Pinus monticola*	Northwestern U.S.; B.C.	Food
Pinenut, Whitebark	*Pinus albicaulis*	Northwestern U.S.; B.C.	Food
Piñon. Synonym for Pinenut			
Pistachionut; Pistache; Green almond	*Pistacia vera*	Mediterranean basin to Southwestern Asia	Food. *See* PISTACHIONUT
Poisonnut	*Strychnos nuxvomica*	India	Medicine
Quandongnut	*Fusanus acuminatus*	Australia	Food
Queenslandnut; Australian nut; Macadamia; Australian hazel	*Macadamia ternifolia*	Australia	Food
Ravensara nut	*Ravensara aromatica*	Madagascar	Spice
Sapucaianut; Paradise nut	*Lecythis zabucajo*	Tropical South America	Food
Sassafras nut	*Ocotea* spp.	South America	Aromatic
Sawarrinut; Pekeanut; Peruvian almond; Butternut; Piki	*Caryocar nuciferum*	Peru; Brazil	Food
Sheanut	*Butyrospermum parki*	British Africa	Food; Soap oil
Snakenut	*Ophiocaryon paradoxum*	Guiana	Charm for snakebite
Soapnut	*Sapindus saponaria*	Southern Florida to Northern S. America	Washing; Ornament
Taguanut; Ivorynut; Vegetable ivory	*Phytelephas macrocarpa*	Central America	Buttons, etc.
Tahiti-chestnut; South Sea chestnut	*Inocarpus fagiferus*	South Seas	Food
Tallownut, Chinese	*Sapium sebiferum*	China	Wax for soap and candles
Tropical-almond; Myrobalan; Tavolanut; Demerara almond	*Terminalia catappa*	Southwestern Asia	Food; Street tree
Tungnut; Wood-oil tree	*Aleurites fordii*	South China.	Paint and varnish. *See* ALEURITES
Tungnut, Japanese	*Aleurites cordata*	Japan to Formosa	Oil. *See* ALEURITES
Walnut, American	*Juglans nigra*	Eastern U.S.	Trade name for lumber of this sp.
Walnut, Ancona	*Juglans regia*	Persia	Trade name indicating streaked figure in Persian Walnut
Walnut, Argentine	*Juglans australis*	Argentina	*See* WALNUT
Walnut, Arizona Black	*Juglans major*	Southwestern U.S.	Food; Lumber

Common names in order of preference	Latin name	Original source	Principal use of nut or plant
Walnut, Bixby	*J. cinerea* x *sieboldiana*	U.S.	Food; Novelty tree
Walnut, Bolivian Black	*Juglans boliviana*	South America	Food; Lumber
Walnut, California (S. Calif.) Black	*Juglans californica*	Southern California	Food; Lumber
Walnut, Cathay	*Juglans cathayensis*	China	Food; Fuel
Walnut, Circassian	*Juglans regia*	Persia	Trade name for lumber of Persian W.
Walnut, Claro		California	Trade name for lumber of California and Hinds Walnuts; also California hybrid walnuts
Walnut, Colombian	*Juglans columbiensis*		
Walnut, Cuban	*Juglans insularis*	Cuba	Lumber; Food
Walnut, Eastern Black	*Juglans nigra*	Eastern U.S.; Ontario	Lumber; Food
Walnut, Ecuador	*Juglans honorei*	Ecuador	Lumber; Food
Walnut, Guatemalan	*Juglans mollis*	Guatemala	Lumber; Food
Walnut, Hinds; N. California Black W.	*Juglans hindsii*	Northern California	Food; Shade; Lumber
Walnut, Intermediate	*J. nigra* x *regia*	U.S.	Hardy ornamental
Walnut, Manchu; Manchurian W.	*Juglans mandshurica*	N. China; Manchuria; Chosen	Food; Fuel
Walnut, Nigornica	*J. californica* x *nigra*	California	Vigorous ornamental
Walnut, Nigrind	*J. hindsii* x *nigra* (Paradox in part)	California	Vigorous ornamental
Walnut, Nigroldiana	*J. nigra* x *sieboldiana*	U.S.	Ornamental tree
Walnut, Notha	*J. regia* x *sieboldiana*	U.S.	Ornamental tree
Walnut, Perbut	*J. cinerea* x *regia*	U.S.	Ornamental tree
Walnut, Persian; English; French; Turkish; Italian; Roumania; Common *et al.*	*Juglans regia*	Persia	Food; Lumber; Ornamental tree
Walnut, Regifornica	*J. californica* x *regia* (Paradox in part)	California	Vigorous ornamental tree
Walnut, Siebold; Japanese walnut	*Juglans sieboldiana*	Japan	Food; Ornamental tree; Fuel
Walnut, Texas	*Juglans rupestris*	Texas, Oklahoma; N. Mex.	Food; Ornamental tree; Fuel
Waterchestnut	*Trapa natans*	South China	Food; Conservatory plant
Waternut	*Eleocharis tuberosa*	South China	Food
Wingnut; Caucasian walnut; False walnut	*Pterocarya fraxinifolia*	Southwestern Asia	Ornamental tree

The chinkapins are closely related to the chestnuts, but are generally inferior in size of nuts and in timber values.

The chocolate nut is the source of the well-known material used in making candies and cocoa. It is extensively cultivated in many tropical regions.

The chufa is a small sedge plant producing a nut-like tuber underground which is an important hog food in the tropics and subtropics. While edible, it is rarely used as human food.

The coconut is the fruit of a palm grown in practically all tropical regions, where it furnishes food, healthful drinks, intoxicants, fibre and coconut oil.

Colanuts, now much cultivated in the American tropics, are the source of an important article of commerce used in making mildly stimulating drinks.

Coquilla nuts, or "coquilhos" as known in Portuguese, are the small coconut-like seeds of the piassava palm of Brazil. They are a by-product from the tree; the main product is fibre. They are elongated oval and 3 or 4 in. long and much used in turnery.

Coquita-nuts are the small, roundish seeds of the Syrup palm from Chile which is much prized as a conservatory plant. The seeds furnish an oil used in making soap.

The filberts are seeds of a number of temperate zone species, some of which are low shrubs while others become large trees. The nuts are roundish or oblong, yellowish brown, usually with gray tomentum over the apical end, a medium thin shell and a single kernel, which is usually slightly hollow at the centre. The filbert is one of the half-dozen or so most important nut-bearing plants of the north temperate zone.

The ginkgonut is the small, whitish, smooth-shelled seed of the Oriental ginkgo tree, also known as Maidenhair tree and as Kew tree. It forms within a fruit greatly like the American persimmon in its mushiness, but exceeding it in foul odour. The seed is roasted by Chinese, who are said to regard it as a great delicacy.

The several hickorynuts, including the pecan, are important food crops grown in the eastern and southern United States. Of these the pecan is the choicest and far the most important. Several others are of great value for their timber.

The javaalmond and the pilinut are close relatives from the eastern Pacific islands, including in particular the Philippines. The shells are very hard and thick, yet the kernels are regarded by many as being fully equal to any other nuts on the world's market.

The lychee is a brownish, roundish, thin, papery and pimpled-shell product containing a raisin-like pulp surrounding a hard, smooth-shelled seed. The edible portion is the pulp. This nut is common in most Chinese stores. It is considered a great delicacy.

The markingnut is closely related to the cashew and is equally poisonous in its effects upon the skin of susceptible persons. The immature juice of the nut is mixed with quicklime and used as an ink. When dry, the juice is the basis of a valuable caulking material and varnish. The seed is edible and is the source of a useful oil.

The pinenuts are seeds of a considerable number of species, native to remote and often more or less arid parts of the earth. The nuts are borne in the axils of the cone scales. The stone pines of Europe and Asia, the pinyon pines of North America, and the Araucarian pine of the Andean region of South America are the most important. With the exception of the Italian stone pine, the seeds of which are sold as "pignolia" and exported, pinenuts are largely consumed in the general regions where they are produced. They are fairly rich in oil and are very pleasing to the taste.

The pistachionut is the small, whitish, thin, but bony-shelled seed of a medium or small-sized tree native to the region including the Mediterranean basin and extending to southwestern Asia. The kernel is of fine texture and of pale green colour throughout; it is much used in colouring and flavouring confections. It is fairly rich in fat.

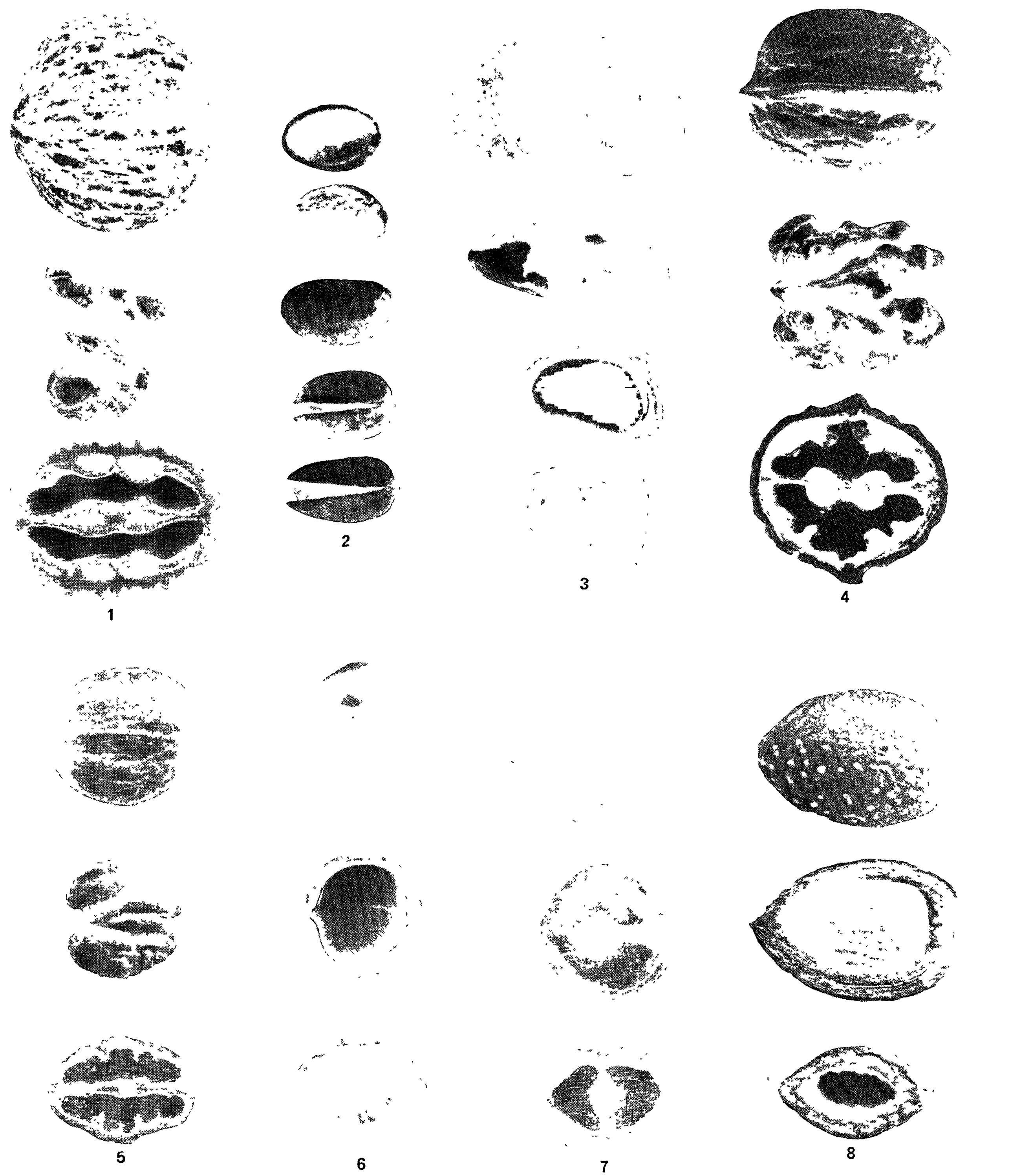
The quandong is a small, roundish, thick-shelled seed of an Australian tree which is mainly used as a preserve.

The ravensara nut is a Madagascar product considerably used as a spice under the trade name of "clove nutmeg," although it is not a true nutmeg.

The sawarrinut is the fruit of a tall-growing tree, the forest timber of which is used in building ships. The trees are cultivated in the American tropics for their very fine nuts. The latter are seldom seen in the world's market, except locally.

The taguanut is the inedible seed of a palm from northern South America, which becomes exceedingly hard and is much used in making buttons. It takes a high polish, colours well and burns with intense heat.

The tungnuts and their close relatives, the candlenut and the mu-yu-oil-nut, are sources of valuable oils used in many forms of manufacture. (*See* ALEURITES.)

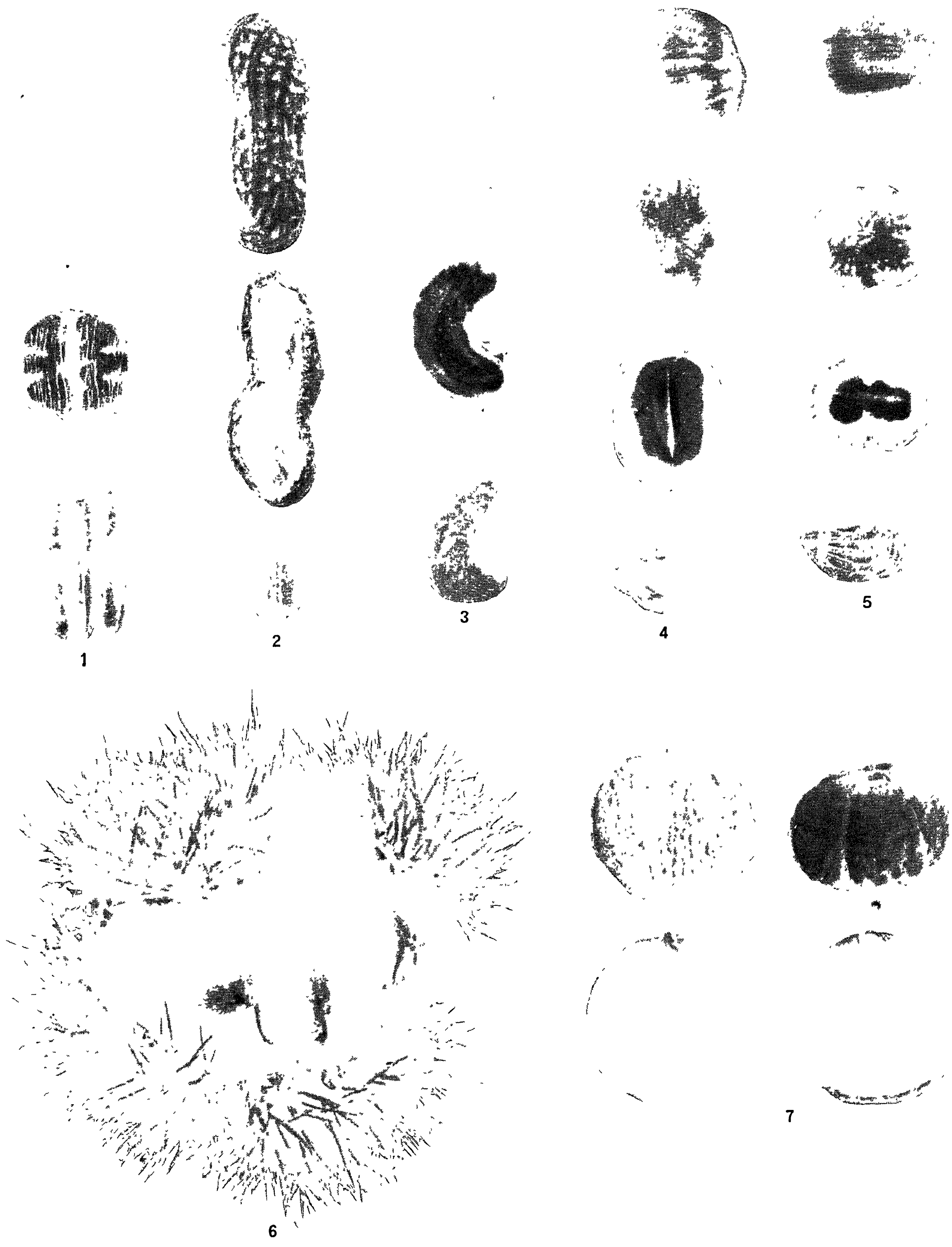


PHOTOGRAPHS, ROBERT TAYLOR

VARIOUS KINDS OF COMMERCIAL AND EDIBLE NUTS

1. Eastern black walnut, *Juglans nigra*, Thomas variety
2. Pistachionut, *Pistacia vera*. Top, nut with shell removed; below, three nuts in shell
3. Brazilnut, *Bertholletia excelsa*
4. Persian (English) walnut, *Juglans regia*, Placentia variety
5. Shagbark hickory, *Carya ovata*, Lingenfelter variety
6. Queensland nut, *Macadamia ternifolia*. Top, whole nut; middle, kernel with half of shell removed; bottom, empty half shell
7. Heartnut, *Juglans sieboldiana cordiformis*, Lancaster variety
8. Sweet almond, *Prunus amygdalus*, Peerless variety

PLATE II



PHOTOGRAPHS, ROBERT TAYLOR

VARIOUS KINDS OF COMMERCIAL AND EDIBLE NUTS

1. Pecan, *Carya illinoensis*, variety Schley (Sly)
2. Peanut, *Arachis hypogaea*
3. Cashewnut, *Anacardium occidentale*
4. European filbert, *Corylus avellana*, Barcelona variety
5. European filbert, *Corylus avellana*, Du Chilly variety, said by some to be identical with Kentish cob
6. Chinese chestnut, *Castanea mollissima*, nuts in bur at ripening time
7. Chinese chestnut, *Castanea mollissima*. Top: left, kernel with pellicle still attached; right, pellicle removed. Below, outer and inner views of end nuts

PHOTOGRAPHS, CLARENCE A REED

FLOWERS AND LEAVES OF VARIOUS NUT PLANTS

1. Shagbark hickory, *Carya ovata*. Pistillate and staminate flowers
2. Pecan, *Carya illinoensis*. Staminate flowers on branch
3. American chestnut, *Castanea dentata*. Flowers and leaves
4. Eastern black walnut, *Juglans nigra*. Staminate and pistillate flowers

The waterchestnut and its close relative, the singharanut, are important sources of human food, rich in starch. Both are annuals extensively grown in the Asiatic subtropics. The former is very abundant in the slow-moving or stagnant waters in the vicinity of the Yangtze river. It multiplies rapidly and may easily get beyond control, as it has in alcoves of the Potomac river below Washington, where it forms a practically impassable blockade at many points near the shore.

The waternut (*matai* in Chinese) is the edible corm of a sedge plant grown under irrigation in southern China. It is much used in making chop suey and is well suited to occidental cookery. The wingnut is the winged seed of a highly ornamental tree from western China. The nut is too small to be of value. (C. A. Rd.)

Nut Culture in the U.S.—Numerous varieties of the pecan are planted for commercial production in the southern states. Hardy strains are producing successfully, however, in Missouri and Illinois. In 1937, which was an excellent year, the U.S. production was estimated by the U.S. department of agriculture at 76,893,000 pounds. The yearly average for 1927–36 was 61,274,000 pounds. Texas led all other states in this ten-year period with an average annual yield of 23,380,000 pounds.

The commercial production of almonds is restricted to various forms of the sweet variety (var. *dulcis*), with increasing preference for those having thinner walls in the stone, as in the paper-shell almonds. The climatically suitable districts are comparatively limited, being confined chiefly to the Pacific states. In California, which usually grows about 99% of the United States crop, the production of almonds in 1938 was approximately 12,100 tons; in 1937, an unusually good year, it was about 20,000 tons.

The commercial production of the old world or Persian walnut, in the United States often called English walnut, has attained its greatest development in specially selected and prepared soils under irrigation in California. However, hardy strains are grown locally with considerable success in the eastern states from Massachusetts westward and southward to Arkansas, especially in climatic situations similar to the Great Lakes region of western New York; Oregon also produces a considerable quantity. In California, where more than 90% of the commercial crop is ordinarily grown, the estimated production in 1938 was 44,000 tons.

NUT (Engineering): *see* Bolt.

NUTATION [from Lat. *nutare,* to nod], a deviation of the celestial pole from its mean position, due to inequalities in the action of the sun and moon on the equatorial protuberance of the earth. The main part of the nutation is a motion of the pole in a circle of 9″ radius in a period of 18.6 years. *See* Precession of the Equinoxes.

The name is also used in reference to the phenomena of certain organs in plants which bend alternately in opposite directions. In some cases the apex of the stem will describe a spiral movement, inclining to all points of the compass in succession; this being termed *circumnutation. See* Lianes.

NUTCRACKER (*Nucifraga caryocatactes*), a European bird of the crow family (*Corvidae*). The plumage is mottled and the tail feathers have conspicuous white tips. The beak is long and the flight undulating. The nutcracker feeds mainly on conifer seeds, but also takes fruits, insects and young birds. The nest is built on the bough of a tree, about 20 ft. from the ground, and is a large structure of sticks lined with grass. The eggs are of a very pale bluish-green, freckled with pale olive or ash colour. Another species (*N. columbiana*) is found in America.

The Siberian nutcracker migrates into western Europe in large flocks, at intervals of approximately 11 years. *See* also Crow.

NUTHATCH, a small bird, so called from its habit of hacking or chipping nuts, which it cleverly fixes, as though in a vise, in a chink or crevice of the bark of a tree, and then hammers with the point of its bill till the shell is broken. The common nuthatch, *Sitta europaea,* is widely distributed through Europe and Asia, some two dozen local races being recognized. The type form, *S.e.europaea,* described by Linnaeus, lives in Scandinavia and north Russia; *S.e.affinis* in England; *S.e.caesia* in middle Europe; and other races in Spain, the Atlas mountains, Italy, Sicily, Asia Minor, Iran, China, Japan, the Caucasus mountains, Siberia, and Kamchatka.

Without being very plentiful anywhere, it is generally distributed in suitable localities throughout its range, those localities being such as afford it a sufficient supply of food. During the greater part of the year it feeds on insects, which it diligently seeks on the boles and larger limbs of old trees, but in autumn and winter it feeds on nuts, beech-mast, the stones of yew-berries and hard seeds. Its bold disposition and the fact that trees favouring its mode of life often grow near houses make it quite tame and it will become familiar with humans on slight encouragement. Its feathers are ash-gray and warm buff and its manner is sprightly. It generally makes its nest in a hollow branch, plastering up the opening with clay and leaving only a circular hole, just large enough to afford entrance and exit. The interior contains a bed of dry leaves or the filmy flakes of the inner bark of a fir or cedar, on which the eggs are laid.

The rock nuthatches, *S. neumayeri* and its races and close relatives, nest and hunt among rocks rather than trees; they range from southeast Europe to Palestine, Iran, and Turkestan. Four other little-known species of *Sitta* occur in various parts of Asia. Four familiar species, using no mud in the nest, are found in North America: red-breasted nuthatch, *S. canadensis,* mostly in Canada but southward in mountains to North Carolina and to California and New Mexico; white-breasted nuthatch, *S. carolinensis,* southeast Canada to South Carolina and northern Texas, with six races, two in Lower California, one in the Panamint and White mountains of California, southeastern United States, Rockies from Canada into Mexico, and the Pacific coast and its ranges; brown-headed nuthatch, *S. pusilla,* of the southeastern United States, with a local race in Florida; and pygmy nuthatch, *S. pygmaea,* of the middle California coast, with one local race from southern California into Lower California and another along the Rockies from British Columbia to the Mexican border.

No nuthatches are found in South America, none in Africa from the Sahara southward, none in New Zealand. A peculiar genus with a single species, *Hypositta corallirostris,* is confined to Madagascar. The Malay velvet-fronted nuthatch, pink and black, and the deep-blue nuthatch with a beautiful blue belly, belong to an allied genus, *Dendrophila,* living in India and the Malay countries and islands. The genus *Neositta,* comprising some seven species and various races of Australian tree-runners, is also found in New Guinea, to which the single species of *Daphoenositta* is confined.

NUTKA. This people held the west coast of Vancouver island, and with the Makah of Cape Flattery form one branch of the Wakashan family, the Kwakiutl constituting the other. The speech relationship of Nutka and Kwakiutl is not close, and the two bodies must have been distinct a long time. Nutka culture is that of the north Pacific coast, with specializations, such as whale hunting, that reflect frontage on the open ocean. Their trade influence is shown by the considerable proportion of words they contributed to the composite Chinook jargon. (*See* G. M. Sproat, *Scenes of Savage Life,* 1868.)

NUTLEY, a town of Essex county, New Jersey, U.S.A., on the Passaic river, 13 mi. W. of New York city, adjoining Belleville and Bloomfield. It is served by the Erie railroad and bus lines. Industries include pharmaceutical chemicals, woollen goods, paper and electric insulation, but the town is primarily a suburban residential community. The population was 26,992 in 1950 and 21,954 in 1940 by the federal census. Nutley was originally called Franklin, after William Franklin, governor of the colony of New Jersey from 1763–76.

NUTMEG, the commercial name of a spice representing the kernel of the seed of *Myristica fragrans,* a dioecious evergreen tree, about 50 to 60 ft. high, found wild in the Molucca islands and extending to New Guinea. Nutmeg and mace are mostly obtained from the Molucca islands, although the cultivation has been attempted with varying success in Singapore, Penang, Bengal, Réunion, Brazil, French Guiana and the West Indies. The trees yield fruit in eight years after sowing the seed, reach their prime in 25 years, and bear for 60 years or longer. Almost the whole surface of the Molucca islands is planted with nutmeg trees,

which thrive under the shade of the lofty *Canarium commune.* The ripe fruit is about 2 in. in diameter, of a rounded pear-shape, and when mature splits into two, exposing a crimson aril surrounding a single seed. When the fruit is collected the pericarp is first removed; then the aril is carefully stripped off and dried, in which state it forms the mace of commerce. The seed consists

NUTMEG (MYRISTICA FRAGRANS), SHOWING (A) SEED WITH ARIL (MACE) ROUND IT; (B) BRANCH SHOWING RIPE FRUITS, ONE OF WHICH IS SPLITTING AND SHOWS SEED INSIDE; (C) TWIG WITH FLOWERS

of a thin, hard shell, enclosing a wrinkled kernel, which, when dried, is the nutmeg.

To prepare the nutmegs for use, the seed enclosing the kernel is dried at a gentle heat in a drying-house over a smouldering fire, the seeds being turned every second or third day. When thoroughly dried the shells are broken and the nutmegs picked out and sorted, the smaller and inferior ones being reserved for the expression of the fixed oil which they contain, and which forms the so-called oil of mace.

"Oil of mace," or nutmeg butter, is a solid fatty substance of a reddish-brown colour, obtained by grinding the refuse nutmegs to a fine powder, steaming it and then compressing it while still warm. The brownish fluid which flows out being afterwards allowed to solidify. Nutmegs yield about one-fourth of their weight of this substance. It is partly dissolved by cold alcohol, the remainder being soluble in ether. The latter portion, about 10% of the weight of the nutmegs, consists chiefly of *myristin,* which is a compound of *myristic acid,* $C_{14}H_{28}O_2$, with glycerin.

The name nutmeg is also applied to other fruits or seeds in different countries. The Jamaica or calabash nutmeg is derived from *Monodora Myristica,* the Brazilian from *Cryptocarya moschata,* the Peruvian from *Laurelia sempervirens,* the Madagascar or clove nutmeg from *Agathophyllum aromaticum,* and the Californian or stinking nutmeg from *Torreya californica.*

NUTRITION. Despite the fact that life may be continued for many weeks without food and for several days without water, for the practical maintenance of life we must have a regular intake of food; nutrition must go on. Food is required for two main purposes: (1) to supply the necessary energy for the production of internal and external work and the maintenance of the body temperature and (2) to supply the necessary material to make good the wear and tear of the tissues in the adult and also, especially in the child, the material required for growth. The study of the problem of nutrition demands therefore the study of the methods by which the various foodstuffs are digested, absorbed and utilized in the body and further how the waste products formed during the various tissue activities are got rid of.

The evidence available would seem to point to the fact that the majority of mankind eat too much rather than too little. Excessive intake may prove to be, probably is, harmful. Certain experiments carried out for purely commercial purposes on the breeding of pelt-bearing animals go to show that such animals do best on a diet just slightly in excess of the bare maintenance ration. (*See* DIET AND DIETETICS.)

CHEMISTRY OF DIGESTION

The essential step which prepares the ordinary food for utilization in the body, for the change into living matter, is digestion, a process which the food undergoes under the influence of the ferments or enzymes present in the gastro-intestinal tract. By this process it is broken down into simpler substances, which can be utilized by the body tissues for conversion into protoplasm and as the supply of energy.

Enzyme Action in General.—The substances which bring about this change are known as ferments, enzymes or zymins. Formerly it was believed that there were two distinct classes of enzymes: those which were living or associated with living cells, and those which were non-living. In 1897, however, E. Buchner and M. Hahn showed that from living cells (yeast) a ferment could be obtained which acted quite as well extracellularly as when it was bound up within the cell. Subsequent work has shown that other organisms act by the enzymes they contain, so that it is now recognized that there is no essential difference between the living or organized ferment and the non-living or unorganized ferment. All ferments probably act as catalysts. Catalysis (*q.v.*) is the process by which reactions are either initiated or accelerated by the mere presence of certain substances which remain unchanged during the process. It has been shown that the action of ferments is specific; *i.e.,* the ferment only exerts its action on definite substances or substrates of definite structural arrangement. The relation of ferment to substrate has been compared to that of a key to its lock. Ferments which bring about the breakdown of proteins are without influence on fats and carbohydrates; those which decompose fats leave proteins and carbohydrates untouched, and so on.

The chemical composition of enzymes is unknown, but it would seem certain that all enzymes have not the same chemical structure. One of their most important physical properties is their colloidal nature, shown by the fact that they cannot, or only with extreme difficulty, pass through a parchment membrane.

Most of the ferments are soluble in water or saline solutions, and in glycerol and water. The ferments are found to have an optimum temperature of action. This temperature in most cases ranges from 37° to 40° C. All true ferments are thermolabile, being destroyed at about 70° C. The action of many of them is retarded when the products of their action are allowed to accumulate. Just as when a chemical reaction is set up its rate tends to decrease and finally comes to a standstill before the reaction is completed—an equilibrium being established—so the reactions set up by enzymes also tend to come to an equilibrium before the complete conversion of the original substance.

A number of the body ferments have now been shown to exist in the tissues in an inactive form. This condition is known as the proferment or zymogen state, and before any action can be exerted it must be activated, usually by some specific substance, as in the case of the activation of trypsinogen by means of enterokinase. The table on page 649 gives a list of the principal ferments concerned in the digestion and metabolism of food-stuffs.

Certain oxydases, catalases and de-aminizing enzymes are found in the tissues generally and play an important part in the various metabolic processes.

Digestion in the Mouth.—The first of the digestive secretions which food encounters is the saliva. It is produced by the three large salivary glands, the parotid, the sub-maxillary and the sub-lingual, is a colourless or slightly turbid viscous fluid with a faintly alkaline reaction and of low specific gravity, and exercises a twofold function. First, it has a mechanical action moistening the mouth and the food and thus aiding mastication and swallowing by securing the formation of a proper bolus

Material acted on	Enzyme	Where found
I. Protein	Pepsin	Gastric juice
	Trypsin	Pancreatic juice
	Erepsin	Small intestine
	Various autolytic enzymes	Tissues generally
II. Fats	Lipase	Pancreatic juice and certain tissues
III. Carbohydrates	Ptyalin (salivary diastase)	Saliva
	Pancreatic diastase	Pancreatic juice
	Maltase	Pancreatic juice
		Small intestine
	Invertase	Small intestine
	Lactase	Small intestine
	Various tissue diastases	Liver, muscle, etc.

of food; it also assists by binding the particles together, an action of special importance when the food is dry. Second, in man and in some of the lower animals the enzyme ptyalin exerts an action in digestion on part of the carbohydrates of the diet. The starches or polysaccharides are broken down, first of all to the simple dextrins and then to the still more simple disaccharide, maltose. The action of ptyalin on starches is thus very similar to that of acids, except that it stops at the formation of maltose. Ptyalin acts best at a temperature of about 40°C and in a neutral or faintly alkaline medium, its action being inhibited by the presence of even very dilute solutions of the mineral acids. If the acid be in sufficient amount the enzyme is destroyed. For this reason the action ceases in the stomach whenever the bolus is completely permeated by the gastric juice. As it takes time for the gastric juice thoroughly to permeate the food mass, which remains for a considerable period in the fundus of the stomach unmixed with the secretion, salivary digestion goes on for about half an hour after food is taken.

Gastric Digestion.—The stomach has two digestive functions: (i.) it acts as a store chamber permitting a full meal to be taken; (ii.) it acts as a digestive organ of importance in preparing the food for further attack in the intestinal canal. But the stomach cannot be regarded as an essential organ, since it has been removed in dogs and in man without apparent interference with health.

Gastric digestion is brought about by the action of the gastric juice, a clear watery, colourless and strongly acid fluid with a specific gravity of about 1003. The amount of hydrochloric acid present in the juice varies with the period of digestion. The acid exists in the stomach in two forms, as free hydrochloric acid and as combined hydrochloric acid The amount of each depends on various factors: (i) the secretion itself; (ii.) the nature of the food; and (iii.) the rapidity with which the stomach empties itself, etc. For instance, after a protein-free meal the hydrochloric acid is for the most part free, whereas, when protein is present, it combines with it and, unless secreted in very large amount, most of the acid is in a fixed condition.

The hydrochloric acid is formed by the activities of certain gland cells in the middle region of the stomach, and the fact that it does not exist as such in the blood proves that it is formed within these cells. That the chlorine comes from the sodium chloride in the food has been shown by the fact that, when the tissues are deprived of this salt, and sodium bromide is given, hydrobromic acid may appear in the gastric secretion.

The hydrochloric acid is essential for the action of the gastric enzyme, pepsin, in splitting up the protein of the food. In addition to this, the acid has a slight action in splitting polysaccharides and disaccharides. Lastly, it acts as a bactericidal agent, preventing bacterial decomposition from taking place, and it may thus prevent certain noxious bacteria, taken in in the food, from gaining access to the intestinal tract, where there is a chance of their flourishing in the rich alkaline medium.

The quantity of juice secreted varies with the nature of the food consumed. Each separate food seems to give rise to a definite hourly secretion of the juice and to a characteristic alteration in its properties.

The principal ferment found in the gastric juice is pepsin, which acts only in the presence of a mineral acid. The action proceeds best at a temperature of about 37°C in an acid medium of 0·2% to 0·3%. Pepsin is elaborated in the so-called chief cells of the gastric glands as an inert precursor—propepsin. It is only when it comes into contact with the acid of the juice that it is activated into attacking the protein of the food.

As already mentioned, the main function of the gastric juice is to deal with the protein moiety of the food and to prepare it for further digestion in the intestine. The first result of the action of this secretion on protein matter is to render it soluble—a metaprotein or acid albumin being formed. This body may be regarded mainly as the product of the action of the hydrochloric acid independently of the pepsin.

The following steps of decomposition are the result of the action of pepsin. From the metaprotein primary and secondary proteoses are formed, and from these peptones are finally produced. The result of this process of digestion or hydrolysis induced by the pepsin is that complex insoluble protein substances of high molecular weight are converted into simpler soluble protein bodies of comparatively low molecular weight. The contents of the stomach—products of protein digestion—are passed on into the duodenum, chiefly as proteoses and peptones.

In addition to pepsin some workers hold that another enzyme is present in the gastric juice. This is the ferment rennet, rennin or chymosin, the sole action of which, so far as is known at present, is to bring about the curdling of milk, the curd formed being subsequently dealt with in the ordinary way by the pepsin. Clotting of milk under the action of rennin occurs at a suitable temperature with great rapidity. This process is said to take place in two stages: (1) the rennin converts the caseinogen of the milk into soluble casein, and (2) this soluble casein unites with the lime salts present in the milk and forms the curd or precipitate. That lime salts are absolutely essential for this process of clotting has been shown by the fact that, if they are removed by precipitation as by oxalates, no clotting will take place even after the addition of a large amount of active rennin. Immediate clotting takes place, however, when the necessary lime salts are restored.

The speed with which the stomach empties itself depends to a great extent on the nature of the food. Plain water leaves the stomach almost at once, salt and sugar solutions at a somewhat slower rate. On a mixed diet, emptying of the stomach in man proceeds very slowly, requiring about four hours. Cannon, by feeding with food impregnated with bismuth and using X-rays, showed that carbohydrates leave most rapidly, then mixtures of carbohydrates and proteins, then proteins, then fats and finally mixtures of fats and proteins. The diet which remains longest in the stomach is a mixture of fats and proteins—rich food, as it is popularly called. Here two factors enter to prevent rapid emptying: (1) the presence of much fat, and (2) the acid secretion engendered by the abundant protein.

There is no doubt that fats present in fine emulsion can be decomposed in the stomach. The action proceeds in a medium which is slightly acid or neutral, being entirely prevented by the presence of strong acids and alkalis. Many workers believe this gastrolipase to be of pancreatic or intestinal origin, and suppose that it gains entrance to the stomach by a reflux flow through the pylorus.

No specific enzyme for carbohydrates has been found in the stomach in man. Certainly a small amount of polysaccharide decomposition takes place, but this is dependent (1) on the ptyalin which comes from the mouth, and (2) on a certain amount of hydrolysis due to the action of the free hydrochloric acid.

Digestion in the Intestine.—The food so far digested in the stomach is known as chyme, and it is passed on to undergo intestinal digestion under the influence of (1) the enzymes of the pancreas, and (2) of other enzymes present in the different secretions of the intestine.

Pancreatic Digestion. The pancreatic juice is the secretion from the pancreas and is discharged into the duodenum. It is a clear, usually thin fluid with a specific gravity of about 1008, and with an alkaline reaction. The most important inorganic constit-

uent is sodium carbonate, which gives the alkaline reaction. This alkaline salt, along with that contained in the intestinal juice, plays an important part in neutralizing the acid chyme.

In the pancreatic secretion there are at least three important enzymes, each with a definite action: (*a*) trypsin, the proteolytic enzyme which brings about the further breakdown of the food proteins; (*b*) a diastase which deals with the carbohydrates, and (*c*) a lipase which acts on the fats.

(*a*) *Trypsin.* This ferment, in the form in which it is secreted—trypsinogen—is inert. Before it can exert its hydrolytic action it must be activated. This activation is brought about by another enzyme found in the intestinal tract—enterokinase. The conversion is brought about as soon as the trypsinogen comes into contact with the enterokinase, the merest trace of which suffices to activate a large amount of trypsinogen.

Trypsin acts on the protein just as pepsin does, by bringing about hydrolytic changes. It differs from the latter in acting best in an alkaline or neutral medium. Its effect is much more energetic than that of pepsin, so that the protein molecule is more completely decomposed.

The character and properties of the products formed in such digestion depend on the nature of the protein acted upon. As will be seen from the following table, proteins vary fairly widely in the proportion of amino acids which they contain.

Approximate Amino-Acid Percentage Composition of Several Proteins

	Gliadin (wheat)	Gelatin	Caseinogen (milk)	Albumin (milk)	Fish muscle (protein)	Ox muscle (protein)
Glycine	0·0	25·5	0·45	0·37	0·00	2·06
Alanine	2·0	8·7	1·85	2·41	+?	3·72
Valine	3·34	0·0	7·93	3·30	0·79	0·81
Leucine	6·62	7·1	9·7	14·03	10·33	11·65
Phenylalanine	2·35	1·4	3·88	1·25	3·04	3·15
Tyrosine	3·04	0·0	5·36	1·95	2·39	2·20
Serine	0·20	0·4	0·5	1·76	(?)	(?)
Cystine	2·40	0·16	0·25	4·1	.	..
Proline	13·22	9·5	8·7	3·76	3·17	5·82
Hydroxyproline	?	14·1	0·23	0·0	..	..
Aspartic acid	0·58	3·4	4·1	9·30	2·73	4·51
Glutamic acid	43·66	5·8	21·77	12·89	10·13	15·49
Hydroxyglutamic acid o	2·40	..	10·5	10·00	..	..
Tryptophane	1·10	0·0	1·6	2·40	Present	Present
Arginine	3·2	8·22	3·81	3·47	6·34	7·47
Lysine	0·63	5·92	8·38	9·87	7·45	7·59
Histidine	1·49	2·94	2·5	2·61	2·55	1·76
Ammonia	5·22	0·49	1·61	1·31	1·33	1·07

(*b*) *Diastase.* This ferment is found in the pancreatic juice apparently secreted in an active form, although some observers hold that it also is secreted in a zymogen form. It is practically identical in its action with the ptyalin of the saliva, converting starch into maltose. It deals with all the starchy food which has escaped conversion into the simple sugars by the ptyalin.

(*c*) *Lipase.* Most of this ferment, if not all, is apparently secreted in the form of a zymogen. There is evidence that the bile salts are the activating agent here, just as the enterokinase acts in the case of trypsin. Lipase can act in any medium acid, neutral or alkaline, and both on emulsified and non-emulsified fats. It converts the fats by a process of hydrolysis into fatty acids and glycerol. It has been found that not only can this enzyme break up fats into their components, but that it also has the power to act in the reverse direction, and in this way bring about the union of fatty acids and glycerol so as to form fats, a process which occurs in the intestinal epithelial cells after absorption.

2 *Intestinal Digestion.* By this is meant the other digestive processes which go on in the intestine under the action of the secretion of Lieberkühn's follicles—the *succus entericus.* This is a yellowish, often opalescent, strongly alkaline fluid. The alkalinity is due to the presence of sodium carbonate. Most of the ferments are found in very small amount in the intestinal juice. They seem to be present actually within the epithelial cells lining the intestine, for extracts made from the intestinal mucous membrane are richer in ferments than the secretion.

The intestinal secretion contains no trace of a ferment acting on native protein, but a ferment—erepsin—is present in fair amount in the intestinal mucous membrane and in small amount in the secretion, which acts in an alkaline medium on proteoses, peptones, and on casein, converting them into amino acids. A lipase has also been detected which is very similar to pancreatic lipase; it, however, attacks only emulsified fats.

Several carbohydrate hydrolysing enzymes have been described in the small intestine. Invertase, the ferment which splits cane-sugar, is present in small amount in the secretion, more abundantly in the extract of mucous membrane. In all probability it deals with the saccharose after or in process of absorption. Maltase is also present in large amount, and here again in greater amount in the extract than in the secretion. The question of the presence of lactase has been much discussed, and it seems probable that suckling animals do possess this enzyme.

Bile.—This fluid, in all probability, has little direct action in ordinary digestion, although it contains substances which act indirectly. The bile salts act as solvents for fats and fatty acids, and as activators of pancreatic lipase. The salts also serve to keep cholesterol in solution. Bile is to be looked upon rather as an excretion, the result of the hepatic metabolism, than as a digestive juice. It has an orange-brown colour, but the colour varies according to the pigment present. It is more or less viscous (not so viscous as bile taken from the gall bladder) and has a specific gravity of about 1010. It has a slightly alkaline reaction, a bitter taste and a characteristic smell. On analysis it is found to have over 2% of solids, of which more than half are organic. It contains in addition to a nucleo-albumin, derived mainly from the bile passages and gall bladder, bile acids, bile pigments, cholesterol, lecithine, etc. The most abundant solids are the salts of the bile acids, of which in man the most important is sodium glycocholate, sodium taurocholate being present in small amount. The bile acids are formed in the liver cells, and when the duct is ligatured they tend to accumulate in the blood.

The pigments amount to only about 0·2%. In human bile the chief pigment is bilirubin, whilst in herbivores biliverdin is more abundant. They are derived from the haemoglobin of the blood, but the pigments are iron-free. They may be regarded as purely excretory products arising from the breakdown of the haemoglobin of effete blood corpuscles.

Cholesterol is a monatomic alcohol, and is probably a waste product. Fats and lecithine are both derived from the liver cells. Of the inorganic constituents calcium phosphate is the most abundant.

The secretion of bile is practically continuous, but it seems to enter the duodenum intermittently. The taking of food increases the flow of bile. The entry of the acid chyme into the duodenum is the stimulus which brings about the ejection of the bile.

Faeces.—The bulk of the waste matter arising from the foods along with the secretions from the alimentary canal form the faeces. On a diet giving little residue the faeces are almost purely intestinal in origin. As a channel of excretion of nitrogenous metabolic waste products they are not very important, although they do play a certain part. The nature of the excreted nitrogenous substances has not been fully examined. It is, however, very difficult to come to any definite conclusion as to what is unabsorbed material and what excreted.

ABSORPTION

Stomach.—No absorption of food-stuffs takes place in the mouth. Absorption from the stomach occurs only to a small extent. Water passes rapidly through the stomach and is practically unabsorbed. Salts are apparently absorbed in a limited amount from their watery solution, the extent of absorption depending to some extent on the concentration of the solution. Sugar is also absorbed to a small extent from its solutions. Alcohol is readily absorbed from the stomach. A small amount of the products of protein digestion may be absorbed. There is no evidence that fats are absorbed under any conditions.

Intestine.—The greatest absorption of the foods takes place in the intestines, especially in the small intestine. It has been shown that practically all the protein digest products have disappeared before the lower end of the small intestine is reached. There are two channels for the removal of the material from the intestine: (1) the blood capillaries spread in the villi, and (2) the lacteals also present in the villi. The foods may reach the blood direct or through the various lymph channels into the thoracic duct and finally into the blood. The lacteals of the villi are channels for the absorption of the fatty parts of the food. The products of the digestion of the proteins and carbohydrates reach the body directly through the capillaries via the portal system. Whether the nervous system plays any part in absorption is not yet determined.

Carbohydrates. These reach the body, as already mentioned, by way of the blood, and in the form of monosaccharides or simple sugars. It has been shown that if lactose be put into a lactase-free intestine, no absorption takes place, the lactose gradually disappearing under bacterial action, whereas when the ferment lactase is present, glucose and galactose, the products of its splitting, are absorbed as readily as cane-sugar and maltose. The body deals with its carbohydrate supply in the form of monosaccharides as if solutions of various sugars, mono- and disaccharides be injected, it is found that the simple sugars are retained, whereas the double sugars are excreted in the urine. The only disaccharide which can be dealt with in the body is maltose, as there is a maltase present in the blood which splits it. Carbohydrates which are not absorbed from the intestine are disposed of by bacterial action.

Fats. Fats are absorbed from the intestine in the form of fatty acids and glycerol, *i.e.*, in the form in which they exist after the action of the lipase. That a resynthesis takes place in the epithelium is shown by the fact that as fat absorption goes on fat droplets are seen to grow in the protoplasm away from the free margin of the cells. As already mentioned, the fat is removed by the lacteals from the cells to the thoracic duct, and then to the general circulation. A small amount of the fat may pass into the body via the blood, but this is practically all retained by the liver. The amount of fat absorbed depends largely on the nature of the fat, especially with reference to its melting-point, fats of low melting-point being most readily taken up.

Protein. It is unquestionable in the light of modern work that the great bulk of the digested protein is absorbed from the intestine via the portal blood stream in the form of amino acids. The work of Abel with his vivi-diffusion apparatus demonstrated very clearly that amino acids circulated in the blood and the work of Folin and van Slyke demonstrated that the amino acids were taken up by the various tissues.

In the large intestine, little absorption of nutrient matter takes place under normal conditions, mainly of course because most of the absorbable material is removed whilst the food is in the small intestine. The principal substance absorbed here is water; and thus the excreta become firm and formed.

METABOLISM

Within the living protoplasmic mass of the tissue-cells activity is ceaseless. The whole series of changes has been given the name of metabolism and within this title are recognized the two phases of building up, *anabolism*, and of breaking down, *catabolism*. There is a constant interplay between these two phases, sometimes rapid, sometimes slow, with a straining towards an equilibrium which is never reached whilst life goes on. When this metabolism is analysed further it is customary to divide it into two parts, the metabolism of energy and the metabolism of matter or material. But it must be made clear that within the living cell metabolism is one and indivisible. Further, although for descriptive purposes it is necessary to discuss the metabolism of the different proximate principles, *e.g.*, protein, carbohydrate, etc., individually the fact must be appreciated that the living protoplasmic mass which forms the content of the cell is not a mere conglomerate of protein, carbohydrate, fat, salts and water, where each constituent may be envisaged as a separate entity. Protoplasm, on the contrary, is a complex colloid—an intimate compound of its various constituents. No constituent can be metabolized without influencing the metabolism of the others.

Protein.—After absorption the amino acids are taken up by the cells of the various tissues and would seem for the most part to undergo sooner or later a disintegrative change, deaminization, in which the amino group (NH_2), is broken off. It is commonly believed that the freed amino group is converted into ammonia (NH_3), which of course does not remain in the free state but becomes neutralized mainly by carbon dioxide to form ammonium carbonate. This ammonium carbonate in its turn is conveyed eventually to the liver, where it is finally transformed into urea and eventually excreted in the urine as a waste product. The nitrogen-free remainder is utilized for energy purposes either directly or indirectly. The work of Lusk and others has shown that under certain circumstances about 58% of the protein molecule can be converted into sugar. Such would seem to be the history of the fate of the bulk of the protein ingested. Of course a certain amount of the ingested material is not broken down in the way above described but is utilized intact by the organism as building material for the repair of tissue waste and for the formation of new tissue as in growth. Despite the variation in composition of the ingested proteins of a mixed diet the fact that all in the course of digestion are reduced to their simple amino-acid components serves a useful purpose in that it permits the various tissues, which have, of course, varying needs, to exercise a selective action over what they will retain and what reject. It is the composition of the tissues which determines the type of retention.

Evidence of the importance of the chemical composition of the protein fed has been had from another aspect which has shown definitely that the organism must receive certain, probably the majority, of its amino acids in the preformed state. Feeding experiments on young growing animals have been carried out where the protein fed was abnormal in that certain amino acids were completely absent. One of the proteins used was zein (from maize), which lacks the amino acids tryptophan and lysine. When young animals were fed on a well selected diet with zein as the sole protein they rapidly went downhill and died. When to the diet as before the appropriate amount of tryptophan was added to make good the deficiency in this amino acid, the animals remained alive but did not grow; when as a further addition lysine was added the animals not merely lived but grew.

Carbohydrate.—Carbohydrate may be regarded as the foodstuff which most readily gives up its energy in the organism. The tendency of modern work is to accept carbohydrate as *the* fuel. After absorption into the blood stream any excess above immediate requirements would seem to be deposited in the liver and muscles in the form of animal starch or glycogen as a readily available form of reserve. If there is a persistent over-ingestion the excess carbohydrate would seem to be converted into fat and thus there is built up a more permanent reserve of energy. Finally if the organism is suddenly flooded with sugar as the result of the ingestion of excessive amounts, much of the sugar is excreted as such in the urine—alimentary glycosuria. Normally the sugar is completely burnt in the organism to form carbon dioxide and water. The complete utilization of the sugar is intimately related to a special secretion of the pancreas to which the name of insulin has been given by its discoverers, Banting, Best, Macleod and Collip. When there is a disturbance of this insulin formation as in the disease known as diabetes, sugar is excreted as such in the urine, the body having lost the power to utilize it. Just how insulin acts is unknown. There is very good reason also, due primarily to the interesting work of Harden and Young on fermentation, to believe, certainly as regards muscle, that before the carbohydrate can be broken down it first enters into combination with phosphorus to form a hexose diphosphate.

Fat.—Fat is not apparently readily metabolized in the body, but it is not probably so stable as one might deduce from the apparent readiness with which it is deposited. It is undoubtedly, so to speak, invested capital, whereas carbohydrate may be looked upon as capital in current account or at most on deposit receipt. When combustion is carried out normally it is complete, the end

products being carbon dioxide and water. For this complete combustion it is essential that a certain amount of carbohydrate be present as is evidenced by the fact that when carbohydrate is withheld from the diet or when it is not available as in diabetes a condition known as acidosis ensues. In acidosis the combustion of fat ceases before combustion is complete, with the result that there is formed in the body and excreted in the urine β-hydroxybutyric acid, aceto-acetic acid and acetone. These substances can be caused to disappear from the urine if a supply of carbohydrate is made available. It would seem that there are two chemical actions involved in the breakdown of the long fatty acid chain, a special process of oxidation known as β-oxidation, associated with desaturation which renders the chain unstable. Although the evidence for the conversion of carbohydrate to fat is plain, there is still lacking indubitable evidence of the conversion of fat to carbohydrate, although many workers accept the idea.

Salts.—Although the mineral salts do not directly contribute to the supply of energy to the body and although generally speaking, they themselves undergo no metabolic change in the body they play a very important part in the various tissue activities. Unless the salts be present in proper amount and in proper proportion, metabolism is impossible. The principal mineral elements found in the body are sodium, potassium, calcium, magnesium, iron, phosphorus, sulphur, chlorine and iodine, with in addition traces of many other elements. Of course these various elements do not exist in the tissues in their free state but as compounds which, in the majority of instances, would seem to be inorganic. As all these substances are continually being lost from the body in the various excretions, it is essential that a sufficient supply be always available in the food. These mineral constituents play the main rôle in the maintenance of the faintly alkaline reaction of the various tissue fluids. As the result of the different metabolic processes which take place in the tissues there is a constant production of acid, chiefly from sulphur and phosphorus, which requires to be neutralized by basic elements like sodium and potassium and probably also calcium and magnesium. The kidney for the most part regulates in a very selective fashion the output of these various inorganic constituents. It must not be imagined, however, that the body can completely protect itself from excessive salt loss, a loss so great that it may give rise to symptoms of a serious character. Thus it has been shown that men who are, in the course of their work, exposed to high environmental temperatures with consequently much sweating, are very liable to a form of cramp. Further it has been noted that the cramp is frequently exacerbated where the men drink freely of water to allay their thirst. Recently it has been found that the condition is due to an excessive loss of sodium chloride from the body carried away in the sweat and that the condition may be cured or prevented by giving the men saline fluid to drink.

Although five-sixths of the total mineral matter of the body is found in bone and in spite of the fact that bone has all the appearance of being firm and resistant the evidence available goes to show that the bony structures must be regarded as active storehouses of mineral matter. When the need arises the body as a whole can draw upon the bones for constituents like lime and phosphates. Under certain conditions the bones indeed may give up so much of their mineral matter that they become soft and can no longer function as an effective frame work.

The other one-sixth of the mineral constituents found in the body are not distributed uniformly throughout the remainder of the tissues. As regards this varying distribution of salts in the tissues and the blood Macallum, in his study of palaeochemistry, produced some most interesting evidence in favour of his view that the present composition of the blood plasma, in so far as its inorganic constituents are concerned, is probably identical with that of the sea water just before the Cambrian period and that the salt concentration in protoplasm represents conceivably the salt concentration of the primaeval ocean in which life first appeared. At any rate the curious ratio of potassium and calcium to sodium, which is characteristic of protoplasm, is reflected in the salt relationship in water drawn from pre-Cambrian formations.

The mineral constituents play an important part without doubt in digestion in that acid must be secreted for gastric digestion and alkali for intestinal digestion.

Water.—In so far as water forms about 60% of the body-weight of man it is very obvious that the part it plays in metabolism must be an important one. It is indeed true that the whole series of chemical actions which are so intimately related to the life of the living organism, be it animal or vegetable, are ultimately referable to changes which take place in solution. It has been conclusively shown that the younger the animal the richer it is in water. It has also been found that the fatter the animal the smaller the percentage amount of water present.

So far as is known water undergoes no change in the body, but nevertheless all the water present in the organism does not come from some source external to the body but is in part formed in the tissues during the metabolism of the various foodstuffs and of the tissues themselves. According to one calculation this internal source of supply accounts for about 16% of the water excreted. It has been also maintained that this intracellularly formed water is of greater value to the living structure than the imbibed water as it presumably does not bring about drastic osmotic changes. It is impossible, however, with the information now available to decide whether the metabolic water in the cell differs in any way from the water received from external sources.

It is of interest to note that animals which live in arid regions, in contradistinction to those which live where water is abundant, excrete as their main nitrogenous waste product uric acid which is voided with the minimum waste of water instead of urea, which has to be excreted in solution.

Methods of Investigation.—Brief reference may here be made to the methods employed in investigating metabolism. No matter the line of attack selected, the investigator is handicapped by the fact that he can only deal with the end products of metabolic activity.

If the extent and degree of metabolic activity of a subject have to be determined we may do so by direct calorimetry. The subject is enclosed in a special chamber or calorimeter so devised that all the heat given off by the subject can be directly collected and measured (fig. 1). These calorimeters, which we owe mainly to the ingenuity and skill of Atwater, Rosa and Benedict, are very delicate and costly pieces of apparatus. In order that there be no escape of the body heat to the environment, the double copper walls of the chamber are fitted up with elaborate electrical equipment which permits of so delicate a balance that heat can neither pass out nor into the chamber. In order to measure the heat given off by the subject, a current of cold water is circulated within the box in continuous piping. If the temperature of the incoming and outgoing water is carefully measured and if the quantity of water passing through be also known the heat lost by radiation and conduction by the subject in a given time can be determined. As part of the heat lost, amounting to about one-fourth of the whole, is eliminated by the subject in the form of water vapour this must be and is also determined by absorbing the water lost in sulphuric acid and subsequent weighing of the acid container. This method of direct calorimetry is very accurate and reliable, but the method is difficult and the apparatus is very liable to get out of order. In addition to this direct measurement of the heat output, the metabolic activity of the subject

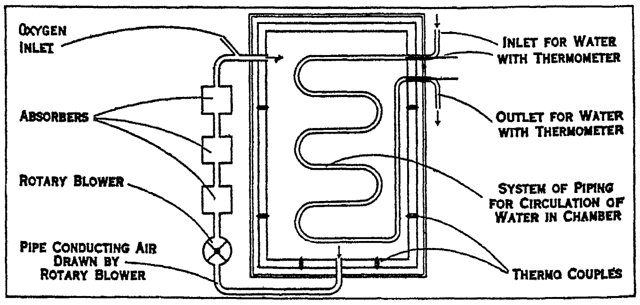
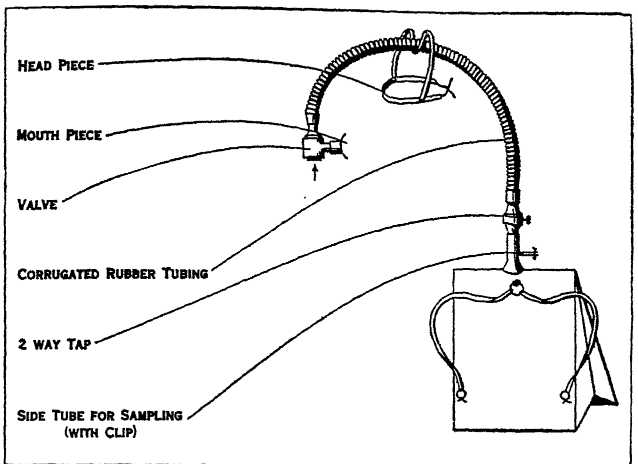


FIG. 1.—SCHEMA PRINCIPLES OF ATWATER-ROSA-BENEDICT RESPIRATION CALORIMETER

can be calculated from a determination of the amount of carbon dioxide given off and the amount of oxygen utilized by the subject in a given period. This method of Indirect Calorimetry can be carried out simultaneously with the direct method and serve as a check upon it. The calorimeter chamber in which the subject is enclosed is gas-tight and the air is circulated through a gas-tight absorbing system (fig. 1) by means of a rotary blower. The



FROM CATHCART, PATON AND PEMBREY, "PRACTICAL PHYSIOLOGY" (EDWARD ARNOLD & CO.)

FIG. 2.—INDIRECT CALORIMETRY: DOUGLAS BAG

carbon dioxide given off is absorbed by means of soda lime, the amount absorbed being determined by weighing the soda lime container at the beginning and the end of the experiment. The carbon dioxide free air is returned to the chamber after the deficiency in oxygen, which is approximately determined by reduction in volume, has been made good from a cylinder of pure oxygen. The amount of oxygen used during the experiment is determined either by measuring by a meter the amount of oxygen passed in or by weighing the cylinder before and after the experiment. The heat lost by the subject can be determined from the amount of oxygen used. The caloric value of a litre of oxygen used in the tissue combustion has been determined. This value varies with the carbon dioxide–oxygen ratio, called also the respiratory quotient (R.Q.), from 4·795 calories with an R.Q. of ·713 which is held to represent the combustion of fat alone to 5·058 calories with an R.Q. of 1·00, which is accepted as representing the combustion of pure carbohydrate by the tissues. The two methods of direct and indirect calorimetry have been found to give almost identical results.

It is obvious that the use of the chamber would act as a great handicap if the determination of energy expenditure were confined to it. To enable measurement of energy expenditure of subjects engaged in actual work a portable apparatus was first devised by Zuntz and later much simplified by Douglas (fig. 2). In this last form the subject wearing either a mask or special mouthpiece, with nose clip, fitted with two one-way valves breathes into a gas-tight bag carried on his back. The air collected in the bag at the end of the experiment is measured by passage through a meter, a sample of the expired air is analyzed in the Haldane gas analysis apparatus and the amount of carbon dioxide and oxygen present is determined. As the composition of the atmospheric air is known it is readily calculated how much carbon dioxide the subject excreted and how much oxygen is utilized in a given time and the caloric values can be determined as above. In order to relate the carbon dioxide output and oxygen utilization to the non-protein moiety of the food the protein metabolized during the period of the experiment is determined from the nitrogen output in the urine. For every gram of urinary nitrogen derived from protein 8·45g. of oxygen are required and 9·35g. of carbon dioxide are given off. Hence to determine the non-protein utilization the appropriate amounts of carbon dioxide and oxygen are deducted from the total amounts. As the amount of nitrogen excreted during the period of examination is minute, in practice it is usually ignored.

When the alterations of the gaseous metabolism are considered they are commonly referred to variations from the so-called Basal or Standard Metabolism. The basal metabolism may be defined as that of a subject lying comfortably at rest in a warm bed and in the post-absorptive condition, *i.e.*, about 12 to 15 hours after the last meal. With the subject in such a condition the metabolism reaches its lowest level. As it has been estimated that functional activities of the various organs may account for about 25% of the resting metabolism (thus the activity of the heart for about 3·6%, respiratory movements for about 10% and the kidney for about 5%) Krogh maintains that it is better to call this resting metabolism standard rather than basal. It, of course, could only be truly basal if all functional activities were in abeyance at the time of the determination.

It is obvious, in view of the fact that humanity is of varying sex and size, that if a universally applicable standard is to be obtained there must be some fundamental unit on which to base assessments. It has been shown that body-weight is not satisfactory. The modern unit selected is the surface-area of the body. A very useful formula for the determination of this area based on height $\times$ weight $\times$ a constant has been worked out by E. F. and D. Du Bois. As the result of their work it is common practice now to take as the fundamental unit the calorie output per square metre surface area.

This basal metabolism is shown to be high in childhood and that as adolescence is reached it falls to a level which is more or less uniformly maintained until about the age of fifty. Thereafter the decline is steady although small. The basal metabolism is also influenced by the sex of the subject, the nature of the food consumed, and environmental conditions like temperature, climate, etc. The most potent factor is, however, muscular work.

FACTORS WHICH INFLUENCE NORMAL METABOLISM

Fasting.—During fasting the body draws upon its own reserve of stored material for its requirements in the production of energy, and the rate of breakdown varies with the energy requirements. An individual kept warm in bed, therefore, stands fasting longer than one who is compelled to take exercise in a cold place. The breakdown of tissue during the early days of a fast is much greater than later, for as the fast progresses the body becomes more economical in its utilization of tissue. During a fast the tissues do not waste at an equal rate; those which are not essential are utilized at a much greater rate than those which are essential to the maintenance of the organism. For instance, it has been shown that during a fast the skeletal muscles may lose over 40% of their weight, whereas an essential organ like the heart loses only some 3%.

The essential tissues obtain their nourishment from the less essential by ferment action, a process which has been termed autodigestion or autolysis. The autolytic products of tissue digestion are practically identical with those which arise during the ordinary gastro-intestinal digestion.

Muscular Work.—The muscular tissue plays the most important part in general metabolism. Not only is muscle the most abundant tissue present, but it is constantly active and is the great energy-liberating machine of the body. Formerly it was believed on the authority of Liebig that muscular work was done at the expense of the protein material, but it has been conclusively shown that the real source of energy in moderate work is the non-protein material, carbohydrates and fats; of these the former plays the greater part in a man on ordinary diet. That there is some influence on protein is shown by the fact that there is a definite but small increase in the output of nitrogen in the urine as the result of muscular work, but it is in no sense proportionate to the work done; whereas the output of carbon dioxide produced by the combustion of the carbohydrates and of the fats is increased proportionately to the work done.

Internal Secretions.—Evidence is accumulating to show that the activities of the various tissues of the body are presided over and controlled not merely by the action of the nervous system but also by certain chemical substances elaborated in special glands known as endocrine glands or glands of internal secretion. The

active secretions of these glands are poured out into the blood stream. There is direct evidence that some of these secretions such as thyroxin from the thyroid gland and insulin from the pancreas exercise a very active influence on metabolism. In regard to the other secretions, more is known about their action on various tissues than of their direct influence on metabolism.

EXCRETION

While comparatively little is known of the intermediate stages in the breakdown of the food constituents, and more particularly of the protein moiety, knowledge of the final products of the metabolic changes excreted is fairly full. The urine is the main channel of excretion for the nitrogenous waste products. Water is excreted by the lungs, the kidneys and the skin.

The urine is a yellowish fluid which varies greatly in its depth of colour, from pale amber to a deep brown. It has a specific gravity of about 1020, varying with the percentage of solids in solution, and it usually has an acid reaction. Among the principal organic substances present are urea, ammonia, purines (uric acid and the so-called purine bases, xanthin, etc.), creatinine, conjugated sulphates, various aromatic bodies and many other substances in small amount, together with the water and inorganic salts.

The following table from Folin indicates the average composition of the urine in regard to the nitrogen-containing constituents, and its variation according to the nature of the diet when this is free of creatin, creatinine and the precursors of the purines.

	Nitrogen-rich diet	Nitrogen-poor diet
Total nitrogen	14·8–18·2g. per day	4·8– 8 0g. per day
Urea nitrogen	86·3–89·4% of total	62·0–80·4% of total
Ammonia nitrogen	3·3– 5·1% " "	4·2–11·7% " "
Creatinine nitrogen	3·2– 4·5% " "	5·5–11·1% " "
Uric acid nitrogen	0·5– 1·0% " "	1·2– 2·4% " "
Undetermined nitrogen	2·7– 5·3% " "	4·8–14·6% " "

Urea, which forms the chief nitrogenous constituent, amounting on an ordinary diet to about 30 g. per day, is for the most part formed in the liver, from ammonia obtained either directly from the blood after absorption from the intestine, or resulting from the deaminization of the amino acids.

Ammonia is present in the form of ammonium salts, and forms about 4% of the total urinary nitrogen. It may exceed this amount under certain conditions, for the most part pathological. The ammonia is utilized by the body to neutralize acids which arise during the various metabolic processes.

Purines (uric acid, xanthin, hypoxanthin, etc.) are all members of a series which have as their common nucleus a body which E. Fischer called purine. The most important member of this series is uric acid. It forms about 2% of the total urinary nitrogen. It has been shown that it has two quite definite sources of origin: (1) from ingested food containing the precursors, and (2) from the tissue-metabolism. The first is known as the exogenous source, and the second as the endogenous. This acid is chemically known as trioxypurine, and may be regarded as the union of two urea molecules with a three-carbon chain fatty acid. All the uric acid formed in the body is not excreted as such, part being, as already mentioned, converted into urea. The amount which is converted into urea varies with the species of animal. The other chief purine bodies present in urine are xanthin and hypoxanthin, purines less oxidized than uric acid; the first is a dioxypurine, and the second is a monoxypurine. The main source of total purine supply would seem to be muscle metabolism. The mother substances from which all are derived in the body are the nucleo proteins. These complex bodies are apparently first broken down by enzyme action to aminopurines. These in their turn have their amino groups split off, and then, according to the degree of oxidation, the different purine bodies are formed.

Creatinine. The physiological significance of this substance is as yet unknown. The daily excretion varies little with the character of the diet, provided, of course, that the diet be creatinine-free. It would seem to be derived from the creatine of muscle, a substance which is very readily changed into creatinine outside the body. Whatever its source, after urea and ammonia it is one of the important nitrogenous substances excreted.

Sulphur excreted in the urine comes chiefly from the sulphur of the protein molecule. It is excreted in various forms: (1) as the ordinary preformed sulphates, *i.e.,* sulphur in the form of sulphuric acid combined with the ordinary bases; (2) as ethereal sulphates, *i.e.,* in combination with various aromatic substances such as phenol, indol, etc.; (3) in the form of so-called neutral sulphur in such substances as cystin, which are intermediate products in the complete oxidation of sulphur.

Phosphorus appears linked to the alkalis and alkaline earths as phosphoric acid. A very small part of the phosphoric acid may be eliminated in organic combination such as the glycerophosphates, etc.

Sodium (mostly as sodium chloride), potassium, calcium and magnesium are the common bases present in the urine.

The lungs are the important channel of excretion for the waste product of carbon metabolism, carbon dioxide or CO_2 (*see* RESPIRATION); and also a very important channel for the excretion of water. In regard to the skin, the sweat carries off a large amount of the water. It has been estimated that about 900 c.c. are excreted each day under normal resting conditions, rising to 7,000 c.c. and over when hard work is done. Sweat contains salts, chiefly sodium chloride, and organic waste products. Of the organic solids excreted from this source, urea forms the most important under normal conditions.

Under pathological conditions, especially when there is interference with free renal action, the amount of nitrogenous waste excreted may become important.

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NUTTING, MARY ADELAIDE (1858–1948), U.S. nurse educator, was born at Waterloo, Quebec, Canada, on Nov. 1, 1858. Educated in private schools, she became a member of the first class in The Johns Hopkins hospital school of nursing, Baltimore, of which school she was principal from 1894 to 1907, when she was given the chair of institutional administration at Teachers college, Columbia university, New York city. There in 1910 the first university department for the education of nurses was created and she was assigned to the chair of nursing and health. During World War I she was appointed by Pres. Woodrow Wilson chairman of the committee on nursing under the National Defense council. In 1920 the "Adelaide Nutting Historical Collection," showing the progress of nursing in the U.S. and other countries, was established in her honour at Teachers college. She retired in 1925.

With Lavinia Dock she wrote *A History of Nursing* and she was also the author of *A Sound Economic Basis for Schools of Nursing.* She died Oct. 3, 1948, in New York city.

NUX VOMICA, a poisonous drug, consisting of the dried ripe seed of *Strychnos nux-vomica,* a tree (Fam. *Loganiaceae*) indigenous to most parts of India, and found also in Burma, Thailand (Siam), Indochina and north Australia. The tree is of moderate size, with a short, thick, often crooked stem and ovate entire leaves, marked with three to five veins radiating from the base of the leaf. The flowers are small, greenish-white, tubular and arranged in terminal corymbs. The fruit is the size of a small orange, and has a thin hard shell, enclosing a bitter, gelatinous white pulp, in which from one to five seeds are vertically embedded. The seed is disk-shaped, about 1 in. in diameter, and $\frac{1}{4}$ in. thick, slightly depressed toward the centre, and in some varieties furnished with an acute keellike ridge at the margin. Externally, it is grayish-green and satiny from a coating of appressed silky hairs. Internally it consists chiefly of horny albumen, which is easily divided along its outer edge into halves by a fissure, in which lies the embryo. The latter is about $\frac{3}{10}$ in. long, and has a pair of heart-shaped membranous cotyledons.

The chief constituents of the seeds are the alkaloids strychnine (*q.v.*) and brucine, each of which constitutes from 1% to 2% of the dried seeds. The two have similar pharmacological actions though brucine is much less active.

NYACK, a village of Rockland county, New York, U.S., on the west bank of the Hudson river (which there expands into Tappan Zee, 3 mi. wide), 14 mi. above New York city. It is served by the Erie railroad, by buses and by a ferry to Tarrytown, nearly opposite. Pop. (1950) 5,889. With the adjacent villages of Upper Nyack, South Nyack, Central Nyack and West Nyack, the population exceeded 11,000 in 1950. The industries include shipyards, machine shops and several factories. Permanent settlement there dates from about 1700.

Nyack was incorporated in 1833 and was named after a tribe of Algonkin Indians.

NYANZA, the Bantu name for any water area of considerable size; especially applied to the great lakes of east Central Africa. The word is variously spelt, *e.g.*, Nyanja, and Nyasa.

NYASA, the third in size of the great lakes of Central Africa. It occurs south of the confluence of the two great rift valleys and extends from 9° 29′ S. to 14° 25′ S. The lake measures along its major axis, which is slightly inclined to the west of north, exactly 350 mi. while the breadth varies very little, the maximum being 45 mi. about the middle. The total area may be estimated at 11,000 sq.mi. The lake lies at an altitude of about 1,650 ft. above the sea. The sides of the valley in which Nyasa lies, which are somewhat irregular towards its southern end, take a decided character of parallel fault scarps in the northern third, and are continued as such beyond the northern extremity. The depth seems to vary between 200 and 430 fathoms, in accordance with the steepness of the shores. The lake receives its water-supply chiefly from the streams which descend from the mountains to the north, all the rest becoming very small in the dry season. Like other lakes of Central Africa it is subject to fluctuations of level, apparently caused by alternations of dry and wet series of years.

At the north-western end is a plain of great fertility, traversed by the Kivira, Songwe and other streams. On the delta of the Rukuru, is the British station of Karonga, the northern port of call for the lake steamers. Southwards the plain narrows, and the sandstone scarp of Mt. Waller rises sheer above Florence bay, the high western plateaux continuing to fall steeply to the water. At Cape Chirombo (11° 40′ S.) the coast bends to the west, and soon the plateau escarpments recede, and are separated from the lake along its southern half by an undulating plain of varying width, with Bandawe and Kota Kota ports on the coasts. A little north of the latter the Bua river, coming from a remote source on the upper plateau, enters by a projecting delta. At Domira bay the coast turns east, contracting the lake to a narrow neck, with Fort Rifu (west), and Fort Maguire, near Makanjira point (east). Beyond this the lake runs southwards into two bays separated by a granitoid peninsula, off which lie several small rocky islands. From the extremity of the eastern bay the Shiré makes its exit to the Zambezi. On the eastern side the escarpments and the boundary fault keep close to the lake, leaving few plains along its shores. In the north-east, the coast is formed by the unbroken wall of the Livingstone range (*q.v.*). On this coast is the station of Lumbira (Tanganyika Territory). The valley of the Ruhuhu, the only important stream which enters the lake from the east, breaks through the Livingstone range. The formation is here Karroo sandstone, corresponding to that of Mt. Waller on the opposite shore. Just north of the Ruhuhu is Manda, on an excellent harbour. To the south the wall of mountains recedes somewhat, and the remainder of the eastern shore shows a variation between rocky cliffs, marshy plains and low hills, to be followed farther south by a wide semicircular bay, generally rock-bound, and ending in Malo point, off which are the largest islands the lake possesses, Likoma and Chisamulu. In the southern half the coast is highest where the Mapangi hills rise to 3,000 ft.

Nyasa, reached in 1859 both by David Livingstone (from the south) and by the German, Albrecht Roscher (from the east), was explored by the former to about 11°, and to its northern end by E. D. Young in 1876. From this date onwards it has been the scene of much civilizing work on the part of British missionaries, traders and government officials, and of Germans also. Its shores are divided between Great Britain (with Tanganyika Territory and Nyasaland Protectorate) and Portugal (with Portuguese East Africa). British steamers, including gunboats, have been launched on Nyasa, which forms an important link in the water-route from the Zambezi mouth to the heart of the continent. The first detailed survey of its shores was executed by Dr. James Stewart (1876–1877), but this has been superseded by later work.

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NYASALAND PROTECTORATE. Nyasaland covers rather more than 40,000 sq.mi., of which 37,374 are land. The country is situated between 9° 45′ and 17° 15′ S., and between 33° and 36° E. Its length from north to south is about 520 mi., while its width varies from 50 to 100 miles. It is bounded on the west by Northern Rhodesia and Portuguese East Africa, on the northeast by Tanganyika Territory, and on the east and south by Portuguese East Africa. The northern half of its eastern boundary is formed by Lake Nyasa.

Physical Features.—Nyasaland consists of elevated plateaus, sometimes separated by low-lying ground. The most important of these are the Nkonde mountains in the northwest, 6,000 to 7,000 ft. high, the Nyika plateau, rising to more than 8,000 ft., and the Angoniland plateau, whose highest points range between 5,000 and 6,000 ft., both of these plateaus being on the western side of the lake: the Mlanje massif, in the extreme southeast, mostly more than 6,000 ft., with several peaks rising above the general level, one attaining 9,843 ft., and the Shiré highlands between Lake Shirwa and the Shiré river, reaching, in their highest point, an elevation of 7,000 feet.

Lake Nyasa (*q.v.*), situated 1,650 ft. above sea level, receives a number of comparatively small rivers from the neighbouring highlands, and is drained southward by the Shiré river, which flows into the Zambezi. The lake has few good harbours, and is swept from time to time by violent northerly and southerly winds. Other large lakes are Lake Shirwa and Lake Chiuta, a sheet of water situated north of Lake Shirwa, and being 30 mi. long and from 2 to 8 mi. broad. The water of Lake Chiuta, like that of Lake Nyasa, is fresh.

Climate.—Three distinct climatic zones may be distinguished. In the low-lying Shiré valley the climate is hot, in October and November temperatures rising to 115° F. In the highlands, at an altitude of 3,000 ft. and above, extreme heat is unknown. Along the shores of Lake Nyasa the high degree of humidity makes the climate particularly trying to Europeans, although the temperature rarely rises above 95°. The dry season lasts from May to September, the weather being comparatively dry and cool. In higher mountain regions occasional frost may even occur during the night. The first rains, accompanied by violent thunder storms, set in after the middle of October and continue periodically until the end of December, when the season of heavy rains begins, lasting from January through March. The annual rainfall is about 50 in. in the highlands, 35 in. in the lowlands.

Vegetation.—Large tracts of the country are still covered with forest, especially away from the centres of European or native settlement. The forests are of little economic value, apart from their effect in checking rapid run-off and soil erosion. Most of the trees are small, the diameter of their trunks at about 4 ft. from the ground being usually from 4 to 12 inches. Timber trees of greater size and value are to be found in damp ravines on the mountain sides and along the banks of the rivers. The most important of these are the patches of Mlanje cypress (*Widdringtonia Whytei*), which yields a soft, durable wood, immune from the attacks of termites. These trees grow on the higher slopes of Mlanje mountain, and are not found elsewhere in Nyasaland. Two species of Brachystegia—Mombo and Nchenga—provide the natives with material for bark cloth and ropes. Tree planting is encouraged, and seeds are easily procurable of the Mlanje cypress, and of several kinds of eucalyptus, which is the most important

of the exotic trees.

Population.—In 1945 the population consisted of 2,044,707 Africans, 2,941 Asiatics, 1,948 Europeans and 455 other non-Africans. Almost half of the Europeans live in Blantyre (*q.v.*) and Zomba; the remainder are scattered widely in various parts of the protectorate. The average density is 55.66 persons per square mile, one of the most thickly populated areas in Africa. The native Africans belong to the Bantu and are composed of many ethnic groups of which the Nyanja, Nguru, Yao (*q.v.*) and Ngoni (or Angoni *q.v.*) are numerically the strongest.

Administration.—The protectorate is administered by a governor appointed by the crown. He is assisted by executive and legislative councils consisting of official and unofficial members. The principal departments of administration are in Zomba. Since March 1, 1945, the country has consisted of three provinces—Northern, Central and Southern—which are divided into three, seven and ten districts respectively. Provincial commissioners are in charge of the former; district commissioners supervise the latter. Towns are administered by town councils; that of Zomba is appointed by the governor, those of Blantyre and Limbe are elective. The native administration after 1933 followed the pattern of indirect rule, allowing African chiefs limited authority under the supervision of the district commissioners. In 1944 advisory councils composed of African chiefs were established in the provinces; these are designed to enable Africans to be more closely associated with the central administration.

Religion and Education.—The majority of the Africans are pagans; only 11% are classified as Christians and 10% as Moslems. Missionary activities are of long standing; the first mission opened near Zomba in 1861. Of the 11 missions which were active in 1940 the following may be mentioned: the Universities mission, the Livingstonia Mission of the Church of Scotland, the Church of Scotland mission, the Dutch Reformed Church mission, and the White Fathers. Education is primarily managed by missions which, in 1938, bore 65% of the expense. The education department assumed control in 1926. In 1942 there were four private schools for Europeans providing education to standard VI only, two schools for Asiatics and 4,171 primary schools for Africans with an enrolment of 173,692 children. Attendance is irregular, and few students complete the four-year course. Forty-seven vocational schools provide training for teachers; 453 men and 155 women were in training in 1941. Chief educational institution is the Jeanes Training Centre at Domasi.

Economy.—Agriculture is the chief occupation in Nyasaland. Besides maize and millet, which are the staple foods of the Africans, both European settlers and African natives grow tobacco, cotton and tea for export. The total tobacco production in 1942 was 24,800,000 lb.; in 1941 17,800,000 lb. were exported. Most of the tea is grown on European estates in the Mlanje district, but there are some plantations in the Cholo district. According to the international tea agreement (1938), Nyasaland agreed not to plant more than 17,700 ac. or produce more than 18,750,000 lb. for sale in the world's markets. The 1942 export was 5,600 short tons. Cotton production was developed gradually, chiefly among Africans, who exported more than 2,240 short tons in 1942. The production of tung oil is encouraged as an export crop; about 5,000 ac. were under cultivation in 1940, and in 1943 58,000 lb. were exported. Coffee production is insignificant. Livestock supply the needs for local markets. There has been an intensive search for minerals by the British South Africa company, holding the mineral rights for the country. The only prospect is the bauxite deposit in the Mlanje district, estimated as 67,200,000 short tons. Ten thousand natives engaged in fishing in Lake Nyasa and Lake Chilwa supply the local markets. Although the African is primarily an agriculturist working on his own farm, many have taken to wage earning. In 1937, 50,000 were seasonally employed in Nyasaland on European estates, while 100,000, or more than 18% of the fit adult population, had found employment outside the country, chiefly in Southern Rhodesia.

The value of exports in 1940 was £1,042,310; in 1941 it rose to £1,271,000; tobacco and tea accounted for more than 95%. Imports consisting of provisions, building material, agricultural implements, and textiles, were valued at £792,966 in 1940 and £1,004,000 in 1941; textiles accounted for more than 35% of the 1941 total. Nyasaland, falling under the Congo Basin treaties of 1885, cannot give a preference in its customs tariff to any state.

Wages in Nyasaland are low; unskilled labourers earn from 6*s.* to 10*s.* a month, domestic servants earn from 6*s.* to 30*s.* Special food allowances are normally provided.

Communications.—Nyasaland is connected with the port of Beira in Portuguese East Africa by a single track 3 ft. 6 in. gauge railway. In 1939 the Nyasaland railways extended from Salima via Chipoka and Blantyre to Port Herald (273 mi.) and connected via Sena and the Zambezi bridge (12,064 ft.) with Dondo in Portuguese East Africa. The railway was serviced by about 1,500 mi. of all-weather road (1938). On the lake was a regular service of ships, but river shipping on the Shiré lost its importance after the completion of the railway in 1935. Capital for the railway was acquired by involved series of loans (*c.* £5,000,000) which became the chief obstacle to the stabilization of Nyasaland's finances. Although the burden of the railway was largely shifted to the United Kingdom, the government insisted that the railway pay what it could, and therefore freight rates remained rather high, retarding the economic development.

(H. A. Wf.; X.)

History.—The first European who visited southern Nyasaland was Jasper Bocarro, who in 1616 carried samples of Zambezi silver from the vicinity of Tete to Malindi near Mombasa. During the next century Jesuit missionaries travelled through many sections of the country and brought back rumours of the existence of Lake Nyasa. The Lacerda expedition which penetrated as far as Lake Mweru in 1798 made the watershed of Lake Nyasa known, but the lake itself was not effectively discovered nor the country opened to Europeans until David Livingstone (*q.v.*) reached it on Sept. 16, 1859. In the following year the first attempt to establish missions was made, but it failed when a small group led by Bishop Mackenzie of the Universities Mission to Central Africa was decimated by fever and Yao hostility in the vicinity of Zomba. The region was, therefore, left to itself until the Livingstonia Free Church mission and the Church of Scotland mission were established in 1875–76. Since the missions found themselves unable to cope with the problems of supplying food and transport, the African Lakes corporation was formed in 1878. This corporation, nicknamed *mandala* (glass) by the natives because its founder, John Moir, wore spectacles, was the most important factor in opening Nyasaland.

The clashes between the missionaries and Arab slave traders brought the first British consuls into the country in 1883, and the African Lakes corporation enlisted volunteers in its unofficial war placed in 1888 under the command of Captain (later Lord) Lugard. At this time, the British government hesitated to interfere officially because Nyasaland was surrounded by Portuguese territory and remained inaccessible. A change in British attitude occurred in 1889, when D. J. Rankin discovered the navigable Chinde mouth of the Zambezi river, the status of which as an international waterway had been recognized in 1884. In the same year Cecil Rhodes' British South Africa company obtained a charter to develop Nyasaland. These developments inspired the British government to send Mr. (later Sir) H. H. Johnston into Nyasaland to negotiate treaties with the native chiefs and to thwart a Portuguese expedition under Major Serpa Pinto designed to link together the Portuguese territories of Mozambique and Angola. Between 1889 and 1891 British influence was consolidated, and as a result of the Anglo-German convention of 1890 and the Anglo-Portuguese convention of 1891, the Nyasaland Protectorate was established and was formally proclaimed in 1892. Johnston was put in charge of it as commissioner and consul-general responsible to the British Foreign Office. For five years he combined this post with that of administrator of the British South Africa company's trans-Zambezi territories which became Northern Rhodesia. With the aid of gunboats and Indian troops he suppressed slave raiding, forced Arabs and Yao into submission and subdued the Angoni, who had harassed the non-Angoni natives. The country was finally pacified in 1897. There

were then about 150 European settlers, nearly all in the vicinity of Blantyre and Zomba.

Sir Harry Johnston was succeeded as commissioner in 1897 by Sir Alfred Sharpe, whose intimate knowledge of the country was valuable in the work of development. The progress made was marked in 1904 by the transfer of the protectorate, up to that time under Foreign Office control, to the Colonial Office. In 1907 the title of the chief official was changed from commissioner to governor and in the same year executive and legislative councils were established. Called at first the Nyasaland Protectorate, the name was changed in 1893 to "The British Central Africa Protectorate," but in 1907 the old name was revived. When in 1910, Sir Alfred Sharpe retired, the urgent problems awaiting solution were economic; chief concern being over Nyasaland's communications with the sea, the river route having proved unsatisfactory. When World War I began, northern Nyasaland was invaded by Germans from East Africa. The governor, Mr. (later Sir) George Smith, was capable and energetic, and he received the full support of both Europeans and Africans.

There were 18,920 Africans recruited for service with the King's African Rifles, and 191,200 rendered seasonal service as carriers and noncombatants. The Germans were repelled, and later Nyasaland became a base for operations against them. There was, however, during the war, a disquieting incident. Among the natives were a number of professed Christians who claimed freedom from white control. One of these men, John Chelembwe, who had been educated in the United States, on his return built a church and preached the independence of Africans. With some 500 followers he rose in revolt in Jan. 1915. Three white settlers were murdered, one a Mr. Livingstone (a descendant of David Livingstone), and Chelembwe preached a sermon in his church with Mr. Livingstone's head placed on the pulpit. The revolt was speedily suppressed by a small force of British and natives, Chelembwe, who had taken to flight, and 20 of his followers were shot.

Following World War I, which brought German East Africa (renamed Tanganyika) within the British orbit, several attempts were made to amalgamate Nyasaland with adjacent British territories. While during the 1920s and 1930s Nyasaland's ties appeared to have been with Kenya and Tanganyika, after 1938 there was a movement to unite it to Northern Rhodesia. In 1939 the governor became a member of the East African Governor's conference as well as of the Inter-territorial conference at Salisbury, an assembly of the governors of Southern Rhodesia, Northern Rhodesia and Nyasaland. On Oct. 18, 1944 the British colonial office formally established a standing Central African committee to promote the closest contact and co-operation between the governments of the three territories. This council under the chairmanship of the governor of Southern Rhodesia held its first meeting in Salisbury, Southern Rhodesia, on April 24, 1945.

See S. S. Murray, *A Handbook of Nyasaland* (1932); *Annual Reports of the social and economic progress of the people of the Nyasaland Protectorate* (annually, British Colonial Office); *Yearbook and Guide of the Rhodesias and Nyasaland, 1938–39* (1939).

(H. A. Wf.; F. R. C.)

NYBORG, a seaport of Denmark on the island of Fyn, in the *amt* (county) of Svendborg. Pop. (1940) 8,994. The town was founded in the 12th century and a castle erected on Knudshoved (Canute's Head). From the 13th to the 15th century Nyborg was one of the most important places in Denmark. In 1658 it was held by the Swedes for about a year. The fortress, built by Christian IV. and Frederick III., was dismantled in 1869, and the ruins of the castle are used as a prison.

NYE, EDGAR WILSON (1850–1896), American humorist, was born at Shirley, Me., on Aug. 25, 1850. His parents removed to a farm on the St. Croix river in northern Wisconsin in 1852, and young Nye was educated in Wisconsin at the academy at River Falls, where he studied law. In 1876 he was admitted to the bar at Laramie, Wyo., where he served as justice of the peace, superintendent of schools, member of the city council and postmaster. Here he began to contribute humorous articles under the pseudonym of "Bill Nye" to newspapers, especially the Cheyenne *Sun* and the Denver *Tribune*. In 1881 he founded at Laramie the *Boomerang*, and his reputation as a humorist was soon widespread. Later he became a successful lecturer, and in 1885, with James Whitcomb Riley, the poet, made an extended tour through the country, each reading from his own writings. Nye removed to New York city in 1886, and passed the later years of his life at Arden, a village in North Carolina, where he died on Feb. 22, 1896. His principal books are *Bill Nye and Boomerang* (1881); *Forty Liars and other Lies* (1882); *Nye and Riley's Railway Guide* (1886), with James Whitcomb Riley; and two comic histories, *Bill Nye's History of the United States* (1894) and *Bill Nye's History of England from the Druids to the Reign of Henry VIII.* (1896).

See *Bill Nye, His Own Life Story, continuity* by F. W. Nye (1926).

NYIKA. This Swahili word means "forest and thorn bush country" and is used by the Swahili to designate a set of Eastern Bantu tribes, who during the 16th century under pressure from the Galla migrated down the coast from the steppes on the left bank of the Tana river. It does not include the Taita, Pokomo, Segeju and Akamba, though these are ethnically connected with the tribes to whom it is applied. The nine tribes included in the term Nyika are the Giryama, now living about 3° south of the Equator, the Rabai, the Duruma and the Digo—all upper Nyika tribes and the most important of the group: the other five are the lower Nyika—the Kauwa, Chonyi, Dzihana, Kambe and the Rihe or Ribe.

Generally speaking they are tall, muscular, well set up and broad-headed. The Digo, however, though well built are slender and have refined oval faces. There are evident affinities with the Northern Hamites, and their general colour is dark brown, becoming paler the nearer Mt. Kilimanjaro is approached. Waist clothes are worn by the men, and women wear many-pleated kilts, but are nude from the waist up, though now the tendency is to dress like Swahili women.

The *kaya* or fortified village was fundamental to their clan organization, but now that war is no longer anticipated, and villages are built outside the fortification, it has lost some of its significance, though still used for the assemblies of elders. The *kaya* is always situated on a hill or in a dense forest and is strongly palisaded. The Pokomo build circular huts like the Galla, but this group generally is characterized by rectangular huts, with a ridge-pole and a thatched roof extending to the ground and thus dispensing with walls. The houses are either gable- or hip-ended.

The Nyika tribes are divided into exogamous clans, which observe certain prohibitions and avoidances and share a general veneration for the hyaena in which all the cognate tribes join except the Pokomo: but now at any rate there is no trace of totemism. The clans of the Digo and Duruma are matrilineal; the rest are patrilineal with the exception of the Rabai, who are in a transitional stage. The Rabai have two sets of clans, male and female, and every man inherits the clan of his father and of his mother, but for all practical purposes he is reckoned as a member of his father's clan; a woman, on the other hand, while she similarly inherits both clans, stresses the mother's. Every clan has its own clubhouse (*lwanda*) and there is also the *moro* or council house, which is the general inter-clan meeting place for men, and houses the friction drum used for convening the council.

The Digo, probably under Arab influence, have hereditary sultans, but otherwise there are no paramount chiefs The government is in the hands of elders, who wear an ivory armlet as a badge of office. Every 13 years males have to be initiated at circumcision into an association analogous to Masai age-grades and after passing through the preliminary degrees they eventually reach the status of elders, among whom there is an inner circle called the Hyaena, which alone knows all the magical spells and consequently inspires great terror. From this circle are selected the "owners of the land," who carry on the government during the space of a *rika* or circumcision cycle.

The bow is the most usual weapon and the arrows are often poisoned. They also carry swords which are, however, as much implements as weapons. The Giryama have a parrying stick unique in the eastern area. Agriculture is carried on by women

who grow maize, millet, vegetables and sweet potatoes. They have sheep and goats but few cattle, and like most of the coastal tribes are careful not to take the cattle out till the heavy dew has dried from the grass, a precaution which does not seem to be necessary to the Bantu and Nilo-Hamitics living at higher altitudes.

The Nyika worship the typical Eastern Bantu deity *mulungu,* a vague abstraction of the sky combined with ancestor-worship with the main emphasis on the latter, the spirits of the dead (*koma*) surviving mortality and taking the world of the living under their charge. *Mulungu* is the dispenser and creator and from his union with the earth have sprung all things in the world including human beings, who are *mulungu's* hens and chickens. There are no professional rainmakers.

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NYIREGYHAZA, the capital of the county of Szabolcs, in Hungary, is situated on the sandy loess Nyirseg plateau. It is an agricultural centre, specializing in the intensive cultivation of fruit and vines. There are also small manufactures, *e.g.,* of soda, soap and agricultural machinery. Pop. (1939) 56,108.

NYKÖPING, a seaport of Sweden, chief town of the district (*län*) of Södermanland, 98 mi. S.W. of Stockholm by a branch from the Stockholm-Malmö railway. Pop. (1943) 14,299.

Nyköping (*i.e.,* New-Market, Latinized as *Nicopia*) begins to appear as a town early in the 13th century. Its castle was the seat of the kings of Södermanland, and after those of Stockholm and Kalmar was the strongest in Sweden. It was burned by Albert of Mecklenburg's party in 1389, by an accidental conflagration in 1665, and by the Russians in 1719. Nyköping lies at the head of the Byfjord, an inlet of the Baltic. The ruins of its once famous castle, the town hall (1662), and the district governor's residence, are notable buildings.

NYMPH, in zoology, is the name given to the immature stages through which all insects with incomplete metamorphosis pass after leaving the egg. At its last moult the nymph gives rise to the perfect insect. (*See* INSECTS.)

NYMPHAEUM, a monument consecrated to the nymphs (*q.v.*), especially those of springs. These monuments were originally natural grottoes, which were traditionally considered the habitations of the nymphs. They were arranged to furnish a supply of water. Subsequently, artificial grottoes took the place of natural. The nymphaea of the Roman period were borrowed from the Hellenistic east (*e.g.,* The Great Nymphaeum of Ephesus). The majority were rotundas, adorned with statues and paintings. They served the threefold purpose of sanctuaries, reservoirs and assembly-rooms. A special feature was their use for the celebration of marriages. Such nymphaea existed at Corinth, Antioch and Constantinople; the remains of some 20 have been found at Rome and of many in Asia Minor, Syria and Africa. The term nymphaeum was also applied to the fountain in the atrium of the Christian basilica. (*See* FOUNTAIN.)

NYMPHS, in Greek mythology, the generic name of a large number of female divinities of inferior rank. The word, the etymology of which is uncertain, seems to mean simply a marriageable woman; this is appropriate, as they are mostly associated with fertile, growing things (as trees), or with water. They are frequently associated with the superior divinities, as Artemis, Apollo, Dionysus, Pan and Hermes (*q.v.*).

The nymphs were distinguished according to the different spheres of nature with which they were connected. Sea nymphs were *Oceanids* or *Nereïds,* daughters of Oceanus or Nereus. *Naiades* (from Gr. νάειν, flow, cf. νᾶμα, stream) presided over springs, rivers and lakes. *Oreades* (ὄρος, mountain) were nymphs of mountains and grottoes, one of the most famous of whom was Echo. *Napaeae* (νάπη, dell) and *Alseïdes* (ἄλσος, grove) were nymphs of glens and groves. *Dryades* (*q.v.*) or *Hamadryades* were nymphs of forests and trees.

In Italy they tended to be identified with native divinities of springs and streams (Iuturna, Egeria, Carmentis, Fons), while the Lymphae (originally Lumpae), Italian water-goddesses, owing to the accidental similarity of name, were identified with the Greek Nymphae.

O This letter, the fourth vowel of the modern alphabet, corresponds to the Semitic *ayin,* which represented not a vowel but a breathing. The Greeks, or possibly their Asianic predecessors, in adapting the Semitic alphabet to their own use used this letter (*omicron*) to express the vowel O, as was the case also with the letters *aleph, he, cheth* and *yodh.* Vowels were not expressed alphabetically in Semitic. The form of the letter on the Moabite stone was small, O, and this small form appears in early Greek inscriptions from Thera and Corinth. In Corinth and in the inscriptions from Abu-Simbel in Egypt there is a form ⬦. A form with a dot in the centre occurs in Thera, ⊙, and this is paralleled in the large Etruscan ⊙. At Miletus a form Ω occurs. The Latin form, taken from the Chalcidic or Etruscan, was O. The minuscule form retains the shape of the majuscule letter.

The Greeks used the letter to represent the short close vowel ŏ. For the long vowel they used a sign Ω (*omega*) probably adapted from O to one of the forms of which in use at Miletus it closely approximates. The western dialects used Ω to represent the long vowel, whether open or close. In the east it was used only for the open vowel, ου being used for the long close vowel as well as for the true diphthong. In the Cyclades however a reversal of this process frequently took place, Ω being used for the close sound whether long or short, O for the open. In Latin the letter stood for the same vowel without distinction of length, and the sound has passed almost unchanged into the Romance languages.

Name of Form	Approximate Date	Form of Letter
Phoenician	B.C. 1,200	O
Cretan	1,100-900	O ◎
Theraean	700-600	O
Archaic Latin	700-500	O
Attic	600	O
Corinthian	600	O
Chalcidian	600	O
Ionic	403	O
Roman Colonial	Pre-classical and classical times	◊ ∩
Urban Roman		O
Faliscan		O
Oscan		Y V
Umbrian		V
Classical Latin and onwards		O

THE DEVELOPMENT OF THE LETTER "O" FROM THE EARLIEST TIMES TO THE PRESENT DAY

In modern English the vowel has undergone changes. The long ō has become a diphthong (*ou*) as in the words *bone, rose.* Short ŏ has become more open and lower, as in *rob.* Before the consonant *r* the sound is rounded and pronounced very far back in the mouth, *e.g., glory, north.* In the word *do* the single letter is used where a more usual orthography would require its doubling. Again in the word *son* one would expect the vowel *u.* In words such as *word, work, world* the sound has been affected by the preceding bilabial. The short sound is the descendant of Middle English short ŏ in which both the close and open short ŏ, which were distinguished in Old English, met. The long ō, now a diphthong, descends from Middle English long ō, an open sound, which was derived from Old English long ā. In Middle English this was a rounded back vowel akin to the modern vowel in the words *shore, north.* Old English close long ō became in Middle English *oo* (ū). (B. F. C. A.)

OAK, the name given to trees and shrubs of the genus *Quercus* of the beech family (Fagaceae, *q.v.*), a large group which includes some of the world's most important timber trees. The oaks are widely distributed over the temperate parts of Europe, Asia, northern Africa and North America, and extend southward in mountains and highlands into the tropics. On the mountains of Europe and North America they grow only at moderate elevations and none approaches the arctic circle. The tendency of many species to vary in a marked degree and the existence of numerous hybrid forms make the determination of the exact number of species difficult, but it is estimated at from about 300 to upwards of 500.

The oaks are readily distinguished by their peculiar fruit, an acorn which consists of a nut partially or wholly enclosed in a cup composed of numerous involucral scales. The carpellate flower contains a single ovary, three-celled at first, but normally becoming one-celled and one-seeded by abortion. The staminate flowers are in small clusters on the usually slender and pendent stalk, forming an interrupted catkin. The alternate leaves are more or less deeply lobed or cut in many species, but in some of the deciduous and many of the evergreen forms are nearly or quite entire on the margin. The well-known *Q. robur,* one of the most valued of the oaks, and the most celebrated in history and myth, may be taken as a type for oaks with sinuated leaves. Though known in England, where it is the only indigenous species, as the English oak, it is a native of most of the milder parts of Europe and of the Caucasus mountains in Asia. More than 40 varieties are in cultivation in European nurseries and collections. The English oak is one of the larger trees of the genus, though old specimens are often more remarkable for the great size of the trunk and main boughs than for very lofty growth. The spreading branches have a tendency to assume a tortuous form, causing a zigzag development; to this peculiarity the picturesque aspect of ancient oaks is largely due. When standing in dense woods the trees are rather straight and formal in early growth, and the gnarled character traditionally assigned to the oak applies chiefly to its advanced age. The fruit matures in a single season. Vast oak forests still covered the greater part of England and central Europe in the earlier historic period. Many of the ancient oaks that remain in England may date from Saxon times; the growth of trees after the trunk has become hollow is extremely slow, and the age of such venerable giants is only a matter of vague surmise. The celebrated Newland oak in Gloucestershire, known for centuries as "the great oak," was 47½ ft. in girth at 5 ft. from the ground. The wood of the English oak, when grown in perfection, is one of the most valuable produced in temperate climates. The heartwood varies in colour from dark brown to pale yellowish-brown, is hard, close-grained and liable to split. The oak of Great Britain was formerly in great demand for the construction of merchant shipping. The fine-grained heartwood is sought by the

cabinetmaker for the manufacture of furniture, as are also the gnarled and knotted portions of slowly grown trees, which are sawn into veneers. Oak was formerly largely used by wood-carvers and was thus applied at a very early date; the shrine of Edward the Confessor, in the abbey at Westminster, was constructed of dark-coloured oak-wood.

The cultivation of this oak in Europe forms one of the most important branches of forestry. Its growth is slow, though it varies greatly in different trees; when grown for large timber oak can rarely be profitably felled until the first century of its growth is completed. It is often grown as an ornamental tree in the eastern United States, where, however, it is usually short-lived. In the southern parts of Australia and in New Zealand it seems to flourish as well as in its native home. An important product of oak woods is the bark, formerly the chief tanning material of Europe. The acorns of the oak possess a considerable economic importance as food for swine. In the Saxon period the "mast" seems to have been regarded as the most valuable product of an oak forest.

Of the European timber oaks, the next in importance to the English oak is *Q. cerris,* the Turkey oak of the nurserymen. This oak abounds all over the Turkish peninsula, on the Taurus ranges, and in many parts of southern Europe; it was introduced into England about 1735, and is common in parks and plantations.

The evergreen holly oak of southern Europe is *Q. ilex,* usually a small tree, frequently of rather shrub-like appearance, with abundant glossy dark-green leaves, more or less prickly at the margin. It abounds in all the Mediterranean countries. The bole sometimes grows 90 ft. in height, but it does not often reach a great size. In its native lands it attains a vast age; Pliny attributes to several trees then growing in Rome a greater antiquity than the city itself.

The cork oak, *Q. suber,* the bark of which yields cork (*q.v.*), is a native of the west Mediterranean area. In Spain the wood is of some value, being hard and close-grained, and the inner bark is used for tanning.

The valonia of commerce, one of the richest of tanning materials, is the acorn of *Q. macrolepis,* a fine species indigenous to Greece and the coasts of the Levant.

Some oaks are of indirect importance because of products formed by their insect enemies. Of these the Aleppo gall (*see* GALLS) is yielded by *Q. infectoria,* a native of Asia Minor and western Asia. *Q. coccifera,* a small bush growing in Spain and many countries around the Mediterranean, furnishes the kermes dye. (*See* KERMÈS.)

In North America the oaks are generously represented. They attain their greatest size and economic importance in the southern United States, especially in the lower Mississippi valley, and reach their maximum diversity as regards species in the highlands of Mexico, notably in the western Sierra Madre range, where they form vast forests. In *The American Oaks* (1925), W. Trelease enumerated 371 species, of which 253 occur in Mexico, 54 in Central America, 3 in Panamá, 4 in Colombia, and 1 in the Antilles (Cuba), while 84 are found in the United States, 10 extending into the southern border of Canada. These vary greatly in size from small, straggling or even creeping shrubs to magnificent forest trees, 150 ft. or more in height, with trunks exceeding 6 ft. in diameter. In addition, Trelease recognized more than 50 named hybrid oaks whose parent species are regarded as satisfactorily determined.

The American oaks fall into two main groups—the white oaks and the red or black oaks—about equal in number and comprising practically all the species. In the white oak group (*Leucobalanus*) the acorns ripen at the end of the first season, the shell of the nut is smooth inside, and the leaves or their lobes, which are usually rounded, are without bristle tips. In the black or red oak group (*Erythrobalanus*) the acorns ripen at the end of the second season, the shell of the nut is hairy inside, and the leaves or their lobes, which are usually sharp-pointed, are bristle-tipped.

Of the oaks found in the United States, upwards of 50 species attain the stature of trees, more than half of which are of economic value for timber or other useful purposes. Fully 20 species attain a height of 100 ft. or more, and 5 equal or exceed a height of 150 ft., with correspondingly massive trunks. These larger oaks constitute the chief supply of native hardwood lumber in North America. Three-fourths of them occur east of the Rocky mountains; the others are found in the Pacific states, chiefly in California, the quality of their timber in general being inferior to that of the eastern oaks.

Among the most valuable eastern white oaks are the typical white oak (*Q. alba*), 80 ft. to 100 ft. high, with a trunk 3 ft. to 4 ft. in diameter, one of the finest North American trees; the rugged and massive bur oak (*Q. macrocarpa*), sometimes 170 ft. high, with a trunk 6 ft. to 7 ft. in diameter; the chestnut oak (*Q. montana*), the post oak (*Q. stellata*), the overcup oak (*Q. lyrata*), and the swamp chestnut or basket oak (*Q. prinus*), all growing to a height of 100 ft. and highly valued for lumber. Noteworthy representatives of the eastern red or black oak group are the red oak (*Q. borealis*), sometimes 150 ft. high; the Shumard red oak (*Q. shumardi*), 120 ft. high; the black oak (*Q. velutina*), 150 ft. high; the somewhat smaller scarlet oak (*Q. coccinea*) and willow oak (*Q. phellos*), all important timber trees.

The oaks of the Rocky mountain region are mostly small trees, often becoming shrubby at the higher elevations. The Rocky mountain white oak (*Q. utahensis*), rarely 45 ft. high, is the largest Colorado oak, and the Arizona white oak (*Q. arizonica*), sometimes 60 ft. high, is the chief oak of New Mexico and Arizona.

In California some 15 species of oak occur. Among the deciduous forms are the valley oak (*Q. lobata*), often 100 ft. to 125 ft. high, sometimes with a massive trunk 10 ft. in diameter; the Oregon white oak (*Q. garryana*), 60 ft. to 100 ft. high, found from San Francisco bay to British Columbia, and the California black oak (*Q. kelloggii*), sometimes 100 ft. high, found also in Oregon. Among the evergreen species are the coast live oak (*Q. agrifolia*) and the interior live oak (*Q. wislizenii*), both medium-sized trees; the scrub oak (*Q. dumosa*), usually 2 ft. to 8 ft. high, abundant in the chaparral (*q.v.*), and the canyon live oak (*Q. chrysolepis*), sometimes growing erect to a height of 110 ft.

The only evergreen species of the eastern states is the live oak (*Q. virginiana*), found near the coast from Virginia to Texas; it grows to a height of 75 ft., usually branching near the buttressed base into a round-topped head, sometimes 130 ft. across. The very strong wood was formerly much used in shipbuilding.

The total cut of oak lumber in the United States in 1899 was 4,551,000,000 bd.ft., an all-time maximum. In 1940 the total cut was 1,467,000,000 bd.ft.; about one-third of this was cut in Virginia, Arkansas and Louisiana, the rest in 33 other states. Commercially, oak lumber is classified as white oak and red oak. White oak lumber is cut principally from the white, chestnut, post, bur, overcup and swamp chestnut oaks; red oak lumber is cut chiefly from the red, Shumard red, scarlet, black and willow oaks.

For world distribution *see* A. Engler and K. Prantl, *Die Natürlichen Pflanzenfamilien* (1887–1909); *see* also C. S. Sargent, *Manual of North American Trees* (2nd ed., 1922); W. Trelease, "The American Oaks," *Mem. Nat. Acad. Sci.* v, xx (1925); G. B. Sudworth, "Check List of the Forest Trees of the United States," *U.S. Dept. Agr. Mis. Cir. 92* (1927).
(F. W. J.; X.)

OAKDALE, a city of Allen parish, Louisiana, U.S.A., in the southwestern part of the state, on the Calcasieu river, and served by the Santa Fe and the Missouri Pacific railways. Pop. (1950) 5,598. Industries include manufacture of hardwood and pine lumber, furniture stock and naval stores.

OAKHAM, a market town, and the county town of Rutland, England, 90 mi. N. by W. of London by the London Midland Region railway. Pop. urban district (1951) 3,537; area 3.5 sq.mi. All Saints' church is chiefly Perpendicular. Of Oakham castle, first mentioned in 1151, the Norman hall (built 1190–1200) is little changed, and is used as the county hall. A custom prevails by which every peer of the realm on first passing through Oakham has to give a horseshoe (or a sum to buy one) to be placed in the hall.

OAKLAND, a city of California, U.S.A., on the mainland shore of San Francisco bay; connected with San Francisco by the 8¼ mi. San Francisco-Oakland bay bridge; the county seat of Alameda county and the third city of the state in size. It is a port

of call for numerous steamship lines and is served by the Santa Fe, the Southern Pacific and the Western Pacific and electric railways; by several air lines and by ferries and motor-coach lines. The population was 384,575 in 1950, in 1940 it was 302,163.

The business section of the city is built on a level crescent-shaped plain along the bay, averaging 3 mi. in width, behind which gently sloping hills rise to an elevation of 1,500 ft., providing residential sections with magnificent views of the bay, with San Francisco and the Golden Gate directly opposite. The land area of the city is 60.25 sq.mi. Adjoining it on the north is Berkeley; to the south, across an arm of the bay, is Alameda. These three cities and the five smaller municipalities of the metropolitan Oakland area (Emeryville, Piedmont, San Leandro, Albany and Hayward) had a population approximating 630,000 in 1950. In the heart of the city is Lake Merritt, a 160-ac. body of salt water and the only salt water lake in the heart of any American city.

After World War II the city undertook a vast program of building, including a civic centre at the south end of Lake Merritt. The University of California, in Berkeley, is only 4 mi. from the Oakland city hall. In Oakland, on a 60-ac. campus in the foothills, is Mills college for women, opened in 1871 by Cyrus T. Mills and Mrs. Mills.

Oakland has 19 mi. of water frontage in the port area. The estuary was dredged out to become a fine seaport bristling with docks, wharves, piers, ship-building cranes and ways. The railroads have solid filled moles and trestles extending from the shore into the bay. Much of the shallow bay front was filled in for additional industrial sites; the Oakland naval supply centre, the army base and the Alameda naval air station were almost entirely built on reclaimed land. The commerce of the harbour (including the Alameda side of the inner harbour) was approximately 4,000,000 tons annually at mid-20th century.

The industrial district lies just behind the water front, extending from Richmond on the north to Hayward in the south, and is traversed by many miles of main-line railroad trackage with spur-line facilities. After World War II, metropolitan Oakland had a great industrial expansion. Manufacturing plants in the metropolitan area obtain raw materials from nearby points, and minerals, petroleum, structural materials and other industrial materials are readily available. Agricultural products are funnelled in from southern Alameda county and adjacent communities for the many food-processing plants. Second only to the Los Angeles area in the Pacific coast production of automobiles and trucks at mid-century, the metropolitan Oakland area ranked first in the world in the production of calculating machines. Processed foods, canned goods, chemicals, electrical machinery, confectionery products, office equipment, paint and furniture were some of the other major industries.

The original site of Oakland was part of the holdings of Don Luis Maria Peralta, who received vast grants from the Spanish crown. In 1842 he divided his lands among his four sons, and the two to whom this region fell established themselves on their estates. From one of them in 1850 Moses Chase leased a tract, and he became the founder of the future city. In 1852 it was incorporated as a town, and in 1854 it was chartered as a city. In 1931 the city adopted a council-manager form of government. The name Oakland was suggested by the groves of oaks in which the first homes were built.

See E. J. Hinkel, *Oakland, 1852–1938* (1939).

OAKMONT, a residential and industrial borough of Allegheny county, Pa., U.S., on the Allegheny river and the Pennsylvania railroad, 12 mi. N.E. of Pittsburgh. Pop. (1950) 7,264; (1940) 6,260.

OAKMOSS, a lichen (*Evernia prunastri*) containing an oleoresin valued in perfumery both for its own fragrance of heavy, oriental type, and as a fixative base. Another species (*E. furfuracea*) having similar properties, is often included under the same common name, which is a translation of the French *Mousse de chêne*. Oakmoss grows on the trunks and branches of trees, also on poles and rails, in mountainous country throughout much of the northern hemisphere, in pale, greenish gray tufts 2 or 3 in. long, extending or drooping, made up of flattened strands which fork repeatedly, ending in pointed tips. The upper or outer surface of these strands is minutely warty and dusted with pale gray soredia, particles which reproduce the plant in the absence of the rare, disk-shaped, sexual fruit bodies (apothecia). The under surface is whitish, channeled in a faint, net-like pattern. Other lichens of the genera Usnea, Ramalina, Parmelia, etc., which grow intermingled with the Evernia, frequently gathered with it in the commercial product, have little fragrance, but may contribute to the value of the oleoresin as a base. Chief sources of oakmoss from about 1900, when the perfume first came into general use, until 1940, were Yugoslavia and France, large quantities being shipped for distillation in northern Europe. After the disruption of trade by war conditions, investigation showed the lichens to exist in Canada and northern United States, and they have been distilled in America to a limited extent. Oakmoss was used in perfumery as early as the 16th century, later forgotten. Baskets filled with it have been found in the ancient royal tombs of Egypt, but whether intended for perfume or, as some suggest, for making bread, is not known. It contains a starchy substance undoubtedly edible.

OAKMOSS (EVERNIA PRUNASTRI). AFTER "THE LICHEN BOOK"

OAK PARK, a village of Cook county, Illinois, U.S.A., 9 mi. W. of Chicago's loop. It is served by the Chicago and North Western, the Chicago, Aurora and Elgin, and the Baltimore and Ohio Chicago Terminal railways. Pop. (1950) 63,529. Assessed valuation of property in 1949 was $161,196,453. The village was incorporated in 1901.

OANNES (also Iannes, Euahanes), in Babylonian mythology, the name given by Berossus to a mythical being who taught mankind wisdom. He is identical with the god Ea (*q.v.*), although there may not be any direct connection between the two names. Berossus describes Oannes as having the body of a fish but underneath the figure of a man. He is described as dwelling in the Persian gulf (Erythraean sea) and rising out of the waters in the daytime and furnishing mankind instruction in writing, the arts and the various sciences. Other epithets of Oannes are Annēdotus, Odakōn, Euedokus, Eneugamos, Eneuboulos, Anēmentos. This antediluvian myth of a fish-like monster is based on the water god Enki of Eridu, patron of wisdom, symbolised as a "goat fish," and identified with Capricorn. (S. L.)

OARFISH, an oceanic fish, *Regalecus,* characterized by the long, compressed body, short head, large eye and long dorsal fin forming a crest on the top of the head. The oarfish is distinguished from its allies, the dealfishes (*q.v.*) by the long filamentous pelvic fins ending in a spatulate expansion (hence their name). These fish reach a length of nearly 40 ft.

OASIS, a fertile spot surrounded by desert (the Greek form is αὔασις which is doubtfully referred to the Coptic word *ouahe,* a dwelling place). On the desert Libyan plateau immediately west of the Nile between Aswan and Cairo are areas where the water comes to the surface or is found in shallow wells, *e.g.,* Oases of Khârga, Dâkhla and Farâfra. The water may come to the surface in springs, upon the artesian principle, or it may collect and remain in mountain hollows. These areas vary considerably in extent; they are always intensively cultivated and support thick growths of date-palms; and all kinds of tropical vegetables, grains and small fruits are grown. Some oases have a large population with substantial dwellings, others are merely halting-places.

OASTLER, RICHARD (1789–1861), English reformer, was born at Leeds on Dec. 20, 1789, and in 1820 succeeded his father as steward of the Thornhills' extensive Fixby estates at Huddersfield, Yorkshire. In 1830 John Wood, a Bradford manufacturer, called Oastler's attention to the evils of child employment in the factories of the district. Oastler at once started a campaign against the existing labour conditions by a vigorous letter, under the title "Yorkshire Slavery," to the *Leeds Mercury.* After many years of agitation, in which Oastler played a leading part, the Ten

Hours bill and other Factory acts were passed, Oastler's energetic advocacy of the factory-workers' cause procuring him the title of "The Factory King." In 1838, however, owing to his opposition to the new poor law and his resistance of the commissioners, he had been dismissed from his stewardship at Fixby; and, in 1840, being unable to repay £2,000 which he owed his late employer, Thomas Thornhill, he was sent to the Fleet prison, where he remained for over three years. From prison he published the *Fleet Papers,* a weekly paper devoted to the discussion of factory and poor-law questions. In 1844 his friends raised a fund to pay his debt, and on his release he made a triumphant entry into Huddersfield. Oastler died on Aug. 22, 1861.

See W. R. Croft, *The History of the Factory Movement, or, Oastler and his Times* (1888).

OATES, TITUS (1649–1705), English conspirator, was the son of Samuel Oates (1610–1683), an Anabaptist preacher, chaplain to Pride, and afterwards rector of All Saints' church, Hastings. On leaving Cambridge he took Anglican orders, and officiated in several parishes, Hastings among them. Having brought malicious charges in which his evidence was rejected, he narrowly escaped prosecution for perjury. He next obtained a chaplaincy in the navy, from which he was speedily dismissed. He now applied for help to Dr. Israel Tonge, a rector who was obsessed with the idea of Roman Catholic plots; Oates was to help him in unravelling the plots. To this end it was decided that Oates should pose as a Catholic. He spent some time at the Jesuit colleges of Valladolid and St. Omer, being expelled from both.

Returning in June 1678 to Tonge, he forged a plot by piecing together things true and false, or true facts falsely interpreted, and by inventing treasonable letters and accounts of preparations for military action. The whole story was written by Oates in Greek characters, copied into English by Tonge, and finally told to one of Charles II's confidential servants named Kirkby. Kirkby having given the king his information, Oates was sent for. He gave details, in 43 articles, of the plot and the persons who had engaged to assassinate Charles. Charles at no time believed this incredible farrago. To bolster up the case a fresh packet of five forged letters was concocted; but the forgery was transparent, and even Sir William Jones, the attorney-general, though a violent upholder of the plot, dared not produce them as evidence.

Oates now made an affidavit before Sir Edmond Berry Godfrey (*q.v.*) to an improved edition of his story, in 81 articles. Among the persons named was Coleman, secretary to the duchess of York, whom Godfrey knew, and to whom he sent word of the charges. Coleman in turn informed the duke, who induced Charles to compel Oates to appear before the privy council. Here Oates was exposed by a few simple questions. But among the papers seized at Oates's request were Coleman's, and in them were found copies of letters written to Père la Chaise, suggesting that Louis should furnish him with money, which he would use in the French and Catholic interest among members of parliament. Among them, too, were these passages: "Success will give the greatest blow to the Protestant religion that it has received since its birth"; "we have here a mighty work upon our hands, no less than the conversion of three kingdoms, and by that perhaps the utter subduing of a pestilent heresy, which has so long domineered over great part of the northern world." The credit of Oates was thus, in the eyes of the people, re-established, and Coleman and others named were imprisoned.

On Oct. 12, occurred the murder of Godfrey. On Oct. 21, parliament met, and Oates was called before the house. A new witness was wanted to support Oates's story, and in November a man named William Bedloe came forward. At first he remembered little; by degrees he remembered everything that was wanted. Oates then accused the queen before Charles of high treason, and carried his tale before the house of commons. The commons voted for the queen's removal from court, but, the lords refusing to concur, the matter dropped. It was not, however, until 1679 that the slaughter of Jesuits and other Roman Catholics upon Oates's testimony and that of his accomplices was checked. Sir George Wakeman, the queen's physician, was accused of purposing to poison the king, and the queen was named as being concerned in the plot. Sir Philip Lloyd proved Oates to have perjured himself, and Wakeman was acquitted. On June 26, 1680, upon Oates's testimony, the duke of York was presented as a recusant at Westminster. But the panic had worn itself out, and Oates retired on a pension. Shortly before the death of Charles, James brought, and won, a civil action against Oates, with damages of £100,000; in default of payment Oates was taken to prison; while there he was indicted for perjury, and was tried in May 1685, soon after the accession of James II. He received a severe sentence with repeated floggings, which was expected to kill him, but to the astonishment of all he survived.

Oates was in prison for three and a half years. Finally he received a royal pardon, with a pension of £300 a year. The remainder of his life was spent in retirement, varied by sordid intrigue. In 1691 he became acquainted with William Fuller, whom he induced to forge another plot, though not with the success he had himself attained. In 1696 he dedicated to William III a book called *Eikon Basilike,* a tissue of invective against "the late king James." In 1698 he obtained admission as a member of the Baptist Church, and used to preach at Wapping; but in 1701, as the result of a financial scandal, he was formally expelled from the sect. He died on July 12, 1705.

BIBLIOGRAPHY.—Oates's, Dangerfield's and Bedloe's *Narratives; State Trials; Journals of Houses of Parliament;* North's *Examen;* the various memoirs and diaries of the period; Fuller's *Narrative;* Dryden's *Absalom and Achitophel;* Burnet's *History;* Narcissus Luttrell's *Relation.* Lingard's *History* gives an exhaustive and trustworthy account of the Popish terror and its victims; and the chief incidents in Oates's career are graphically described by Macaulay. On the question of the place of his education see *Notes and Queries* (Dec. 22, 1883). *See* also T. Seccombe's essay in *Twelve Bad Men* (1894, bibliography).

OATH (O.Eng. *âdh*), an asseveration or promise made under non-human penalty or sanction. The word is found throughout the Teutonic languages, but without ascertainable etymology.

Retribution for Violation (*see* DYNAMISM).—The harm or penalty consequent on perjury may be considered to result directly, without any spirit or deity being mentioned. Thus among the Nagas of Assam, two men will lay hold of a dog or a fowl by head and feet, which is then chopped in two with a single blow of the dao, this being emblematic of the fate expected to befall the perjurer. Or a man will take hold of the barrel of a gun, a spear-head or a tiger's tooth, and solemnly declare, "If I do not faithfully perform this my promise, may I fall by this!" (Butler in *Journ. Asiatic Soc., Bengal,* 1875, p. 316).

In Siberia, in lawsuits between Russians and the wild Ostiaks, it was usual to bring into court the head of a bear, the Ostiak making the gesture of eating, and calling on the bear to devour him in like manner if he does not tell the truth. Similar oaths are sworn on the head or skin of a tiger by the Santals and other indigenous tribes of India. Death by a tiger precludes reincarnation and therefore involves social and physical extinction. Both in the old and modern world oaths by rivers are most sacred. In earlier ages men swore inviolably by Styx or Tiber, and an oath on water of the Ganges is to the Hindu the most binding of pledges, for the goddess will take awful vengeance on the children of the perjurer. The Tungus brandishes a knife before the sun, saying, "If I lie may the sun plunge sickness into my entrails like this knife."

The transition to invoking gods conceived in human form is shown in the treaty-oath between the Macedonians and the Carthaginians recorded by Polybius (vii 9); here the sun and moon and earth, the rivers and meadows and waters, are invoked side by side with Zeus and Hera and Apollo, and the gods of the Carthaginians. The heaven-god, able to smite the perjurer with his lightning, was invoked by the Romans, when a hog was slain with the sacred flint representing the thunderbolt, with the invocation to Jove so to smite the Roman people if they broke the oath (Liv. i 24; Polyb. iii 25). But bears and tigers are as apt to kill truth-tellers as perjurers, and the lightning-flash falls without moral discrimination. In the *Clouds* of Aristophanes, the Socrates of the play points out that notorious perjurers go unharmed, while Zeus hurls his bolts at his own temple and the tall oaks, as if an oak-tree could perjure itself.

The doctrine of miraculous earthly retribution on the perjurer

lasted on in legend, as where Eusebius relates how three villains conspired to bring a false accusation against Narcissus, bishop of Jerusalem, which accusation they confirmed by solemn oath before the church, one wishing that if he swore falsely he might perish by fire, one that he might die of the pestilence, one that he might lose his eyes; a spark no man knew from whence burned to ashes the first perjurer's house and all within, the second was consumed by the plague from head to foot, whereupon the third confessed the crime with tears so copious that he lost his sight (Euseb. *Hist. Eccl.* vi 9). In general the supernatural retribution on perjury has been transferred to beyond the grave.

International Forms.—Gestures such as grasping hands, or putting one hand between the hands of another in token of homage, are not oaths, but ceremonies of compact. Even the covenant among many ancient and modern nations by the parties mixing their blood or drinking one another's is in itself only a solemn rite of union, not an oath proper.

The act of swearing by weapons may signify that the swearer if forsworn is to die by such a weapon; or the warrior may appeal to his weapon as a powerful or divine object (*see* Du Cange, *s.v.* "Juramenta super arma"; Grimm, *Deutsche Rechtsalterth.*, p. 896). Stretching forth the hands towards the object or deity is a natural gesture, used by Israelites (Gen. xiv 22; Deut. xxxii 40; *see* Dan. xii 7; Rev. x 5). In France a juror takes oath by raising his hand, saying, "Je jure!" The Scottish judicial oath is taken by the witness holding up his right hand uncovered, and repeating after the usher, "I swear by Almighty God, and as I shall answer to God at the great day of judgment, that I will," etc.

In the ancient world sacrifice (*q.v.*) often formed part of the ceremony of the oath; typical examples may be found in the Homeric poems. Details of the old Scandinavian oath have been preserved in Iceland in the Landnámabók (*Islendinga Sögur*, Copenhagen, 1843); a bracelet (baugr) of two rings or more was to be kept on the altar in every head court, which the godi or priest should wear at all law-things held by him, and should redden in the blood of the bullock sacrificed, the witness pronouncing the remarkable formula: "Name I to witness that I take oath by the ring, law-oath, so help me Frey, and Niörd, and almighty Thor" (hialpi mer svâ Freyr, ok Miördr, ok hinn almâttki Âss), etc. This was doubtless the great oath on the holy ring or bracelet which the Danes swore to King Alfred to quit his kingdom.

Under Christ's injunction, "Swear not at all" (Matt. v 34; also James v 12), many Christians have shrunk from taking oaths, *see* writings of the Fathers. In more modern times Anabaptists, Mennonites and Quakers have refused to take even judicial oaths. On the other hand, the laws of Christendom from early ages have been directed against such swearing as was considered profane or otherwise improper, and against perjury. Constantine's laws required every witness in a cause to take oath; this is confirmed in Justinian's code which even in some cases requires also the parties and advocates to be sworn (*Cod. Theod.* xi 39; *Justin. Cod.* iv 20, 59). Bishops and clergy were called upon to take oath in ordination, monastic vows, and other ecclesiastical matters (*see* details in Bingham, *Antiq. of Chr. Church,* xvi 7). The Reformation conformed to this principle in Art. xxxix of the church of England. The Christian oath on a copy of the Gospels seems derived from the late Jewish oath taken holding in the hand the scroll of the law (or the phylacteries), a ceremony itself possibly adapted from Roman custom (*see* treatise "Shebuoth" in *Gemara*). The practice of kissing the book, established in England, appears in the middle ages (J. E. Tyler, *Oaths,* pp. 119, 151). The book was often laid on the altar, or the swearer laid his hand on the altar itself, or looked towards it; or touched relics of saints on the altar. Other objects, as the cross, the bishop's crosier, etc., were sworn by (*see* Du Cange, *s.v.* "Jurare"). An oath ratified by contact or inspection of a sacred object was called a "corporal" or bodily oath, as distinguished from a merely spoken or written oath.

Oath Formulas.—Among the oath formulas used in Christendom, that taken by provincial governors under Justinian is typical of one class: "I swear by God Almighty, and His only begotten Son our Lord Jesus Christ, and the Holy Ghost, and the Most Holy Glorious Mother of God and ever Virgin Mary, and by the Four Gospels which I hold in my hand, and by the Holy Archangels Michael and Gabriel," etc. The famous oath of the kings Louis and Charles at Strassburg in A.D. 842 runs: "By God's love and the Christian people and our common salvation, as God shall give me knowledge and power," etc. In the oath of fealty in the capitularies of Charlemagne in 802 is found the familiar form "Sic me adjuvet Deus," corresponding to formulas of pre-Christian Rome. This became widely spread in Europe, appearing in Old French "Si m'ait Dex," German "So mir Gott helfe," English "So help me God." A remarkable point in its history is its occurrence in the "So help me Frey," etc., of the old Scandinavian ring-oath already described. William the Conqueror swore "by the splendour of God," Richard I "by God's legs," John "by God's teeth"; other phrases are given in Du Cange as "per omnes gentes," "per coronam," "par la sainte figure de Dieu," "par la mort Dieu," etc.

Law.—In England the coronation oath is administered by an archbishop or bishop in the presence of the people, who, on their parts, reciprocally take the oath of allegiance to the crown. *The archbishop or bishop shall say:* "Will you solemnly promise and swear to govern the people of this United Kingdom of Great Britain and Ireland and the dominions thereto belonging according to the statutes in parliament agreed on, and the respective laws and customs of the same?" *The king shall say:* "I solemnly promise so to do." *Archbishop or bishop:* "Will you to the utmost of your power cause law and justice, in mercy, to be executed in all your judgments?" *King:* "I will." *Archbishop or bishop:* "Will you to the utmost of your power, maintain the laws of God, the true profession of the Gospel, and the Protestant reformed religion established by law? And will you maintain and preserve inviolably the settlement of the Church of England and the doctrine, worship, discipline and government thereof, as by law established in England? And will you preserve unto the bishops and clergy of England, and to the churches therein all such rights and privileges as by law do or shall appertain to them, or any of them?" *King:* "All this I promise to do." *After this the king, laying his hand upon the holy Gospels, shall say:* "The things which I have here before promised I will perform and keep; so help me God," *and then shall kiss the book.* (*See* CORONATION.)

The chief officers of state take an "official" oath well and truly to serve his majesty. Special oaths are taken by privy councillors, archbishops and bishops, peers, baronets and knights, recruits and others. The old oath of allegiance, as administered (says Blackstone, *Commentaries,* book i chap. x) upwards of 600 years, was replaced in the reign of William III by a shorter form; and it now runs: "I . . . do swear that I will be faithful and bear true allegiance to His Majesty . . . , his heirs and successors, according to law." Statutes of Charles II and George I enacted that no member should vote or sit in either house of parliament without having taken the several oaths of allegiance, supremacy and abjuration. In modern times a single parliamentary oath was substituted for the three, and this was altered to enable Roman Catholics to take it; Jews were enabled to sit in parliament by being allowed to omit the words "on the true faith of a Christian." In its present form the parliamentary oath consists of an oath of allegiance and a promise to maintain the succession to the crown as limited and settled in the reign of William III. The right to affirm in lieu of taking the parliamentary oath was first raised in the case of Charles Bradlaugh (*q.v.*). The "judicial" oath taken by judges of the court of appeal or of the High Court of Justice, and by justices of the peace is "to do right to all manner of people after the laws and usages of this realm, without fear or favour, affection or ill-will." Jurors are sworn, whence indeed their name (*iuratores*); in felonies the oath administered is: "You shall well and truly try and true deliverance make between our sovereign lord the king and the prisoner at the bar whom you shall have in charge, and a true verdict give according to the evidence." (*See* PRACTICE AND PROCEDURE: *Juries.*) The oath of the jurors in the Scottish criminal courts is: "You [the jury collectively] swear in the name of Almighty God and as you shall answer to God at the great day of judgment that you will truth say and no truth conceal in so far as you are to pass upon this assize." In the ancient

custom of compurgation, once prevalent in Europe, the accused's oath was supported by the oaths of a number of helpers or compurgators who swore to their belief in its validity.

Witnesses in English law courts must give their evidence under the sanction of an oath, or of what is equivalent to an oath, and the ordinary form of oath adapted to Christians is: "The evidence you shall give . . . shall be the truth, the whole truth, and nothing but the truth. So help you God." Many alterations of the English law as to oaths have been made in relief of (1) those Christians who object on conscientious grounds to the taking of an oath, and (2) of those persons who refuse to admit the binding force of an oath. Special provision was first made for Quakers, Moravians and Separatists; then followed general enactments relating to civil and criminal proceedings respectively, till finally the law was embodied in the Oaths Act 1888, which enacted that "every person upon objecting to being sworn, and stating, as the ground of such objection, either that he has no religious belief, or that the taking of an oath is contrary to his religious belief, shall be permitted to make his solemn affirmation instead of taking an oath." . . . The form of affirmation prescribed by the Oaths Act was as follows: "I, *A. B.*, do solemnly, sincerely, and truly declare and affirm," etc. Under s. 5 of the same act a person might swear in the Scottish form, with uplifted hand (no book of any kind being used) and if he desired to do so "the oath shall be administered to him in such form and manner without question." With the desire of making universal the method of administering the oath the Oaths Act 1909 was passed. A Christian swears on the Gospels, holding a copy of the New Testament in his uplifted right hand, the hand being uncovered, and his head being also uncovered. A witness may elect to be sworn on any version of the Bible which he considers most binding on him, as a Roman Catholic on the Douai Testament or Bible. A Jew is sworn on the Pentateuch, holding a copy thereof in his right hand, the head being covered. A Mohammedan is sworn upon the Koran. He places his right hand flat upon the book and puts the other hand upon his forehead, bringing his head down to the book and in contact with it. He then looks at the book for some moments. Buddhists are sworn on the Buddhist doctrines, Sikhs upon the Granth, Parsees upon the Zend Avesta, Hindus upon the Vedas, or by touching the Brahmin's foot, and, according to caste custom, Indian witnesses sometimes insist upon the oath being administered by a Brahmin; but in India witnesses now generally affirm. Kafir witnesses swear by their own chief, and a Kafir chief by the king of England. When a Chinese witness is to be sworn, a saucer is handed to him which he takes and, kneeling down, breaks into fragments.

The administering or taking of unlawful oaths is criminal in English and Scots law. Statutes relating to the offense were passed in 1797, 1799, 1810 and 1812, and it is evident from the preamble of the latter act (Unlawful Oaths Act 1812) that they were aimed at those societies in the United Kingdom at the time of the French Revolution which required or permitted their members to take an unlawful oath. Supplementary statutes were passed in 1817 and 1837. Children of tender years, who, in the opinion of the court, have not sufficient intelligence to understand the nature of an oath, may give evidence without being sworn.

United States.—In the United States oaths required by way of qualification for public office or citizenship are generally prescribed by constitutions or statutes. At an early date provisions were made for simple affirmation for the benefit of those whose religious faith proscribed the taking of an oath. Witnesses in the law courts or before legal or administrative officials invested with the power of administering oaths must give their evidence under oath or by affirmation. Belief by the witness in a God and an appeal to Him as an avenger of falsehood are the essentials of the oath. Liberal allowances may thus be made for the taking of oaths by non-Christians, the witness being sworn in such fashion as he considers binding on his conscience. Professed atheists have on occasion been excluded from the witness stand, but generally the religious belief of a witness can only be used to impeach his credibility. No special form need accompany the administration of an oath, unless required by statute, provided that some formal act be done to impress the witness with the distinction between sworn statements and bare assertions.

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OATS. The oat plant belongs to the genus *Avena* and is one of the more important cereal crops. The grain is used largely as feed for livestock, although some is processed directly into food for humans.

The flowering and fruiting structure is a terminal panicle that is usually lax or spreading. In some of the rarer types, the branches of the central axis are reduced so that in appearance the panicle approaches the spikes or heads of other small grains. The panicles may be either approximately symmetrical or with a preponderance of branches and their terminal spikelets hanging to one side, producing what is called side oats. The panicle is made up of numerous branches and spikelets which in turn are composed of two papery glumes and usually two florets. The primary and secondary florets are held together by a short, thin rachilla. The individual floret has a lemma and palea that enclose three stamens, a pistil and two lodicules.

After fertilization the pistil develops into a one-seeded fruit called a caryopsis. The fruit, also called the groat, is closely clasped by the lemma and palea except in hull-less types where it is freed upon threshing. In *Avena nuda*, an uncommonly grown naked species, spikelets may have eight to ten florets, and two to eight may be fertile.

The lemma and palea, the covering or hulls containing the groat, are usually without hairs for the most part in cultivated oats (*Avena sativa*). In a large number of the wild forms, however, the lemma is covered with numerous hairs. The lemma also bears a weak awn in many cultivated varieties and sometimes a large and twisted awn as in the case of the wild types. The hull colour at maturity may vary considerably from yellow to white, black, brown or red. In some wild species of oats empty glumes remain attached to the panicle branches after the kernels have fallen to the ground. In cultivated species, however, most of the kernels remain attached until threshed. The basal articulation of the spikelet is useful in the classification of species. Sometimes the secondary kernel is tightly clasped by the lemma of the primary kernel; this is known as doubling or bosom kernels. Sometimes the first flower may be sterile and yet not doubled. The caryopsis or groat weighs about 20 mg. and the lemma and palea about 6 mg. in cultivated oats. The oat panicle usually is from 4 to 21 in. long and may have as few as 8 to 10 kernels or as many as 200, and averages about 45 kernels in number.

The leaves of the oat plant are thin, narrow and long. They are very prominent in the early phases of growth, but become less prominent upon maturity, at which time the culms are elongated and produce what is called the stalk or culm of the plant. There is no auricle at the base of the leaf blade, this being in contrast with the other small grains. The stems are usually hollow except at the nodes. Culms are from two to five feet tall and the number per plant depends largely upon the rate of sowing, the fertility of the soil and growth conditions. Roots are fibrous and numerous, and penetrate the soil to various depths.

Origin.—It was previously thought that cultivated oats were derived chiefly from two species, the common wild oat (*Avena fatua*) and the wild red oat (*A. sterilis*). Some cereal workers held that common white oats (*A. sativa*) were derived from *A. fatua* with a spreading panicle and that red oats (*A. byzantina*) came from *A. sterilis*. Later some workers believed that *A. sterilis* was the progenitor of both the red oats and white oats. Wild oats were first found growing in different regions of western Europe. Early writers mentioned the possibility that oats were found as a weed mixed with barley and therefore may have been distributed as a mixture in barley. From western Europe oats spread to other temperate parts of the world and have been in production under a wide range of conditions

Classification.—The genus *Avena* is composed of polyploid series, as is true of *Triticum*, the haploid chromosomes numbering 7, 14 and 21, or 14, 28 and 42 in the vegetative cells. There are several recognized species in the 7-chromosome group, most of

them being wild types. There are at least two species recognized as being in the 14-chromosome group. In the third group with 21 chromosomes are found the common white and yellow cultivated varieties, ordinary wild types, hull-less and *Avena byzantina,* the cultivated red oat. There are also wild forms found in this series.

The different species have been classified by numerous workers, most of whom do not agree in detail.

The common wild oat is a weed in many sections of the world although in some areas it is cut for hay or grazed. Because the seeds may lie dormant for long periods it is difficult to eradicate this type of oat. Kernels mature more rapidly at the top of the panicle and drop to the ground as they ripen, even though the culm may still be green. The panicle of the wild oat is usually longer and more lax than that of the ordinary cultivated sorts.

Fatuoids or false wild oats have been observed in nearly all cultivated varieties. Fatuoid kernels also drop to the ground as in the case of wild oats. However, false wild types do not constitute a weed hazard.

The various common oats are grown in cooler and more temperate regions of the world. Side and late-maturing common oats occur in northwestern Europe and northern sections of the United States and Canada. The smaller yellow-kernelled varieties occur in southwestern U.S.S.R. and in the corn belt of the United States. Red oats are grown principally in the warmer climates, including the southern sections of the United States and the Mediterranean regions of Europe and Africa. Australia also produces some of the common red oats. These are considerably more heat tolerant than are the common types. Hull-less (*A. nuda*) forms are found in the highlands of Tibet, northern India, Turkestan and western China.

Some of the more important older agricultural varieties of oats in North America are Kherson, Silvermine, Victory, Fulghum, Red Rustproof, Markton, Gopher, Columbia, Cornellian, Patterson, Banner, O.A.C. selections, the "Victoria-Richland" group and "Bond" varieties including Clinton, Bonda and Cherokee. Some of the newer varieties are Branch, Clintland, Craig, Floriland, Mustang and Sauk. Varieties from other sections of the world are as follows: Victory, Record, Golden Rain, Potato, Elder, La Industria, Binder, Golden Rain II, Gelbhafer, Sunrise, S.E.S. no. 52, Victoria, Red Algerian, Belar, Dun, Santa Fe and Landhafer.

Cultivation and Use.—A large part of the oats produced in the United States is sown in the spring. There are three groups of spring-sown oats: those that are of midseason to late in maturity; early white and yellow types; and the spring-sown red types that are grown principally in the Great Plains of the United States. There is also a large area of fall-sown oats in the southern section of the United States. Seeding is done in practically all months of the year in various areas of the world.

Oats are less exacting in their soil requirements than are other cereals with the exception of rye. They seem to be able to extract nutrients from the soil that would not be available for wheat and barley. In the presence of sufficient moisture, oats will do comparatively well on soils that are sandy and low in fertility and on soils high in acidity, but will do well under fertile conditions. Rye, however, as a rule will produce crops on soils that are too poor for satisfactory oat production. In the corn belt of the U.S. oats are grown widely in rotation with corn and forage crops. Oats are used as a nurse crop with grasses and legumes that are to be used later for forage purposes. Since oat culture is relatively simple, a good crop may be obtained by either disking or plowing in the fall or spring, followed by sowing seed with a grain drill or with a broadcast seeder. The rate of seeding is about ten pecks to the acre.

Production is usually greater when sown soon after frost has left the ground in the spring-sown area. Various kinds of machines may be used for harvesting, according to local conditions. One method is the use of a binder followed by shocking the bundles and then threshing by means of a separator. In some areas harvesting is done by more primitive means.

In the early 1950s about 93% of the U.S. crop was used for feed. It is fed to all classes of livestock as grain in pure form or in mixtures of feed. The straw is used for animal feed and is excellent for animal bedding. Oats are also used for pasturing in various sections of the world, and the crop is also cut for hay. Oats have long been a favourite source of breakfast food. Rolled oats or oatmeal is used mostly for porridge, although other kinds of breakfast food are manufactured from the grain of the oat plant. It is also used in cookies, breads and puddings.

The oat grain is known to be high in protein and fat content. It is also a very good source of vitamin B_1, and has an appreciable amount of vitamin E. The grain has as much riboflavin as other cereals, but much less niacin than wheat. It is practically devoid of vitamins C and D. Leaves of growing young plants are high in a large number of nutritional elements including the "grass juice factor," which is in commercial usage.

The oat crop enters industrial usage to a small extent. Other than breakfast foods one of the principal industrial products is the liquid aldehyde called furfural. This is made by the destructive distillation of the oat hulls in the presence of acid and steam under regulated conditions. Furfural is used in selective solvents for various purification purposes, in paint remover, lacquer solvents and in adiponitrile, which in turn is used in developing nylon. Limited medical products come from oats.

In most regions of the world, oat culture faces the hazards of rust, smut, *Septoria* and other diseases which may greatly reduce yield and quality. Plant breeders strive to attain resistance to these major diseases and to lodging for the enhancement of quality and yields. In certain areas drought resistance and the survival of fall-sown varieties are much-needed characteristics sought by the plant breeder. Inasmuch as oats are self-pollinated and breed true after pure lining, improvements are easily utilized in production increase. The development of new varieties by means of hybridization followed by purification and testing has commanded considerable attention from oat breeders the world over for many years.

One of the main problems in breeding is the selection of plant progenies in early generations that will resist disease and have high productive capacity. Specialized races of pathogenic fungi complicate the problem of breeding for disease resistance. In the decades between 1930 and 1950 much progress was made in oat breeding in the United States. During those years hybridization and selection were used to develop smut- and rust-resistant varieties. After 1950 plant breeders experimented with several types of irradiation and chemicals with the hope of inducing gene mutations for disease resistance.

Production.—For several years world production averaged about 4,300,000,000 bu. on about 130,000,000 ac. European and Asian production was a bit low immediately after World War II.

For the ten-year period 1942–51, the United States averaged 1,324,614,000 bu., averaging 33.5 bu. per acre. The years of highest production, about 1,500,000,000 bu., were 1945 and 1946, when the predominant varieties were the "Victoria" group, Vicland Tama, etc. Because of susceptibility of the fungus *Helminthosporium victoriae,* these varieties were replaced by the "Bond" group, Clinton, Bonda, etc., which later proved susceptible to leaf rust and race 7 of stem rust. Other principal producing nations, with approximate post-World War II annual averages, were: U.S.S.R., 720,000,000 bu.; Canada, 340,000,000; France, 225,000,000; Federal Republic of Germany, 145,000,000; United Kingdom, 200,000,000. (H. L. Ss.)

OAXACA or OAXACA DE JUÁREZ, capital of the state of Oaxaca de Juárez, Mex. Pop. (1950 est.) 45,000. At an altitude of 5,070 ft., Oaxaca stands in the warm, semitropical temperate Valley of Oaxaca, flanked by lesser fertile valleys and ranges of the Sierra Madre del Sur. The Pan-American highway, continuing south from Mexico City, passes through Oaxaca en route to Tehuantepec and Guatemala. In 1947 the narrow-gauge rail connection to Puebla, 211 mi. N., was broadened to standardize the track. By mid-century a projected highway of 180 mi. to the Pacific port Puerto Angel had been paved to Miahuatlán.

A beautiful colonial city, Oaxaca is notable for its green onyx buildings, especially the 16th-century cathedral, its important Indian market and its handicraft industries. It is built on the site of an Aztec garrison post founded in 1486. (HD. C.)

OAXACA DE JUÁREZ, a southern state of Mexico that includes the greater part of the Isthmus of Tehuantepec on its Pacific side. Pop. (1950) 1,444,929, the majority of whom are Indians divided into more than 15 major tribes. Area, 36,365 sq.mi. The capital, Oaxaca de Juárez (*q.v.*), is near the centre of the state on a high plateau girt by mountains. Northern maritime ranges of Mexico join to form the Sierra Madre del Sur, which runs southeasterly through central Oaxaca with many peaks more than 10,000 ft. high and culminating in Zempoaltepec (11,142 ft.), from which minor spurs extend; the Sierra dies on the Isthmus of Tehuantepec, which is low, hot and arid, as are other Pacific coastal lowlands. The Atlantic lowlands near Veracruz are hot and humid, but most of the state enjoys mild, healthful conditions in its several broad valleys and fertile uplands. The Pan-American highway from Mexico City traverses the state

southeasterly through the Valley of Oaxaca and across the isthmus, while transisthmian rail lines from Puerto Mexico to Salina Cruz (*q.v.*) and trunk lines from Puebla and Veracruz form an incomplete rail net within the state.

Oaxaca is an agricultural and mining area, with a broad range of crops and products, chief among which are maize, wheat, coffee, sugar, tobacco, fibres and tropical fruits. It manufactures items for local consumption: cigarettes, soap and famous Indian blankets or serapes from wool. Its mountains are veined with minerals, including gold, silver, uranium, diamonds, onyx and many minor substances. In colonial times Oaxaca was a fabulous producer of silk and of cochineal for dyestuffs.

In pre-Columbian times the state was inhabited by many Indian groups, chief of whom were the kingdoms of the Zapotecos and Mixtecos, whose remains are found at Mitla and Monte Alban (*see* CENTRAL AMERICA: *Archaeology*) and whose descendants form the majority of the population. Benito Juárez, after whom the state is named, and Porfirio Díaz were born in Oaxaca.

(HD. C.)

OB or **OBI,** river of Asiatic Russia, known to the Ostiaks as the As, Yag, Kolta and Yema; to the Samoyedes as the Kolta or Kuay; and to the Tatars as the Omar or Umar. Its length is roughly 3,200 mi.; the area of its basin is considerably more than 1,000,000 sq.mi. and the navigable waters in its basin total more than 17,000 mi. Its source is in the Altai mountains and its course is through hilly country to the Kirghiz steppe and thence it flows to its delta in the gulf of Ob, an inlet of the Arctic ocean 600 mi. in length. In its middle course, south of its junction with the Irtish, and extending between the two streams, are the Vasuigan swamps, named from the Vasuiga, a left bank tributary of the Ob. They extend for 100,000 sq.mi. and in summer are impassable marshes, with dense thickets of cedars, larches and pines. In spring they are flooded and are then known as the Vasuigan sea. In winter they become ice-bound and may be crossed. When drained the land proves fertile. North of the swamps the river flows through coniferous forest to Berezov, and passes Obdorsk, where there is a Veterinary Institute for the help of the reindeer breeders and to which small sea-going vessels can penetrate.

After receiving its largest tributary, the Irtish, the Ob divides into more than one arm and is of little use for navigation except for barges bringing fish from the delta in the autumn. Above the junction of the Irtish, steamers and barges ply upon the Ob and its tributaries the Irtish, the Tobol, the Tavda and the Tura in summer. In 1915 there were 350 steamers and several hundred barges chiefly carrying corn, flour, salt and timber, in addition to passengers. The east-west river traffic is giving place to railway communication, but the north-south route is still important. The river is frozen from November to May or June; floods, ice and floating timber impede navigation for some time after the thaw.

The fact that in its southern parts the Ob approaches so close to the Yenisei that short and easy portages link them, made the penetration of Siberia by the Cossacks an easy task. The Chulim, a tributary of the Ob, in its upper course is at one point only 6 mi. from the Yenisei, but a canal link is impossible owing to the great difference in level, while the Ket river, another right bank tributary of the Ob has canal communication with the Kas, a tributary of the Yenisei.

The Irtish, which is quite as important as the Ob, rises as the Black Irtish, south of the Mongolian border, and flows through the Dzungarian gate into Russia, where it expands into Lake Zaisan, and then cuts its way across a spur of the Altai into the plains. There are lakes, many of which are salt and are rapidly drying; flourishing villages stand on the site of what in the early part of last century was Lake Chany.

OBADIAH, the fourth of the "minor prophets," the otherwise unknown author of the shortest book in the Old Testament, whose 21 verses, even, show evidence of the expansion or addition of which a manuscript, as distinct from a printed book, so easily admits. Whilst the first fourteen verses address Edom in the second person singular, with apparent reference to recent disasters that have befallen that people, the last six address Israel in the second person plural, promising judgment on the nations, including Edom, and proclaiming the eschatological "Day of Yahweh," when the lost territories shall be recovered. (The "join" is made in verse 15, of which *a* belongs to the latter, and *b* to the former, prophecy.) The Edomites (identified with "Esau," verse 6; *cf.* Gen. xxxvi. 1) occupied the mountainous country south of the Dead Sea, on both sides of the Arabah; hence the reference to their rock-dwellings (verse 3). The aid which they gave to the Babylonians against Jerusalem in 586 (Ps. cxxxvii. 7, etc.) was never forgiven, and its remembrance inspires the present prophecy (verses 11ff.). The actual disaster that befell the Edomites was probably some invasion by the neighbouring nomads, *e.g.*, the Nabatean Arabs (verse 7). The opening paragraph of Malachi may refer to the same event; if so, we may suppose the prophecy of Obadiah in its earlier part to belong to the first half of the fifth century B.C. The dominant thought of it is that at last Edom has received its deserts at the hand of Yahweh. We do not know at what date this earlier portion was continued and incorporated into the more general prophecy concerning the future vindication of Judah, with which the book now closes. The original prophecy has elsewhere been reproduced, as well as expanded. Its first five verses occur in almost the same form in Jer. xlix. 14–16 & 9 (*cf.* also Joel ii. 32), a passage probably later than Obadiah. *See* EDOM.

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OBAN, small burgh and seaport, Argyllshire, Scotland, 113 mi. N.W. of Glasgow by L.M.S., and about the same distance by water. Pop. (est. 1938) 5,794. Its bay is screened by the island of Kerrera and sheltered by hills to the north and east. The Roman Catholic pro-cathedral was erected by the 3rd marquis of Bute. Oban, a government fishing station in 1786, is now the centre of tourist traffic for western Argyllshire and the islands.

At the north end of the bay stands the ruin of Dunolly Castle, the old stronghold of the Macdougalls of Lorne, whose modern mansion adjoins it. In the grounds is a huge conglomerate rock called the Dog Stone (*Clach-a-choin*), from the legend that Fingal used to fasten his favourite dog Bran to it. About 3 m. N.E. are the ruins of Dunstaffnage Castle. It was here that the "Stone of Destiny," now contained in the base of the coronation chair at Westminster Abbey, was kept before its removal to Scone.

OBBLIGATO or **OBLIGATO,** in the modern sense, a musical term for an instrumental accompaniment to a musical composition which, while in one way independent, is included by the composer on purpose and in a prescribed form, instead of being left to the discretion (*ad libitum*) of a performer.

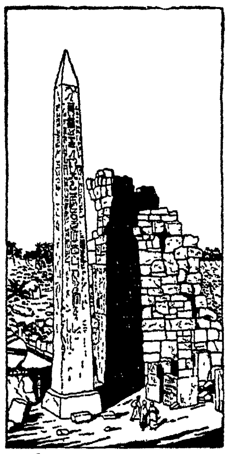
OBEDIENT-PLANT (*Physostegia virginiana*), a North American herb of the mint family (*Labiatae*), called also false dragon-head and lion's-heart, native to moist soil from Quebec to Ontario and Minnesota, and south to Florida and Texas. It is an erect, usually unbranched perennial, 1 to 4 ft. high, bearing oblong or lance-shaped, sharply-toothed, pointed leaves and dense terminal clusters (spikes) of pale-purple, rose-coloured or sometimes white flowers, about 1 in. long. The flower displays the peculiar characteristic of remaining temporarily at whatever angle it may be placed with reference to the stem.

OBELISK, a form of monumental pillar; and also the term for a bibliographical reference-mark in the form of a dagger. The typical Egyptian obelisk is an upright monolith of nearly square section, generally ten diameters in height, the sides slightly convex, tapering upwards very gradually and evenly, and terminated by a pyramidion whose faces are inclined at an angle of 60°. Obelisks were usually raised on pedestals of cubical form resting on one or two steps, and were set up in pairs in front of the entrance of temples. Small obelisks have been found in tombs of the Old Kingdom. The earliest temple obelisk still in position is that of

Senwosri I. of the XIIth Dynasty at Heliopolis (68 ft. high). A pair of Rameses II. (77 and 75 ft. high respectively) stood at Luxor until one was taken to Paris in 1831. Single ones of Tethmosis I. and Hatshepsut still stand at Karnak and remains of others exist there and elsewhere in Egypt. Colossal obelisks were erected by only a few kings, Senwosri I. in the Middle Kingdom and Tethmosis I., Hatshepsut, Tethmosis III. and Rameses II. of the Empire. Smaller obelisks were made in the Saïte period. The Romans admired them, and the emperors carried off some from their original sites and made others in imitation (*e.g.*, that for Antinous at Benevento); 12 are at Rome, one in Constantinople; two, originally set up by Tethmosis III. at Heliopolis, were taken by Augustus to adorn the Caesareum at Alexandria: one of these, "Cleopatra's Needle," was removed in 1877 to London, the other in 1879 to New York. The pyramidions were sheathed in bright metal, reflecting the sun's rays as if they were thrones of the sunlight. They were dedicated to solar deities, and were especially numerous at Heliopolis, where there was probably one of immemorial antiquity sacred to the sun. The principal part of the sun-temple at Abusir built by Neuserrē of the Vth Dynasty appears to have been in the shape of a stumpy obelisk on a vast scale; only the base now remains, but hieroglyphic pictures indicate this form. The hieroglyph of some other early sun-temples shows a disc on the pyramidion . The material employed for the great obelisks was a pink granite from Syene, and in these quarries there still remains, partially detached, an example 70 to 80 ft. long. The largest obelisk known is that in the piazza of St. John Lateran at Rome, set up by Tethmosis III. at Heliopolis in the 15th century B.C. and brought from Egypt by Constantine the Great and erected in the Circus Maximus, being ultimately re-erected in 1552 by Pope Sixtus V. It was 105 ft. 9 in. high, including the pyramidion, and its sides measured 9 ft. 10 in. and 9 ft. 8 in. respectively. On the base of the obelisk of Hatshepsut at Karnak, 97 ft. 6 in. high, there is an inscription stating that it and its fellow were made within the short space of seven months.

There was another form of obelisk, also tapering, but more squat than the usual type, with two of the sides narrow and terminating in a rounded top. One such of Senwosri I., covered with sculpture and inscriptions, lies at Ebgīg in the Fayum.

In Abyssinia, at Axum and elsewhere, there is a marvellous series of obelisk-like monuments, probably sepulchral. They range from rude menhirs a few feet high to elaborately sculptured monoliths of 100 feet. The loftiest of those still standing at Axum is about 60 ft. high, 8 ft. 7 in. wide, and about 18 in. thick, and is terminated by a rounded apex united by a necking to the shaft. The back of the obelisk is plain, but the front and sides are subdivided into storeys by a series of bands and plates, each storey having panels sunk into it which seem to represent windows with mullions and transom. These architectural decorations are derived from a style of building as found by a German expedition extant in an ancient church; courses of stone here alternate in the walls (both inside and out) with beams of wood held by circular clamps. In front of the best-preserved obelisk is a raised altar with holes sunk in it apparently to receive the blood of the sacrifice to the ancestors. Most of these must date before the adoption of Christianity as the State religion in the 6th century.

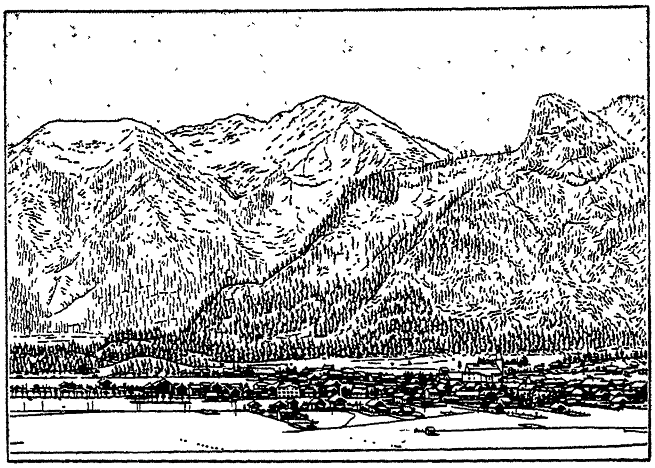

OBELISK (KARNAK)

See G. Maspero, *L'Archéologie égyptienne* (new ed., 1907); H. H. Gorringe, *Egyptian Obelisks* (New York, 1882; London, 1885, etc.); F. W. von Bissing and L. Borchardt, *Das Re-Heiligtum des Königs Ne-woser-Re* (1905); on the ancient method of raising obelisks, L. Borchardt, "Zur Baugeschichte des Amonstempel von Karnak," in Sethe's *Untersuchungen zur Geschichte und Altertumskunde Aegyptens*, vol. xv. For the Abyssinian obelisks *see* especially E. Littmann and D. Krencker, *Vorbericht der deutschen Aksum Expedition* (1906). (F. Ll. G.)

OBERAMMERGAU, a village of Bavaria, Germany, situated among the foot-hills of Kofel mountains, a range of the Alps, in the Ammer valley, 64 m. S.S.W. of Munich. Pop. about 1,700. The outside walls of many of the houses are decorated with fresco paintings, reproductions of famous biblical masterpieces. The villagers make toys and pottery, and carve wooden crucifixes, rosaries and images of saints. These carvings are shipped to all parts of the world and are found in many churches.

THE OBERAMMERGAU PASSION PLAY

The village is famous for its performance of a Passion play every ten years. This is probably the most important survival of the miracle plays so popular from the 13th to the 16th century. Contrary to popular belief, this production is not a portrayal of the life of Christ, but only of the events of his last few days on earth, known as Passion week.


A VIEW OF THE VILLAGE OF OBERAMMERGAU, SITUATED IN THE MOUNTAINS OF BAVARIA

In 1633 the village was stricken with the scourge of the Black Death. As an expression of gratitude for the cessation of the scourge the inhabitants vowed to enact the Passion and death of Christ every ten years. The first performance was given in 1634 and repeated every ten years until 1674, after which the dates were changed so as to fall on decimal years. This now has been faithfully kept with the exception of 1870, when the Franco-Prussian War interfered. The earliest extant text of the play was written in 1662, probably by the monks of Ettal, a monastery situated a few miles from Oberammergau. The text is slightly revised every ten years. The music was composed by Rochus Dedler, a schoolmaster of the parish, in 1814. The initial performance of the play is given the first Sunday in May, and is repeated every Sunday, with two or three extra performances each week. On account of the unsettled conditions resulting from the World War the 1920 production was postponed until 1922, during which year it was played 61 times. It starts at eight o'clock in the morning and continues for eight hours, with a short intermission at noon. The characters are chosen by a committee made up of the village priest, burgomaster, village council and members selected by popular vote. No one may participate in the spectacle unless he is a native of the village and is of unimpeachable moral character and dramatically qualified to enact the rôle for which he is chosen. Over 700 characters participate in the play. This includes the orchestra of 50 members and the chorus of 46. It is estimated that more than 300,000 witness the production each season. The proceeds are divided into four equal parts: one for the preparation of the play, one for the furnishing of homes for the visitors, one for the church and one for the players.

The play is enacted on a large open-air platform, the audience occupying an auditorium with a capacity of about 6,000, viewing the play through an immense oval opening in front of the auditorium. The play consists of 18 acts and a number of tableaux. Each act is prefaced by an orchestral selection and a choral anthem giving the motif of the act. This, in turn, is followed by

a tableau based on the Old Testament prefiguring the theme of the act. For instance, the scene depicting the Crucifixion is preceded by a tableau representing the offering of Isaac as a sacrifice by Abraham. The chief characters are the Christus, the Twelve Disciples, Mary the mother of Jesus, Mary Magdalene and Martha. Anton Lang (1875–1938) held the distinction of portraying the part of the Christus for three decades, 1900, 1910 and 1922. The participants regard their rôles with religious devotion and enact their parts with the deepest reverence. In the years between the representations of the play, performances are given of many classics for the purpose of training the prospective players for the Passion play, in enunciation, stage bearing and all other requirements of dramatizing. No wigs or facial make-up are permitted. The costumes, however, are of the biblical period and are of the very best material. The participants train their hair and beards and study to assume the general appearance of the characters for which they are candidates.

OBERHAUSEN, a town in the Prussian Rhine province, Germany, 5 mi. east of the Rhine, 20 mi. N.E. of Düsseldorf, on the main railway line to Hanover and Berlin, and at the centre of an important network of lines radiating hence into the Westphalian coal and iron fields. Pop. (1939) 191,305. The first houses of Oberhausen were built in 1845, and it received its municipal character in 1874. The town has large iron-works, coal-mines, rolling-mills, zinc smelting-works, dye-works, railway workshops and manufactures of wire-rope, glass, chemicals, sugar, porcelain and soap. It was bombed in World War II.

OBERLIN, a city of Lorain county, Ohio, U.S., 34 mi. W.S.W. of Cleveland, on federal highway 20 (by-pass) and served by the New York Central lines and bus. Population in 1950 was 6,457. It is a pleasant residential city, the seat of Oberlin college. In 1926 it adopted a manager form of government. Oberlin college was founded in 1833 by the Rev. John J. Shipherd (1802–44) and Philo P. Stewart (1798–1868), and was named after John Frederick Oberlin (d. 1826), the Alsatian pastor and philanthropist. Its educational plant at mid-20th century was valued at about $9,800,000; its endowment funds aggregated $24,000,000; the library had about 500,000 bound volumes; and the student body numbered more than 2,000. Oberlin college includes the college of arts and sciences, the graduate school of theology and the conservatory of music.

The "Oberlin theology" (not now identified with the college) centred in the teachings of Pres. Charles Finney, a powerful preacher and teacher, who carried on remarkable revival services in eastern cities of America and in England and Scotland. The modern theological position of the college was reflected in the writings of Pres. Henry C. King (1858–1934) and of Dean Edward I. Bosworth of the theological seminary (1861–1927). Oberlin was the first American college to adopt coeducation, and in Aug. 1841 three women were regularly graduated from the classical course—the first women in America to receive the degree of bachelor of arts on conditions like those prevailing in the best men's colleges of the time. Oberlin was also a pioneer (1835) in refusing to debar students on account of race. A substantial proportion of the students earn part of their expenses.

Oberlin was a "station" on the underground railroad. The attic of President Finney's home frequently sheltered slaves who were escaping to Canada. In 1858 a runaway slave, John Price, was captured in Oberlin by a U.S. marshal, and was rescued at Wellington (9 mi. S.) by a band of Oberlin professors and others, in consequence of which 30 professors were arrested and imprisoned. This was a famous fugitive slave case. The village was founded as a home for the college, and was incorporated in 1846.

OBERON, king of the elves. In the legendary history of the Merovingian dynasty he is a magician, brother of Merowech (Mérovée). In the *Nibelungenlied* he guarded the treasure of the Nibelungen. In the German mediaeval poem of *Ortnit,* the hero is aided in his wooing by his father Alberich, the king of the dwarfs. As Oberon, king of the fairies, he fills a similar rôle in *Huon of Bordeaux* (*q.v.*). Shakespeare used the fairy element in *A Midsummer Night's Dream,* and Wieland in his epic *Oberon* (1780). Ben Jonson wrote a masque of *Oberon, or the Fairy Prince* (*Works,* 1616). Weber's opera, *Oberon,* to the words of J. R. Planché, was first produced at Covent Garden in 1826.

See also C. Voretzsch, *Epische Studien. Die Kompositionen des Huon von Bordeaux* (Halle, 1900).

OBITER DICTUM, that which is said by the way; specifically, in law, an opinion expressed by a judge incidentally in the course of a case, on a point of law not material to the issue or to the grounds of the decision; such *obiter dicta* have no binding authority.

OBJECT and **SUBJECT,** in philosophy, the terms used to denote respectively the external world and consciousness. The term "object" is used generally in philosophy for that in which an activity of the mind ends, or towards which it is directed. With these may be compared the ordinary uses of the term for "thing" simply, or for that after which one strives, or at which one aims. "Subject," is originally the material or content of a discussion or thought, but in philosophy is used for the thought or the thinking person. The relation between the thinking subject and the object thought is analogous to the grammatical antithesis of the same terms: the "subject" of a verb is the person or thing from which the action proceeds, while the "object," direct or indirect, is the person or thing affected. The true relation between mind or thought (subject) and matter or extension (object) is the chief problem of philosophy, and may be investigated from various standpoints (*see* PSYCHOLOGY and METAPHYSICS).

OBJECTIVISM, in philosophy, a term used, in contradistinction to SUBJECTIVISM, for any theory of knowledge which to a greater or less extent attributes reality (as the source and necessary pre-requisite of knowledge) to the external world. The distinction is based upon the philosophical antithesis of the terms Object and Subject, and their respective adjectival forms "objective" and "subjective." In common use these terms are opposed as synonymous respectively with "real" and "imaginary," "practical" and "theoretical," "physical" and "psychic." A man "sees" an apparition; was there any physical manifestation, or was it merely a creation of his mind? If the latter the phenomenon is described as purely subjective. Subjectivism in its extreme form denies that mind can know more than its own states. Objects, *i.e.,* things-in-themselves, may or may not exist: the mind knows only its own sensations, perceptions, ideal constructions and so forth. In a modified form "subjectivism" is the philosophic theory which attaches special importance to the part played by the mind in the accumulation of experience. *See* PSYCHOLOGY and related articles.

OBLATE, an ecclesiastical term for persons not professed monks, friars or nuns, who have devoted themselves or have been devoted as children by their parents to a religious life. "Oblate" is more familiar in the Roman Church as the name of a religious congregation of secular priests, the Oblate Fathers of St. Charles. This congregation was founded in 1578 under the name of Oblates of the Blessed Virgin and St. Ambrose by St. Charles Borromeo, archbishop of Milan (*see* BORROMEO, CARLO). There is a similar congregation of secular priests, the Oblates of Mary the Immaculate, founded at Marseilles in 1815. *See* the *Catholic Encyclopaedia, s.v.* "Oblate."

OBLATION, an offering, a term, particularly in ecclesiastical usage, for a solemn offering or presentation to God. It is thus applied to certain parts of the Eucharistic service in the Roman Church. There are "two oblations," the "lesser oblation," in which the bread and wine yet unconsecrated are presented after the offertory, and the "greater oblation;" the "oblation" proper, forming the latter part of the prayer of consecration, when the "Body and Blood" are ceremonially presented. *See* the *Catholic Encyclopaedia, s.v.* "Oblation."

OBLIGATION, in law, a term derived from the Roman law, in which *obligatio* signified a tie of law (*vinculum iuris*), whereby one person is bound to perform or forbear some act for another. The *obligatio* of Roman law arose either from voluntary acts or from circumstances to which legal consequences were annexed. In the former case it was said to arise from contract, in the latter

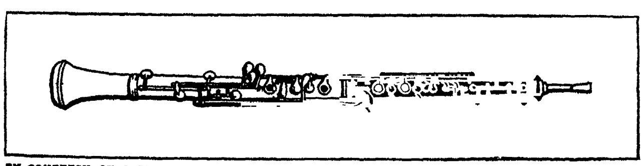
from tort, or from acts or omissions to which the law practically attached the same results as it did to contract or tort. *Obligatio* was used to denote either end of the legal chain that bound the parties, the right of the party who could compel fulfilment of the *obligatio*, the *creditor*, or the duty of the party who could be compelled to fulfilment, the *debitor*. In English law obligation has only the latter sense. Creditor and debtor have also lost their Roman law signification; they have been narrowed to mean the parties where the obligation is the payment of a sum of money. But in legal systems, chiefly founded on Roman law, the original meanings remain. In English law obligation is used in at least four senses—(1) any duty imposed by law; (2) the special duty created by a *vinculum juris*; (3) not the duty, but the evidence of the duty—that is to say, an instrument under seal, otherwise called a bond; (4) the operative part of a bond. The third and fourth uses of the word are chiefly confined to the older writers. The party bound is still called the obligor, the party in whose favour the bond is made the obligee. The word "bond" is, of course, a mere translation of *obligatio*. Obligations may be either perfect or imperfect. A perfect obligation is one which is directly enforceable by legal proceedings; an imperfect or moral obligation (the *naturalis obligatio* of Roman Law) is one in which the *vinculum juris* is in some respects incomplete, so that it cannot be directly enforced, though it is not entirely destitute of legal effect.

American law is in general agreement with English. The term obligation is important in the U.S.A. from its use in art. i. s. 10 of the constitution, "No state . . . shall pass any . . . law . . . impairing the obligation of contracts." This does not affect the power of Congress to pass such a law.

OBOE or **HAUTBOY.** The treble member of the class of wood-wind instruments having a conical bore and a double reed mouthpiece, the oboe consists of a conical wooden tube, composed of three joints, upper, middle and bell, and of a short metal tube to which are bound by many turns of waxed silk the two thin pieces of cane that form the mouthpiece. These pieces of cane are so bevelled and thinned at the end which is taken into the mouth that the gentlest stream of compressed air suffices to set them vibrating and thereby to set up the rhythmical series of pulses which generate the sound waves in the stationary column of air within the main tube of the instrument.

The compass of the oboe is from B flat below the treble stave to F in alt, or even a note or two higher, with all chromatic semitones. Its quality of tone is thin, penetrating and even somewhat nasal. It is possible to play on it diatonic and chromatic scale and arpeggio passages, legato and staccato; leaps; cantabile passages; sustained notes, crescendo and diminuendo, grace notes and shakes (with reservations).

The first appearance of the instrument in a musical work occurs in Sebastian Virdung's *Musica getutscht und aussgezogen* (1511). It there bears the name of *Schalmey*, and is already associated with an instrument of similar construction called *Bombardt*. There exists, however, much earlier evidence, in the illuminated mss. and in the romances of the Middle Ages, of the great popularity of the instrument in all parts of Europe. The oboe was known during the early Middle Ages as *Calamus, Chalumeau* (France), *Schalmei* (Germany) and *Shawm* (England), while after the Renaissance we find instruments of this type ranged in complete families from the soprano to the bass and known respectively as the little Schalmey; the discant Schalmey; the alto Pommer; the tenor Pommer; the bass Pommer; and the great double quint Pommer.



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THE OBOE IN ITS MODERN FORM

The 17th century brought no great changes in the construction of the four smaller instruments of the family. Extensively used in France, they were there called "haulx bois" or "hault-bois," to distinguish them from the two larger instruments which were designated by the words "gros bois." Haultbois became hautbois in French, and oboe in English, German and Italian; and this word is now used to distinguish the smallest instrument of the family still in use.

The reform in the construction of the flute due to Theobald Boehm of Munich about 1840, a reform which principally consisted in the rational division of the tube by the position of the lateral holes, prompted Triebert to try to adapt the innovation to the oboes and bassoons; but he failed, because the application of the system denaturalized the timbre of the instruments, which it was necessary, before all things, to preserve. Further improvements, however, made upon the same lines by Barret and later by Rudall Carte, have transformed the oboe into the most delicate and perfect of reed instruments, as which it constitutes one of the most valuable and indispensable members of the modern orchestra.

OBOK, a seaport on the north shore of the Gulf of Tajura, N.E. Africa, acquired by France in 1862. It gave its name to the colony of Obok (now French Somali coast protectorate). (*See* SOMALILAND: *French.*) The port is separated from the open sea by coral reefs, but is only partially sheltered from the winds. The French in 1896 transferred to Jibuti, on the opposite shore of the Gulf, the seat of government of the colony. Obok is connected with Aden and Jibuti by submarine cables. It is only a native village with a population of about 300.

OBRECHT, JACOB (also HOLBRECHT) (*c.* 1430–*c.* 1500), Dutch composer, was born probably at Utrecht about 1430. About 1474 Erasmus was under him as a choir boy at Utrecht, where he was chapel master, and in the same year Obrecht seems to have held an appointment at Ferrara. He was afterwards director of the Cambrai school of singing, and at some time lived in Florence, where his name is associated with Josquin, Isaac and Africola, and the musicians who clustered round Lorenzo's court. The principal records of his later years are found in Antwerp Cathedral, where he was chapel master from 1491 until his death. That he possessed immense contrapuntal skill and was considered one of the greatest masters of the age there is evidence in the praise of his contemporaries and successors, the honours bestowed upon him, and the visits received by him at Antwerp. The finest of his eight masses, *Fortuna Desperata*, was published in Amsterdam (1870) and appears in 1880 in the *Maatschappij tot Bevordering der Toonkunst* (*No. ix.*). He also wrote chansons and motets. The finest of the motets is *Salve crux arbor vitae*. Great interest attaches to his *Passion*, in which the chorus impersonates all the characters in the story and the narrative is given to the tenor in recitative.

A definitive edition of his works has been published by Johannes Wolf (*Werke van Jacob Obrecht*, Amsterdam and Leipzig).

OBREGÓN, ALVARO (1880–1928), Mexican soldier and president, was born in the district of Alamos, Sonora, on Feb. 17, 1880. During his early life as a planter he became an advocate of land reforms to better the condition of the peons and Indians, and in 1912 he entered the services of Madero, a man of similar ideals. With Indian troops which he recruited, Obregon aided in suppressing the revolt of Orozco against Madero, and later he again took the field against Felix Diaz whose successful revolt led to the downfall of Madero and the establishment of Huerta as provisional president. Obregon then joined the counter-revolution of Carranza who had remained true to Madero. After a string of victories culminating in the successful storming of Sinaloa and Culiacan and the capture of Guadalajara, the way to Mexico City was opened, and on Aug. 15, 1914, Obregon led the Carranza troops into the capital. Huerta fled.

In the struggle which arose between Carranza and Zapata and Villa, Obregon remained loyal to Carranza. He defeated Zapata finally at Pueblo in Jan. 1915. In April he conducted a campaign against Villa for the control of central Mexico and by winning the battles of Celaya and Leon forced Villa back to his mountain fastnesses. As leader of the radical wing of Carranza's followers and chief of the army, Obregon possessed power enough to force into the new Constitution of 1917, against Carranza's wishes, the

famous article 27 which provided for the restoration of communal lands to the Indian villages, limited the size of individual land holdings, deprived religious organizations of the right to hold lands and reserved to the government the ownership of all mineral and petroleum resources. The new constitution also provided that no president should succeed himself, but in 1920 Carranza took steps to have himself retained in power, one of these steps being an order for the arrest of Obregon. Obregon escaped to Sonora where a revolt against Carranza was already in progress and put himself at the head of the troops. In a short time he was master of the situation and on Dec. 1, 1920, was elected president. He immediately adopted a friendly tone toward the United States and other foreign countries, and in 1923 the United States recognized his government. His administration was made notable by many labour and agrarian reforms and by a sincere effort to carry the provisions of the 1917 constitution into force. In 1924 he supported Calles, his minister of the interior, for president. His opponents under Huerta charged fraud in the election and started a revolution. Obregon once more took the field, defeated the rebels and drove Huerta into exile. Obregon was again elected president on July 1, 1928, but on July 17 before taking office he was assassinated.

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OBRENOVIĆ, the name of a dynasty which supplied several rulers of Serbia in the 19th century. *See* MILOŠ OBRENOVIĆ I; MICHAEL OBRENOVIĆ III; MILAN OBRENOVIĆ IV; and ALEXANDER (ALEXANDER OBRENOVICH).

O'BRIEN, WILLIAM (1852–1928), Irish patriot, was born at Mallow, Co. Cork, on Oct. 2, 1852, son of James O'Brien, a solicitor's clerk. He was educated at the Cloyne diocesan college and at Queen's college, Cork, and began journalism in 1869. In 1881 he became editor of *United Ireland*, which he conducted with such vigour (Aug.–Oct.) that it was suppressed for the time being, and O'Brien was shut up in Kilmainham jail with Charles Parnell and others. There he drew up the famous "No Rent" manifesto, which led to the Land league's being outlawed.

Released in 1882, O'Brien resumed his campaign in *United Ireland*. He was elected M.P. for Mallow in 1883. In 1886, O'Brien started the slogan of "no reduction, no rent." Parnell was much out of Ireland and eventually disavowed the "plan," but O'Brien had stirred up a fierce agitation, met by the British government with the Coercion act of 1887, under which O'Brien was sent to Tullamore jail. On his release he appeared in the house of commons to renew his obstructive tactics there.

After the O'Shea divorce case in which Parnell was involved he tried to mediate between the Parnellites and the anti-Parnellites, siding with the majority who rejected Parnell's claim to retain leadership. In 1900, after years of bitter strife, both sections were reunited under the Parnellite John Redmond, largely as a result of O'Brien's formation of the United Irish league. Having given active support to the Land conference, which secured agreement between the landlords and tenants' representatives and resulted in the Wyndham Land act of 1903, O'Brien became convinced that nationalists and unionists could unite for common purposes. He founded the All for Ireland league, which obtained a large following in County Cork, in opposition to Redmond's control of the United Irish league. But O'Brien's personal following did not survive the rise of the Sinn Fein agitation, and after World War I (Irish participation in which he had supported) he withdrew from public life. He died on Feb. 25, 1928.

O'BRIEN, WILLIAM SMITH (1803–1864), leader of Young Ireland, was born in Co. Clare on Oct. 17, 1803, and educated at Harrow and at Cambridge. He used his second name of Smith on inheriting his maternal grandfather's estates in Limerick. He entered parliament in 1828 as member for Ennis and from 1835 to 1848 represented the county of Limerick. Although he actively supported Catholic emancipation he opposed Daniel O'Connell's election for County Clare in 1828 and continued to oppose repeal of the legislative union until O'Connell's imprisonment at the end of 1843. O'Brien then joined the Repeal association and was at once appointed deputy leader while O'Connell was in prison. He became closely associated with Thomas Davis and Gavan Duffy and the brilliant group who later became the Young Ireland party; and in 1846 he led them in withdrawing from the Repeal association, when O'Connell demanded repudiation of any conceivable resort to arms. Early in 1847 they formed the Irish confederation, to press for a more active policy during the years of famine. In May 1848, after a mission to Paris to congratulate the new French republic, O'Brien was tried for sedition, but acquitted. He exercised a restraining influence while the young men urged preparations for an armed rising, but the government issued warrants to arrest all the most active leaders. O'Brien then assembled all the leaders to make a last stand in County Tipperary and appealed for a general rising. It collapsed in a short collision with the police and military at Ballingarry. O'Brien was arrested at Thurles, tried for high treason and sentenced to be hanged, drawn and quartered. The sentence was, however, commuted to exile to Tasmania for life. O'Brien obtained a full pardon in May 1856 and returned to Ireland. He died at Bangor, North Wales, on June 18, 1864.

OBSCENITY. By English common law it is an indictable misdemeanour to give an obscene exhibition or to publish any obscene matter, whether it be in writing or by pictures, effigy or otherwise. But the test of criminality as accepted in England is whether the exhibition or matter complained of tends to deprave and corrupt those whose minds are open to immoral influences and who are likely to visit the exhibition, or to see the matter published. If the exhibition or publication is calculated to have this effect, the motive of the publisher or exhibitor is immaterial. Even in the case of judicial proceedings, newspapers are not privileged to publish evidence which falls within the definition.

Besides the remedy by indictment there are statutory provisions for punishing as vagabonds persons who expose to public view in public streets or adjacent premises obscene prints, pictures or other indecent exhibitions. These are supplemented by the Indecent Advertisements act of 1889. By the Obscene Publications act of 1857 powers are given for searching premises on which obscene books, etc., are kept for sale, distribution, etc., and for ordering their destruction, and the post-office authorities have power to seize postal packets containing such matter and to prosecute the sender under the Post-Office act.

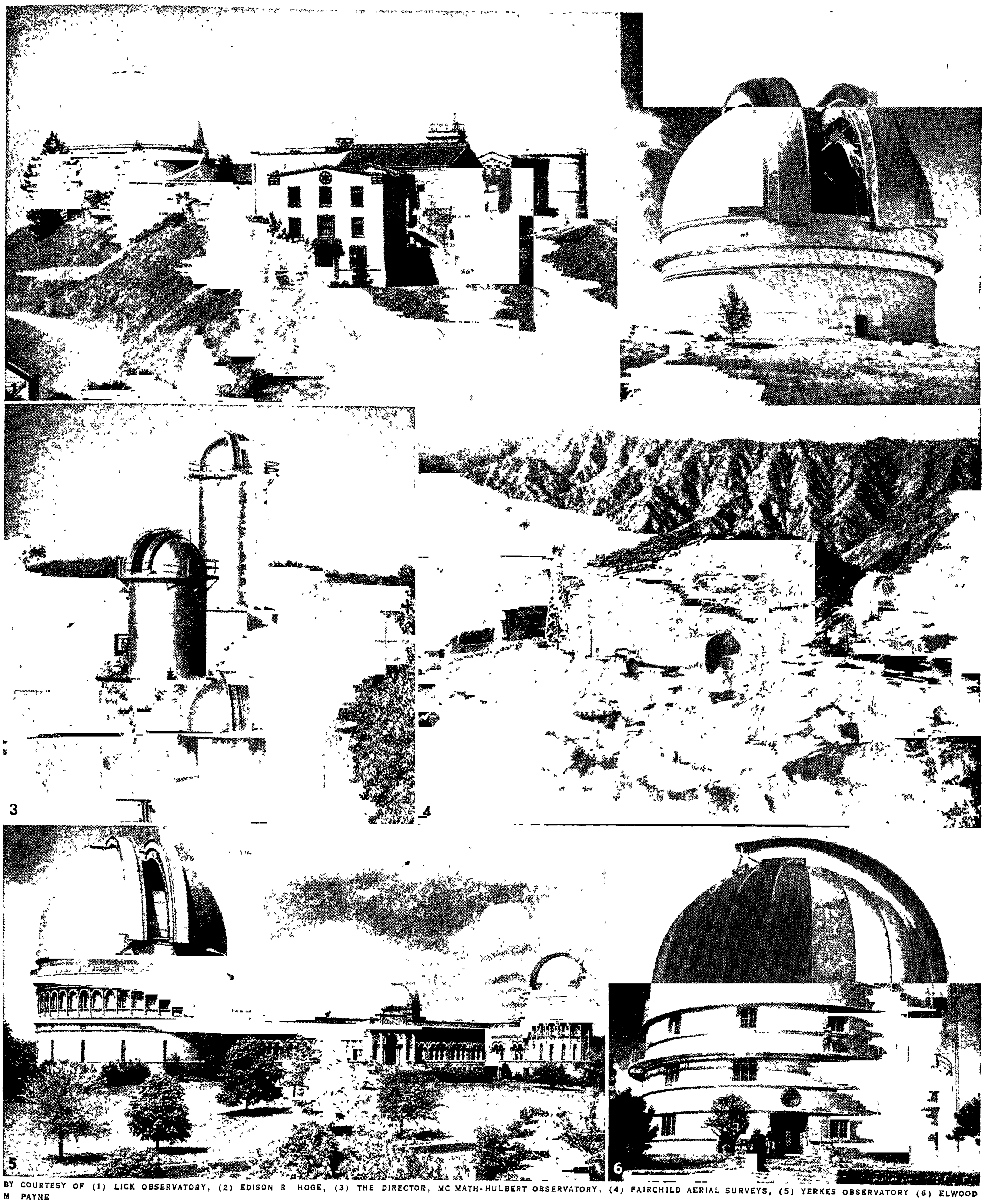
The use of obscene or indecent language in public places is punishable as a misdemeanour at common law, but it is usually dealt with summarily, under the Metropolitan Police act of 1839, or the Town Police Clauses act of 1847, or under local by-laws.

In the United States, the different states provide punishment for obscene libel, the exhibition of obscene pictures and the display or use of obscene language in public. The federal government penalizes sending of obscene matter through the mails.

Under the tariff act of 1930 (U.S. Code § 1305) the U.S. may ban the import of "any obscene book." "Obscene" is legally defined in the courts as "tending to stir the sex impulses or to lead to sexually impure thoughts." In a decision of the U.S. district court (1933) by Judge John M. Woolsey, the ban was lifted on James Joyce's modern classic *Ulysses*. Legal precedent was established in the opinion, which describes an investigation of a work of art on literary as well as juridical grounds, from the point of view of both intent and results.

Indecent acts committed with intent to insult females are punishable under the Vagrancy act of 1824 as amended by sec. 42 of the Criminal Justice act of 1925, and if committed otherwise under the acts of 1839 and 1847. (W. DE B. H.; X.)

OBSERVATORY (ASTRONOMICAL). The erection of special buildings for astronomical research is a practice of long standing. It is said by Diodorus that the great temple of Belus at Babylon was built for astronomical purposes, and, since there is indication in the Chinese records that the gnomon was used for measuring the height of the sun in the reign of the emperor Yao (2300 B.C.) it may be said that the beginning of practical astronomy was contemporaneous in eastern and western Asia. There is no evidence of the existence of an observatory of Greek or Alexandrine origin until the time of Ptolemy Soter, who, about 300 B.C., built one at Alexandria. The earliest records from an observatory known to be extant are those of Hipparchus (*c.* 140 B.C.) who has left a catalogue of stars from observations made at the island of Rhodes, repeating those made earlier at Alexandria.

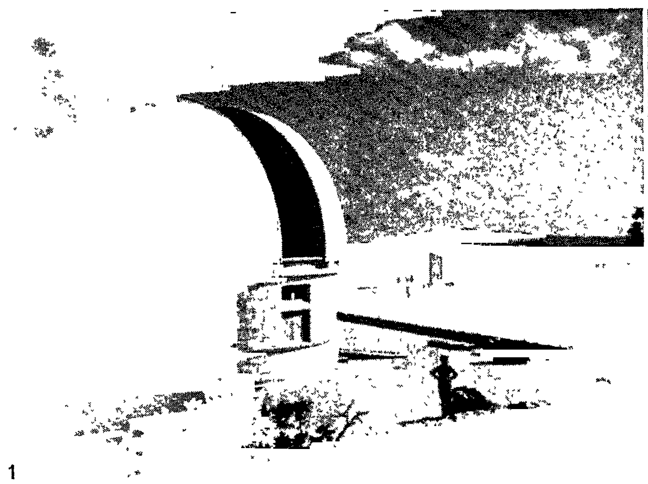


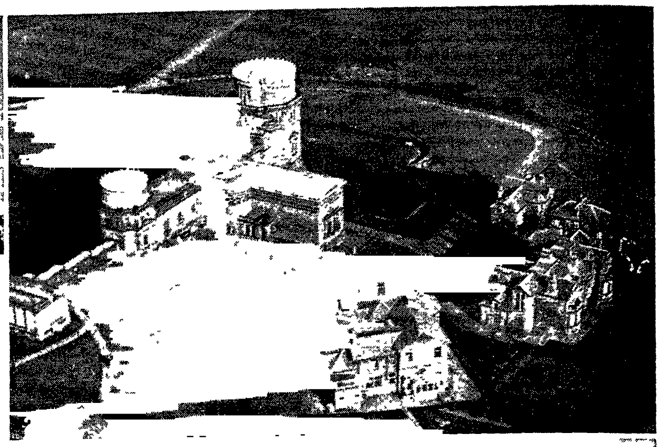
BY COURTESY OF (1) LICK OBSERVATORY, (2) EDISON R HOGE, (3) THE DIRECTOR, MC MATH-HULBERT OBSERVATORY, (4) FAIRCHILD AERIAL SURVEYS, (5) YERKES OBSERVATORY (6) ELWOOD M PAYNE

AMERICAN OBSERVATORIES

1. The Lick observatory on Mt. Hamilton, Calif., completed in 1887–88. The domes on main buildings covering the 36-in. and 12-in. refractors are shown
2. Mt. Palomar observatory in California. Installation of the observatory's 200-in. reflecting telescope was postponed for the duration of World War II
3. The McMath-Hulbert observatory of the University of Michigan. Located near Pontiac, Michigan, and devoted to solar work. The smallest dome houses a 24-in. reflecting telescope. The middle tower contains a coelostat and the tower-type solar telescope with a 30-ft. spectrograph. The highest tower also houses a coelostat and tower-type solar telescope
4. Mt. Wilson observatory, near Pasadena, Calif., established in 1904–05. Its largest reflecting telescope, completed in 1917, has a mirror 100 in. in diameter
5. Yerkes observatory of the University of Chicago, at Williams Bay, Wisconsin, completed in 1897. View from the southwest
6. The W. J. McDonald observatory. Dome of the 82-in. reflecting telescope at Mount Locke, Texas. Founded in 1939 jointly by the University of Texas and the University of Chicago

OBSERVATORY (ASTRONOMICAL)





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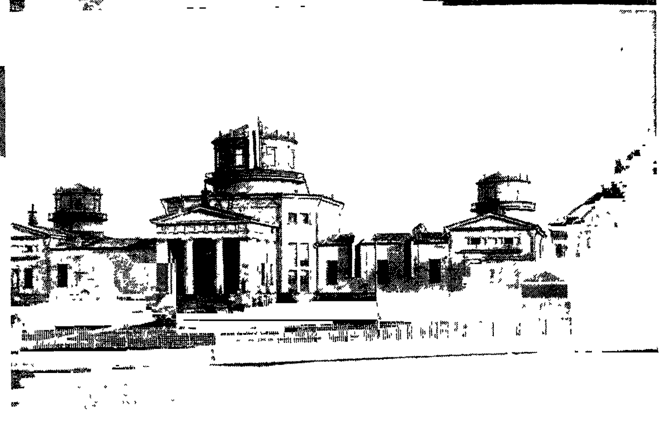

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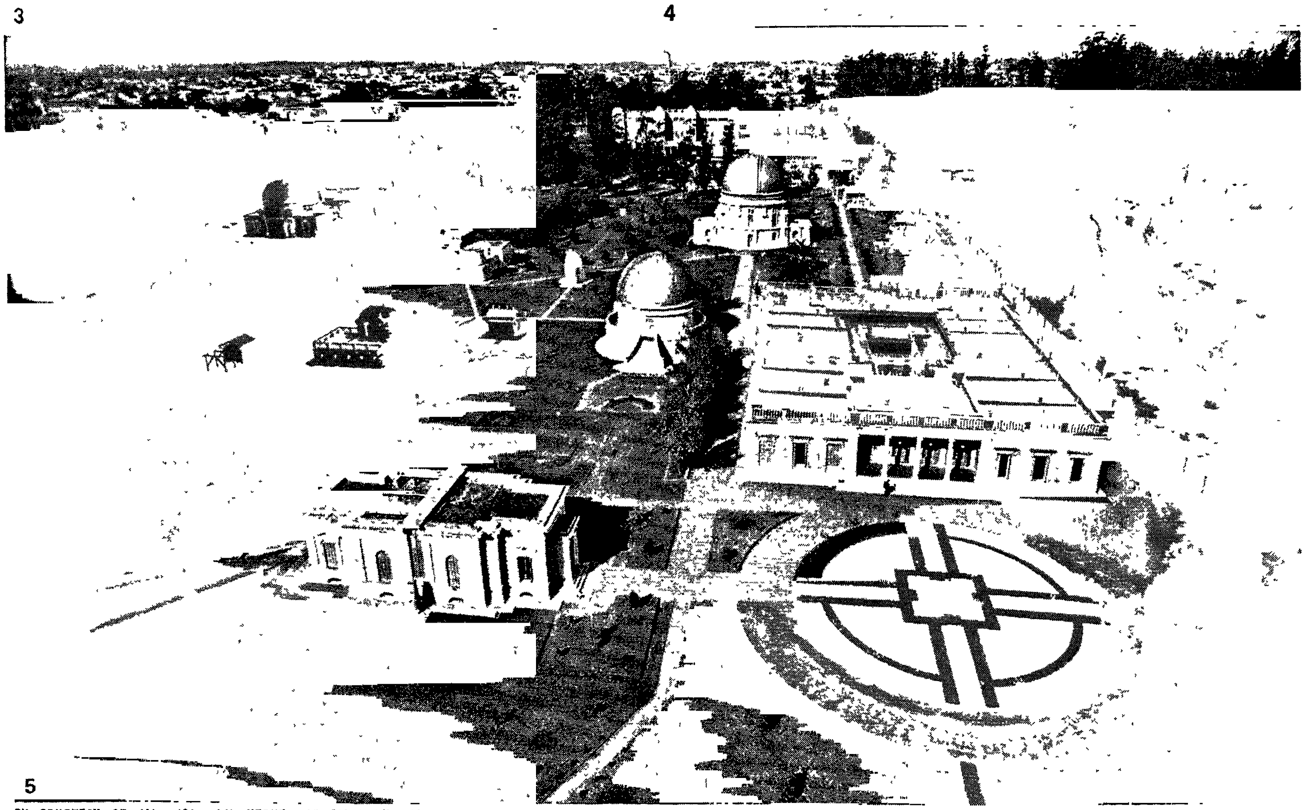

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BY COURTESY OF (1), (3), (4) YERKES OBSERVATORY, (2) THE ASTRONOMER ROYAL FOR SCOTLAND, (5) THE DIRECTOR, LA PLATA OBSERVATORY

OBSERVATORIES OVER THE WORLD

1. Dome of the 48-in. reflecting telescope of the Astrophysical observatory near St. Michel, 60 mi. northeast of Marseille, France
2. Royal observatory, Edinburgh, Scotland. On Blackford hill. Established in 1896 in place of an observatory on Calton hill, Edinburgh
3. Office building of the Astrophysical observatory near St. Michel, France
4. General view of the historic building of the Pulkowa observatory in the U.S.S.R., destroyed during the siege of Leningrad in World War II. The Russian government planned to reconstruct the building on the original plans
5. General view of the La Plata observatory at La Plata, Argentina

Three hundred years later, Ptolemy (A.D. 150) compiled a star catalogue, but it is doubtful whether this was from his own observation and, therefore, whether he had an observatory beyond that at Alexandria.

The art of astronomical observation was revived several hundred years later in western Asia when observatories were established at Damascus and Baghdad and one at Mokatta by Caliph Hakim about A.D. 1000. A splendid observatory was built at Maragha in northwest Persia by Hulagu Khan about A.D. 1260, but the most productive was that of the Persian Prince Ulugha Beigh, grandson of the great Tamerlane, who, at Samarcand with his assistants, made a catalogue of stars from observations with a large quadrant in the first half of the 15th century. Later in that century, about 1471, John Müller of Königsberg, better known as Regiomontanus, set up an observatory at Nuremberg, with the help of Bernard Walther of that city, furnished with instruments of his own design, and after his death in 1476, clocks, then a recent invention, were added to the equipment. The first observatory, however, that may be considered a prototype of modern national observatories was that of Tycho Brahe on the island of Hveen. To the building commenced on Aug. 8, 1576, he gave the appropriate name Uranibourg.

Tycho Brahe's Observatory.—This building was of some magnificence and large enough to house Tycho and several young men who lived with him as students or observers. It was furnished with a large quadrant attached to a wall in the plane of the meridian, for to this astronomer is due the credit of appreciating the advantage of size in instruments of this type, and of the principle which is embodied in the mural circle. Here Tycho Brahe with his assistants, one of whom was Longomontanus, a name well known in the science, observed the heavens and produced a catalogue of the positions of more than 1,000 stars. On the death of his patron, Frederick II in 1588, Tycho was deprived of royal favour and income. In 1597 Tycho left Denmark, the observatory at Hveen having been already dismantled.

The invention of the telescope in 1609 opens a new chapter in the history of observatories, and the building at Padua in which Galileo discovered and made the first observations of Jupiter's satellites on Jan. 8, 1610, may be regarded as the first of a new class. Others were created as additions to universities or similar institutions during the 17th century. In 1637, King Christian IV of Denmark established a permanent observatory at Copenhagen, which was completed 20 years later and then placed under the direction of Longomontanus.

John Hevel, or Hevelius, a member of a noble family of Danzig, built an observatory in 1641 in his own house and furnished it with an azimuthal quadrant of 5-ft. radius and a sextant of 6 ft., with which he measured the meridian altitudes of stars, sun, moon and planets, and their distances from one another in the manner of Tycho—that is, with plain sights, believing this to be superior to the newly adopted telescopic method.

Paris, Greenwich and Others.—Hevelius died early in 1687 and his work was not carried on, but by that date there had come into existence the two national observatories at Paris and Greenwich. The former was built in the years 1667–71, according to the plans of Claude Perrault, as an architectural monument. Under the Cassinis and others, it has done much for astronomy. The Royal observatory, Greenwich, was founded in 1675 for the definite purpose of the improvement of navigation. Architectural pride again entered into the design, for Sir Christopher Wren wrote of it to Bishop Fell of Christ Church, Oxford, as built "a little for pomp" referring to the main building. The essential instruments were housed apart, and at the present time, Wren's beautiful creation is merely a small item in its extensive domain.

Few establishments of the kind were erected during the next half century. Mainly because of the occurrence of the transit of Venus in 1769, George III built and furnished the King's observatory at Kew. The improvement in reflecting telescopes by James Short and the invention of the achromatic object glass in the latter part of the 18th century marked the beginning of many observatories that have since become famous. The Radcliffe observatory at Oxford was erected 1771–74 from funds bequeathed by Dr. Radcliffe, a court physician "for charitable purposes," the words being interpreted somewhat widely. Provost Andrews bequeathed a substantial sum for building and endowing an astronomical observatory for the University of Dublin, which was built at Dunsink in 1783, but not furnished with instruments until many years later. An observatory was established and endowed at Armagh in Ulster in 1793, in charge of Primate Robinson, while the most prolific British observatory of the period was that of William Herschel at Bath, Datchet and Slough, successively.

Early Continental Observatories.—Continental observatories established during this period were those of Mannheim (1775), which was transferred to Karlsruhe in 1880, and again to Heidelberg in 1896; Lilienthal founded by Schroter in 1779, and furnished with a reflector made by Herschel; Leipzig where a small observatory existed on the tower of the university in the years 1787–90; Breslau (1790); also one at Seeberg near Gotha, founded by Duke Ernest II in 1788 that was made famous by Zach and Encke. The observatory at Palermo, Sicily, where Piazzi made his famous catalogue of stars, was founded in 1790; and at about the same time Lalande and his assistants were observing transits of stars from an observatory in l'École Militaire, Paris.

THE NINETEENTH CENTURY

British Observatories.—A full list of observatories, public and private, founded in Great Britain during this next 100 years would be large. An observatory on Calton hill, founded by a private association, the Edinburgh Astronomical institution, in 1818, was taken over by the crown as a royal observatory in 1834, and transferred to its present site on Blackford hill in the years 1889–96. Cambridge university observatory was founded in 1820 and under its noted directors, George Biddell Airy, James Challis, John Couch Adams, Robert Stawell Ball and Arthur Stanley Eddington has done valuable work, and now well equipped with instruments, has a solar and astrophysical observatory. The Radcliffe observatory at Oxford was originally in the charge of the Savilian professor of astronomy but this arrangement lapsed and the offices of professor and Radcliffe observer became distinct about 1839. In 1875 the University observatory came into existence largely through the liberality of Warren de la Rue, for the use of the Savilian professor. The work of this observatory has been largely photographic. An observatory was established at Liverpool mainly for the time service of the port in 1838, and at Glasgow a small observatory attached to the university, of which Dr. Alexander Wilson had been the first director about 1760, was enlarged and transferred to a new site in 1836.

Among private observatories the reflecting telescope with 6-ft. mirror made by Lord Rosse and set up at his seat, Parsonstown, Ireland, in 1845, is famous, and scarcely less so are the smaller instruments of the same type made by William Lassell, and used by him at Liverpool 1844–52.

Observatories established in England in the second half of the 19th century were those of De la Rue, a pioneer in astronomical photography, at Cranford in Middlesex; of George Knott at Cuckfield, Sussex; of William Huggins, the famous spectroscopist, at Tulse hill, the private observatory of Norman Lockyer, who afterwards developed spectroscopic research at a state-supported establishment at South Kensington. Those of Edward Crossley at Halifax, Yorkshire, and Thomas Espin at Towlaw, Durham, have reputations based on double-star observations.

Colonial Observatories.—A feature of the 19th century was the establishment of British Colonial observatories. Acting on the proposal of the Board of Longitude in 1820, the Lords Commissioners of the Admiralty resolved to establish an observatory at the Cape of Good Hope for the improvement of practical astronomy, which came into being in the year 1829, and has adequately fulfilled its purpose as a government observatory under the directorship of Frank Maclear, Edward James Stone, David Gill, George Washington Hough and Harold Spencer Jones of the present day. This observatory has a reversible transit circle of the latest type, and a heliometer and an equatorially-mounted twin telescope with objectives 24 in. and 18 in. in aperture for photo-

graphic and spectroscopic work—gifts of Frank Maclear.

The first observatory on Australian soil was one on Dawes point, the headland on which stands the present Sydney observatory, established in 1786. In 1853 Robert L. Ellery was appointed to superintend an astronomical observatory at Williamstown which was removed to Melbourne in 1861–63. With the observatories of Sydney and Perth, Melbourne has taken a share in the international work of charting the heavens by photography, and in addition meridian observing, magnetism, seismology, meteorology and time service form its activities. The Adelaide observatory was not completed until 1861. The observatory of Western Australia at Perth was established 30 years later. The aim of a small observatory established at Wellington, New Zealand, under Sir James Hector in 1869 for time service was later enlarged and the institution is now called the Dominion observatory.

Continental Observatories.—During this period many observatories were established on the continent of Europe, two of which were made famous by the labours of Wilhelm Struve. The University of Dorpat, Livonia, Russia, possessed in 1809 an observatory of small dimensions, scantily equipped, of which Struve, a student of astronomy in the university, was given charge in the year 1813. His successful work attracted the attention of the Russian government, and soon the observatory was furnished with such instruments and pecuniary means as to raise it to the rank of a first-class establishment, where Struve, almost single-handed, produced results of a very high standard. Attracted by Struve's work the Emperor Nicholas in 1833 resolved to erect a central observatory for the empire of Russia, and, largely to Struve's design, an observatory was completed in 1839, at Pulkowa near St. Petersburg, which was considered to be the finest and best equipped of the time. Another observatory of the first half of the 19th century, though not on the magnificent scale of Pulkowa, but associated with the name of a distinguished astronomer, was that of Königsberg, established by the king of Prussia in 1813 and put in the charge of F. W. Bessel who had already made a reputation at the observatory at Lilienthal. The observatory at Altona near Hamburg, completed in 1823, was made famous because of its association with Heinrich Christian Schumacher, to whose personality is ascribed the encouragement given to astronomy by the Danish government. In 1874, this observatory was transferred to Kiel, which had then become the chief German naval station, and formed the international central bureau for distribution of astronomical information until World War I, when this useful work was transferred to Copenhagen.

The Royal observatory at Berlin had its origin in the year 1705. It was with the 9-in. refractor of this observatory that the planet Neptune was first seen. The establishment of an observatory at the University of Bonn was decided on by the king of Prussia, in 1836, and Friedrich Wilhelm Argelander, who had been director of the Abo observatory, Finland, transferred to Helsingfors in 1837, was chosen as director. Although the instruments of this observatory are not large, the stupendous work of Argelander, carried on by his successors, in star cataloguing, indicates its principal branch of activity. The University of Strasbourg has an observatory attached to it completed by the German government in 1881, consisting of three magnificent buildings placed in a large open garden. Its largest telescope, the great equatorial, a refractor with object glass of 20-in. aperture, is said to have been the largest in Germany at the time of its erection. The University observatory, Vienna, built on a new site in the years 1874–80 to replace one that dated from the middle of the 18th century, is a large structure standing in grounds of 14 acres in extent, with an imposing façade and surmounted by four domes designed on the model of the Berlin observatory. Basle (1874), Bordeaux (1879), Breslau (1790), Budapest (1856), Cracow (1791), Kazan, Leipzig (1790, remodelled in 1861) are other universities of Europe that have observatories attached to them. At Heidelberg (Königstuhl), a private observatory founded by Dr. Max Wolf in 1877, was merged with Grand-Ducal institute, established in 1898, which combined two sections; one an astrometric observatory that had existed successively at Schoetzingen, Mannheim and Karlsruhe since 1762 (*v. supra* Mannheim), and an astrophysical observatory under the direction of Dr. Wolf.

Among the notable observatories in northern Europe established two or more centuries ago but greatly expanded in later years is the Stockholm observatory, founded in 1748, and now equipped with a large double equatorial telescope, a 40-in. reflecting telescope and many modern auxiliary instruments; the observatory of the University of Upsala founded in 1739; the Royal observatory of Lund, first established in 1670; and the University observatory of Copenhagen originally built about 1650 on the summit of the famous "round tower."

Before World War I there were ten French national observatories under the control of a consultative committee that reported annually to the government. The Paris observatory of the 17th century has been mentioned. Some that were resuscitated or created in the ten years after the war of 1870–71, have history behind them. An observatory at Marseilles, founded by the order of Jesuits about the year 1700, was taken over in 1749, after the expulsion of the Order, as the Royal Naval observatory and made famous by Jean Louis Pons, Pons Joseph Bernard, Adolphe Gambart, Jean Valz and Jean Chacornac. A new observatory was built in 1862 with which the older one was incorporated and the names of Jean Stephan, Jérome Coggia and Alphonse Louis Nicolas Borrelly recall many discoveries of minor planets and comets made with its instruments. The observatory at Toulouse had a predecessor as early as 1718, but the existing establishment dates from about 1840 when it was erected and supplied with excellent instruments at the public expense, but with an inadequate staff, so that it was devoted for many years solely to meteors and meteorology.

The observatory at Bordeaux, together with those at Paris, Toulouse and Algiers, has taken a share in the international work of charting the heavens by photography. The Algiers observatory, about half a century old, is an imposing group of buildings set up on a hill at Boudzareah, near Algiers. The two observatories that complete the ten are the solar physical observatory at Meudon near Versailles and the observatory at Nice, bequeathed by the founder to the University of Paris in 1899 and now ranking as a national institution.

American Observatories.—The first American observatory is said to have been erected at Chapel Hill, N.C., in 1831–32. It was destroyed by fire in 1838. Projects for observatories were set on foot at Williams college, Mass., in 1836; at Hudson, O., 1836–37; and for the National observatory at Washington which was actually established by Lieut. J. M. Gilliss of the U.S. navy in 1843–44. The movement was encouraged and in many cases observatories were created by collective financial help. By the efforts of Prof. D. M. Mitchel money was raised for shares in a public company to build an observatory at Cincinnati. The first meeting of stockholders was held on May 23, 1842, and an object glass 11 in. in diameter, which was quite large for that epoch, was procured during the summer. The Litchfield observatory of Hamilton college, New York, was founded by public subscription in 1852. An observatory attached to the University of Missouri in 1853 was afterwards improved by a gift from Dr. S. S. Laws. In 1856, the Dudley observatory, Albany, was established by gifts from citizens of that city, and took its name from the largest donor, Mrs. Blandina Dudley. The Allegheny observatory was founded as an annex to the university in 1860, and was completed in 1867 through the liberality of W. Shand. The Dearborn observatory of the University of Chicago was built in 1864. The Halsted observatory, attached to Princeton university, came into existence in 1866. The Leander McCormick observatory of the University of Virginia (1883), Washburn observatory of the University of Wisconsin (1878), Michigan University observatory, Ann Arbor (1855), and other university observatories are used both for purposes of education and for astronomical research.

The U.S. Naval observatory at Washington is somewhat akin to Greenwich, since it is a nationally-supported institution for the purposes of the navy. Chronometers and compasses are tested, and the staple astronomical work has been the making of star catalogues and astronomical calculations. One of the most famous of these observatories of the 19th century is that of Harvard college, Cambridge, Mass., whose origin is associated with the

personality of William Cranch Bond, a member of a Cornish family that emigrated in 1786 and settled in Portland, Me., where he was born in 1789. Bond had great aptitude for scientific research, especially astronomy, and when, in 1837, it was decided to build an observatory for Harvard college, he, though engaged in a profitable manufacturing business, accepted the invitation to take charge. No salary was attached to the office until the year 1846. The original Harvard observatory (Dana House, 1839) and the new observatory (1843–47) were established by public subscription. Under the direction of Prof. E. C. Pickering, the work of this observatory was mainly photometric and spectroscopic. Harvard had no telescope of size, until the new observatory was furnished with a 15-in. equatorial telescope, one of the two largest made up to that time. Later a refracting telescope of 24-in. aperture was added, the gift of Miss Catherine Bruce. It had a branch observatory in Arequipa, Peru, at a high elevation in the Andes, built and largely supported by a sum of money bequeathed for the purpose by Uriah Boyden, but this branch was in 1928 transferred to South Africa. Yale university has an observatory, founded in 1882, which is known for its work on the determination of stellar parallaxes and theoretical astronomy. The private observatory of Percival Lowell at Flagstaff, Arizona, has attracted attention because of the observations of the surfaces of the planets made there, for which it was founded in 1894.

In South America, there had been an observatory at Buenos Aires in 1822, whose period of activity was short, so that the National observatory at Santiago, Chile, may be regarded as the first permanently founded (1856) on this continent. The National observatory of the Argentine republic, established at Cordoba in 1870, has done good service in cataloguing the stars of the southern hemisphere. It now has a 60-in. reflecting telescope. There are other observatories in South America.

The last quarter of the 19th century may be said to have seen the beginning of the era of the large telescope, though the large specula of Parsonstown (6 ft.) and Melbourne (4 ft.) were earlier. The 26-in. refractor at Washington dates from 1873, but a few years later, a telescope was made on a considerably larger scale through the benevolence of James Lick, who died in San Francisco on Oct. 1, 1876. This telescope, with object glass 36 in. in diameter, is set up in an observatory on Mt. Hamilton, Calif. In 1895 a reflector with a silver-on-glass mirror of 36-in. diameter, that had been used by Dr. Common, was presented by Edward Crossley of Halifax, England, and with these two instruments and others, the Lick observatory, dedicated to the University of California, has done much photographic and spectroscopic observation. The size of the larger instrument was surpassed ten years later when, in Oct. 1897, through the efforts of Dr. George Ellery Hale, C. T. Yerkes presented a refracting telescope with object glass of 40-in. aperture, together with a large observatory building containing it on the shore of Lake Geneva, Wis., to the University of Chicago. From that date the Yerkes observatory has been a centre of astronomical activity. The program has been, to a great extent, spectroscopic and astrophysical but micrometrical work on double stars, planets and satellites, has had a place, together with work in connection with the discovery and observation of comets.

TWENTIETH CENTURY

Modern Observatories.—The names and locations of active and inactive observatories are printed yearly in the *American Ephemeris and Nautical Almanac*. The progress of astronomy and the changes in the aim of celestial research have brought changes in the characteristics of observatories. At the beginning of the 19th century the equipment of an observatory may be said to have consisted of a meridian instrument with an equatorial as subsidiary; today the latter is generally the more important instrument, and usually is supplemented by photographic equipment and numerous auxiliary instruments. The routine determination of the positions of sun, moon, the planets and stars, however, still continues as standard work at Greenwich, Washington and other national observatories, since such records are necessary for the maintenance of fundamental astronomy.

Outstanding facts of the 20th century have been the making of large telescopes, in some cases of novel design for special researches, and the establishment of branches to existing observatories in places considered more suitable meteorologically than those of their parents. One important example is the observatory set up in 1904–05 on Mt. Wilson, 5,700 ft. above sea level, near Pasadena, Calif. This observatory was established by Dr. George Ellery Hale as a department of the Carnegie Institution of Washington, D.C. The telescopes are on Mt. Wilson where the observations are made. The library, laboratory, administrative offices, and machine shop are in the valley below. For solar observations two tower telescopes—one 150 ft. high and one 60 ft. high—are used. A revolving mirror known as a coelostat and a fixed mirror on the top of the tower reflect the sun's light through an object glass downwards. In each of the towers the spectrograph is mounted in a well under the tower, the depth of the well being one-half the height of the tower. With these instruments a continuous photographic record of the sun's surface is maintained day after day. This observatory has two large reflecting telescopes, one having a mirror 60 in. in diameter and one with a mirror 100 in. in diameter, the latter being the largest (in 1945) in use in the world. The 100-in. mirror is carried on an equatorial mounting and has an interferometer for measuring the diameters of stars. Optical arrangements for both telescopes provide for the use of different focal lengths in the Newtonian, Cassegrain, or coudé form. Further equipment includes a horizontal solar telescope, a 50-ft. interferometer, a 20-in. reflector, and a 10-in. and a 5-in. photographic refractor.

Another large American observatory is the McDonald observatory of the University of Texas. Established in 1939 on Mount Locke, 6,828 ft. above sea level, in the Davis mountains of Texas, it was organized under a co-operative agreement between two universities, in which the University of Texas built the observatory and the University of Chicago provided the scientific staff. The mirror is 82 in. in diameter and is mounted in a telescope of the cross-axis type, with the tube situated on the side of the polar axis. There is a prime-focus camera used for direct photography at the focus of the 82-in. mirror, without other reflections such as are common in a Newtonian telescope. A second camera provides for direct photography at the Cassegrain focus. Spectrographic equipment includes a slitless spectrograph for low-dispersion, spectra, a spectrograph for use at the Cassegrain focus and a coudé focus spectrograph for high-dispersion spectra. The program at McDonald is mainly spectrographic.

Mount Palomar Observatory.—This observatory, which had not yet (in mid-1945) been formally named, was established by the California Institute of Technology to which the International Education board of the Rockefeller foundation made a grant in 1929 for the construction of a 200-in. reflecting telescope. Its operation is under a joint co-operative plan between the California institute and the Mount Wilson observatory of the Carnegie institution. Its location is on Palomar mountain in southern California about 100 mi. distant from Pasadena and Mount Wilson, at an elevation of 5,600 ft.

The dome and building for the great telescope were erected in 1938. The dome, which is 137 ft. high and of about the same diameter, is insulated throughout to protect the telescope from change of temperature when not in operation. The building which supports the dome has three floor levels on which are offices, photographic rooms, air-conditioning units, electrical switchboards and motors, and a large vacuum chamber for aluminizing the 200-in. mirror.

In the centre of the building, rising to the height of the third or operating floor, is the heavy structural steel framework which supports the two pedestals carrying the telescope. The frame or yoke in which the tube rests is rectangular in shape with tubular side members 10 ft. in diameter. A unique feature is the horseshoe-like form of the north member of the yoke which permits the telescope to be turned northward as far as the north pole. The lower surface of this member is accurately faced and serves as the north-bearing surface of the telescope mounting. The tube and frame, weighing a total of about 500 tons, are carried on a system of bearings employing high-pressure oil pads which nearly

eliminate friction and provide remarkable ease of motion.

The tube, 22 ft. in diameter, is designed to avoid angular deflections at its ends and thus to reduce injurious effects of flexure. Uniform driving of the telescope is accomplished by a synchronous motor fed by current generated by a vibrating string standard and suitably amplified. The major portions of the mounting including the oil-bearing system have been erected and tested.

The disk for the 200-in. mirror is a single block of "pyrex" glass cast by the Corning Glass works. It consists of a surface plate about 6 in. thick supported by a network of deep ribs. An opening 40 in. in diameter is cast in the centre of the disk. The mirror, which will weigh about 16 tons when completed, was brought to a spherical form in 1938, more than 5 tons of glass being removed in the process. The slow and difficult work of parabolizing the surface was then commenced but was interrupted by the outbreak of World War II. It was estimated that about one year would be required to complete the parabolization and to figure the auxiliary mirrors to be used in conjunction with it. The finished telescope may be used in any one of three forms: Newtonian or primary focus with a focal length of 55 ft.; Cassegrainian combination, equivalent focal length 267 ft.; coudé combination, equivalent focal length 500 ft.

In addition to the 200-in. telescope under construction, the Palomar observatory has in operation an 18-in. telescope of the Schmidt type and several smaller instruments. A 48-in. Schmidt telescope working at ratio F/2.5 and utilizing a 72-in. concave mirror is also being built. The mirror for this powerful telescope has been completed and the dome erected.

Other Observatories.—Canada has a 72-in. reflector at the Dominion Astrophysical observatory established in 1916 at Victoria, B.C., as a branch of the Dominion observatory at Ottawa, which itself had grown from a modest establishment used by the survey department. The telescope has been devoted chiefly to astrophysical work. In 1935 this size was surpassed by the 74-in. pyrex mirror at the David Dunlap observatory of the University of Toronto. In spite of a rigorous climate this reflector has performed admirably.

In the eastern hemisphere an observatory specially adapted for solar investigation was established at Canberra by the federal government of Australia as a link in the chain of such institutions round the world, of which the Solar Physics observatory at Cambridge, England (removed from South Kensington in 1911), and that at Kodaikanal, southern India (which was established as a government institution about 1900 and replaces, in part, the observatory of the government of Madras founded in 1792) are others. A site has been chosen in southwest Africa under the auspices of the Smithsonian institution of Washington for a station for the special study of solar radiation. The Harvard southern station has been transferred from Arequipa in Peru to Mazelspoort, 14 mi. from Bloemfontein, Orange Free State, Union of South Africa. At this station is one of the two 60-in. telescopes in the southern hemisphere. The second is at the National observatory, Cordoba, Argentina. Yale University observatory has set up a southern branch at Johannesburg; and the Detroit observatory of the University of Michigan has done the same at Bloemfontein through the aid of a generous donor. The principal instrument is a refractor of 27-in. aperture, which is used mainly for observing double stars. In the same connection it may be noted that the observatory of the Union of South Africa at Johannesburg which dates under its present name from 1912 (having previously been known as the Transvaal observatory, when it was mainly a meteorological station) has a 26-in. refracting telescope. The observatory at Durban, in charge of the colonial government of Natal, was closed in 1912. The dome and mounting for a 74-in. reflecting telescope of the Radcliffe observatory, Oxford, have been erected at Pretoria, South Africa, but completion of the mirror in England was delayed by war conditions. In 1942 the New National Astrophysical observatory in Tonanzintla, Mexico, was dedicated. Its principal instrument is a 22-in. reflecting telescope of the Schmidt type.

Some notable additions were made to the observatories of Europe in the first quarter of the 20th century. As the climate of Pulkowa was considered to be unfavourable for observation, through the influence of Oscar Backlund, who was its director for 21 years, branch establishments were founded—one at Odessa in 1898 for the astronomy of position; another at Nicolaieff, 75 mi. from Odessa, in 1912, for a similar purpose; and a third at Simeis in the Crimea. Backlund died in 1916, but in the last few years of his life the Russian government sanctioned the expenditure of large sums of money for the purpose of procuring astrophysical and astrophotographic equipment for the new observatories, and during 1926 a reflecting telescope with a mirror one metre in diameter and a photographic refractor with an objective of 41-in. aperture were supplied to the Simeis observatory by a British firm. The observatory of Geneva, which is of very early foundation (1772), now possesses a reflector with mirror, one metre in diameter, the gift of a member of the staff. The Astrophysical observatory at Potsdam, which dates from the year 1878, was enriched by the addition of a 32-in. photographic refractor in the year 1899, and in 1921 a tower telescope was erected in its grounds as a tribute to Prof. Albert Einstein. The building is modern and original.

A tower telescope has been set up at the Royal Astrophysical observatory at Arcetri (Florence) designed for solar observation. A new object glass was supplied to this institution in 1925 by the German government, by way of war reparation. The Italian Royal observatory at Milan, with which the name of Gíovanni Virginio Schiaparelli is associated, has been removed and improved by the help of resources similarly supplied. The observatory at Bergedorf, Germany, five miles south of Hamburg, developed out of a local school of navigation in the city of Hamburg. Contributions by the citizens for instruments enabled the school to grow into the Hamburg municipal observatory. In 1906 it was transferred to Bergedorf and the new establishment was completed in 1909. This observatory continues to do star-cataloguing work and supplies a time service for the city, but it is well equipped for astronomical observations of other kinds. It has a reflector, one metre in aperture, and a large twin telescope for photography. This observatory has been specially successful in the discovery of comets.

In Great Britain, the Norman Lockyer observatory, originally the Hill observatory, is on the top of Salcombe hill near Sidmouth, Devon. This observatory, at a height of 560 ft., contains instruments from the observatory of the late Dr. Frank McClean at Rusthall, near Tunbridge Wells, and others used at the government establishment formerly at South Kensington. The spectroscopic classification of stars and the determination of their parallaxes from examination of their spectra, are items in its program.

An observatory of an unusual type was established in France in 1930 by Bernard Ferdinand Lyot of Meudon, who set up his apparatus on the Pic du Midi in the Pyrenees mountains at an elevation of 9,300 ft. Here, with a special refracting telescope and optical system of his own design, he obtained remarkable results in the photography of the solar corona, prominences and spectrum of the corona in full sunlight. Using a cinematograph, he was able to record the movements of the prominences by means of motion pictures. A station of the Harvard College observatory using equipment of a type similar to that of Lyot was established at Climax, Colo., in 1940.

The effect of World War II upon observatories was twofold; in some cases invasion and physical damage ended all scientific work at least temporarily; in other cases reduction in operating staffs and transfer of research to war problems limited normal activity. Many observatories in continental Europe and some in England were damaged, and two great Russian observatories, Pulkowa and Simeis, were almost totally destroyed. The condition of numerous others was still (in 1945) unknown. Plans were initiated, however, for the construction of several new observatories and the expansion of others at the close of the war, especially in eastern and western Europe and some parts of the United States.

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OBSERVER CORPS IN AIR DEFENSE. World War I, England.—At the beginning of world war hostilities in 1914, the necessity of an air-raid warning service was hardly envisioned, but it was not long before the importance and desirability of such an observer system to transmit intelligence of enemy aircraft activity became evident in the British Isles. Flash warnings, it was obvious, would prove invaluable for air defense as well as to centres about to be attacked.

At first in Great Britain the defenses were limited to telephone reports to the admiralty from police within 60 mi. of London. In 1915 the system was extended to cover England and Wales, with reports telegraphed by local chief constables to the admiralty, which then informed the war office.

In 1916 the war office took charge, a more efficient system of observers was introduced with cordons of 30 mi. outside vulnerable areas, while London was provided with two cordons and coastal posts were established. In the autumn of 1917 the London air defenses were reorganized under General Ashmore. The aeroplane patrol improved steadily, but information from the observers as to enemy aircraft operations was not yet quick enough or reliable enough to aid the defensive pilots. German activity early in 1918 being confined to London and its south and east, a new system was devised: the attacked areas were covered with the various units of the defense, coastal posts, squadrons, guns, searchlights and balloon aprons. These units reported activity of the enemy aircraft, the information filtered through certain centres and then was added to a big map in headquarters. All report message lines were open during operations and no connections were necessary. Extensive telephone construction work was not completed until after May 19, 1918, the date of the last air raid.

Air defense revival early in 1924 found large vulnerable areas without observers; despite the simplicity of demands by the service, intelligence reports would be lacking on enemy aircraft movements over Great Britain. Therefore the country was covered by watchers in series of observation posts, six to eight miles apart, equipped with complete telephone service. The year 1924 saw the first experimental operation around Cranbrook, the reporting centre. It proved the system feasible, and valuable experience was gained.

In 1925 the system was extended to two zones covering the whole of Kent and Sussex, each zone consisting of a network of observer posts with lines to a local centre and then to the headquarters of the air defense. Chief constables and special constables manned the equipment, and the R.A.F. tested the layout by day and night operations. As a result the organization received the official sanction of the home office and the war office, and by 1927 the system embraced Hampshire, Sussex, part of Surrey, Kent, Essex and half of Suffolk. Observers, without pay, were efficient and alert.

World War II.—Air raid defense or the protection of the civilian population caused both Allied and axis governments grave concern, so much so that in 1938 German, Swedish and British civil defense personnel were working together in and around the dockyard towns on the Medway in England and witnessing exercises carried out with a view to saving life and dealing with casualties. The Germans provided much better shelter than the British, but Britain was *facile princeps* in its fire-fighting organization.

Before World War II, Sir John Anderson (later home secretary and minister of home security in Great Britain, 1939–40) lectured to the Imperial Defense college and to the staff colleges on air raid precautions. People with foresight began to think of the future safety of Great Britain and the commonwealth, and passive defense, air raid precautions or civil defense, the new baby of national defense services, was born. It was not at first a popular step and roused little public interest; during the first year of World War II, before the heavy bombing attacks on Great Britain began, quite a large percentage of citizens almost suggested scrapping the carefully built civil defense organization. The cabinet and the home office meanwhile had deputed to a dozen regional commissioners the duty of co-ordinating civil defense, and these chosen deputies used that time as one of valuable training for fire fighters, rescue and decontamination squads, stretcher bearers, ambulance drivers and attendants, air raid wardens, repair parties, control and reporting personnel, etc. Preparation was made for dealing with the damage to water mains, gas, sewerage and electric light installations.

The shelter problem necessitated the appointment of a special regional commissioner in London. Generally speaking, adequate shelter was provided by local authorities, but some of the boroughs failed to provide proper shelter and since the deep-shelter policy was turned down by the government as too costly to provide or, for a variety of reasons, an impossible undertaking, basements, surface shelters, underground tube station shelters, etc., were put under central control. Bunks were constructed and made available for distribution, priority of supply being given to the crowded East End boroughs. In recasting the shelter problem, the community was impressed with the need for dispersal as opposed to crowding thousands together in large communal shelters. Some of the bigger shelters were hit, and the casualties were heavy.

Civil defense in Britain was a community business on a territorial basis. Local government was mainly responsible for recruiting its members, acquiring its vehicles, establishing its depots and control centres and, largely, for its training and administration. Usually the town clerk, the chief local government official, was appointed official civil defense controller. In some cities and towns this duty was taken over by the chief constable.

Air raid defense from the civil viewpoint was concerned firstly with saving life, limb and suffering. Property generally came second, but industries, utility services and food supplies had high protection priorities, and it was the duty of the regional commissioners to ensure the minimum interference with production, war effort, health, morale and the education and upbringing of youth. Civil defense, when faced squarely, became a matter of common sense. Expert opinion helped in matters of shelter construction, protection against blast and splinter effect, fire fighting and the strengthening of buildings and special protection of such key points as power stations, pumping stations and communication centres. Water supplies for fire fighting during large-scale attacks were not at first up to requirements. The defect was overcome later by the building of an elaborate system of static water tanks and reservoirs.

British National Fire Service.—The National Fire service, built to start with on the peacetime fire brigade system, was enlarged by what was first called the Auxiliary Fire service, comprising thousands of men and women. The National Fire service built up a vast network of controls which extended and co-operated throughout Britain, and developed a new, highly disciplined fire organization that was visited by the fire services of the United States, Canada and other Allied countries, whose representatives worked with the National Fire service for weeks at a time before going back to their own lands armed with experience of wartime fire fighting.

There were 1,725 fires in the city of London on Dec. 8–9, 1940, and 780 serious fires on Dec. 29, 1940, when the Guildhall was damaged and eight Wren churches were destroyed.

On March 19, 1941, there were 1,880 fires within the London region. The heaviest "fire blitz" occurred on the night of April 16, 1941, when there were no fewer than 2,251 fires, mainly in Chelsea, Westminster and Lambeth. On May 10 there were 2,154 fires in the centre and West End of London. The fire blitz then began in Liverpool. Following the London fire blitz of Dec. 1940, the government ordered compulsory fire fighting by civilians. Ellen Wilkinson (parliamentary secretary for the ministry of home security 1940–45) took over the general direction of the fire guard, and between the National Fire service and the wardens' service millions of men and women were trained and exercised until fire watching and fire fighting became part of air raid defense.

Civil Defense Services in Britain.—More than 1,000,000 people were enrolled in civil defense in Great Britain. In London alone, excluding the fire guard, nearly 250,000 people were en-

rolled to man the different services. The air raid wardens were the "front line soldiers" of the blitz; a very great proportion of them were volunteers or "part-timers." Wardens' work included a greater variety of duties than fell to the lot of any other civil defense service. The control room staff—operators, messengers, teleprinter girls, tally board and plotting clerks and the representatives of the heads of services—were in the charge of a selected deputy who supervised the reports from the wardens; the staff dissected them and dispatched the requisite aid. Members of the rescue party services were mainly builders' workmen, trained to lift steel girders and shift masonry and concrete blocks. They tunnelled under the debris of demolished buildings and cleared a way for the stretcher bearers. The rescue parties had their trucks fitted with standard equipment: jacks, levers, pulleys and tackle, wire and hemp rope, acetylene cutting plant, shores, sheer-legs, picks, shovels, axes and tools enough to satisfy most lifesaving and demolition requirements. The ambulance service was mostly run by women in civil defense. In London alone this ambulance service conveyed 93,524 casualties to hospitals and 609,783 inter-hospital patients. Other uses were made of this form of transport, and nearly 1,000,000 repair workers were carried for first aid to bombed buildings.

Closely associated with the ambulance service were the mobile hospital units of the field hospital type, usually with a crew of eight: medical officer, qualified hospital nurse, five assistants and man driver. Included in the casualty services were first-aid posts situated in places selected according to density of population and distance from hospitals. Hospitals, their size and capabilities were all worked into the civil defense plan, as were rest centres and mobile supporting columns, consisting of rescue parties and casualty units equipped to be rushed to any area which, through concentrated bombing, found its resources inadequate. An organization for housing the homeless was included in air raid defense and whether the bombed-out people were to be accommodated for a very short time or permanently proved a very heavy commitment, especially in London, where well over 1,000,000 homes were hit and more than 250,000 destroyed. (E. R. G. R. E.)

The Royal Observer corps was reorganized in 1946, and by 1950 it had a strength of 13,000 men and 2,000 women. (X.)

United States.—In the United States no effort toward creating aircraft warning systems had been made until about 1933. Following the great earthquake in Long Beach, Calif., in 1933, when the sheriff of Los Angeles county, Eugene W. Biscailuz, found he was without communications to the stricken area 20 mi. away, an organization for communications in event of disaster was formed. From this evolved the civilian aircraft warning service, utilizing networks of observations and detection of possible enemy aircraft over areas 250 mi. from a central point. These points were known as information centres.

The war beginning in Europe in 1939 intensified the study of this subject in the United States. In total war any object in enemy territory is a military target. The army air corps and allied services conducted several blackouts and enemy air raids, simulating as nearly as possible actual warfare.

These exercises were carried out from 1937 to Jan. 1941. The locations covered were southern California, North Carolina, Alabama and the New England area including the metropolitan area of New York. The first air warning exercise to be conducted in the United States was over 9,000 sq.mi. in southern California and central California in 1937; utilizing the Los Angeles county plan, the tests were carried out by the First Wing G.H.Q. air force and the 63rd antiaircraft artillery for two weeks. March field, corps area headquarters, was the theoretical objective of the enemy.

The information centre for southern California was equipped with every means of communication, including telephone, telegraph, county forestry circuit, Edison power and light telephone circuit, teletypewriter circuits, Santa Fe railroad and Southern Pacific railroad telephone and telegraph circuits, commercial radio and amateur wave lenghts in addition to the county short-wave, two-way portable radios under control of the sheriff's office and the army radio network.

A second exercise covering 80,000 sq.mi., comparable to the area of the British Isles and Ireland, was held in 1938. In 1939 the most extensive effort of this type ever attempted in practice involved the entire Pacific coast. Four information centres were set up, two in California, one in Oregon and one in Washington. Army intelligence reported briefly that the service "worked."

From this trial came opportunity to expand further the service. The civil advisory system was inaugurated, operating directly out of the centres, by which information about approaching enemy aircraft was sent directly from communications centre by the sheriff's office to defense industries, aircraft plants, oil, electric and water systems. During exercises, every vital industry within a radius of 250 mi. was given the warning within a few minutes.

In collaboration with the U.S. army, the Los Angeles county system, known as the aircraft warning system, proved so efficient that it was adopted, with slight modifications, by other large concentrations of population in the United States.

For a large-scale national emergency, the nation was divided into four general areas, with communication centres as follows: northeast, Mitchel field, N.Y.; southeast, Tampa, Fla.; southwest, Los Angeles and March field, Calif.; northwest, Spokane, Wash. It was planned to have the intelligence from observation post spotters flow into the centres after first having been directed through filtering stations in each local area.

Under the general plan of the aircraft warning service, the southern California sector information centre was established at Alhambra, a suburb of Los Angeles, with all incoming circuits terminating at this point. There were four outgoing channels of communication, two radio, one telephone and one teletypewriter circuit from Alhambra to March field, U.S. air corps defense headquarters. To inform all officers in the Alhambra information centre simultaneously of the contents of a received "flash message," a translux projector was employed, projecting each message on a moving tape which in turn was reflected on a screen above the operating map. The map itself was a relief scale map horizontally placed and surrounded by a gallery for personnel. It was operated by a control board of 300 individual push buttons for lighting up the courses of invading aircraft.

The purposes of the test were to co-ordinate the communication systems of the various agencies comprising the aircraft warning service and train the observers in the proper procedure for transmission of messages, identification of aircraft, etc.

An aircraft warning experiment was held in the New York-New England region from Jan. 21 to 24, 1941, under the direction of the G.H.Q. air force. A corps of civilian observers, organized under the auspices of the American Legion, worked with the army. The communications network was operated by the American Telephone and Telegraph company and its affiliated companies.

The test was excellently co-ordinated and proved the feasibility of the plan which the army was formulating. As a result of the test an orientation and indoctrination course was held at Mitchel field, L.I., from March 25 to April 13, 1941, during which all knowledge on the subject was weighed and explored with a view to setting up a fixed and standardized aircraft warning service. (H. E. Hy.)

In Sept. 1939 the governor of New Jersey appointed an emergency defense committee. In May 1940 Tennessee and Virginia organized the first state defense councils. By May 1, 1941, defense councils had been established in most of the states and in more than 1,000 communities. On May 20, 1941, the president, by executive order, established the Office of Civilian Defense. The interest of the U. S. public in air raid defense followed the course of the war. At the time of Pearl Harbor, civilian defense had 3,516,600 volunteers and 7,031 defense committees. Two years later there were more than 12,000,000 registered, of whom 5,534,000 were assigned to duty in the protective services. By then the United States had the largest force of civilian volunteers ever formed for war service. Air raid defense included the army, the air force, Civil Air Patrol, state guards, state police, Red Cross and community welfare services. Each had a role and was prepared to carry out its part.

When war was declared, the framework was well under way.

The pattern was that set up in England as a result of experiences there in 1940 and 1941. These demonstrated that the armed forces and the peacetime services of fire, police and medicine were not capable of meeting the impact of the new strategy of total war; that the existing services should be expanded with added equipment and personnel; new services should be added and the individual schooled to take care of himself and his home; and the nation should be mobilized to protect itself.

The OCD (headed by a director appointed by the president), with nine regional offices, was the national organization. Each state had its state defense council and many local councils, of which there were, at the peak, more than 12,000. Every community likely to be attacked organized one. The national government had no authority over the state or local councils. The OCD was a planning and co-ordinating body. The state and local defense councils were the operating units.

OCD set up the Civil Air Patrol, Forest Fire Fighters service, Facility Security program and civilian protection schools. Its training manuals and guidance on gas defense, blackout, dimout, shelters, camouflage, organization, communications, safety measures and the many other problems of civilian defense were followed by state and local councils. It became the research and advisory centre.

The army air force operated the Aircraft Warning service, with about 600,000 volunteers to warn communities of impending attack. To ensure necessary uniformity, the army promulgated an air raid warning system and controlled practice blackouts. The local units had the true responsibility. Operating through a staff, air raid warden, auxiliary police, auxiliary fire, utility repair, road repair, emergency medical and related services and headed by a commander—the mayor, a well-known citizen, or the head of the police department—these people took their task seriously. They knew that if they failed in their mission there was little hope for their community. Each local unit was expected to be strong enough to handle any anticipated attack.

Every community was far short of the fire equipment necessary to handle effectively the fires resulting from even a small attack. To meet this, in Feb. 1942, congress appropriated $57,000,000 for pumpers, hose and other equipment for communities in critical zones, and $43,000,000 for gas masks, helmets, arm bands, medical supplies and miscellaneous equipment for the individuals of the defense corps.

Neither Germany nor Japan was capable of bombing the United States during World War II. How well the civilian defense organization would have kept down the effect of any air raid attack was unknown. Some units performed creditably in local emergencies, which were, in some sense, tests of their efficiency. Experiences elsewhere pointed to many ways in which it might have been improved, yet it accomplished much. It stood out as the greatest example of U.S. mass mobilization, organization and training ever undertaken by volunteers. Communities found a way to unite by themselves for their own welfare. It gathered the people behind the war effort.

After World War II civilian volunteers, serving without pay, were organized as members of the Ground Observer corps, established to supplement coverage provided by radar networks. The civil authorities were made responsible for the administration of the corps, including recruitment, assigning duties, etc., and the air force supervised the tactical operation, including training. The air force headquarters was established at Ent Air Force base, Colorado Springs, Colo. A number of filtre centres were organized as central points to gather information from observers, plot the course of aircraft, pass on the information to the military air defense authorities, etc.

World War II experience and a trial run called Operation Lookout, made in Sept. 1949, indicated that such a system might afford substantial protection.

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OBSIDIAN, a glassy volcanic rock of acid composition. Rhyolitic lavas frequently are vitreous, and when the glassy matter greatly predominates and the crystals are few and inconspicuous the rock becomes an obsidian; the chemical composition is essentially the same as that of granite; the difference in the physical condition of the two rocks is due to the fact that one consolidated at the surface, rapidly and under low pressures, while the other cooled slowly at great depths and under such pressures that the escape of the steam and other gases it contained was greatly impeded.

Only a few obsidians are entirely vitreous; usually they have small crystals of felspar, quartz or a ferromagnesian mineral, and when these are numerous the rock is called a porphyritic obsidian.

These crystals have, as a rule, good crystalline form, but the quartz and felspar are often filled with enclosures of glass.

All obsidians have a low specific gravity (about 2·4) both because they are acid rocks and because they are noncrystalline. Their lustre is vitreous except when they contain many minute crystals; they are then velvety or even resinous in appearance. Black, gray, yellow and brown are the prevalent colours of these rocks.

In hand specimens they often show a well marked banding which is sometimes flat and parallel, but may be sinuous and occasionally is very irregular, resembling the pattern of damascened steel.

When crystals are present they generally have their long axes parallel to the fluxion.

Even when conspicuous and well formed crystals are not visible in the rock there is nearly always an abundance of minute imperfect crystallizations (microlites, etc.). They are often so small that high magnifications may be necessary to ascertain their presence. Some are globular and others are rod shaped; they may be grouped in clusters, stars, rosettes, rows, chains or swarms of indefinite shape. In banded obsidians these microlites may be numerous in some parts but few or absent in others. The larger ones polarize light, have angular outlines like those of crystals, and may even show twinning and definite optical properties by which they can be identified as belonging to felspar, augite or some other rock-forming mineral.

These microlites or crystallites (*q.v.*) show that the glassy rock has a tendency to crystallize, which is inhibited only by the very viscous state of the glass and the rapidity with which it was cooled. Another type of incipient crystallization which is excessively common in obsidian is spherulites (*q.v.*), or small rounded bodies which have a radiating fibrous structure. They are of globular shape, less frequently irregular or branching, and may be elongated and cylindrical (axiolites). In some obsidians from Teneriffe and Lipari the whole rock consists of them, so closely packed together that they assume polygonal shapes like the cells of a honeycomb. In polarized light they show a weak gray colour with a black cross, the arms of which are parallel to the crosswires in the eyepiece of the microscope and remain stationary when the section is rotated.

Often bands of spherulites alternate with bands of pure glass, a fact which seems to indicate that the growth of these bodies took place before the rock ceased to flow.

As cooling progresses the glassy rock contracts and strain phenomena appear in consequence. Porphyritic crystals often contract less than the surrounding glass, which accordingly becomes strained, and in polarized light may show a weak double refraction in a limited area surrounding the crystal. Minute cracks are sometimes produced by the contraction; they are often more or less straight, but in other cases a very perfect system of rounded fissures arises. These surround little spherules of glass which are detached when the rock is struck with a hammer. There may be concentric series of cracks one within another. The minute globular bodies have occasionally a sub-pearly lustre, and glassy rocks

which possess this structure have been called perlites (*q.v.*).

Although rocks wholly or in large part vitreous are known from very ancient geological systems, such as the Devonian, they are certainly most frequent in recent volcanic countries. Yet among the older rocks there are many which, though finely crystalline, have the chemical composition of modern obsidians and possess structures, such as the perlitic and spherulitic, which are very characteristic of vitreous rocks. By many lines of evidence we are led to believe that obsidians in course of time suffer devitrification; in other words, they pass from the vitreous into a crystalline state; but since the changes take place in a solid mass, they require a very long time for their achievement, and the crystals produced are of only extremely small size. A dull stony-looking rock results, the vitreous lustre having entirely disappeared, and in microscopic section this exhibits a cryptocrystalline structure, being made up of exceedingly minute grains principally of quartz and felspar. Often this felsitic devitrified glass is so fine-grained that its constituents cannot be directly determined even with the aid of the microscope, but chemical analysis leaves little doubt as to the real nature of the minerals which have been formed. Many vitreous rocks show alteration of this type in certain parts where either the glass has been of unstable nature or where agencies of change such as percolating water have had easiest access (as along joints, perlitic cracks and the margins of dikes and sills). Obsidians from Lipari often have felsitic bands alternating with others which are purely glassy. In Arran there are pitchstone dikes, some of which are completely vitreous, while others are changed to spherulitic felsites more or less silicified.

Obsidians occur in many parts of the world along with rhyolites and pumice. In Europe the best-known localities for them are the Lipari Islands, Pantelleria, Iceland and Hungary. Very fine obsidians are also obtained in Mexico, at the Yellowstone park, in New Zealand, Ascension and in the Caucasus. Included in this group are some rocks which are more properly to be regarded as vitreous forms of trachyte than as glassy rhyolites (Iceland), but except by chemical analyses they cannot be separated. It is certain, however, that most obsidians are very acid or rhyolitic. The dark, semi-opaque, glassy forms of the basic igneous rocks are known as tachylytes (*q.v.*). The typical obsidians exhibit the chemical peculiarities of the acid igneous rocks (viz., high percentage of silica, low iron, lime and magnesia, and a considerable amount of potash and soda) as shown in the following table.

	I Yellowstone park	II Iceland	III Mexico
SiO_2	74·70	75·28	73·63
A_2O_3	13·72	10.22	14.25
FeO	0·62	..	1.80
Fe_2O_3	1·01	4·24	..
CaO	0·78	1.81	tr.
MgO	0·14	0.25	1.42
K_2O	4·02	2.44	4·39
Na_2O	3·90	5·53	4.61
H_2O	0·62	0.23	..

(J. S. F.)

OBSTETRICS. Obstetrics is the branch of medical science dealing with childbirth, and is concerned with the care of women from conception through pregnancy and labour, and to the completion of the lying-in period, when the reproductive organs have returned to their normal nonpregnant condition. The word itself is derived from the Latin *ob* ("against," "in front of") and *stare* ("to stand"), indicative of the accoucheur in the middle ages, when the attendant stood before the obstetrical chair to receive the child as it was extruded. With gynaecology (*q.v.*), which treats of the diseases peculiar to women, it provides for the care of conditions in, and related to, the female reproductive function. The two subjects are generally taught and practised as a single discipline since their fields are so interdependent and overlapping. There is a growing tendency to begin obstetrical supervision even before conception. In the United States many states make statutory provision for premarital examinations directed particularly at the control of congenital syphilis by preventing the marriage of infected individuals. A more thorough evaluation of reproductive capacity was being demanded by many women before marriage. Such examinations include study of the bony pelvis, the pelvic organs and the organism as a whole for evidence of disease or deformity that might make childbearing unusually hazardous. The old idea that the obstetrician is concerned only with confinement had given way to a newer concept that his duties include all types of supervision necessary to ensure the delivery of a healthy child from a healthy mother.

Pregnancy.—The gestation period in humans averages 280 days from the beginning of the last normal menstrual period, or 266 days from the ovulation which led to conception, assuming that ovulation occurred 14 days before the anticipated period which was missed. Pregnancy is accompanied by significant alterations in the physical economy of the body and by definite mental changes so that the whole body participates. These variations from the nonpregnant normal impose additional stresses which are likely to overload any organ or system that is not completely normal, and may thus lead to serious complications. Not only must the organism provide materials for the growth of the reproductive organs, especially the uterus and breasts, but it must supply the growing conceptus with the elements essential for its growth. These demands become greater as pregnancy advances and the rate of foetal growth increases, and lead to an increasing metabolic strain. The last two or three months constitute the period when these stresses and strains are most likely to disturb the normal body functions. These facts finally forced recognition of the necessity for professional supervision during the greater part of pregnancy; and the development of a program for such prenatal care constituted an outstanding contribution in the field of preventive medicine.

Ante-Partum (Prenatal) Care.—Early in the 20th century there developed an increasing awareness of the need for, and the practical advantages of, medical supervision during pregnancy. This program calls for an initial visit to a physician as soon as pregnancy seems probable, and repeat visits at stated intervals. At the first visit a general physical examination is made with special attention to the pelvic organs and the bony pelvis to determine their integrity and adequacy. In many communities blood is taken for a test for syphilis, for determination of the Rh factor and for routine studies of the haemoglobin and blood cell content. Any apparent inadequacy is subjected to further study. At subsequent visits (every four weeks in the early months to every week in the last month), the weight is recorded, the blood pressure tested, the urine examined and the course of the pregnancy evaluated. The woman comes to know her attendant who assumes the responsibility for advising diet, for regulating physical activity, for treating complaints as they arise and for general supervision aimed at avoiding serious complications and assuring a successful outcome of the pregnancy. Competent authorities ascribe a considerable share of the marked reduction in maternal mortality after 1930 to the beneficial results of ante-partum care, in that it tends to prevent untoward pregnancy manifestations or to detect them in an early stage when they are amenable to treatment.

The pregnant woman is subject to all the diseases and accidents of the average adult and, in addition, is exposed to certain risks inherent in the pregnant state. Among the latter, the most common is abortion (or miscarriage), the expulsion of the conceptus before the period of viability (generally taken as 28 weeks). This may result from causes operative in the mother or the conceptus —spontaneous abortion; from malicious interference with the pregnancy—criminal abortion; or from medical intervention designed to protect the mother's health or life—therapeutic abortion. It is estimated that 10% to 20% of all pregnancies terminate themselves (spontaneous abortion) in the first few months. The most common cause is the failure of some portion of the conceptus to develop properly, its expulsion representing a form of biological economy. The incidence of criminal abortion is not determinable because of the secrecy surrounding its performance, but it has been estimated that 500,000 to 700,000 such illegal procedures were being carried out at mid-20th century in the United States annually. Therapeutic abortion is generally limited

to women with chronic diseases that tend to be aggravated by pregnancy; as the medical treatment of these conditions improves, the reasons for therapeutic abortion become less common. The chief risks in any type of abortion are infection of the uterus and haemorrhage from incomplete separation of the placenta. Under the influence of therapy with antibiotics and blood transfusions, these conditions became much less likely to prove fatal than was formerly the case.

Another inherent pregnancy danger is the possibility of the development of toxaemia of pregnancy, one of several related but seemingly different conditions characterized by hypertension, albuminuria and oedema, which may terminate in generalized convulsions (eclampsia). Toxaemia at mid-century was still one of the three major causes of mortality, but ante-partum supervision had considerably reduced its severity and its death rate. Its cause was still unknown in spite of years of work by many investigators.

Labour.—Labour, the period of parturition, appears approximately 280 days after the onset of the last normal menstruation; variations of two or three weeks in either direction are not uncommon and are usually of no significance. At the appointed time the uterus begins to contract to expel its contents and the contractions are called "labour pains." The process is divided into three (or four) stages depending upon the events transpiring in the birth canal. The first stage, which involves the dilatation of the cervix, the mouth of the womb, is the longest and may last many hours; the second lasts from complete dilatation of the cervix to birth of the child; and the third from then until the expulsion of the placenta (afterbirth). Some authorities include a fourth stage which lasts for an hour or more after birth of the placenta, or until the uterus is thoroughly contracted and the danger of haemorrhage from relaxation of that organ is passed. The entire process may take days, but is generally completed in 12 to 18 hrs. First labours are generally longer than succeeding ones. The primary motive power in all stages of labour is the strong intermittent contractions of the uterine muscle, aided in the second and third stages by reflex or voluntary efforts of the abdominal muscles.

In the first stage the uterine contractions slowly dilate the cervix by pulling it up over the foetal part which is the lowest. Normally this part is covered by the bag of waters, or amniotic sac, in which the child lies. When this sac breaks early, permitting escape of some of the fluid, there is a dry labour. This latter condition was formerly thought to produce long, difficult labours, but it is now recognized that premature rupture of the bag of waters does not materially alter the birth process provided other conditions are normal. In fact, artificial rupture of the sac is widely employed to induce labour when some condition makes it advisable. The child usually descends little during the first stage, especially if the sac remains intact. In the second stage the force of the uterine and abdominal muscular contractions drives the child down, through and out of the birth canal according to certain patterns, the mechanism of labour depending upon the way the child is lying. As the child leaves the uterus, this organ contracts to accommodate to the reduction in the volume of its contents until at the end of the stage its cavity contains only the placenta. The contractions of the third stage separate the afterbirth from its attachment to the uterine wall and then expel it from the canal. In the fourth stage the muscle fibres contract and retract to close off the vessels torn through by separation of the placenta and thus prevent excessive blood loss.

Usually at full term the top of the child's head, the vertex, comes first and this is thought of as the normal position for birth. Occasionally (3% to 4%), the buttocks, or breech, are lowermost, and rarely the child lies crosswise (transverse presentation). A breech presentation is more serious for the child, who may suffocate if not expelled or extracted promptly, while a transverse presentation offers an insurmountable obstacle to the birth of a normal-size child and must be treated by operative intervention. It is common practice to attempt to change a breech or transverse presentation to a vertex by external manipulation before the onset of labour. Failing that, some operative procedure may be required to effect delivery.

Twins occur about once in 80, and triplets once in 6,400 births. Quadruplets and quintuplets are correspondingly still more uncommon. In any multiple pregnancy birth is likely to occur prematurely because of overdistention of the uterus, and the children are generally smaller than normal. It is uncommon for the total weights of the children to exceed 15 to 17 lb. Single children rarely weigh more than 11 lb. (5,000 g.), and the average is about seven and one-half lb.

In the 20th century there was an increasing tendency in most areas to alleviate the pains of labour by the use of analgesic and anaesthetic drugs. Although dozens of drugs, singly and in combination, had been employed by mid-century, none had been universally accepted. The ideal medication which would relieve pain without slowing the birth process or injuring either mother or child had not been discovered. It had become possible, however, to reduce the pain safely to a point where childbearing was not the ordeal it once was.

Delay in the birth process caused either by disproportion between the child and the maternal pelvis or by ineffective pains (uterine inertia) is the most common complication of labour. With modern methods the adequacy of the pelvis can usually be determined before labour, and delivery effected by Caesarean section in those cases where normal birth seems impossible. Under the influence of improved surgical technique, the availability of blood transfusions and the protection from infection offered by the antibiotics, abdominal delivery came to be a relatively safe method of treating such complications. First-stage inertia is combated with rest under narcotics and the maintenance of fluid balance, with Caesarean section available should vaginal delivery eventually prove impossible. Second-stage inertia is managed with forceps or some other form of manipulation.

Haemorrhage during or shortly before the onset of labour is caused by early separation of the placenta which may either be normally implanted well up on the uterine wall (ablatio, or abruptio, placentae), or located over the cervix when dilatation inevitably produces bleeding (placenta praevia). These conditions are dangerous to both mother and child, but especially to the latter who suffers from asphyxia and is, moreover, generally premature.

The third and fourth stages present one of the most serious complications of childbearing—post-partum haemorrhage. Excessive bleeding after delivery of the child is usually due to incomplete separation of the placenta or to failure of the uterus to contract and retract properly after that structure has been expelled. The time-honoured remedies, removal of the afterbirth, employment of uterine massage and administration of oxytocic drugs, are supplemented by blood transfusions. The lifesaving virtues of a hospital blood bank are nowhere better illustrated than in this complication.

Puerperium.—The puerperium, or lying-in period, continues from the end of the fourth stage of labour to the restoration of the pelvic organs to the nonpregnant state—usually six to eight weeks. The necessary anatomical changes occur with extraordinary rapidity; *e.g.,* the uterus, which weighs two pounds at the termination of labour, comes to weigh two ounces after six weeks, and its blood vessels, which carried the burden of nourishing the child for nine months, are replaced by new vessels suitable to this smaller size. Unless the child is suckled, menstruation reappears usually in about eight weeks; lactation may be accompanied by absence of the menses.

It was thought formerly that full recovery of the mother depended upon maintenance of a semi-invalid regimen, ten days or more of bed rest and several additional weeks of restricted activities. The later tendency, especially in the United States, was toward early ambulation and prompter return to normal activity by women with normal pregnancies and labours. It was believed that such a course not only ensured more rapid convalescence but also greatly reduced the incidence of "milk leg," formerly a frequent and serious puerperal complication.

The chief risk during the lying-in period is puerperal fever, caused by the growth of pathogenic bacteria in the wounded areas of the birth canal, especially the uterus. These organisms are

generally introduced from without during or shortly after labour but may occasionally be resident in the birth canal where they are relatively innocuous until presented with the favourable growth conditions developing after delivery. Aseptic surgical technique during labour can largely control exogenous infections but has little effect on endogenous organisms, since it is impossible to sterilize the birth tract. However, both prevention and cure of pelvic infections can generally be effected with antibiotic drugs and repeated blood transfusions.

Mortality.—As late as 1933 the position of the United States among the nations of the world with respect to maternal mortality was far from enviable; the rate that year was 6.2 maternal deaths per 1,000 live births, while Sweden had a rate of only 3.1 and the white population of New Zealand, 4.4. The corresponding rate for England and Wales was 4.5 deaths per 1,000 live births.

After 1933, however, many factors became operative to reduce this largely unnecessary loss of life among women in the prime of life. Ante-partum supervision was expanded to include the majority of pregnant women; intra-partum and post-partum care was improved by the provision of more obstetrical beds in well-regulated hospitals, by the availability of physicians better trained in obstetrical care and the progressive elimination of untrained midwives and by the introduction of chemotherapeutic and antibiotic drugs and of banks for storing blood and blood substitutes. The impact of any one of these factors could not be defined since the death rate declined at a fairly steady rate. From 6.2 in 1933, it fell to 4.4 in 1938, to 2.5 in 1943 and to slightly below 1.0 in 1949 for the United States. Figures available for England and Wales for 1947 showed a rate of 1.2 maternal deaths per 1,000 live births.

It was possibly significant that the greatest percentage drop in maternal mortality was in infected abortions—92%, and in infections during childbirth and the puerperium—84%, while the decrease in toxaemias of pregnancy and the puerperium was 79% and in haemorrhage of pregnancy and of childbirth and the puerperium—66%, the smallest decline in any category. (E. D. P.)

History.—As with the Egyptians and Hebrews, among the Greeks the skilled attendants for women in labour were women. There are indications in the Hippocratic writings (400 B.C.) of his interest in the disorders of females, and his oath forswears the use of abortifacients. In the writings attributed to Hippocrates' followers, some of these subjects are dealt with more fully; but while the physician was sometimes called in to give advice in a difficult labour, he was usually called only in a case where the child was already dead, and then he told how he had to mutilate and extract it. In the medical school of Alexandria, Herophilus (*fl.* 300 B.C.) gave a truer idea of the anatomy of the female than had previously prevailed; other physicians gave evidence of their interest in midwifery and the diseases of women; and Celsus (in the reign of Augustus) reported that surgeons could sometimes bring about the delivery by the operation of turning the infant.

In the middle of the 16th century, Ambroise Paré, a French surgeon, revived the operation of podalic version and showed how the infant could often be saved instead of being broken up and extracted piecemeal. Three sets of compilations, containing extracts from the various writers on obstetrics and gynaecology from the time of Hippocrates onward, were published under the title *Gynaecia*, or *Gynaeciorum*, in 1566, 1586 and 1597. After the middle of the 17th century, more medical men began to publish treatises, and parturient women began to call on men to attend them in natural labours. Heinrich van Deventer, a Dutch obstetrician, in 1701 gave a scientific description of the pelvis, and by 1716 doctors were using the "harmless forceps" with which a living child could be extracted in conditions where formerly the child's life was sacrificed and the mother's life endangered.

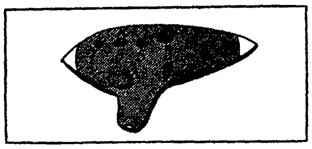
In the following centuries, greater strides were made than in all the preceding ages. In the 18th century various universities established chairs of midwifery, and two new operations—symphysiotomy and the induction of premature labour—enhanced the powers of the obstetrician. Two outstanding achievements in the 19th century were the alleviation of the pains of labour by anaesthesia and the arrest of mortality from so-called puerperal fever by antiseptic measures. (X.)

Bibliography.—F. G. Dickinson and E. L. Welker, "Maternal Mortality in the United States in 1949," *J.A.M.A.*, 144:1395 (Dec. 16, 1950); International Vital Statistics summary, *Vital Statistics*, special reports, vol. 9, no. 36, pg. 427, U.S. Department of Commerce (May 2, 1940); N. J. Eastman, *Williams Obstetrics* (1950). (E. D. P.)

OCALA, a city in the interior of Florida, U.S., 100 mi. S.W. of Jacksonville; the county seat of Marion county. It is on federal highways 27, 301 and 441 and is served by the Atlantic Coast Line and the Seaboard Air Line railways and by Eastern Air Lines. Pop. (1950) 11,741; (1940) 8,986. The city is the centre of mineral deposits having high-quality pure lime and limerock. It was the original centre of the Florida phosphate industry. There are also a crate-box-hamper factory, lumber yards, creamery, meat-packing and fruit-packing plants and building material, concrete pipe, citrus concentrate, shirt and insecticide plants. Five miles E. is Silver Springs (so called from the transparency and refractive powers of its waters), which has a circular basin 300 ft. in diameter and 65 ft. deep and discharges more than 300,000 gal. a minute, its outflow forming a navigable stream 9 mi. long emptying into the Ocklawaha river.

Ocala was settled in 1845 and chartered as a city in 1868. It has a council-manager form of government. The name is Seminole, meaning fertile soil.

OCAÑA, a town of central Spain, in the province of Toledo; on the extreme north of the tableland known as the Mesa de Ocaña, with a station on the railway from Aranjuez to Cuenca. Pop. (1940) 9,806 (mun., 9,953). Ocaña is the Vicus Cuminarius of the Romans, and was the dowry that El Motamid of Seville gave his daughter Zaida on her marriage to Alphonso VI of Castile (1072–1109).



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THE OCARINA, A WIND INSTRUMENT POPULAR AMONG STREET PLAYERS

OCARINA, a wind instrument invented in Italy, which is classed with musical toys or freaks. It consists of a vessel in the shape of an egg with a pointed base and perforated with holes and a tube like a spout in the side, containing the mouthpiece. In America, it is sometimes called a "sweet potato."

O'CAROLAN (or Carolan), **TURLOGH** (1670–1738), Irish bard, son of John O'Carolan, a farmer, was born at Newtown, near Nobber, Co. Meath. At 18 he became blind from smallpox. He received special instruction in music, and used to wander with his harp round the houses of the surrounding gentry, mainly in Connaught. The number of Carolan's musical pieces, to nearly all of which he composed verses, is said to exceed 200. He died March 25, 1738, and was buried at Kilronan.

His poetical *Remains* in the original Irish, with English metrical translations by Thomas Furlong, were printed in Hardiman's *Irish Minstrelsy* (1831). Many of his songs were preserved among the Irish manuscripts in the British Museum.

OCCAM, WILLIAM OF (*c.* 1300–1349), English schoolman, known as *Doctor invincibilis* and *Venerabilis inceptor,* was born at Ockham, Surrey, and after joining the Franciscans, studied from 1312 to 1318 at Merton college, Oxford, where he taught until 1324, when he was summoned to Avignon to account for some of his doctrines. While he was confined to his convent, in 1326, John XXII ordered various theses from his works to be examined by the masters of theology, but his works were not actually condemned. Two years later his championship of the Spirituals brought him into a further conflict with the pope, and as a result, he and Michael of Cesena, general of the order, joined the emperor Louis of Bavaria, who was at that time in contest with the papal curia. It was for Occam's share in this controversy that he was best known in his lifetime. Michael of Cesena died in 1342, and Occam, who had received from him the official seal of the order, was recognized as general by his party. He probably died at Munich in 1349, having tried to be reconciled with the church after the death of the emperor.

Occam was one of the most interesting figures in the great contest between pope and emperor, which laid the foundation of modern theories of government, in the disintegration of scholasti-

cism and in the rise of theological scepticism. In the *Opus nonaginta dierum* (1330) (written in reply to John XXII.'s libellus against Michael of Cesena), and in its successors, the *Tractatus de dogmatibus Johannis XXII. papae* (1333–34), the *Compendium errorum Johannis XXII. papae* (1335–38) and in the *Defensorium contra errores Johannis XXII. papae* (1335–39), Occam only incidentally expounds his views as a publicist, the *Compendium* being of special interest because it selects four papal constitutions which involved a declaration against evangelical poverty, and insists that they are full of heresy. The *Super potestate summi pontificis octo quaestionum decisiones* (1339–42) attacks the temporal supremacy of the pope, insists on the independence of kingly authority, which he maintains is as much an ordinance of God as is spiritual rule, and discusses what is meant by the State. His views on the independence of civil rule were even more decidedly expressed in the *Tractatus de jurisdictione imperatoris in causis matrimonialibus,* in which he contends that it belongs to the civil power to decide cases of affinity and to state the prohibited degrees. By 1343 his great work the *Dialogus* (*see* Goldast ii. 398–957), in which he attempted to summarize his views, was in circulation. His last work, *De Electione Caroli IV.*, restates his opinions upon temporal authority.

In philosophy, Occam's most significant doctrines fall within the departments of psychology, metaphysics and theology. In the first, he contends that since singulars alone exist, the universal, which is a kind of mental label, has an objective value only inasmuch as it is thought; that the *intellectus agens* and the *species intelligibiles* are superfluous because abstraction follows naturally upon perceptions or intuition, the fundamental form of human knowledge; that will and not intellect is the primary faculty of the soul, and that both faculties, like memory, are identical with the substance of the soul; and that a *forma corporeitatis* must be admitted if the independence of the soul is to be preserved. In metaphysics, Occam teaches that matter has its own essence apart from form; that accidents are only aspects of substance; that the problem of individuation is meaningless because each thing is singular in itself, and that between essence and existence there is no real distinction. The famous dictum—*Essentia non sunt multiplicanda praeter necessitatem*—has become known as "Occam's Razor," but it was already stressed by Duns Scotus. In theology, Occam's scepticism is especially noticeable in his assertion that the existence of God and His attributes, including His unity and infinity, are not strictly provable. According to Occam, the most characteristic activity of God is willing, and moral laws are good only because God wills them and not in their own right.

Bibliography.—Occam's political works were edited by Goldast (Frankfurt, 1614) and further mss. by R. Scholz (Rome, 1914). The *Dialogus* appeared separately in 1495, the *Defensorium contra Joannem XXII.* in 1513, and the *De Imperatorum et pontificum potestate* in 1927 (edit. C. K. Brampton). Of the non-political works, the *Commentary on the Sentences* appeared in 1483 and 1495, the *Quodlibet* in 1487 and 1491 and the logical treatises fairly frequently in the 15th and 16th centuries.

See Prantl, *Geschichte der Logik* (1855–70); Riezler, *Die literarischen Widersacher der Päpste zur Zeit Ludwig des Baiers* (1874); A. J. Little, *Grey Friars in Oxford* (1892); F. Bruckmüller, *Die gotteslehre W. v. Ockham* (Munich, 1911); L. Kugler, *Der Begriff d. Erkenntniss bei W. v. Ockham* (Breslau, 1913); J. Hofer, "Biographische Studien über W. von Ockham" in *Arch. Fran. Hist.* (1913); R. L. Poole, *Illustrations in Mediaeval Thought* (2nd ed., 1920); A. Pelzer, "Les 51 articles de G. d'Occam censurés à Avignon en 1326" in *R. Hist. eccles.* (1922); F. Federhofer, "Ein Beitrag zur Bibliographie und Biographie des W. v. Ockham" in *Philos. Jahrb.* (1925), and "Die Psych . . . W. v. Ockham," in *Philos. Jahrb.* (1926). Full bibliography in Überweg, *Gesch. der Philosophie* (ed. 2, 1928).

OCCASIONALISM, in philosophy, a term applied to that theory of the relation between matter and mind which postulates the intervention of God to bring about in the one a change which corresponds to a similar change in the other. The theory thus denies any direct interaction between matter and mind. It was expounded by Geulincx and Malebranche to avoid Descartes's dualism of thought and extension, and to explain causation.

OCCLEVE (or Hoccleve), **THOMAS** (1368–1450?), English poet, was born probably in 1368/9. What is known of Occleve's life has to be gathered mainly from his works. At eighteen or nineteen he obtained a clerkship in the Privy Seal Office, which he retained on and off, in spite of much grumbling, for about thirty-five years. In 1399 he received a small annuity, which was not always paid as regularly as he would have wished. "The Letter to Cupid," his first poem to which we can affix a date, was translated from *L'Epistre au Dieu d'Amours* of Christine de Pisan in 1402, evidently as a sort of antidote to the moral of *Troilus and Cressida,* to some mss. of which we find it attached. About 1410 he settled down to married life, and the composition of moral and religious poems. His longest work, *The Regement of Princes* or *De Regimine Principum,* written for Prince Hal shortly before his accession, is a tedious homily on the virtues and vices, imitated from Aegidius de Colonna's work of the same name, from the suppositious epistle of Aristotle, known as the *Secreta secretorum* and the work of Jacques de Cessoles (*fl.* 1300) rendered into English later by Caxton as *The Game and Playe of Chesse.*

On the accession of Henry V. Occleve turned his muse to the service of orthodoxy and the Church, and one of his poems is a remonstrance addressed to Oldcastle, calling upon him to "rise up, a manly knight, out of the slough of heresy." Then a long illness was followed for a time, as he tells us, by insanity. His "Dialog with a Friend," written after his recovery, gives a naïve and pathetic picture of the poor poet, now fifty-three, with sight and mind impaired, but with hopes still left of writing a tale he owes his good patron, Humphrey of Gloucester, and of translating a small Latin treatise, *Scite Mori,* before he dies. His hopes were fulfilled in his moralized tales of "Jereslaus' Wife" and of "Jonathas," both from the *Gesta Romanorum,* which, with his "Learn to die," belong to his old age. After finally retiring from his privy seal clerkship, he was granted in 1424 sustenance for life in the priory of Southwick, Hants, on which, with his former annuity, he appears to have lived till about the middle of the century. A "Balade to my gracious Lord of Yorke" probably dates from 1448 or later.

The main interest for us in Occleve's poems is that they are characteristic of his time. They illustrate the blight that had fallen upon poetry on the death of Chaucer. The nearest approach to the realistic touch of his master is to be found in his "Male Regle," which, written about 1406, gives some interesting glimpses of his "misruly youth." But these pictures of 15th-century London are without even the occasional flash of humour that lightens up Lydgate's *London Lackpenny.*

A poem, "Ad beatam Virginem," generally known as the "Mother of God," and once attributed to Chaucer, is copied among Occleve's works in ms. Phillipps 8151 (Cheltenham), and may thus be regarded as his work. Occleve found an admirer in the 17th century in William Browne, who included his "Jonathas" in the *Shepheards Pipe* (1614). Browne added a eulogy of the old poet, whose works he intended to publish in their entirety (*Works,* ed. W. C. Hazlitt, 1869, ii. 196–198). In 1796 George Mason printed six *Poems by Thomas Hoccleve never before printed . . .*; "De Regimine Principum" was printed for the Roxburghe Club in 1860, and by the Early English Text Society in 1897. *See* Dr. F. J. Furnivall's introduction to *Hoccleve's Works; The Minor Poems, in the Phillipps MS. 8151, and the Durham MS. III. 9,* ed. F. J. Furnival; ii. *The Minor Poems in the Ashburnham MS. Addit. 133,* ed. Israel Gollancz; iii. *The Regement of Princes A.D. 1411–12, and fourteen of Hoccleve's minor poems,* ed. F. J. Furnivall (Early English Text Society, 3 vols., 1892–1925).

OCCULTATION, in astronomy, the hiding of one celestial body by another passing in front of it; commonly the passage of the moon or of a planet between the observer and a star or another planet.

OCCULTISM: *see* Magic.

OCEAN AND OCEANOGRAPHY. "Ocean" is the name applied to the great connected sheet of water which covers the greater part of the surface of the earth. But the ocean is less than the hydrosphere in so far as the latter term includes also the water lying on or flowing over the surface of the land. The conception of an encompassing ocean bounding the habitable world is found in the creation myths of the most ancient civilizations. The Babylonians looked on the world as a vast round mountain rising from the midst of a universal sheet of water. In the Hebrew scriptures the waters were gathered together in one place at the word of God, and the dry land appeared. The Ionian geographers looked on the circular disk of the habitable world

as surrounded by a mighty stream named Oceanus, the name of the primeval god, father of gods and men, and thus the bond of union between heaven and earth.

Since the Pythagorean school of philosophy upheld the spherical as against the disk-shaped world, some of the ancient geographers, including Eratosthenes and Strabo, looked upon the hydrosphere as forming two belts at right angles to each other, one belt of ocean following the equator, the other surrounding the earth from pole to pole as in the *terra quadrifida* of Macrobius; while others, including Aristotle and Ptolemy, looked upon the inhabited land, or *oikoumene,* as occupying the greater part of the earth's surface. Until the discovery of America and of the Pacific ocean the belief was general that the land surface was greater than the water surface. (*See* MAP.) Only in the 19th century has the existence of the southern continent been demonstrated within the limits of Antarctica.

Oceanography is the science which deals with the ocean. Of recent years the use of "hydrography" as the equivalent of physical oceanography has acquired a certain currency, but as the word is also used with more than one other meaning (*see* SURVEYING) it ought not to be used for oceanography.

History of Research and Organization.—Research in oceanography began in recent times, especially since the rapid increase in the study of the exact sciences during the 19th century. Observations at sea with accurate instruments became common, and the ships' logs of today are provided with headings for entering daily observations of the phenomena of the sea-surface. The contents of the sailors' scientific logs were brought together by the U.S. enthusiast in the study of the sea, Matthew Fontaine Maury (1806–73), whose methods and plans were adopted at international congresses. Many millions of observations are recorded in ships' logs; this firsthand material is preserved in appropriate offices of various nations. The contents of these logs, it is true, refer more to maritime meteorology than to oceanography properly so called.

This material for the study of the surface phenomena of the ocean has been supplemented in relation to the study of the depths of the ocean, by the records of numerous scientific expeditions and latterly by publications embodying systematic observations on a permanent basis. Valuable observations were made in oceanography during the expeditions of Captain James Cook and the polar explorers, especially those of Sir John Ross in the north and Sir James Ross in the south. The period of deep sea investigation began about 1850 when it became possible to measure ocean depths with precision. (*See* SOUNDING.) At this time, an exact knowledge of the depths of the ocean assumed an unlooked-for practical importance for the laying of telegraph cables at the bottom of the sea. Another stimulus came from the biologists, who began to realize the importance of a more detailed investigation of the life conditions of organisms at great depths in the sea.

These preliminary trips of scientific marine investigation were followed by the greatest purely scientific expedition ever undertaken, the voyage of H.M.S. "Challenger" round the world under the scientific direction of Sir Wyville Thomson and the naval command of Sir George Nares. This epoch-making expedition lasted from Christmas 1872 to the end of May 1876, and gave the first wide and general view of the physical and biological conditions of the ocean as a whole. Almost simultaneously with the "Challenger," a German expedition in S.M.S. "Gazelle" conducted observations in the South Atlantic, Indian and South Pacific oceans; and the U.S.S. "Tuscarora" made a cruise in the North Pacific, sounding out lines for a projected Pacific cable. Since that time investigation has been carried out by ships of all nations, on a scale too extensive for detailed record.

In 1902 at Stockholm was founded the International Council for the Study of the Sea, whose headquarters are in Copenhagen. The idea is to help and control the fisheries in the Baltic, the North sea, the Norway sea and Barents sea, as well as in British and Irish waters. Besides the northwestern European states Portugal, Spain and Italy have also become members of this union, which has done much to improve the instruments and methods of oceanography. Generally, each government has built or fitted out a research steamer for the work. The United States of America, Canada and Japan also take part.

Surface of the Ocean.—If the whole globe were covered with an ocean of uniform depth and at rest, the surface would form a perfect ellipsoid of revolution. But the water surface is broken by land, and the mean density of the substance of the land is 2.6 times as great as that of sea water, so that the gravitational attraction of the land must necessarily cause a deviation of the plumb line toward the continent. Hence, the geoid or figure of the ideal sea surface is not part of an ellipsoid of rotation but is somewhat irregular. Recent pendulum observations have shown great local differences in density in the earth's crust, a marked deficiency of mass under high mountains and excess under the bed of the ocean. The intensity of gravity at the surface of the sea far from land has been measured on several occasions and has been found to be normal. The inequalities of the geoid are not more than 100 m.

In the absence of other forces the sea surface would always coincide with the geoid, but distortions of the ocean surface arise from the effect of the tide-producing forces and from meteorological causes and may be periodic or unperiodic in their occurrence. Except for the tides, they do not amount to more than one or two metres. The atmosphere affects sea level by its varying pressure. Atmospheric precipitation poured into the sea by the great rivers must necessarily maintain a permanent rise of the sea level at their mouths, and from this cause the level around the coasts of rainy lands must be higher than in mid-ocean. The Baltic is fuller in the time of the summer rains than in winter, when the rivers and lakes are frozen and most of the precipitation on the land is snow. A similar range occurs on the Netherlands coast in the North sea, where the maximum level is reached in October, the month of highest rainfall, and there is a range of 200 mm. to the minimum level at the time of least rainfall in early spring. Heating and cooling of the surface layers are accompanied by expansion and contraction and also lead to rhythmic variation of sea level.

In the monsoon regions the half-yearly change from onshore to offshore winds produces noticeable differences in level, the total range being 237 mm. The influence of wind on water level is most remarkable in heavy storms on the flat coasts of the North sea and the Baltic, when the rise may amount to many feet. In the region of tropical storms the extreme winds may cause a heaping-up of water capable of devastating the low coral islands of the Pacific. The old speculations as to a great difference of level between the Mediterranean and the Red seas have been proved by precision levelling to be erroneous.

Deviations from the geoid amounting to more than one metre are also related to the presence of the permanent ocean currents as described below.

Land and Water.—The ocean waters are continuous around the antarctic, and the names Atlantic, Pacific and Indian oceans are applied to the three large "gulfs" that extend northward between the continents. Because of the topographic relationships the North Polar sea is considered as a part of the Atlantic ocean. Southern or Antarctic ocean is sometimes used to designate the waters of the southern latitudes extending from the antarctic to the subtropical convergence (about 40° S.).

Various systems have been proposed and used for designating subareas of the open ocean. Some of these are based on arbitrarily designated boundaries, others make use of the bottom topography and others are based on climate, currents and physical and biological criteria.

Examination of the globe shows that the proportion of water is much greater in the southern hemisphere than in the northern.

All oceans and seas	361.06×10^6km.^{2}	70.8%
All land.	148.89×10^6km.^{2}	29.2%
Northern hemisphere—Oceans and seas .	154.70×10^6km.^{2}	60.7%
—Land . . .	100.28×10^6km.^{2}	39.3%
Southern hemisphere—Oceans and seas .	206.36×10^6km.^{2}	80.9%
—Land . . .	48.61×10^6km.^{2}	19.1%

Relief of the Sea Floor is important for many reasons. It forms the lower and lateral boundaries of the ocean waters; its

elevations impede the free flow of water; it affects the distribution of sediments and is of interest to the geomorphologist and geologist. The development of echo-sounding devices (about 1925) greatly accelerated the study of submarine topography by providing a simple and rapid method of obtaining depth measurements.

The greatest depths occur in the Pacific ocean where soundings of about 10,500 m. have been obtained in the Philippine trench by the "Emden" and more than 10,000 m. in the Japan trench by the U.S.S. "Ramapo." The greatest depth in the Atlantic, 8,750 m., was obtained by the U.S.S. "Milwaukee" in the Puerto Rico trench. The great depths in the Pacific exceed the elevation of Mount Everest by about 1,500 m.

The relative distribution of elevation and depth can be shown by a hypsographic curve, showing two primary levels of reference, one slightly above sea level, the other at depths between 4,000 to 5,000 m. Elevations of more than 1,000 m. on land and depths greater than 6,000 m. represent only a small percentage of the earth's surface. Also, there is only a relatively small percentage of the sea bottom with depth between 200 and 3,000 m. The mean elevation of the land is 840 m. and the mean depth of the oceans is 3,800 m. The hypsographic curve should not be interpreted as an average profile of the land surface and sea bottom because the highest mountains are commonly near the coast line (*e.g.*, west coast of South America) and the greatest depths are found near the margins of the ocean and not in the middle of the oceanic depressions.

The continental shelf, with depths less than 200 m. to 400 m., is of variable width, ranging from about 750 mi. to the north of Norway and the U.S.S.R. to virtually zero off mountainous coasts. It averages about 30 mi. in width. Although the average slope of the shelf is small, detailed surveys reveal minor terraces, ridges, hills and depressions as well as steep-walled canyons, some of which are probably related to erosion and deposition during periods of lowered sea level. The inclination of the continental slope varies between about 2° and 3.5°, being least off low-lying land and steepest off mountainous coasts. Submerged slopes of volcanic islands are similar to the exposed portions and may be as great as 50°.

The *Carte Générale bathymétrique des océans dressée par ordre de S.A.S. le Prince Albert de Monaco,* first issued by Prince Albert of Monaco in 1904 and more recently by the International Hydrographic bureau at Monaco, is the standard representation of oceanic bottom topography. Periodic revisions are made, and the third edition was being issued when interrupted in 1939 by the outbreak of World War II. Smaller and less detailed charts of deep-water topography are published by various national hydrographic agencies.

With the great increase in bathymetric knowledge since 1930, agencies such as the Geological Society of America have sponsored the preparation of detailed charts of the continental shelves and slopes. These have brought to light a complex topography of which the most striking features are submarine canyons which cut into the slope and sometimes across the shelf. Off the Hudson, Congo and Indus rivers are canyons which bear some relation to the rivers. Others occur in areas where there are no large rivers. In general, they are V-shaped in profile, with bottoms sloping continuously outward. Some are winding and many are branched. The larger canyons are comparable in size and relief to the Grand Canyon of the Colorado river. The question as to the origin of these canyons is unsettled.

MARINE SEDIMENTS

Most of the sedimentary rocks on land were deposited under the sea. A study of the various marine environments of deposition, the associated marine organisms, texture, composition and colour of the sediments is therefore of interest beyond the realm of oceanography because only in the sea can be found the answers to many geological problems.

Sir John Murray is credited with the first intensive investigation of marine sediments, and the report on the "Challenger" material (Murray and A. Renard, 1891) set the pattern for many later investigations. The development of chemical and physical techniques has opened new fields of study; for example, X-ray spectroscopy has provided a means for identifying the fine-grained clays which were previously considered to be amorphous material.

Sources of Sedimentary Material.—The materials found on the sea floor can be grouped in six general classes, although the proportions of each may vary between wide limits:

1. *Terrigenous debris,* arising from mechanical disintegration and chemical decomposition of exposed rocks, is carried to the sea.

2. *Volcanic debris* is contributed by land volcanoes as well as those completely below the sea surface. Volcanic ash is carried for tremendous distances in the air and floating pumice is widely dispersed by currents.

3. *Remains of organisms,* principally the hard calcareous skeletal structures of plants and animals, make up a large proportion of many deep-sea sediments and also shallow-water deposits in tropical seas. Skeletal structures of silica are less abundant but are widely distributed. Both plant and animal remains are important. These organic remains correspond to the fossils in rocks.

4. *Inorganic precipitates* are never abundant but are sometimes conspicuous and diagnostically important. Examples are calcium carbonate (in a few areas), dolomite, iron and manganese oxides, phosphatic and barite nodules and, where H_2S is present, ferrous sulphide.

5. *Products of chemical transformation* are minerals formed by the interaction of sea water and rock particles. Examples are glauconite, phosphorite, feldspar, phillipsite and clay minerals.

6. *Extra-terrestrial materials* are extremely rare, but small magnetic spherules and small brown crystalline spherules occurring in red clay are believed to be of meteoritic origin.

Transportation of Sedimentary Material.—Material introduced to the sea by erosion, rivers, the air, or produced in the sea, may be carried for great distances before it reaches its last resting place. With the exception of ice and organic rafting, it is a general rule that small particles, or at least light material, will be carried the greatest distances from their point of origin.

Ice is important only in the higher latitudes. Glaciers carry a heavy load of unsorted rock debris and, when they calve, the resulting icebergs may carry boulders and pebbles as well as finer material thousands of miles before they melt and drop the last of their burden to the bottom. Sea ice near shore is often frozen solid to the bottom during winter. When it thaws on top it may break away and carry with it the frozen sediment which is dumped elsewhere as the thawing continues.

Organic rafting does not carry much material but, like the icebergs, rafts of land vegetation or large seaweeds may transport rocks and pebbles far from land.

Atmospheric transport of volcanic ash distributes this material all over the earth. In areas where strong offshore winds blow across arid regions, as off the west coast of Africa, aeolian debris forms an important constituent of the deep-sea sediments.

Currents carry material in several different ways. Slowly sinking particles will be carried along as they gradually fall toward the bottom. Near and on the bottom, material may be moved by mudflows, sliding, rolling and saltation, or may be carried in suspension. All these processes have their counterparts in the atmosphere in landslides, drifting sand and snow and in dust storms. There is little direct evidence of mudflows, but they are believed to be common in areas of steep slopes and rapid deposition. The eroding velocity required to move particles on the bottom is not well known, but it is believed that a flow of about ten centimetres per second will carry particles less than one millimetre in diameter.

Gross Properties of Marine Sediments.—The over-all characteristics of a sediment are colour, texture and composition. Marine sediments vary from white through gray to black, with additions of various amounts of yellow, red, blue or combinations of these colours. Light-coloured sediments are usually coarse-grained. Black sediments are typical of stagnant conditions. Near rivers the sediments are often reddish, and most shallow terrigenous deposits are green or olive-green. The deep-sea red

clay is reddish or brown in colour, and sediments high in skeletal materials are generally light-coloured. Texture covers a wide range, from boulders and cobbles to those sediments composed entirely of impalpable clay. Most samples contain a range in particle sizes and, except in areas of currents, are not well sorted. The composition is of course an index of the sources of the constituents of a sediment. Microscopic and chemical analyses are the direct ways of determining the composition.

Pelagic and Terrigenous Sediments.—Pelagic sediments are those found in deep water far from land. Materials containing less than 30% of organic remains are called red clay. The organic deposits are then divided into calcareous and siliceous oozes which contain more than 30% of organic remains. Calcareous oozes are: (1) globigerina ooze, in which pelagic foraminiferal remains are dominant; (2) pteropod ooze, containing conspicuous shells of pelagic molluscs; and (3) coccolith ooze, containing large numbers of skeletal fragments of Coccolithophoridae. Siliceous oozes are: (1) diatom ooze, containing principally diatom frustules; and (2) radiolarian ooze, containing abundant skeletons of radiolaria. Terrigenous sediments are variable in colour, texture and composition, but always contain some recognizable terrigenous debris. On the basis of texture they are designated as cobbles, gravel, sand, silt, mud, etc., or combinations of these terms. Some indication of composition or origin is indicated by such terms as calcareous, siliceous, coral, volcanic, glacial, etc., generally prefixed by an adjective describing the colour.

Distribution of Pelagic Sediments.—Red clay and globigerina ooze are the most abundant types. Diatom oozes are restricted to high latitudes, and radiolarian oozes are almost exclusively limited to the Pacific, whereas pteropod ooze is significant only in the Atlantic.

Composition of Pelagic Sediments.—There are three extreme types of pelagic sediments: those completely devoid of organic remains (that is, pure red clay), those entirely composed of calcareous remains and those made up of siliceous remains. Actually, most sediments can be considered as mixtures in varying proportions of the three extreme types, although sediments high in calcareous remains contain few siliceous skeletons, and vice versa. The great differences in texture, physical and chemical composition of the three extreme types are reflected in the properties of a sediment sample. Calcareous sediments usually contain some material larger than 0.1 mm., but broken and disintegrated shells may make up most of the sample. The red clays have a median diameter of about 0.001 mm. Diatoms and radiolarian remains are usually larger than 0.1 mm.

Chemical analyses of red clay (free from calcium carbonate) show that, compared to igneous rocks, it is higher in aluminum, iron and manganese, and lower in calcium, potassium and sodium. The higher proportion of iron and manganese is believed to be the result of deposition of their oxides in the sediments as concretions. Nodules containing these oxides are frequent constituents of red clay. The fine material is believed to originate on land and, to some extent, by the submarine weathering of volcanic material. The following clay minerals have been found in marine sediments: kaolinite, montmorillonite, hydrated halloysite and a muscovitelike clay. Many of these substances are capable of basic cation exchange.

Calcium Carbonate Deposition.—Most of the calcareous deposits are of organic origin, but in certain restricted shallow-water areas, such as in the Red sea and on the Bahama banks, direct chemical deposition occurs. Precipitation of calcium carbonate by organisms is favoured by warm temperatures and by the activity of plants which reduce the total CO_2 content of the water and thus increase the $CO_3^=$ ion concentration. In the open ocean the deposition of calcium carbonate is affected by (1) solution during settling to the bottom and (2) solution on the bottom. The concentration of calcareous debris will depend on these two factors and, in addition, upon the relative rate of accumulation of inorganic debris. Below 3,000 m. the calcium carbonate content decreases rapidly with depth. In the North Pacific the content is relatively low at all depths. The decrease with depth is believed to be the result of solution during sinking and on the bottom, and the anomalous condition in the North Pacific can probably be explained in terms of these factors. Calcareous remains behave as coarse particles and accumulate on topographic highs, whereas the fine-grained clays are swept into the depressions.

Organic matter forms a small but important constituent of the sediments. The decomposable organic debris settling to the bottom forms the source of food for benthic animals and bacteria; in turn, their activities alter the chemical environment on and in the sediment, and burial of organic debris removes from solution significant quantities of carbon, nitrogen and possibly other elements. Organic-matter content averages about 1% in pelagic sediments and 2.5% in nearshore deposits. High values are found in bays, estuaries, isolated basins, fjords and beneath stagnant waters such as the Black sea. In general, the organic-matter content decreases with depth in the sediment core because of bacterial decomposition. Organic material in fossil sediments is believed to be the source of petroleum.

Rates of sedimentation have been estimated by stratigraphic and supply methods. Core samples up to about three metres long taken in the open ocean of the Atlantic have revealed varying composition with depth. Based on the pelagic foraminiferal remains and on the presence of layers containing coarse terrigenous debris, supposedly ice-borne, it has been possible to establish the thickness of the layer deposited since the last glacial period. The average rates for globigerina ooze, red clay and a terrigenous blue mud are 1.2, 0.86 and 1.78 cm. per 1,000 years, respectively.

Other scattered data indicate rates of deposition of the order of 1.0 cm. per 1,000 years or less for pelagic deposits. Although highly variable, it is believed that nearshore deposits accumulate at an average rate of about 10 cm. per 1,000 years.

Factors Determining Character of Sediments.—The factors most important in determining the character of marine sediment are (1) general topography and depth of the site of deposition, (2) relation of site of deposition to sources of inorganic material, (3) physical and chemical conditions in the water column overlying the site of deposition. Topography is, in one sense, a measure of the action of water movements in transporting material, highs being swept clear of fine debris which finds its way into depressions. The various modes of transportation and proximity of sources of material must also be evaluated. The character of the physical and chemical conditions is the fundamental factor in estimating the contribution of calcareous and siliceous skeletal material and of organic matter.

CHEMISTRY OF SEA WATER

If suspended material of organic and inorganic origin is excluded, sea water is an aqueous solution of dissolved solids and gases. For the more abundant elements the early results of W. Dittmar (1884), based on the "Challenger" material, agree well with the best estimates based on analyses up to 1940.

The table contains a list of all elements known to be present as dissolved compounds excluding gaseous oxygen, nitrogen and the inert gases neon, helium and argon. A total of 49 elements are known from direct or indirect analyses.

Chlorine, present as chloride ion, is the most abundant element and accounts for about 55% of the dissolved solids. Six ions, chloride, sodium (30.6%), sulphate (7.7%), magnesium (3.7%), calcium (1.2%) and potassium (1.1%) together make up more than 99% of the dissolved solids. It will be noted that for the following elements ranges in concentration are indicated: silicon, nitrogen compounds, phosphorus compounds, arsenic, iron, manganese and copper. These are substances which are present in small amounts but which are essential to living organisms. Nitrate, phosphate and silicate are often called fertilizers or plant nutrients.

Dissolved Gases.—All the atmospheric gases are present in solution in sea water. In stagnant areas (no dissolved oxygen) hydrogen sulphide is found and methane may be present.

The solubility of oxygen and nitrogen decreases with increasing temperature and salinity. At saturation, the following values occur in water of $Cl = 19‰$.

	Oxygen, ml./l.	Nitrogen, ml./l.
0° C.	8.08	14.40
20° C.	5.38	9.65

Although the ratio of oxygen to nitrogen in the atmosphere is 1:3.7, in the sea water it is about 1:1.7 because of the greater solubility of oxygen.

Dissolved nitrogen gas is not affected by biological activity and is always present at about the saturation value determined by the temperature and salinity. At depths greater than a few hundred metres oxygen is generally below saturation because of its utilization. In large areas of the Pacific at mid-depths it is present in amounts less than 1 ml. per litre. In the euphotic zone (less than 100 m.) photosynthetic activity may increase the oxygen content over the saturation value.

*Elements Present in Solution in Sea Water**
(Dissolved gases not included)

Element	mg./kg. Cl=19 00‰
Chlorine	18,980
Sodium	10,561
Magnesium	1,272
Sulphur	884
Calcium	400
Potassium	380
Bromine	65
Carbon	28
Strontium	13
Boron	4.6
Silicon	0.02 –4.0
Fluorine	1.4
Nitrogen (comp)	0.01 –0.7
Aluminum	0 5
Rubidium	0 2
Lithium	0.1
Phosphorus	0 001–0 10
Barium	0 05
Iodine	0.05
Arsenic	0 01 –0 02
Iron	0 002–0 02
Manganese	0 001–0 01
Copper	0 001–0 01
Zinc	0.005
Lead	0.004
Selenium	0 004
Caesium	0 002
Uranium	0 0015
Molybdenum	0.0005
Thorium	<0.0005
Cerium	0.0004
Silver	0.0003
Vanadium	0.0003
Lanthanum	0.0003
Yttrium	0.0003
Nickel	0.0001
Scandium	0.00004
Mercury	0.00003
Gold	0.000006
Radium	$0.2–3 \times 10^{-10}$
Cadmium	..
Chromium	..
Cobalt	..
Tin	..

*From H. U. Sverdrup, M. W. Johnson and R H Fleming, *The Oceans* (Prentice-Hall, Inc., 1942).

Carbon dioxide in sea water is chiefly present as carbonate and bicarbonate ions balanced against basic cations. It is present in the following forms, and for any given set of conditions an equilibrium prevails:

CO_2 (dissolved) $\rightleftarrows H_2CO_3 \rightleftarrows HCO_3^-$ (bicarbonate) $\rightleftarrows CO_3^=$ (carbonate). To remove all CO_2, a strong acid must be added to sea water. If CO_2 is removed, the equilibrium is shifted toward more carbonate ion; if CO_2 is added, the amounts of bicarbonate and then carbonic acid and dissolved CO_2 increase. In equilibrium with the atmosphere, the amount of free CO_2 and H_2CO_3 solution decreases with increasing temperature.

The *p*H or hydrogen ion concentration depends upon CO_2 content, temperature and salinity, and varies between about 7.5 and 8.4. The higher values occur near the surface and the lower values in water where the oxygen has been consumed and converted to CO_2 in respiration.

The alkalinity is a measure of the basic cations balanced against weak acids (carbonic and boric). It bears a relatively constant ratio to the chlorinity and is affected slightly by precipitation and solution of calcium carbonate.

The solubility of calcium carbonate is not definitely known. Apparently warm surface sea water is nearly saturated or slightly supersaturated, whereas the deeper waters are undersaturated where much oxygen has been consumed.

Effect of Rivers.—The composition of the dissolved salts in river water is variable and depends upon the amount of rainfall and type of rocks and soil which have been in contact with the water. F. W. Clarke (1924) has estimated that rivers each year add 2.73×10^9 metric tons of dissolved solids to the sea. Calcium carbonate is notably more abundant in river water, but in the sea there is a deposition by organisms which probably balances this tendency to increase the content of calcium. Estimates of the age of the ocean based on the present rate of supply of elements by rivers lead to values of about 100,000,000 years, a much shorter time than estimates made by other means.

Geochemistry of the Ocean Waters.—The total amount of dissolved salts in the sea is about 5×10^{16} metric tons. This would form a layer of salts 45 m. thick over the entire earth, or 153 m. thick over the present land area. It is estimated that about 600 g. of rock have been weathered for every kilogram of water in the oceans. Sulphur, chlorine, bromine and boron occur in amounts greater than were present in this amount of rock and were presumably present as volatile substances in the primeval atmosphere. Elements forming relatively soluble compounds, notably calcium, sodium, potassium, magnesium, carbon, strontium, selenium and iodine are present in amounts greater than 1% of the potential supply. Silicon, aluminum and iron which are abundant in rocks are present only as minor constituents in sea water because they do not form soluble compounds.

Composition of Marine Organisms.—Most of the elements listed in the table have been found in organisms, some of which also contain a few rare elements not yet reported directly from sea water. It is best to consider the composition of marine animals in three parts, organic material (soft tissues), skeletal structures and body fluids. The composition of carbohydrates, lipids and proteins are relatively uniform in elementary composition. Skeletal structures vary greatly, and the inorganic solutes in the body fluids are only slightly modified sea water. A comparison of the relative compositions of organisms and the dissolved material in sea water shows that the organisms "concentrate" nitrogen and phosphorus, and sometimes iron and silicon in their tissues and skeletons. Since these elements are scanty they can virtually be exhausted and, hence, produce desert conditions in the sea—barren of plant and animal life because of lack of fertilizers rather than of water.

It has been found that the ratios of carbon:nitrogen:phosphorus in marine organisms and in sea water are virtually constant, 41:7.2:1 by weight or 106:16:1 by atoms. Their depletion through photosynthetic activity and their regeneration during respiratory activity is parallel. Regions low in phosphorus are low in nitrogen and when the oxygen content is low the nutrients are abundant. The surface layers of the open ocean are deserts because of the virtual absence of phosphate and nitrogen compounds. Regions where deeper waters are brought to the surface by winter overturn, mixing or upwelling are the verdant jungles of the sea, teeming with microscopic plant life, zooplankton, fishes and marine birds (*see* MARINE BIOLOGY). In higher latitudes, low temperatures and lack of light limit photosynthesis during the winter and allow time for the regeneration of the nutrient elements. Estimates of total production can be made on the basis of the depletion of nutrients (*see* below).

Salinity and Chlorinity.—In 1902 an international commission established the relationships between salinity, chlorinity and the density of sea water. Salinity is a defined measure of the total dissolved solids (salt content) of the water. The chlorinity is an easily measured quantity obtained by titrating sea water with silver nitrate following a prescribed method. The two are related as

$$\text{Salinity} = 0.03 + 1.805 \times \text{chlorinity}.$$

Both terms are always expressed as grams per kilogram, that is, parts per thousand, for which the symbol ‰ is used.

In the titration with silver nitrate, bromides and iodides are precipitated with the chlorides but are computed as if they were chlorides. Hence, the chlorinity is greater than the chloride content. Because changing atomic weights slightly affect this relationship and because of the difficulty of preparing standard chloride

solution of sufficient accuracy, all oceanographic work is based on "normal water" (*eau de mer normale*) prepared under the auspices of an international commission.

The validity of the salinity: chlorinity relationship depends on the results of careful chemical analyses which have shown that, regardless of where the water is collected, the ratios between the abundant elements are virtually constant. Slight variations are known to occur in certain elements affected by biological activity, and in areas of high dilution the concept of constant composition is not valid because the ratios of dissolved salts in river water are variable and different from those in the sea.

Because of the constancy of composition, the density at a given temperature is related to the salinity and chlorinity; and if one of them is known, the others can be obtained from M. Knudsen's *Hydrographical Tables*. Salinity is rarely measured directly and the chlorinity titration is the standard method of determining the concentration of sea water. Density and certain other physical properties are also used. Density measurements are made with pycnometer bottles, by total immersion hydrometers, or floats. Electrical conductivity and refractive index methods have also been devised. Since density and the other properties depend on temperature, they are always standardized against chlorinity measurements on control samples.

Temperatures in the oceans range from about $-2°$ C. to more than $30°$ C. The lowest value is limited by the freezing point of sea water, and the upper limit by processes of radiation and exchange of heat with the atmosphere. Temperatures higher than $30°$ C. may occur in land-locked tropical seas such as the Red sea and the Persian gulf. The range in salinity is generally between $33^0/_{00}$ and $37^0/_{00}$. The surface salinity in high latitudes, in regions of heavy rainfall and off large rivers, may be much lower, and in certain semienclosed areas, such as the Gulf of Bothnia, may approach zero. In isolated seas in intermediate latitudes, such as the Red sea, the salinity may exceed $40^0/_{00}$.

A representative salinity of $35^0/_{00}$ or a chlorinity of $19^0/_{00}$ ($S=34.325^0/_{00}$) is often used in discussions of the composition of sea water.

Pressure.—Hydrostatic pressure is expressed in atmospheres or units of the centimetre-gram-second system. An atmosphere is equal to 1.0133×10^6 dynes/cm². One million dynes per square centimetre was designated as 1 bar by V. Bjerknes. The unit in common use in oceanography is the decibar, one-tenth of a bar. One atmosphere corresponds to approximately ten metres of water; therefore, depths in metres and pressures in decibars are expressed by nearly the same numerical value.

Pressures range from zero at the surface, neglecting atmospheric pressure, to more than 1,000 atmospheres (about 15,000 lb. per square inch) or 10,000 decibars in the deepest parts of the ocean.

Density of Sea Water.—Density is the mass per unit volume and is usually reported as grams per cubic centimetre. The density of sea water depends upon its temperature, salinity and the hydrostatic pressure. Density is represented by the symbol $\rho_{s,t,p}$, the subscripts indicating the three variables. Since the density of sea water is in the range 1.000 to 1.040, it is common practice to report σ_t values where

$$\sigma_t=(\rho_{s,t,p}-1)\ 1{,}000.$$

If the water is at $0°$ C. and atmospheric pressure, the direct relationship between density, salinity and chlorinity is given by M. Knudsen's *Hydrographical Tables*. At any other temperature the correction for the thermal expansion can be obtained from the same source. The compressibility correction necessary for computing the density *in situ* was derived by Bjerknes and J. W. Sandström.

In oceanographic work the specific volume (α) is often used instead of the density. Because the range in values is small it is convenient to employ specific volume *anomalies* which are indicated as δ where

$$\delta=\alpha_{s,t,p}-\alpha_{35,0,p},$$

the value of $\alpha_{35,0,p}$ being that of water of salinity $35.0^0/_{00}$, temperature of $0°$ C. at the indicated pressure, p, expressed in decibars. Tables for obtaining δ are given by H. U. Sverdrup, M. W. Johnson and R. H. Fleming.

PHYSICAL PROPERTIES OF SEA WATER

The properties of pure water are dependent upon temperature and pressure; those of sea water are also affected by the salinity. Details concerning the physical properties can be found in the International Critical Tables and are stated by N. E. Dorsey, and by Sverdrup *et al.* Earlier compilations are given by O. Krümmel.

Heavy water (deuterium oxide) is present in sea water in amounts greater than in fresh water or rain water. The ratio of hydrogen to deuterium is about 7,000: 1.

Thermal expansion increases with temperature, pressure and salinity.

Thermal conductivity is essentially the same as for pure water. The molecular transfer of heat, however, is rarely a significant process in the sea, where the state of motion results in eddy conductivity which is many times greater.

Specific heat at constant pressure decreases slightly with increasing salinity, temperature and pressure.

Latent heat, the amount of heat required to produce one gram of water vapour at the same temperature as the water, decreases with increasing temperature. Between $0°$ and $30°$ C., latent heat in calories $=596-0.52\times t°$ C.

Adiabatic temperature changes must be taken into account in studying the temperature distribution in the deep basins. Compression results in heating, expansion or pressure release in cooling. Although the effect is small, water raised from 10,000 m. will cool more than $1°$ C. when brought to the surface. The adiabatic gradient is approximately $0.1°$ C. per 1,000 m.

Colligative properties, vapour-pressure lowering, freezing-point depression and osmotic pressure depend upon the salinity. The effects of temperature on all of these properties is believed to follow the usual relationships for solutions.

Maximum density of pure water is at nearly $4°$ C. For sea water the temperature of maximum density decreases with increasing salinity. For salinities greater than about $25^0/_{00}$ the temperature of maximum density is below the freezing point; hence, the water continues to cool and mix until freezing occurs at the surface.

Compressibility must be known to compute density *in situ.* It decreases with increasing temperature, salinity and pressure.

Viscosity and diffusion, like thermal conductivity, have little effect on the transfer of momentum and of chemical properties because of the dominant role of turbulent transfer. Eddy coefficients much greater than the laboratory values, but highly variable, are found in the sea.

Surface tension decreases with increasing temperature and increases slightly with salinity. Organic substances in solution often reduce the values below those for "pure" sea water.

Refractive index has been used as an indirect method for measuring the salinity. It increases with salinity and decreases with increasing temperature.

Electrical conductivity has also been used for an indirect method of determining salinity. The conductivity increases with salinity and temperature.

Velocity of sound in sea water increases with increasing temperature, salinity and pressure, with extreme range of values between about 1,450 and 1,550 m. per second. Water is a good conductor of sound, absorption losses being negligible except at supersonic frequencies. Echo-sounding systems are based on timing the interval required for a sound impulse to travel from the ship to the sea bottom and for the echo to return to the ship. Horizontal transmission of sound is used in surveying work (radioacoustic-ranging).

Absorption of radiation (transparency and colour). The penetration of light in the sea is important not only in heating the water but also to the photosynthetic activity of plants and to the vision of animals. Pure water is most transparent to radiation in the blue and green portions of the spectrum; thus, sunlight transmitted through clear water appears blue. Studies of sea water indicate values approaching those of pure water but in many areas,

particularly near shore, the transparency is much reduced and there is a shift in the colour of the transmitted light toward the green and yellow.

The reduced transparency in the sea is believed to be caused by minute particles of dust and organic debris that scatter the light. In coastal waters organic debris and a dissolved yellow substance, probably of organic origin, contribute greatly to the reduced transparency.

Water is virtually opaque to ultra-violet and infra-red radiation. Approximately 50% of the sun's radiation is in the long-wave, infra-red region and is absorbed in the first few centimetres of water.

The transparency of sea water has been studied by means of the Secchi disk, by spectrophotometers and by photoelectric cells with filters which are lowered in the sea. Photographic plates exposed at depths as great as 1,000 m. have shown some fogging, but the amount of light present below 500 m. in clear tropical latitudes is probably inadequate for vision. In coastal waters this limit of visibility may be as shallow as 50 m.

The colour of the sea ranges from a deep blue in areas of clear water such as the Sargasso sea and the Mediterranean to blue-green and green, and a greenish-brown near shore. The colour of the water is usually recorded on the "Forel scale," which is an arbitrary series of colours ranging from blue to yellow. The blue colour is attributed to the scattering of light by extremely minute particles and possibly by molecules so that it is comparable in origin to the blue of the sky. Near shore the green and yellow are associated with plankton, organic and inorganic debris and yellow pigment. The sea surface is sometimes discoloured by concentrations of debris or living organisms. "Red water" is common in certain areas where tremendous concentrations of algae or dinoflagellates occur. The Red sea and the Vermilion sea (Gulf of California) are named for such phenomena.

ICE IN THE OCEAN

Ice in the ocean occurs as icebergs or as sea ice. Icebergs are formed by the "calving" of glaciers and consist therefore of pure ice. Sea ice is ice that forms when sea water freezes and generally contains salt. There is an elaborate terminology to describe icebergs and sea ice.

When sea water is cooled to its freezing point, which lies below that of fresh water, elongated crystals of pure ice are first formed. These grow rapidly into a matrix in which sea water becomes trapped in amounts which depend upon the rate of freezing. Sea ice therefore consists of pure ice full of small cells that contain brine. When the temperature of the ice decreases, the cells decrease in size and the brine becomes more concentrated. On the other hand, when the temperature of the ice rises, the cells increase in size and the brine becomes diluted. When the temperature of the ice approaches the freezing point of pure ice (0° C.), the ice becomes honeycombed and the brine trickles down, leaving the upper layers free from salt. Thus, at the end of the summer the tops of hummocked arctic ice consist of pure ice which on melting renders potable water.

The physical properties of sea ice depend upon the salt content of the ice and upon the presence of air bubbles.

OCEANOGRAPHIC METHODS

Oceanographic studies fall into two general groups, those observations which must be made *in situ,* and those that can be made on collected samples which, once obtained, can be examined at a later time either on shipboard or in the laboratory. In the first group of observations are soundings, observations of water movements (currents, waves and tides), temperature, transparency and certain other physical properties. In the second group are studies of the chemical and physical properties of the water, examination of biological collections and marine sediments, which are nearly always based on a laboratory examination of the samples. Rather specialized devices are necessary for making observations and collecting samples from below the sea surface.

Soundings in deep water are obtained by paying out a single or multistrand wire with a weight attached to the end. When the weight strikes the bottom, the tension on the wire is reduced and the amount of wire paid out is read off on a "metre-wheel." Depths greater than 10,000 m. have been measured in this way. The introduction of sonic-sounding (echo-sounding) devices has simplified this phase of the investigations.

Subsurface temperatures are usually measured by means of reversing thermometers, first developed about 1878. These are special mercury-in-glass instruments enclosed in a heavy glass sheath to protect them from pressure. These devices will measure temperatures with an accuracy of ±0.02° C. and can be used to the greatest depths. They are usually attached to the water-sampling bottles and lowered on a heavier wire rope than that used for sounding. Reversing thermometers, although extremely accurate, do not provide detailed information on the vertical distribution of temperature. To obtain such information continuous temperature recorders, such as the bathythermograph, have been devised, which can be lowered from a vessel under way and which record temperature against depth in the upper 300 m.

Water samples for salinity determination and for physical and chemical examination are obtained by special metal "bottles" which usually have the thermometers attached to them. One or more of these bottles are attached to the wire rope and lowered while open. At the required depth a messenger is dropped down the wire which activates a mechanism closing the first bottle and releasing another messenger which closes the second bottle, and so on. When all bottles have closed, they are raised to the surface and emptied into special glass bottles for later study.

Bottom samples are collected by means of snappers, coring tubes and dredges, and for work in deep water these are usually massive and require heavy gear for lowering and raising them. Snapper samplers are built like clam shells and scoop up a sample of the superficial layers of the sediment. Coring tubes are driven into the sediment by heavy weights or by an explosive charge which is detonated when the device strikes the bottom. Cores up to about 10 m. in length have been collected in depths as great as 4,000 m. Snappers and coring tubes can be used only in sand and soft sediments. To collect samples of rock it is necessary to use drag buckets or strengthened types of dredges similar to those used in biological collecting. Methods used to collect plants and animals are described elsewhere (*see* MARINE BIOLOGY).

TEMPERATURE AND SALINITY

Heating, Cooling and Evaporation.—The surface layers of the oceans receive heat by absorption of radiation from the sun and the sky and lose heat by back radiation, by conduction to the atmosphere and by evaporation. Heat is also transported into or out of any region by currents. The temperature in a given area depends, therefore, in a complicated manner upon the season, the circulation of the atmosphere and the currents. Although a small amount of heat is conducted through the ocean bottom from the interior of the earth, its effect on temperature distribution is masked by features related to the circulation of the water.

Evaporation takes place when the vapour pressure at the sea surface is greater than that in the air, and this condition always exists when the sea surface is warmer than the air. The greatest contrasts between air and sea temperatures are found in winter off the eastern coasts of the Asiatic and North American continents when cold polar continental air flows out over the warm waters of the two mighty currents, the Kuroshio and the Gulf stream. Therefore, by far the largest evaporation takes place off the eastern coasts in winter. Simultaneously, the air is heated and will arrive on the west coasts of the continents as moist and warm air. The oceans function as a huge system of circulating warm water; the surface layers are heated in summer, and the warm waters are carried north along the east coasts of the continents where in winter they give off part of their heat content to the air and supply the atmosphere with moisture.

Temperature and Salinity of the Sea Surface.—Merchant ships of different nations have collected from the oceans so many observations of sea-surface temperatures that it has been possible to prepare charts showing the average annual temperature of the sea surface as well as mean monthly temperatures.

Over the large tropical areas of the oceans the average sea-surface temperature is above 25° C., exceeding 27° in the Atlantic ocean and 28° in the Pacific and Indian oceans. According to Otto Krümmel, the percentage areas of the different oceans of high surface temperature are as follows:

Percentage of Ocean Surface

With temperature	Atlantic	Indian	Pacific
Above 77° F. (25° C.)	22.4	38.0	40.1
Above 68° F. (20° C.)	50.1	51.7	58.4

In the Atlantic and Pacific oceans these warm areas are narrow in the eastern parts of the seas and wide in the western parts, but in the Indian ocean this feature is reversed. To the north and south of the warm region the sea-surface temperature decreases and the isotherms tend to run east-west. There are many exceptions to this rule, however, particularly in the eastern parts of the Atlantic and Pacific oceans where the currents exercise a great influence upon the course of the isotherms.

The annual variation of the sea-surface temperature is small in the tropics where the annual range is only 1°–2° C. In the southern oceans the annual range reaches a maximum of 5°–6° C. in about lat. 35° S. and decreases again to about 2° C. in the antarctic water. In the North Pacific and the North Atlantic oceans the average annual range reaches about 9° C. in lat. 40° N. and decreases to a small value when approaching the arctic. In the northern oceans the east-west variation in annual range is more conspicuous than the north-south. Thus, in lat. 40° N. the annual range of surface temperature is about 17° C. on the east coast of Japan as compared with 4° C. on the American west coast. This and similar contrasts are related to the character of ocean currents.

The diurnal range of the sea-surface temperature is small throughout. In the tropics the range is from 0.2° to 0.3° C. and in middle latitudes in summer it is about 0.4° C. The range depends upon the altitude of the sun at noon, the cloud cover and the wind velocity. It increases with increasing noon altitude of the sun and decreases with increasing cloudiness and wind.

The salinity of the surface water is less well known because the determination of the salinity is more difficult than the measurement of the sea-surface temperature. Most of the available data are obtained from analysis of water samples collected by merchant ships. They are sufficient for the construction of charts showing average salinity but the seasonal variation in salinity can be examined in limited areas only.

In each of the oceans the average sea-surface salinity in any latitude is, according to Georg Wüst, equal to a basic value plus a term which depends upon the difference between evaporation and precipitation:

$$S=S_0+k(E-P)$$

where S is the average surface salinity, S_0 the basic value, E the evaporation (in centimetres), P, precipitation (in centimetres) and k is a constant. The constant k is the same for all oceans, but the basic salinity value differs from ocean to ocean. For the southern oceans, the South Atlantic and the South Pacific, the values are similar, 34.50‰ (parts per thousand) and 34.64‰, respectively, but for the North Atlantic the basic value is 35.30‰ and for the North Pacific it is 33.7‰. The Indian ocean has not been examined. The higher value for the Atlantic is probably related to the outflow of high-salinity water from the Mediterranean.

According to the above formula, a high surface salinity is found where evaporation greatly exceeds precipitation, and a low surface salinity is encountered where precipitation exceeds evaporation. Thus, belts of maximum salinity are found in both hemispheres in latitudes 20° to 25° where precipitation is small. The extremes are about 37.5‰ in the North Atlantic, 37.0‰ in the South Atlantic, 35.5‰ in the North Pacific and 36.5‰ in the South Pacific and Indian oceans. The belts are separated from each other by an equatorial region of lower salinity, 34.0 to 35.0‰, corresponding to the equatorial rain belt, and poleward salinities lower than 34.0‰ are found, corresponding to decreased evaporation and increased precipitation.

Only the major features of the salinity distribution are governed by this simple relationship. Details are related to the currents and, near land, are influenced by outflow of river water. In enclosed seas into which rivers empty, like the Black sea or the Baltic, low surface salinities are found, but in arid regions the salinity of an enclosed sea may be high. Thus, in the Red sea the salinity may exceed 41‰.

In the open ocean the seasonal variation of salinity appears to be small, but in coastal areas large variations occur associated with changes in discharge of river water and changes in currents.

Subsurface Temperature and Salinity.—Processes of mixing tend to produce a surface layer of nearly uniform temperature and salinity. In the tropics the intensity of mixing is nearly the same throughout the year, but in higher latitudes it is much more intense in winter than in summer. In winter it reaches to a depth of 100 to 300 m., and serves to return plant nutrients, phosphates and nitrates to the upper layers. Below the depth to which the winter mixing reaches, there is generally a layer, within which the temperature decreases rapidly with depth, which is called the main thermocline. This layer is not horizontal but is inclined, depending upon the currents. In the northern hemisphere it drops to the right relative to an observer with his back to the current. In summer the mixing penetrates to shallower depths only, depending upon the force of the prevailing wind and other factors. Below the depth to which the summer mixing reaches, is found a seasonal thermocline which in any given locality varies greatly in sharpness and depth.

Below the main thermocline, or roughly below a depth of 300 m., the temperature and salinity in any locality remain constant throughout the year except for such fluctuations as are related to fluctuations in currents. Temperature and salinity vary both horizontally and vertically, however, and these variations are closely related to the character of the oceanic circulation, as described later on.

In an examination of subsurface temperatures and salinities two useful tools have been introduced. B. Helland-Hansen showed that, when in a given region the temperature is plotted against the salinity, the observed values fall on a curve which defines a characteristic temperature-salinity relationship. On the basis of an analysis of such temperature-salinity relationships it has been possible to show that within each ocean characteristic water masses exist comparable to the air masses, which are discussed when dealing with the atmosphere. These relationships have been useful in studying the origin, depths of spreading and modifications of the water masses.

In each ocean there exist water masses which appear embedded between waters of different characteristics and which, with increasing distance from their region of origin, become mixed with the surrounding waters and lose their identity. Thus, the water which flows out from the Mediterranean along the bottom of the Straits of Gibraltar has a high salinity, and between latitudes 50° N. and 40° S. can be traced over the entire eastern North and South Atlantic by means of a salinity maximum at depths varying from 1,000 to 2,000 m. Similarly, low-salinity water sinks in the Antarctic in about lat. 50° S. and spreads to the north, where in the Atlantic ocean it can be traced to 20° N., and in the Indian and Pacific oceans to about 10° S. For tracing the spreading of such special masses, Wüst developed "the core method," the principle of which is to follow maxima or minima of temperature and salinity which are found near the centre, or core, of the water mass. The two methods, together with an examination of the oxygen content, have greatly clarified our concepts of the deep-water circulation of the oceans.

Basins.—Large bodies of ocean water, such as the waters of the Mediterranean, the Black sea, and the Red sea, are enclosed in basins which are in communication with the open oceans through narrow and shallow straits. In other instances the openings to the open ocean may be wide and fairly deep, but the sill depth in the openings may still be small compared with the depths on either side. Examples of such basins are found in the Caribbean sea, the Gulf of Mexico and between the islands of the East Indian archipelago.

Basins can be divided into two types, depending upon the man-

ner in which exchange of water with the ocean takes place. In one type, water flows in along the surface of the openings and out along the bottom, and in the other type the outflow takes place at the surface and the inflow along the bottom. In all cases the water in the basin will be uniform, but in the first type the basin water is formed by sinking of surface water in the basin itself, and its character depends upon the particular climatological conditions of the region. This, for instance, is the case in the Mediterranean and in the Red sea, where basin waters have a high salinity and a temperature corresponding to the lowest winter temperature in the area, in the Mediterranean a salinity of 38.6‰ and a temperature slightly above 13°, in the Red sea a salinity of about 40‰ and a temperature of about 20°. In the other type, the basin water has the character of the oceanic water that flows in over the sill, but the exchange is often so slow that the water in the basin is practically stagnant. This is the case in the Black sea where water diluted by run-off flows out along the surface of the Bosporus and where Mediterranean water flows in along the bottom, mixes with the outflowing water and reaches the Black sea with a salinity of about 22‰ and a temperature of 8°–9° C. In the Black sea this water is stagnant so that instead of containing oxygen it contains large quantities of hydrogen sulphide. Similar basin conditions are found in a number of fjords.

Where many wide openings exist, the surface water often flows freely through several openings, and the character of the water in the basin is determined by that of the oceanic water at the greatest sill depth. In these instances the renewal of the basin water is more rapid, and stagnating conditions are not encountered. In several of these basins the salinity of the basin water is uniform, but the temperature increases toward the bottom, corresponding to the effect of adiabatic processes. Thus, in the Mindanao trench the salinity below a depth of 3,500 m. remains constant at 34.67‰, but the temperature increases from 1.58° at 3,500 m. to 2.48° at 10,000 m., corresponding nearly to the increase which would result if water of a temperature of 1.58° were lowered adiabatically from a depth of 3,500 m. (a pressure of about 350 atmospheres) to a depth of 10,000 m. (a pressure of about 1,000 atmospheres).

OCEAN CURRENTS

Relation between Currents and Distribution of Temperature and Salinity.—The existence of large-scale permanent ocean currents is related to the fact that the sea surface is not flat but in many areas is inclined relative to the true horizon. Where the sea surface is inclined, the water tends to run downhill; but the effect of the earth's rotation enters so that the current runs, instead, parallel to the height contours of the sloping sea surface. It is well known that the wind does not blow from regions of high pressure to regions of low pressure, but that in the northern hemisphere, an observer with his back to the wind has the high pressure on his right and the low pressure on his left. This experience is explained by stating that the wind blows in such a manner that the pressure gradient is balanced by the deflecting force of the earth's rotation (the Coriolis force) which is directed at right angles to the motion, in the northern hemisphere to the right and in the southern hemisphere to the left. Similarly, an observer facing in the direction in which a current flows has, in the northern hemisphere, the sea surface rising on his right and dropping on his left, and the component of gravity acting along the sloping sea surface is balanced by the Coriolis force. The slope of the sea surface, however, is small. Off Cape Hatteras, where the Gulf stream flows toward the northeast with a speed of up to 3 knots, the sea surface rises to the southeast with a slope of 1.5:100,000. That is, it rises about 1 ft. in 11 nautical miles.

Observations show that the permanent currents extend to depths of several hundred metres, but their speed decreases with depth. The existence of these currents demonstrates that the gentle slopes of the sea surface are also permanent features which are related to the distribution of density. At great depths the density of the water is nearly uniform and, since the currents are weak, the pressure is nearly constant in any level surface. The heights of the water columns which exert this constant pressure depend, however, on the average density of the water. Where the average density is low, the water column is long; and where it is high, the water column is short. Consequently, the free surface of the sea must slope down from regions of low density to regions of high density or, since low density is generally equivalent to high temperature and high density is equivalent to low temperature, it can also be stated that the sea surface slopes down from warm regions to cold regions. Since a current flows along the contour lines of the sloping sea surface, one has the simple rule that a current flows in such a direction that in the northern hemisphere the warm water is on the right and the cold on the left of an observer looking downstream. Where a deep mixed layer exists, the rule indicates that the depth of the main thermocline increases to the right.

With this rule in mind, the general relationship between temperature distribution and currents is readily recognized. Thus, the Gulf stream off the North American east coast has the warm waters of the Sargasso sea on the right and the cold coastal waters on the left. The branch of the Gulf stream that flows along the west coast of Norway has the warm waters on the right, the coastal side, and the cold waters of the Norwegian sea on the left, and the south-flowing California current has the cold waters on the left, in this case on the coastal side.

Computation of Ocean Currents.—Ships' observations have rendered information as to the surface currents, and charts of surface currents have been prepared by the hydrographic offices of different nations. Few direct observations of subsurface currents are available, and our knowledge of these is mainly based on computations, using the above stated relationship between the distribution of density and the currents. Numerous deep-sea observations of temperature and salinity have been made from which the density at different depths can be found. Knowing the density, it is possible to compute the slope of the ocean surface, and of any other surface of constant pressure, relative to the slope of a selected pressure surface. Using the rule that when steady conditions exist, the component of gravity acting along a sloping pressure surface must be balanced by the Coriolis force, the currents can be computed relative to the unknown current at the selected standard surface. If it can be shown that at this surface the currents are weak, the computation renders the true currents.

This method was first proposed by H. Mohn and was later further developed by B. Helland-Hansen on the basis of the investigations by V. Bjerknes. The computations are now carried out by means of convenient tables and have given a fairly complete picture of the currents above a depth of about 1,000 m. At greater depths the currents are so weak that conclusions as to the direction of flow have to be based upon special features of the distribution of temperature and salinity.

Ocean Currents and Winds.—The relation between the ocean currents and the distribution of temperature and salinity has been described above, but nothing has been stated as to the manner in which the currents are maintained. Turning to that question we find that the oceanic circulation can conveniently be considered as composed of two systems: (1) a system of fairly rapid currents which are mainly confined to the upper 1,000 m. or less and are maintained by the prevailing winds, and (2) a system of slow and sluggish currents which reach to the ocean bottom and are caused by sinking of water that, in the enclosed seas of lower latitudes, has attained a high density by evaporation, and in high latitudes by cooling or by freezing of ice.

The prevailing winds exercise a twofold influence upon the ocean circulation. In the first place they maintain shallow wind currents, and in the second place they maintain the distribution of density to which the major currents are related. The nature of a pure wind current was first examined by V. W. Ekman, following a suggestion by F. Nansen, and was later studied by C. G. Rossby. Their theories have been developed on the assumption that the Coriolis force associated with the motion is at each depth balanced by a frictional force. The theoretical conclusion is that at the sea surface the current is directed about 45° from the wind, to the right in the northern hemisphere and to the left in the southern. With increasing depth the direction of the current turns right

(left) and the velocity decreases until at a depth of 50–100 m. the direction is opposite to that at the surface and the velocity is only a small fraction of the surface velocity. These conclusions have in the main been substantiated by observations.

The net transport of water by a pure wind current is directed at right angles to the wind, to the right in the northern and to the left in the southern hemispheres. This transport leads to the secondary effect of the permanent winds. Wind currents produced by the semipermanent anticyclonic winds of the subtropics will tend to transport the warm surface waters toward the centre of the anticyclone. Thus, they maintain an accumulation of warm water in the central region of high atmospheric pressure and as a result the sea surface slopes down in all directions from that region. This feature can exist as a permanent feature only in the presence of ocean currents which roughly run in the direction of the prevailing winds. Similarly, where the wind blows along a coast, with the coast on the right-hand side, the pure wind current will push the warm surface waters against the coast and a current must result running parallel to the coast in the direction of the wind. Where the coast is to the left, the warm surface waters are pushed out to sea and are replaced on the coast by cold water which rises from depths of a few hundred metres. This process, which is known as upwelling, occurs characteristically on the coast of California (spring and summer), Peru and northwest and southwest Africa (all year), as well as in other localities during limited periods. In these cases cold water is present along the coast and again a permanent current develops running parallel to the coast and in the direction of the wind.

From the preceding it follows that the permanent ocean currents are maintained by the prevailing winds and tend to flow in the direction of the wind. The currents therefore reflect the circulation of the atmosphere but with such modifications as arise from the effects of the coast lines. The broad equatorial currents flowing to the west are maintained by the steady trade winds. According to the rules which were stated, the depth of the main thermocline must, in the trade wind regions, increase with increasing distance from the equator and, consequently, near the equator water of relatively low temperature must be found at shallow depths. The presence of this water is related to the direction of the currents and is not an evidence of ascending motion, as is often stated.

On reaching the eastern shore of the continents the waters of the equatorial currents must bend north or south. The swift, narrow and warm currents along these shores, the Gulf stream, the Kuroshio, the Brazil current and the Agulhas stream (off southeast Africa) are therefore not maintained by the local winds but by the trade winds. When these currents turn seaward in middle latitudes, the bulk of the waters is soon deflected equatorward and the currents off the western coasts of the continent are broad, weak and cold (the Canary current, the California current, the Peru (Humboldt) current and the Benguela current). Where the coast lines permit circulation in higher latitudes, the contrast between eastern and western coasts is reversed. Thus, in the Norwegian sea the cold East Greenland current flows south off the coast of Greenland whereas a warm branch of the Gulf stream system flows north off the west coast of Norway.

The equatorial counter currents, which, in the calm belts, flow to the east as swift and narrow currents embedded between the equatorial currents, are also maintained by the winds but in a more complicated manner. The drag of the trade winds blowing to the west is not completely compensated for by the transport related to wind currents, but the drag also pulls the warm surface waters toward the eastern coasts of the continents. Consequently, sea level is a little higher off the eastern than off the western coasts, the difference in elevation being about 14 cm. in the Atlantic and about 60 cm. in the Pacific ocean, according to oceanographic observations. The equatorial currents, therefore, flow slightly uphill. In the belt of calms or variable winds between the two trade-wind regions there is no drag toward the west which can maintain the up-slope. There the water flows down the sloping surface toward the east, the calm belt lying so close to the equator that the effect of the earth's rotation in deflecting the currents is small. In the Atlantic and Pacific oceans the counter currents are found in 5°–10° N. and vary in intensity with the seasons, but in the Indian ocean the corresponding current is found in 5°–10° S. only during the season of the northwest monsoon which reaches peak intensity in February–March.

Deep-Water Circulation of the Oceans.—The ocean waters are in stable stratification; that is, the density increases with depth and the deep basins of the oceans are filled by water of a density greater than that at the surface. The difference in density between surface and deep water is particularly conspicuous in the tropics where the surface waters are relatively light because of their high temperature. Wherever the density of surface water is increased by cooling or evaporation so that it becomes greater than that of the surroundings, the water sinks and spreads horizontally when it reaches a layer of the density which it had upon leaving the surface. When surface water sinks, it is replaced by water which rises from some greater depth, and this process is called convection. The depth to which convection extends depends upon the manner in which density increases with depth.

In the tropics, cooling never takes place, and evaporation is not intense enough to increase the salinity to such an extent that water of high density is formed in the open sea. The convection processes in the tropics are therefore limited to a shallow surface layer. In middle latitudes the convection reaches deeper in winter, but only in such enclosed seas as the Mediterranean and the Red sea, where evaporation is great, do they penetrate to great depths. In high latitudes, on the other hand, where excessive winter cooling takes place, the convection processes may reach to the bottom of the ocean.

In the North Atlantic, regions of deep convection are found between Iceland and Greenland and in the Labrador sea, where the North Atlantic water, of a salinity close to 35‰, is cooled during the winter. When this water is cooled to between 2.5°–3° C., it attains the same density as the bottom water, and convection can reach from the surface to the greatest depth. On an average for the whole year, about 4,000,000 tons sink every second and spread as a slow deep-water current toward the south. In sections showing vertical distributions of temperature, salinity and oxygen content, this water can be traced by its high salinity, about 34.9‰, its temperature of about 3° C. and its high oxygen content. It fills all the deep basins of the North Atlantic and continues into the South Atlantic at depths between 2,500 and 3,500 m. as far south as lat. 40° S., where it gradually loses its identity because of mixing with water of antarctic origin. In the upper layers of this water mass the temperature and salinity are increased by addition of water from the Mediterranean. The Mediterranean has the character of a large evaporation basin which, below the sill depth of the Strait of Gibraltar, is filled by water of a uniform temperature of about 13° and a salinity of about 38.6‰. This warm and saline water flows out along the bottom of the Strait of Gibraltar, sinks, spreads and mixes with other water masses over large parts of the North Atlantic at depths between 1,000 and 2,000 m. Some water of Mediterranean origin is carried into the South Atlantic, where it can be traced to the latitude of the Cape of Good Hope. The high salinities and high temperatures at moderate depths in the North Atlantic were previously taken as evidence that high-salinity water was sinking in about lat. 30° N., but this concept can not be upheld.

Sinking of surface waters also takes place around the Antarctic continent. There the salinity of the surface water is generally low, but on the shelf surrounding the continent the salinity is greatly increased in winter by the freezing of ice, and water of a temperature of −1.9° C. and a salinity of 34.6‰ is formed and sinks. During sinking it becomes slightly mixed with water of somewhat higher temperature and salinity and reaches the bottom with a temperature of −0.4° C. and a salinity of 34.65‰. Thus, this water has a lower salinity than the bottom water of the North Atlantic, but it has also a lower temperature and is therefore slightly denser. It spreads toward the north, and in the Atlantic ocean it can be traced to about 10° N. lat.

Characteristic of the Antarctic is also a convergence of the

surface currents, which can be followed all around the continent between latitudes 50° and 60° S. Surface water of salinity 33.8‰ sinks at this convergence and spreads to the north at depths between 600 m. and 1,000 m. Although the salinity of this Antarctic intermediate water increases by mixing as the water spreads toward the north, a salinity minimum can be traced to 30° N. lat. Part of the intermediate water mixes with the underlying water of North Atlantic origin and is carried back again to high southerly latitudes where it rises toward the surface.

The deep-water circulation of the Indian ocean is simpler because the only major source of deep water is found in the south. The Antarctic bottom water and the Antarctic intermediate water can both be recognized, and between them is found a large water mass which contains components of North Atlantic and Antarctic origins. This water moves to the south at depths between 2,000 m. and 3,000 m. and rises to the surface in the Antarctic.

In the northern part of the Indian ocean, conditions are complicated by the spreading of high-salinity water which flows out from the Red sea along the bottom of the Strait of Bab-el-Mandeb. The amount of Red sea water which enters the Indian ocean, however, is much smaller than the amount of Mediterranean water flowing into the Atlantic and the effect upon distribution of temperature and salinity is correspondingly less.

In the North Pacific ocean no region is found comparable to the regions in the North Atlantic where bottom water is formed. To the north of lat. 45° N. the salinity of the surface waters of the Pacific is generally so low, less than 32‰, that, in spite of winter cooling, the density of the surface water never increases enough to develop deep convection. An appreciable deep-water circulation is therefore confined to the region of the South Pacific where, again, the Antarctic bottom water and intermediate water flow north. These waters are mixed with the great bulk of deep water which contains components of Atlantic and Antarctic origins which have passed to the south of the Cape of Good Hope and to the south of Australia and New Zealand. A return flow to the south takes place between depths of 2,000 m. and 3,000 m.

In the North Pacific the deep water is exceedingly uniform and the circulation sluggish, as evidenced by the low oxygen content of the water. Below a depth of 2,000 m. the salinity varies between 34.65–34.7‰ and the temperature between 2° C. and 1.5° C. A slight renewal of deep water probably takes place by exchange with the South Pacific, deep water moving slowly north in the western Pacific and south in the eastern Pacific. This motion is superimposed upon a general clockwise circulation which extends from the surface to the bottom but is slow below a depth of a few hundred metres.

Relation between Oceanic Circulation and Organic Productivity.—Around the Antarctic continent we find not only sinking of surface water but we also find that large volumes of deep water are drawn to the surface. These bring with them relatively high concentration of phosphates, nitrates and other plant nutrients, and the antarctic waters can therefore support a large amount of marine life. The waters are among the most productive of ocean areas, as evidenced by the large whaling industry which has developed in the antarctic since the turn of the century.

In general, regions of high productivity are found wherever an overturn of the surface layers takes place, regardless of the mechanism which brings about such an overturn. In parts of the North Atlantic, vertical convection reaches in winter to the bottom, and by this intense overturn the surface waters are well supplied with nutrients which, in summer when light conditions are favourable, can support enormous populations of diatoms and other minute marine plants.

In other regions of the North Atlantic and over large parts of the North Pacific, the winter convection reaches to depths of a few hundred metres only, but the mixing caused by this convection is sufficient to restore to the surface layers large amounts of plant nutrients and thus make possible a high productivity during summer. Upwelling (p. 690) has a similar effect, and the regions of upwelling off the coasts of California, Peru, Chile and southwest Africa, are also regions of high productivity.

The deep water of all oceans contains relatively large amounts of plant nutrients (see *Chemistry of Sea Water*, above). In the North Atlantic, the concentrations of these are lower than in any other ocean.

BIOLOGICAL OCEANOGRAPHY

The marine plants and animals should be thought of as a part of the sea, even as the salts are a part of the sea. They are intimately bound to its physical processes and are in themselves the activators of chemical changes that involve alternating phases of the mineralized and organic state of certain salts and gases so vital to biological, chemical and geological oceanography.

Historically, the early biological studies of the sea were exploratory and mainly descriptive. They were concerned largely with the systematic cataloguing of the different kinds of organisms found in the sea. This is still the natural procedure in the investigation of new areas. The exploratory-descriptive phase is exemplified especially by the great "Challenger" expedition of 1873–76 and by various expeditions of the U.S. fish commission steamer "Albatross" from 1883 to 1920. The descriptive phase, though far from complete for the oceans as a whole, is in many regions drawing to a close and, especially since the beginning of the 20th century, has given way to a second phase which is primarily analytical. The analytical phase is concerned particularly with the factors that are important in governing the biological economy of the sea. Some of these factors will be brought out in the course of discussion.

The sea is the world's largest biological environment. The available living space that it provides is about 300 times greater than that of the combined terrestrial and fresh-water environments. This results not only from its vast horizontal expanse (71% of the earth's surface) but especially from the great vertical range from the surface to great depths.

For convenience of study the marine environment is divided into two major divisions, namely, the benthic, comprising all of the bottom from high-tide level to abyssal depths, and the pelagic, comprising all of the water covering the bottom. The benthic division is subdivided into the littoral system and the deep-sea system, with the dividing line arbitrarily set at the 200-m. depth contour. The upper part of the littoral system to a depth of about 40 to 50 m. is the eulittoral. Its greatest depth corresponds to the lower limit for growth of the more abundant attached plants.

The population of the entire environment is divided into three major ecological groups: (1) the benthos, which includes all organisms such as seaweeds, barnacles, clams, crabs, etc., that live on the bottom, either attached, burrowing or creeping; (2) the nekton, consisting of the strong-swimming animals such as fishes, whales, etc., of the pelagic division; (3) the plankton, which includes floating plants and animals that possess little or no effective swimming power and are therefore carried more or less helplessly by the water currents. The planktonic forms are constantly in danger of sinking to unfavourable depths.

The plankton is divided into two main divisions: (a) phytoplankton, comprising the microscopic floating plants of which the most important are, first, the diatoms and, second, the holophytic dinoflagellates, the latter being a borderline group between plants and animals; (b) zooplankton, which comprises a multitude of floating or feebly swimming animals, mostly microscopic to a few millimetres in size.

From the standpoint of the economy of the sea, the phytoplankton and the zooplankton are the fundamental groups upon which nearly all sea life is dependent either directly or indirectly. This results from the fact that the floating diatoms and dinoflagellates are the chief synthesizers of primary food, while the animals that make up the zooplankton are the chief grazers utilizing this plant crop and converting it into animal substance for the use of carnivorous animals. For this reason, investigations of the oceans have been concerned largely with the ecological factors, physical, chemical and biological, that affect or control the production and utilization of these two fundamental groups.

All biological groups must, however, be carefully investigated,

for only thus can we hope to understand the essential interrelationships of the groups and to evaluate the part played by each in the various phenomena of the sea. (*See* MARINE BIOLOGY for other details.)

Factors of Phytoplankton Production (Organic Production).—Phytoplankton growth is dependent upon a number of more or less clearly defined interacting variable factors, one or more of which may be critical to production. The factors of production are either primary or secondary. The primary or direct factors are those concerned with the energy supply, food supply and rate of metabolism. They are light, nutrients, temperature and salinity, and control the growth and proliferation of the individual plant cell. Any one of them which, at the moment, is not optimal in relation to other factors in the water is a limiting factor. Thus, light is always a limiting factor at low intensities. The secondary factors control the density of the population, as discussed later.

Light, the radiant energy of the sun, is intercepted by the plant pigments and used in their manufacture of carbon compounds from carbon dioxide and water. In simple form, this is expressed by the equation $6CO_2+6H_2O=C_6H_{12}O_6+6O_2$.

In this endothermic reaction the resultant organic substance of the plant contains more energy than was present in the reactants CO_2 and H_2O. This extra energy derived from the sun is stored in the complex plant substance, later to become available as chemical energy for life processes of the plant and also, directly or indirectly, for that of all animals and heterotrophic bacteria.

The oxygen set free in the process of carbon assimilation is used in part by the plant, but the excess oxygen is an important source for the aeration of the upper layers of the sea. A 5-day period of lively diatom growth may, for example, increase the oxygen content of the water by as much as 2.2 ml. per litre.

Oxygenation by phytoplankton therefore has many far-reaching biological and chemical implications and has to be taken into account also when studying the "age" or source of water masses because the oxygen content is an index of past conditions.

Only the upper water layer, to depths of 80 m. or less, has sufficient light for the process of photosynthesis. This layer is known as the euphotic zone and varies greatly in depth depending upon latitude, turbidity and season. The depth at which the light intensity is just sufficient to bring about a balance between oxygen production and oxygen consumption during the process of photosynthesis is known as the compensation depth. It is the maximum depth at which the light intensity is sufficient for the plants to survive but not enough for crop increase.

It has been concluded by British investigators that for inshore waters of the latitude of Loch Streven, Scotland, the compensation depth in summer is at 20 to 30 m., while during the winter it is near the surface. In Oslo fjord it was at 10 m. during March. During midsummer in Puget sound it is between 8 and 18 m. Diatoms are often found below the compensation depth. They apparently have sunk there and, though some photosynthesis still takes place at this level, it is not sufficient for long survival.

The compensation depth, like the optimum depth for photosynthesis, is not the same for all species. In mid-latitudes the optimum depth for a mixed population is usually less than ten metres, but it is not at the immediate surface. Experiments indicate that the rate of photosynthesis is proportional to light intensities only at intermediate intensity of illumination. Diatoms exposed to intense light close to the surface sometimes concentrate their chloroplasts for mutual protection against the light. This is known as systrophe, and for *Coscinodiscus excentricus,* it takes place at a light intensity of about 9.69 cal. per square centimetre per hour.

Plant nutrients (*i.e.,* the dissolved nutrient salts) constitute the inorganic food supply of the plants. Chief among these are the compounds of nitrogen and phosphorus. The importance of these in the control of phytoplankton production was first anticipated in 1899 by K. Brandt. Subsequently, with improved methods of chemical analysis they have repeatedly been shown to fluctuate with periods of diatom growth. There is some evidence that iron may be a limiting factor for neritic (coastal) species according to H. H. Gran. Manganese and certain unknown accessory growth factors are known to be influential in promoting growth. At best, sea water is only a dilute nutrient medium but large concentrations are not needed. For example, a concentration of 10 mg. of phosphorus to 1,000 l. of water will produce a vigorous growth of diatoms when other factors are favourable.

The absorption of dilute nutrients is facilitated by the small size of the phytoplankton organism, because with reduction of absolute size there is an increase in the ratio of surface to volume. Thus, in comparing a plant 1 mm.^{3} with 1,000 plants of 0.001 mm.^{3} there is a tenfold aggregate increase in surface area of the smaller plants and a hundredfold improvement of conditions for diffusion of salts at these surfaces.

The silicates, used in building diatom shells, are drawn upon measurably during diatom growth, but it has not been shown that the reduction in silica is sufficient to constitute a limiting factor.

With each 10° C. rise in temperature, within favourable limits, the rate of metabolism is increased two- to threefold, according to Jacobus van't Hoff's law. In the mixed population of the sea the effect is not simple, however. The thermal requirements differ for different species, with the result that there may be a seasonal succession of different biological groups, each with its own optimal temperature range. Thus, certain diatoms flourish best during cool periods and are replaced by others as the waters become warmer. The warmth-loving dinoflagellates frequently dominate during the warmest periods.

Salinity is a factor significant mainly in maintaining favourable osmotic conditions between the organism and the water in which it lives. Some species are euryhaline (tolerate a wide range of salinity), others are stenohaline (tolerate only narrow limits). Hence, salinity is largely a selective agency determining the species composition rather than the crop production.

The secondary factors of phytoplankton production are mainly those controlling density of population. Under favourable conditions of light, nutrients and temperature, the increase in phytoplankton is extremely rapid, because the method of reproduction is by simple cell division. Through this reproductive habit the population increases by geometrical progression. Cell division may occur as often as twice a day. Nevertheless, the standing crop may at times be small despite favourable primary factors. Any circumstance that operates to withdraw large numbers of individuals must function as a check which affects materially the total numbers that can be produced in a given time. Among the obvious checks are (1) consumption by animals and (2) sinking or transport to unfavourable layers through action of gravity or adverse water currents.

1. Vast quantities of phytoplankton are consumed by the herbivorous zooplankton animals, especially by the copepoda. It has been observed by various investigators that large populations of phytoplankton and zooplankton do not usually exist concurrently in the same area. This disparity is believed to result primarily from heavy grazing by the abundant zooplankton in the area. An alternate hypothesis (animal exclusion) maintains, however, that thick clouds of phytoplankton (diatoms) are avoided by the copepoda, which seek depths below the euphotic zone. A difference in the rate or direction of flow of surface and deep water then tends to segregate the two groups.

2. The rate of sinking of a body heavier than water is controlled by the relation of surplus weight to friction. Most plankton organisms are heavier than water. The small size characteristic of these organisms is, however, an effective adaptation to their floating existence, for with reduction of absolute size there is provided a relatively large friction surface to retard sinking. But, despite this adaptation, there is still a constant loss through the effect of gravity. Many diatoms can be found below the compensation depth, and bottom sediments in certain areas are composed in large part of the shells of diatoms that were produced in surface layers.

A more rapid loss of plants from the zone of optimum light may occur in areas with strong turbulence in passages or channels where surface water and its passive population is shifted to depths of low light intensity. Ascending currents may bring them back to the lighted water, but the period spent by the plants below the com-

pensation depth is a total loss to production. Some degree of stability resulting from increased surface temperature or lowered salinity is therefore advantageous temporarily. However, the advantage gained may result in rapid depletion of the nutrient salts and an accompanying drop in production pending renewal of surface waters by diffusion or by water currents.

Water Currents and Plant Nutrients.—Coincident with the production of a heavy crop of diatoms, there is a sharp drop in the concentration of plant nutrients. Some nutrients are regenerated through bacterial action on dead organisms within the euphotic layer, but there is a continual sinking of organisms and organic detritus from this layer toward the bottom. This effects a serious withdrawal of the nutrient elements from the surface and an accumulation in the deeper water where, because of insufficient light, they cannot be used by plants.

Thus, a deep stratum of water overlying the ocean floor becomes a storehouse for mineralized plant nutrients. It is from this storehouse that (in accordance with A. Nathansohn's theory of 1906) the fertilizing minerals are brought to the lighted surface through the action of ascending water currents. These currents may be of somewhat different origin, but all are of utmost biological importance. In coastal waters, turbulence maintains a more or less steady supply of nutrients in the euphotic zone.

In offshore waters there are areas of divergence characterized by a flow of surface waters away from each other and a replacement by deeper water. Such areas are commonly productive. Conversely, the areas of convergence of old surface waters are relatively barren. In boreal regions the convection currents initiated by cooling and sinking of surface waters in autumn and winter replace the surface waters that were depleted because of summer plant growth under conditions of marked water stratification. In these regions there are frequently spectacular spring outbursts of phytoplankton production. Prolonged winds may shift the surface layers and cause temporary currents and upwelling on a small scale.

The renewal of nutrients on a grand scale through upwelling of deep water is exemplified by such areas as the west coast of Africa and South America. There the Benguela current and the Peru current, respectively, are laden with nutrients that give rise to notably abundant phytoplankton production that may extend far to sea with the flow of water outward from the coast. In general, coastal areas and shallow banks are more productive than the open sea because it is in these situations that the physical forces are most effective in bringing about renewal of surface water by nutrient-rich subsurface water. (*See* also p. 691.)

Environmental Factors and the Marine Animals.—All animals are of course indirectly dependent upon light for production of primary food. The development of sight has made many forms also directly dependent upon this factor. But the relative independence regarding solar light has made it possible for all depths of the sea to become populated by some type of animal life.

Many of the studies concerning the influence of this factor deal with its control of the vertical distribution of pelagic animals. Characteristically, the copepoda, chaetognatha, some fishes and many other forms have their daytime maximum concentration in depths of 50 m. or more, where the light intensity is much reduced. But with the approach of night many of these animals migrate gradually toward the surface, and return again to deeper water at or before dawn. This behaviour is commonly spoken of as diurnal migration and is a conspicuous phenomenon of the sea. There can be little doubt that light is the motivating stimulus, but its action appears to be in some way linked to geotropism (reaction to gravity). The response to light is not always the same for both sexes, and it sometimes differs also for different stages of development.

In the open ocean there is also a correlation between the amount of light and the colour of pelagic animals. At the surface the colours of fishes are largely silvery or white with backs of green, blue or black. Invertebrates of the plankton are commonly faint red, blue or hyaline. In mid-depths the fishes are silvery and the plankton animals are commonly red or of shades of violet and brown. In abyssal depths the colours tend to uniform shades of red, brown, violet-black or black, without the bizarre markings of shallow-water animals.

Many of the deep-sea forms have structural peculiarities that are associated with absence or reduction of solar light. Conspicuous among these structures are protruding eyes, long tactile organs and light-producing bodies.

Light production (phosphorescence) is not confined to deep-sea animals. Conspicuous among bioluminescent forms are the microscopic Dinoflagellata which live near the surface. At night the crest of waves or the wake of a ship may glow with blue-green light when the water is agitated, causing myriads of these tiny forms individually to emit short flashes.

Together with this glow are usually seen larger, brighter flashes caused by various types of jellyfish and small Crustacea. The light is produced chemically by oxidation of a simple protein called luciferin in the presence of a catalyst called luciferase.

With respect to temperature requirements, animals are either eurythermic, tolerating a wide range of temperature, or stenothermic, tolerating only a narrow range of temperature. Many are eurythermic in the adult stage but are stenothermic with respect to reproduction or to survival in the larval stage. The thermal relationships determine the range of distribution and the spawning season of many species inhabiting the sea. Usually the adults can survive a greater range of temperature than is favourable to successful reproduction, and for this reason they may have an extended area of sterile distribution. These areas are restocked regularly or occasionally by submature or mature migrants from adjacent reproductive areas. Where sharp temperature transitions are lacking along coasts, there also the faunal areas are poorly defined, as is true along the European Atlantic coast and the North American Pacific coast. It frequently happens that animals requiring low temperatures are found in the littoral zone in the higher latitudes, but in the sublittoral or deep-sea zones in the low latitudes. This is known as equatorial submergence.

The salinity of sea water is the one factor which above all others distinguishes the marine environment from other aquatic environments. Most other factors, excepting those associated with the magnitude and depth of the sea, can be duplicated in lakes or streams. Only a few animals like the salmon and eel can migrate, however, from one environment to the other.

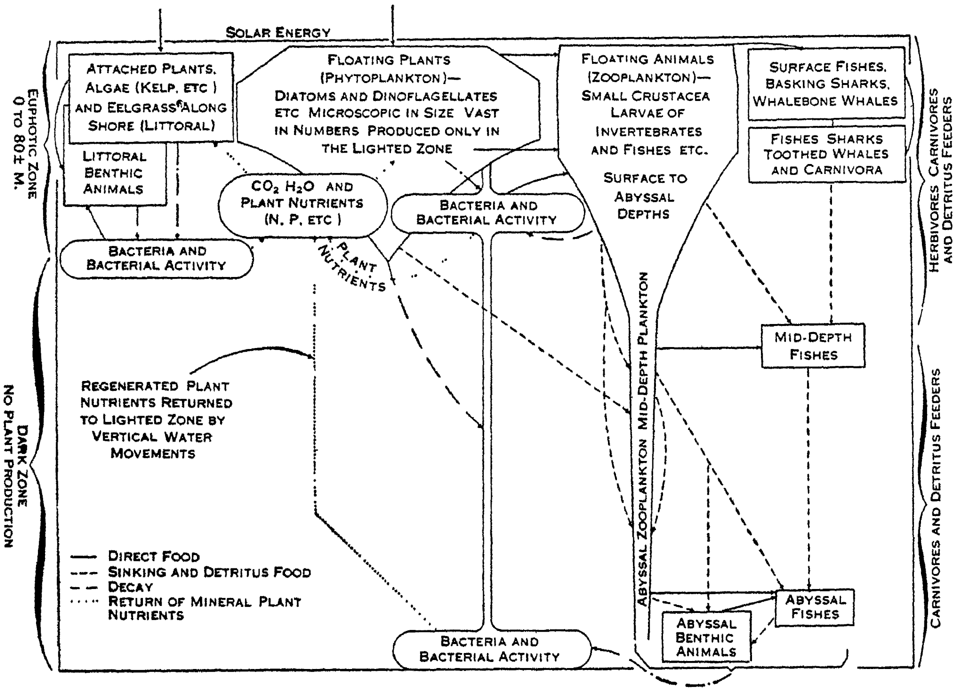
Many euryhaline coastal forms can endure a marked reduction of salinity for extended periods, but will succumb if sea salts are entirely absent. The stenohaline species (capable of tolerating only a narrow range of salinity) are characteristic of the open ocean, where there are no marked variations in this factor.

In general the animals find an ample supply of oxygen produced by plants or dissolved from the air and distributed by the water currents. Even in the oxygen minimum layer in the open sea some planktonic animals have been found, despite almost complete absence of oxygen. In poorly ventilated basins or bays the decomposition of organic material precipitated from above may lead to exhaustion of the oxygen and development of hydrogen sulphide. In these toxic situations only anaerobic bacteria can exist.

The dependence of animals, directly or indirectly, on the circulation of water in the sea cannot be overstressed. The importance of this factor lies especially in the dispersal of wastes of metabolism, the aeration of the water, the renewal of plant nutrients, the distribution of temperature, the dispersal of temporary and permanent planktonic organisms and the transport of planktonic or detrital food to the many sessile or burrowing benthic animals.

The planktonic organisms, especially the eggs and larvae of the benthic animals (nearly all of which, excepting the deep-sea forms, have pelagic eggs or larvae), live a hazardous existence. They are always in danger of being transported to areas of unfavourable water or to bottoms or depths that are inimical to the adult stage following the period of floating life.

To overcome this hazard the species with planktonic young produce a prodigious number of eggs. In current systems that form a closed or semiclosed circuit, or where the currents are mainly oscillations of the tide such as occur in deep bays or along the coasts, the planktonic population is largely endemic; its whole life history can be studied within the area. Frequently plankton from



FROM H. U. SVERDRUP, M. W. JOHNSON AND R. H. FLEMING, "THE OCEANS" (PRENTICE-HALL, INC , 1942)

THE MAIN FEATURES OF THE INTERRELATIONS OF MARINE ORGANISMS

outside areas are swept more or less regularly into these situations, or some of the local population may be swept out.

If the change in conditions is not too great, the migrants may live as adults in the new environment, but they are usually incapable of successful reproduction. The animals that have drifted from their endemic area are known as indicator species and are frequently a material aid in studying the source of water masses. Large current systems—for example, the Gulf stream and North Atlantic current—are capable of maintaining a characteristic endemic population of warm-water species. But upon cooling and by admixture of water from the north, the warm-water species are gradually replaced by the cold tolerant boreal or arctic forms.

The Role of Bacteria in the Sea.—The role of bacteria in the metabolism of the sea is concerned mainly with transformations of organic material to the inorganic or mineral state and not with the production or storage of organic material. There are a few autotrophic marine bacteria (capable of synthesizing organic material), but the organic material produced by them is negligible. Most bacteria in the sea are heterotrophic; *i.e.*, they obtain their energy for life processes through the oxidation of organic compounds. These compounds may be in the particulate state as plant or animal tissue, or they may be in solution in the water.

There is evidence that the organic matter in solution in the sea is several times greater than that occurring as a standing crop in the particulate state. The concentration of the dissolved matter is remarkably uniform, and it is believed that the upper limit of concentration represents a threshold value maintained at a level below ten milligrams per litre by the bacteria.

Since plants use only the mineralized nutrients, this reclaiming of dissolved matter by conversion to simple mineralized plant nutrients by bacteria is essential to the biological cycle of the sea. Equally important are the transformations through bacterial decomposition of the particulate organic matter.

In the process of bacterial decomposition of organic material, a series of steps is involved, each with its specific types of bacteria. Thus, a step in the nitrogen cycle is the simplification of the organic molecule by splitting off the NH_2 group from the amino acids. Many types of bacteria can do this. At this point the nitrogen may be assimilated by the diatoms.

However, the cycle is usually carried forward by the nitrifying bacteria forming nitrates from ammonia and nitrites ($NH_3 \rightarrow NO_2 \rightarrow NO_3$). Ammonia may also be oxidized to nitrite photochemically. The cycle is somewhat further involved by the presence of nitrate-reducing and -denitrifying bacteria, which may reverse the chemical process at least in part ($NO_3 \rightarrow NO_2 \rightarrow N_2$).

This is believed to occur in environments lacking or poor in oxygen, where the bacteria obtain their oxygen by reducing these compounds. True denitrifiers and also nitrogen fixers appear, however, to be unimportant in the economy of the sea.

Phosphorus, carbon and sulphur cycles are also activated by bacteria. In experiments, the phosphates are quickly regenerated, but renewal of this nutrient in nature appears to require three to four months.

The carbon of organic compounds is returned as carbon dioxide, which is always present in ample quantity for plant growth. A small amount of sulphur is used by plants in the form of sulphates, but an important product of organic decomposition is hydrogen sulphide which, when present in large quantities, is inimical to plant and animal life.

The distribution of bacteria in the sea is governed by the distribution of particulate organic material. Hence, two centres of large bacterial populations occur. One of these is within the euphotic zone, where the phytoplankton and zooplankton are abundant. The second is on the bottom, where organic material accumulates as a result of sinking of plankton and nekton from the overlying water. Most bacteria are periphytic; *i.e.*, grow attached to solid surfaces such as diatoms, copepoda and sand grains. Therefore, relatively few appear to be truly planktonic.

The outstanding features of the interrelations of marine organisms and of the organic-inorganic cycle are diagrammatically shown in the figure.

Measurement of Organic Production in the Sea.—Gross organic production is defined as the amount of organic material synthesized from inorganic material by autotrophic organisms in unit time in unit volume of water or unit area of sea surface.

The indices of production commonly used are briefly as follows:

1. *Direct census.* By this method the individual plants (diatoms or dinoflagellates) from a known quantity of water are counted under a microscope, and the results are reported as cells per litre or cubic metre of sea water *in situ*. Counts from isolated observations are, of course, only measurements of the standing crop. To obtain an estimate of production for an interval of time, successive samples are needed, together with data on the rate of reproduction and consumption in the intervening periods.

This method, though essential to the analysis of the biological groups, is not adequate by itself to show the volume of production, hence complementary methods, mainly chemical, are used.

2. *Plant pigment analysis.* This consists of extracting (with acetone) the pigments from the plants of a known volume of water and thus determining the pigment units, each unit being equivalent to 3.3×10^{-3} mg. of organic carbon.

3. *Oxygen production.* For each 0.536 mg. of carbon assimilated by the phytoplankton there is set free 1 ml. of oxygen. One experiment in the Gulf of Maine showed a maximum production of 2.33 ml. per litre of oxygen at the surface in about nine hours, while the whole water column 1 $m.^2 \times 44$ m. deep produced 29.1 l. of oxygen; *i.e.*, a fixation of 15.6 gr. of carbon.

4. *Plant nutrient consumption.* A rather constant ratio exists between carbon, nitrogen and phosphorus in the organic content

of mixed plankton. The ratios C:N:P=41:7.2:1 by weight are about the same as it is for these elements in sea water. The drop in concentration of the mineralized state of any of these elements in sea water over a period of time is therefore a good index of the extent of synthesis of organic substance that has taken place (plus an unknown quantity equal to the nutrients that have been regenerated during the period).

Other estimates of organic production are based upon the quantity of animals. Plants, of course, are the only real producers in the sea, but the quantity of animals produced in a given area must depend upon the capacity of the area to produce plants. Therefore, the productivity of an area may be judged roughly by the amount of zooplankton it supports or, in some instances, by the products of fisheries.

Zooplankton is usually reported as numbers of cubic centimetres per cubic metre of water or per square metre of ocean surface. In the Gulf of Maine, where the copepod *Calanus finmarchicus* dominates the plankton, the concentration of this animal was found to be from 0.2 to 5.3 cc. per cubic metre over a large part of the gulf. The standing crop of the copepod plankton for the whole gulf was of the order of 4,000,000 tons. The crop increase between May and September was a net gain of 8,000,000 tons.

The correlation of fisheries products with plankton production is especially evident in connection with the plankton-feeding fishes such as the sardine, herring, etc., and with the catches of whalebone whales. Off the coast of California, for example, the upwelling of water at the coast gives rise to a rich crop of phytoplankton and zooplankton, and from this area about 550,000 tons of sardines alone have been fished in a year. This is equivalent to more than a ton a minute throughout the year.

Great whaling operations are carried on in the waters of the Antarctic, the feeding grounds of the blue whale and other species that feed upon the animal plankton.

The waters of these areas are also notably rich in plant nutrients and in phyto- and zooplankton.

The abundance of benthic animals in many coastal areas, and in rich inlets such as Puget sound, is also a reflection of the heavy plant production which takes place there. In contrast, there is a scarcity of benthic life in great ocean depths. This scarcity results partly from the small production of plankton in the surface waters of the open sea (as explained earlier) and partly from the dissolution of the surface products before they reach the bottom in their course of sinking.

(*See* also WAVES OF THE SEA; ZOOLOGICAL COLLECTING: *Marine Collecting*.)

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(H. U. S.; M. W. J.; R. H. Fg.)

OCEAN CITY, a city of Cape May county, southeastern New Jersey, U.S., about 10 mi. S.W. of Atlantic City, is served by the Pennsylvania-Reading Seashore lines. The population was 6,040 in 1950 and 4,672 in 1940 by the federal census. Located on the northern end of Peck beach, a barrier beach along the Atlantic, the city is flanked by Great Egg Harbor bay on the west and the ocean on the east. It offers the advantage of convenient access to both the ocean and calm inland waters and became a popular summer resort.

It was connected by bridges with Longport to the north and Somers Point to the west. There are truck farms in the area. The city was incorporated in 1897.

OCEAN CITY is also the name of a resort town and port of Worcester county, southeastern Maryland, 28 mi. E. of Salisbury. Pop. (1950) 1,234. It is noted for big-game fishing.

OCEAN GROVE, a summer resort of Monmouth county, New Jersey, U.S.A., on the Atlantic coast, adjoining Asbury Park on the south. It is served by the Central of New Jersey, the New York and Long Branch and the Pennsylvania railways and motor-coach lines. The resident population in 1950 was 3,806. There are many hotels, private cottages and a mile of boardwalk along the sea front. Ocean Grove was founded in 1869 by the Ocean Grove Camp-Meeting association of the Methodist Episcopal Church as a place for religious worship, rest and recreation, free from all kinds of undesirable amusements, and it keeps much of its original character. Vehicular traffic (except police, fire, ambulance and physician) is prohibited on Sunday.

OCEANIA, a geographical area extending from Australia, in the west, to the most easterly islands of Polynesia, in the east, and from New Zealand, in the south, to Micronesia and the Sandwich islands, in the north. Ethnologically the area is divisible into six principal regions (*q.v.*): Australia; Tasmania; Melanesia, a group of islands extending from Fiji, in the south-east, to New Guinea, in the west; New Guinea, which, however, is a geographical rather than an ethnological unit, for the eastern and north-eastern coastal regions are Melanesian, while the west really falls under Indonesia; Polynesia, an island area of considerable racial and cultural uniformity, comprising the greater part of the Pacific; Micronesia, an island area comprising that part of the Pacific which lies between New Guinea, Polynesia and the Philippines.

Racial History.—There is little doubt that man first entered this area from the west, and subsequent migrations have all had an easterly, or, in the case of Australia, a southerly trend. The problem of dissecting out the racial components of the peoples on the eastern and southern periphery is, therefore, comparatively simple. Furthermore, the uniformity, both of physical type and culture, and evidence of a more or less historical kind, show that the Polynesian area is of comparatively recent occupation, even allowing for more than one principal set of migrations. But in New Guinea and Melanesia, the principal gateways into Oceania, conditions are more complex, and the racial history of this area has been only tentatively elucidated. Australia, again, shows considerable physical and cultural uniformity with many variations, but the existence of varieties of the Papuan type of man in Tasmania, with a very primitive culture, suggests that man entered and crossed the length of Australia at an extremely early date.

Principal Groups.—The six principal divisions of this region, Australia, Tasmania, Melanesia, New Guinea, Polynesia and Micronesia, can be fairly readily distinguished from one another, both racially and culturally, though, in the case of New Guinea, there is not that racial and cultural uniformity which characterizes each of the other areas. Apart from New Guinea, with its great diversity of race and culture, some general characterization of culture as well as race can be made of each of the other areas. Language, for example, will readily separate Australia, and in all probability Tasmania, from the group Melanesia, Polynesia and Micronesia. The speech of these three areas, together with the Melanesian and Indonesian part of New Guinea, is clearly referable to one family, the Austronesian (*q.v.*), extending from part of India and Burma, through Malaya and Indonesia to the extremities of Polynesia. But while the Polynesian languages may be described as dialects of one language, there is considerably more diversity within the Melanesian sub-division of this family.

This Austronesian speech is associated with a distinctly higher culture, particularly in Polynesia and Micronesia, the Melanesians being in some respects intermediate between these groups and the Papuans of New Guinea, though among Papuans there is great variety of culture, the result, no doubt, of various degrees of blending of immigrant cultures with perhaps more than one indigenous culture brought into New Guinea and Melanesia by the original Papuans.

The Australians, culturally as well as physically, betray a marked contrast, not only with the Austronesian-speaking peoples of Oceania, but also with the Papuans of New Guinea. Horticulture, well-developed throughout the rest of the area, excepting Tasmania, is entirely absent, and the economic life is, consequently, of a very low order. Nevertheless, an elaborate social organization and ceremonial life and considerable variation in such stable aspects of culture as the disposal of the dead, survive in Australia.

Mode of Life.—The Australians and Tasmanians, being hunters and collectors, are necessarily nomadic, though within more or less well-developed tribal areas. Their most important possessions are their hunting weapons, spears, boomerangs and tools rudely chipped out of stone. The aridity of most of Australia during the greater part of the year, and the very short period during which nature provides abundant food, cause most of the non-economic activities of the Australians to be concentrated in the brief period of spring, when magico-religious rites with the object of increasing the food supply are performed, initiations are conducted, and, in fact, most of the tribal, in contrast with family, activities take place.

In the rest of the area, with its basis of horticulture, the economic struggle is not so keen, and the population is a settled one, except for a few nomadic or semi-nomadic peoples in New Guinea. Diet is mainly vegetarian, taro, yams, bread-fruit, sweet potato, coco-nuts, sago and bananas being the principal foods. In island and coastal regions fish is largely consumed, and almost everywhere pigs are reared and reserved for consumption on occasions of importance, such as marriage festivals and mortuary feasts. Although cannibalism is common, the eating of human flesh is usually a ceremonial act of revenge, or associated with mortuary or other rites. Canoes capable of long sea voyages are constructed, principally in the island areas. Double canoes, and outrigger canoes of various patterns and, formerly, double canoes which only survive at the present day in a limited part of New Guinea, are the commonest, the larger ones being provided with sails. While intercommunication is much hampered by warfare, goods are traded over considerable distances, and in many areas well-developed systems of currency occur.

Social Organization.—One feature of social organization appears to be common to the whole of this area, namely, the systematic non-genealogical use of relationship terms, generally known as the classificatory system. If we select any person in a village and enquire as to his relationship to others in the village, he will rarely be at a loss, for everyone is likely to be a mother, or a brother, an uncle or a father-in-law, etc., in this classificatory sense, and such relationships will be found to hold to a large number of persons in other more distant villages. Moreover, these classificatory relationships are important determinants of conduct, many rights and duties being dependent on relationship, though when the relationship is very distant in the classificatory sense they are hardly distinguishable. One of the most important functions of this relationship system lies in the regulation of marriage, those lying in certain relationships being prohibited from marriage, while in some cases only those persons who can establish a given relationship between themselves are allowed to marry. Marriage, however, is generally regulated, at least in part, by the clan (*q.v.*) which is usually, throughout this area, the most important social unit. Particularly in Australia, Melanesia and New Guinea, and to a slightly less extent in Polynesia, is the clan a fundamental unit of the social structure. Membership of the clan is determined by descent through the father or the mother, both varieties being common, and marriage is prohibited within the clan. As a rule, the clan is also totemic (*see* TOTEMISM), this totemic aspect being peculiarly important in Australia, where totemic rites form a large part of the ceremonial life of the natives. In parts of the area, especially Australia and Melanesia, the clans are grouped into two exogamous moieties (*see* DUAL ORGANIZATION), and there is some evidence which suggests that a dual organization once extended over most of the area or occurred among their ancestors before their migrations into Oceania.

Political Organization.—In Australia and parts of Melanesia, age appears to be an important qualification of leadership, councils of elders deciding matters of tribal importance. In parts of Melanesia there is little vested authority, a more or less communistic system prevailing, while in other parts, authority depends on the acquirement of prestige derived from the holding of feasts, or the acquisition of wealth. Hereditary chieftainship is

common in Polynesia, where a considerable social gulf may exist between nobles and commoners.

Initiation.—Ceremonies of initiation into manhood occur amongst Australians and many Papuans, and are found amongst some Melanesians, mainly in connection with secret societies (*q.v.*), which in some cases dominate the social organization.

Religion.—The belief in spirits of the dead is general throughout this area, and some degree of cult of the dead is present everywhere. In some cases, mortuary ceremonial reaches a very high degree of elaboration, particularly in the case of chiefs. Violent orgies of mutilation on the occasion of a death are reported from Australia, and in extreme form from Polynesia. But the existence of an elaborate mortuary ceremonial is not necessarily associated with anything that can be called a worship of the dead, which is probably confined to Polynesia, parts of Melanesia and Micronesia. Between spirits of the dead, or ghosts, and spirits or gods not definitely associated with some ancestor, there is no sharp line of demarcation, but sometimes there are separate words for these two kinds of beings, and a different cult is associated with each, a practice common in Melanesia. Certain ghosts or spirits may be of sufficient importance to rank as gods, who are able to affect more or less the destinies of man, or who are credited with having performed certain acts of creation, or to have introduced important foods or new customs. An elaborate mythology centres around these culture heroes throughout the area, and provide us with suggestive hints as to culture movements and culture contacts in the past.

There is, perhaps, more uniformity throughout the area in the realm of magic (*q.v.*) than in that of religion, in so far as it is possible to separate the two, for there is a transparent sympathetic basis of almost all the magical practices. In addition to direct sympathetic magic without the aid of ghosts or spirits, we also find, particularly in Melanesia, the coercion of both ghosts and spirits for the attainment of what are usually anti-social ends. Divination of sorcerers is also common, which, together with fantastic beliefs concerning the powers of sorcery, accounts for a good deal of the strain to which social relations between individuals, and between groups is subjected in this part of the world. One of the commonest causes of murder is revenge for supposed sorcery.

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(W. E. A.)

ARCHAEOLOGY

From permanent contact with European settlers in the latter part of the 18th century the transition from the Stone to the steel age was rapid. Previously writing was unknown in the area, if we except the pictographic "script," as yet imperfectly explained, of Easter island (*q.v.*).

Although it is improbable that any of the more important monuments have entirely escaped observation and record, the greater part of the area has never been properly surveyed in an archaeological sense, and the published records available for many islands are meagre and of unequal value. The only islands of which anything like detailed surveys have been published are Easter, the Australs, the Marquesas, Hawaii (some islands), the Carolines (Ponape, and Kusaie) and, in part, New Zealand and the Chathams (*see* Bibliography). Surveys of Tonga, Tahiti, Necker I., Rapa-iti, and some smaller islands (Fanning, Malden, Christmas, etc.) are now in preparation by the Bishop Museum, Honolulu.

Absence of Palaeolithic Culture.—In the moist climate, perishable objects were quickly destroyed, and pottery being absent in Polynesia (except Fijian vases introduced into Tonga), the materials for archaeological study are practically limited to stone tools and monuments. No evidence of a Palaeolithic culture has been found in any part of Oceania. The prevailing tools are everywhere axes or adzes of stone (occasionally also of shell), polished wholly or in part, although flaked obsidian was also used in certain islands where it occurred (*e.g.* Easter, New Zealand, New Britain), and roughly flaked quarrying tools bearing a superficial resemblance to palaeolithic hand-axes are found in Easter island. Judged by its tools, the prehistoric culture of the area belongs entirely to the neolithic phase.

The ethnographical division into Melanesia and Polynesia holds good, in the main, for archaeology. In the former region adzes are of the "celt" type and rounded or sublenticular in section; in the latter they are predominantly straight-edged and angular in section, and further subdivided into a tanged and tangless type, characteristic of east and west Polynesia respectively. The distribution of monuments is in substantial agreement with that of the tools, and the elaborate structures of masonry characteristic of Polynesia scarcely occur west of Fiji, where the few stone monuments found are crude and megalithic in character. Exceptions in the Solomon and Banks islands may be regarded as relics of Polynesian migrations eastwards, or as due to later reflex movements.

Absence of Stratified Sites.—No stratified sites showing culture sequence, except in a minor degree in New Zealand, have been found. The habit of making funerary offerings seems to have been little developed, and grave-goods, where discovered, do not differ markedly from artifacts of recent date. Only in parts of Melanesia has the occurrence of deposits distinct in character from the products of the historic inhabitants been observed.

POLYNESIA

In Polynesia there is at present little archaeological evidence of a succession of cultures; monuments and implements represent at most an earlier and, in some cases, a higher phase of the culture that continued into historic times. Exceptions do occur, however; adzes of distinctively Melanesian type, found in Tahiti, and the carvings of bird-headed men in Easter island suggest the possibility of a pre-Polynesian occupation of parts of eastern Oceania by the negroid race. The evidence is too scanty to be entirely convincing, and the presence of a strong negroid strain in the inhabitants of eastern Polynesia is more probably due to racial intermixture during the Polynesian migrations through Melanesia than to a fusion in the islands in which it is found.

Eastern Polynesia.—In all the island groups east of Tonga and Samoa, without a single important exception, occur the remains, now more or less ruined, of megalithic structures, the sacred places or *marae* of the Polynesians. These consist typically of paved rectangular enclosures, surrounded by stone walls, and containing one or more rectangular stone platforms, sometimes, as in Tahiti, of stepped pyramidal form. The elements were variously combined, and differ in details of construction, contour and size. Thus in the Marquesas the walls are low or absent, in the Australs the platforms are generally lacking, while in Tahiti and Hawaii all features are generally present. The platforms were faced with large boulders or hewn blocks of stone or coral, sometimes weighing many tons, and often neatly fitted in regular courses, although mortar was never employed. The core consisted of earth or rubble, and sometimes contained burial pits or vaults. Platforms served also as substructures for sacred houses built of perishable material, for the exposure of the dead, as sacrificial altars, etc.; and the question whether they were intended primarily as tombs has yet to be settled by excavation. Many of them were originally surmounted by large figures of wood or stone in conventionalized human form. Such stone figures, some still *in situ,* are found in Hawaii (Necker), Easter island, Pitcairn, Tahiti, and the Australs (Raivavai), and in the Marquesas, where they exactly resemble those carved in wood. In the Marquesas, platforms, which always had vertical sides, were also much used for secular purposes, both in public assembly places (*tohua*) as seats for the spectators of dances, and as foundations for the ordinary dwelling-houses. The extreme development of terraces and platforms in the latter islands is due to the scarcity of level ground in the steep and narrow valleys, and to the abundance of suitably shaped boulders and easily worked volcanic stone. The largest recorded platform, that of Oborea, in Tahiti, now almost destroyed, measured 90 by 29yd. at the base, and rose in 10 or 11 steps to a height of about 50ft.;

but in general these structures did not exceed 12ft. in height. The antiquity of particular structures cannot be determined from internal evidence, but they were presumably built by ancestors of the historical Polynesians, who on traditional evidence did not reach the area earlier than the 7th century A.D. The fact that they occur in similar form in all groups, including Tahiti and Hawaii, which remained without intercommunication after the great voyages of the 13th and 14th centuries, as well as on intermediate islands, afterwards uninhabited, like Malden and Fanning, shows that the type must have been fully developed by the time of these voyages. Many were still in use when discovered, and some were even constructed in the historic period.

In Pitcairn island, which was uninhabited when occupied by the mutineers of the "Bounty" in 1789, are found many traces of a former Polynesian settlement. The *maraes* and stone figures are said to resemble those of Easter; but a number of large stone chisels and broad-edged axes dug up in the soil are quite exceptional in type. Other small islands, uninhabited at the time of their discovery, but bearing evidence of former Polynesian settlement, include Palmerston, Flint, Malden, Christmas, Fanning, Necker (Hawaii).

Western Polynesia.—In Samoa and Tonga typical walled *maraes* are not found, but in the former island there are numerous flat-topped mounds and platforms of considerable antiquity. Some of these were substructures for temples; others were used for burial. But certain earth and stone mounds of exceptionally large size, in Upolu and Savaii, appear to have been constructed for defensive purposes. One of these, near Apia, measures approximately 100yd. square at the base and is 35ft. high; it is traditionally supposed to have served as a platform for the houses of Tongan chiefs. In the mountainous interior of Upolu (Samoa) is a group of upright basalt slabs on a paved floor (*O Le Fale-o-le-Fe'e*), evidently the supports of a former house or temple, while in Savaii there are remains of roads and raised causeways elaborately engineered but long disused, and partly destroyed by an overflow of lava.

The most striking example of a true megalithic monument is the trilithon (Haamonga) on Tongatabu; it consists of two uprights and a lintel stone mortised into them, 15ft. high, and is stated by tradition to have been erected in the 13th century by Tui-ta-Tui in connection with a Kava feast. Not far distant are a large upright slab and two stone-faced house platforms. On the north coast of Tongatabu are the equally remarkable "tombs of the kings" (*langi*), formerly reserved for the burial of sacred chiefs called "Tooitongas"; these are stepped or terraced platforms containing burial vaults and are faced with hewn coral blocks measuring up to 22ft. in length. The earliest of these also probably date from the 13th century, but the construction of similar tombs continued down to the middle of the 19th century. Some of them are merely enclosures of rough stones.

Stone fortifications occur on many islands, and reach their highest development in the terraced entrenchments and solid stone towers on the mountains of Rapa-iti. Of the petroglyphs, representing stylized human and animal figures, concentric circles, etc., which are found abundantly in Hawaii and the Marquesas, some by their situation seem to have had religious significance, while others are only "travellers' marks"; many are of recent date.

New Zealand and Chatham Islands.—The final settlement of New Zealand by Polynesian immigrants from Rarotonga in the 14th century was preceded by an earlier branch of the same race, possibly also by people of Melanesian affinities, though this is disputed. Archaeology throws little light on this question, except in so far as no adzes of Melanesian type have been found in the older deposits. Only one properly stratified site has been excavated, viz.: Moa-bone Point Cave, near Christchurch, Otago, where the remains found in the lowest stratum prove the early inhabitants to have hunted the extinct moa. Although accurate dating is impossible, considerable antiquity is suggested by the fact that the coast has sunk several feet since the deposits were formed. The rock-paintings and the implements, which include knives, saws, drills, spear-points and finely "retouched" scrapers, of quartzite, obsidian, chalcedony and chert, indicate that the culture of the moa-hunters did not differ essentially, except in its higher standard of craftsmanship, from that of the historical Otago Maori.

The earthwork and stone fortifications belong for the most part to Maori (*q.v.*) culture, as do probably the pit dwellings and terraces of the Pelorus and Auckland districts and the artificial caves and figures carved in the soft tuff of Rotorua. Curious figures incised in a sandstone pit in Auckland and rock-carvings in the Kaingaroa plains representing canoes of modified Maori type are among the more interesting recent discoveries. The Chatham Islands appear to have been colonized by pure Polynesians, the extinct Moriori (*q.v.*), coming from the South island of New Zealand in about the 12th century. Their stone implements resemble Maori types, with the exception of tanged obsidian blades; tree-carvings and much weathered bird figures incised on cliffs have been reported.

MICRONESIA

The most important monuments of Micronesia are found in the Caroline islands, where both on Ponape and Kusaie extensive groups of buildings intersected by canals were constructed on artificially enlarged reefs protected by sea-walls. They take the form of rectangular paved courtyards, frequently in contiguous clusters, constructed by laying natural columnar blocks of basalt lengthwise and crosswise in alternate layers. These walls rise in places to a height of more than 20ft., but were not roofed. The enclosures formerly contained houses of perishable material, traces of which remain; also platforms, terraced or pyramidal, in which were sepulchral vaults roofed with coral or basalt slabs. The most striking and best preserved of these structures is the royal cemetery of Nan Tauach at Matolenim (Ponape), which stands in a double enclosure and contains four burial chambers. Enclosed burial platforms of a somewhat similar type occur farther west in Yap and the Bunaj islands. They have certain elements in common with the *marae* of Polynesia, to which they are possibly related either directly or as collateral branches from the same cultural stem. Although the date at which these "sacred cities" of the Carolines were begun is not clear, they were still inhabited at the time of their discovery, and the tradition of how they were constructed by means of inclined planes of tree trunks survives. The stone pounders, and shell and other objects found in the tombs, do not suggest a high antiquity.

In several of the Marianne islands occur groups of conical pillars called *Lat'te*, of square-cut coral, surmounted by large hemispherical capitals, and constructed either of monoliths or layers of coral cemented together. These are always arranged regularly in two parallel rows, and the most probable explanation is that they were supports for the floors of raised temples or houses, since destroyed. Remains of a burial have been found in a cavity in one of the capitals, but this was presumably only a secondary usage. The largest, in Tinian, are 15ft. in height with capitals 6 or 7ft. in diameter; those of Guam and other islands are much smaller. Associated with these monuments, and suggestive of some ceremonial purpose, are remains of burials, pottery, stone mortars and other artifacts.

MELANESIA

In various parts of Melanesia, from New Guinea to Fiji, are found relics of a prehistoric culture or cultures, which cannot as yet be dated or correlated satisfactorily. An important region covers the east end of New Guinea, New Britain and the adjacent archipelago, where the remains found include ornamented pottery (somewhat similar to that of prehistoric Japan), engraved skulls, obsidian implements and stone pestles and mortars, some of which occur at a considerable depth in river gravels and all of which are quite distinct from the products of recent inhabitants. In the same region, but within a more limited area, are low stone circles, lines and heaps of stones, now used as squatting places and, in part at least, of recent origin. Rock paintings and engravings are numerous in the district behind Port Moresby, some of them coated with a film of calcium carbonate, indicating a certain antiquity. Megaliths are widely distributed and irrigation terraces are found throughout Melanesia. In the Solomon islands (Bou-

gainville and San Cristoval) upright stones occur singly and in groups; in San Cristoval some villages are bordered with stone walls or platforms, and numerous stone-faced and earth mounds, containing shafts leading to burial chambers, and sometimes surmounted by stone statues, small dolmens or upright stones, are still in use. They may be related to Polynesian burial platforms. Their form and the mortuary customs associated with them have led to a comparison with early Egyptian mastabas; attention has also been called to a supposed resemblance of certain pig-tail figures to Egyptian royal statues, but this seems too remote to justify the emphasis laid upon it by some authorities. In the New Hebrides the antiquities include menhirs, stone sacrificial "tables" or dolmens, walls and high platforms, and obsolete types of pottery ornamented in a great variety of styles. There is an exceptional development of stone walls and buildings in the Banks islands, some, however, of recent construction. In general, chronological evidence is almost entirely lacking for these monuments, and the difficulties of distinguishing between ancient and modern are increased by the fact that parts of Melanesia are still living in a "megalithic period." In New Caledonia stone statues (in caves in Lifu) and a few "dolmens or trilithons" have been reported. Petroglyphs are common to all these groups, and particularly numerous in New Caledonia, where they take the form of human and animal figures, spirals and other patterns. Some of the better structures may be attributed either to late waves of Indonesian immigrants, or to reflex Polynesian influence, which has affected many of these islands in comparatively recent times; the *nanga* of Fiji so closely resemble Polynesian *marae* as to leave no doubt of their common origin.

Migrations and Hypotheses.—There is general agreement, on the evidence of oral traditions supported by physical, linguistic and botanical evidence, that the ancestors of the Polynesians—a composite stock including Caucasian, Mongolian and Negroid elements—must have come originally in a series of migratory waves from the Asiatic continent. Their starting-point cannot be definitely fixed; hypotheses vary as between India (Ganges or Chota Nagpur), Assam, and the Cambodia-Siam region of Indo-China. In favour of the latter view is the fact that a people speaking an allied language (Mon-Khmer) and having physical affinities with the Polynesians is still living there. They had probably settled in the Indonesian archipelago by the latter part of the first millennium B.C., whence they proceeded in at least two main streams of migration by way of Melanesia or Micronesia to Fiji, which they reached in about the 5th century A.D. Thence eastern Polynesia and New Zealand were settled in successive voyages during the 7th to 14th centuries. Hawaii seems to have been reached first by a direct migration from Indonesia and subsequently by a branch of the main wave from south-eastern Polynesia; this conclusion is supported by archaeological study which recognizes two distinct types of *heiau* (*marae*), the later of which corresponds more closely with the Tahiti-Marquesas type.

The hypothesis that Oceania served as a highway for the diffusion of an "archaic civilization," originating in Egypt in the 3rd millennium B.C., and including the practices of sun worship, mummification and the building of megalithic structures; and that the stone monuments of Oceania are attributable to the bearers of this culture-complex, has been a subject of considerable controversy. If tradition is right in asserting that Polynesian migrations did not reach the eastern Pacific before the 6th or 7th centuries A.D., and if, as appears probable, these people were the builders of the monuments in that area, it is evident that the older civilizations of America cannot have been inspired by them. On the other hand, since they were in contact with Asia till a relatively late period, they can hardly have escaped the influence of old-world culture or have failed to carry some of its elements with them into the Pacific. The view that Oceania was peopled by migration from America finds little support at the present time. But the theory has recently been advanced that the monuments and culture of eastern Oceania may owe something to the influence of Central and South America, the coasts of which were quite probably visited by the intrepid Polynesian navigators. The absence of pottery has been used by others as an argument for the very early isolation of the Polynesians; the loss of this art was, however, an inevitable result of prolonged wanderings among coral islands, where the material with which to practise it was not available.

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OCEANUS, in Greek mythology, the river which encircles the earth (conceived as flat) (Gr. 'Ωκεανός). Beyond it, to the west, are the land of the Cimmerians, where the sun never shines, the country of dreams, and the entrance of the underworld. Oceanus is in Hesiod (*Theog.* 133, 337–370) the son of Uranus and Ge, the husband of Tethys, father of 3,000 streams and 4,000 ocean nymphs. In Homer he is the origin of the gods. Herodotus and Euripides use the word in practically the modern sense of *ocean; see* OCEAN AND OCEANOGRAPHY.

OCELLUS LUCANUS, a Pythagorean philosopher, born in Lucania in the 5th century B.C., perhaps a pupil of Pythagoras himself. Stobaeus (*Ecl. Phys.* i. 13) has preserved a fragment of his Περὶ νόμου (if he was really the author) in the Doric dialect but the only one of his alleged works which is extant is a short and unauthentic treatise *On the Nature of the Universe.*

Editions of the Περὶ τῆς τοῦ παντὸς φύσεως, by A. F. Rudolph (1801, with commentary), and by F. W. Mullach in *Fragmenta philosophorum graecorum,* i. (1860); H. Diels, *Die Fragmente der Vorsokratiker* (4th ed., 1922); Eng. trans. (1831) by Thomas Taylor. *See* also Überweg, *Grundriss der Gesch. der Philosophie,* Bd. i. (1926).

REDRAWN FROM A PHOTOGRAPH, N.Y. ZOOLOGICAL SOCIETY

OCELOT (FELIS PARDALIS)

OCELOT, a wild cat (*Felis pardalis*), ranging from Texas to Paraguay. The short smooth fur is ochraceous brown above, marked with numerous black-bordered blotches which tend to form oblique bands. The underside and feet are white. Ocelots reach a length of about $3\frac{1}{2}$ ft., while the tail is 18 in. They live in forests and are ready climbers. Cranially, the ocelot resembles the larger cats, with flattened profile and a strong sagittal crest. (*See* CARNIVORA.) (J. E. HL.)

OCHINO, BERNARDINO (1487–1564), Italian Reformer, was born at Siena. He entered the order of Observantine Friars, the strictest sect of the Franciscans, and rose to be its general, but, craving a yet stricter rule, transferred himself in 1534 to the newly founded order of Capuchins, of which in 1538 he was elected vicar-general. In 1539 he delivered at Venice a remarkable course of sermons, showing a tendency to the doctrine of justification by faith, which is more marked in his *Dialogi VII.* published soon after. He was suspected and denounced, and when the Inquisition was established at Rome, Ochino was at once cited, but was deterred from presenting himself at Rome by the warnings of Peter Martyr and of Cardinal Contarini. After some hesitation he escaped across the Alps to Geneva. He was cordially received by Calvin, and within two years published six volumes of

Prediche (Eng. trans., Ipswich, 1548), tracts rather than sermons, explaining and vindicating his change of religion. He was minister of the Italian Protestant congregation at Augsburg from 1545 until 1547, when the city was occupied by the imperial forces in the Schmalkaldic War. Escaping by way of Strasbourg he found an asylum in England, where he was made a prebendary of Canterbury, received a pension from Edward VI.'s privy purse, and composed his chief work, *A Trajedy or Dialogue of the unjust usurped Primacy of the Bishop of Rome* (1549), originally written in Latin, but extant only in the translation of John Ponet, bishop of Winchester. The conception of the *Trajedy* bears a remarkable resemblance to that of *Paradise Lost;* and it is almost certain that Milton, whose sympathies with the Italian Reformation were so strong, must have been acquainted with it, and with some of Ochino's later works. In the *Labyrinth* (dedicated to Queen Elizabeth), he assailed the Calvinistic doctrine of predestination.

The accession of Mary in 1553 drove him from England, and he became pastor of the Italian congregation at Zürich. In 1563 the publication of his *Thirty Dialogues,* in one of which his adversaries maintained that he had justified polygamy under colour of a pretended refutation, led to his banishment. He found refuge in Poland until the edict of the 6th of August, 1564, banished all foreign dissidents. He died at Schlakau in Moravia, about the end of 1564.

See *Life* by B. O. Benrath (2nd ed., Brunswick, 1892; Eng. trans. by Helen Zimmern, 1876).

OCHRES, which vary in colour from pale yellow to deep red, brown and violet, and are native earths coloured with hydrated iron oxide, are of two kinds—one having a clayey basis, while the other is a chalky earth; the former variety is in general the richer and purer in colour of the two. Both kinds are widely distributed in beds or pockets, mainly in stratified rocks and rubble and rarely as extensive deposits. Some ochres require only grinding, whereas other varieties require calcination whereby the original colour is modified. In this process the associated earth exercises a marked influence, clayey ochres developing red and violet tints, while chalky varieties take brownish-red and dark brown hues. The well-known ochre, Terra di Siena, which in its native state is a dull-coloured earth, assumes when burnt a fine warm mahogany-brown hue highly valued by artists. Ochres containing much organic matter are sometimes calcined to improve their drying properties in varnish or oil. Ochres are also artificially prepared in large quantities—Mars yellow is either a pure hydrated ferric oxide or an intimate mixture of that substance with an argillaceous or calcareous base, and such compounds by careful calcination can be transformed into Mars orange, violet or red, all reliable pigments. *See* PAINTS, CHEMISTRY OF.

OCHRIDA (Serbo-Croatian *Ohrid*), a city of South Serbia, Yugoslavia, on Lake Ochrida, occupied by axis troops in 1941. Pop. (1931), 9,776, mainly Albanians, with some Serbs and Bulgars. The lake, 2,260 ft. above sea level, with an area of 107 sq.mi. and a maximum depth of 938 ft., lies amid magnificent scenery and is famous for its salmon trout. Malaria is prevalent. Ochrida occupies the site of the ancient *Lychnidos,* which was added to the Macedonian empire by Philip II. (382–336 B.C.) and destroyed by the Bulgars in A.D. 861. The Bulgarian tsar, Samuel, made Ochrida his capital, but was expelled, and in 1014 his empire was conquered by the Greek emperor Basil II. The see of Ochrida was founded by St. Clement in 916, and during the Bulgarian occupation their patriarchate was established here. In 1459 the Serbian patriarchate being suppressed, the administration of the Church was transferred to Ochrida. In 1890 a Bulgarian bishop was appointed to the see, which then became a centre of Bulgarian propaganda.

See Gelzer, *Der Patriarchat von Achrida* (Leipzig, 1902); Dr. Jovan Cvijić, "Researches in Macedonia," etc., *Geog. Journal,* vol. xvi. (1900); T. R. Georgevitch, *Macedonia* (1918).

OCHS, ADOLPH SIMON (1858–1935), American newspaper publisher, was born in Cincinnati, O., on March 12, 1858, of well educated Jewish parents who had emigrated in their youth to the United States from Bavaria. The father, Julius Ochs, was an officer of the United States forces in the Mexican War of 1848, and the Civil War, 1861–65. In 1865 the family settled in Knoxville, Tenn., where Adolph while still a boy attending primary schools delivered newspapers. At the age of 14, he became a printer's devil on the *Knoxville Chronicle.* In 1875–76 he was employed as a compositor by the Louisville, Kentucky, *Courier-Journal.* In 1877 he assisted in establishing the *Chattanooga Dispatch,* and in 1878, at the age of 20, with little or no capital, he gained control of the *Chattanooga Times,* at that time a decrepit newspaper. Assuming at the same time the duties of publisher, editor and business manager, he soon placed the *Chattanooga Times* on a firm basis, and brought it to a leading position among newspapers throughout the South.

In 1896 he acquired the controlling ownership of the *New York Times,* which had long been one of the leading newspapers in the United States, but was then in financial difficulties after 30 years of prosperity. Mr. Ochs then formed the New York Times Company. With a ripe experience in all departments of newspaper making, he steadily strengthened the paper's journalistic and financial position, and resuscitated it from a bankrupt newspaper with less than 10,000 bona fide circulation, to a newspaper with national reputation, a net paid sale (1934) of 466,000 copies on weekdays and 730,000 on Sundays, and from 2,000,000 to 20,000,000 agate lines of advertising annually. Times Square, New York, was named after the Times Building, which was erected in 1905.

Meantime, in 1901, Ochs became proprietor of the *Philadelphia Times,* which he merged with the *Public Ledger* and sold to Cyrus H. K. Curtis in 1912. He was a founder of the Southern Associated Press and later an organizer of the Publishers' Association of the City of New York. From 1900 to his death in 1935 he was a director of the Associated Press.

The influence of Ochs upon newspaper publishing in the United States has been very marked and highly beneficial. Entering New York publishing when the so-called "yellow journalism" was at its height, and in competition with half a dozen of the richest and most powerful newspapers in America, he boldly adopted the slogan, "All the News That's Fit To Print," and devoted his paper not to sensations, but to giving intelligent readers a daily news report, trustworthy, complete, non-partisan and decent.

In a few years Ochs made *The Times* the outstanding example of enterprise in news gathering and ultimately the most widely read newspaper in the United States. In its reporting of the news *The Times* identified itself with pioneers and explorers in various fields—Marconi, Peary, Lindbergh, Byrd (North and South Pole and trans-Atlantic flights), Amundsen, Ellsworth, Scott, Shackleton and others. In its expression of opinion, *The Times* was and remains essentially independent, its editorial position being best described by Ochs himself as intended "to reflect the best informed thought of the country, honest in every line, more than courteous and fair to those who may sincerely differ from its views."

Steadily withstanding the temptation to print a "comic" section and other features detached from the news of the day, Ochs was a pioneer in many newspaper innovations, among which were the introduction in newspapers of rotogravure printing of news pictures, a book review supplement and an open forum for letters to the editor, with the widest latitude for the presentation of opinions in conflict with the editorial views of *The Times.* He was also a pioneer in the adoption of standards to improve newspaper advertising typography, and of standards of advertising designed to exclude all false and misleading material.

Following these principles, he made *The New York Times* "the newspaper of record," publishing the only complete American newspaper index and printing an edition on rag paper for libraries, offices, institutions and those who preserve records. His interest in making accurate source material available to the public was shown in another manner when, with The New York Times Company, he underwrote in 1925, at a cost of over $500,000, the preparation of the manuscript of the *Dictionary of American Biography* by the Learned Societies of America.

In 1918 the trustees of Columbia University in New York awarded *The Times* the first Pulitzer Gold Medal in Journalism

for Meritorious Public Service. In 1922 Ochs was made an honorary Master of Arts by Yale university.

In subsequent years he received honorary doctorates from Columbia university, New York university, Dartmouth and Lincoln university.

He was also awarded the French Legion of Honour and in 1927 received the gold medal of the National Institute of Social Sciences for his services in promoting and maintaining high standards of journalism.

No honour gratified Ochs, however, more than that which came to him in 1928.

In that year of 1928, the community in which he had made his humble start conferred on him the title of "Citizen Emeritus of Chattanooga."

For the story of *The New York Times* see *History of The New York Times* by Elmer Davis (1921) and *Seventy-fifth Anniversary Supplement of The New York Times*, published Sept. 18, 1926. For the history of the *Chattanooga Times* see *Chattanooga Times Jubilee Issue*, July 1, 1928. (L. Wi.)

OCHTERLONY, SIR DAVID, Bart. (1758–1825), British general, was born at Boston, Mass., U.S.A., on Feb. 12, 1758, and went to India as a cadet in 1777. He served under Lord Lake in the battles of Koil, Aligarh and Delhi, and was appointed resident at Delhi in 1803. In 1804, having been promoted to the rank of major general, he defended the city with a very inadequate force against an attack by Holkar. He served in the Nepal War, which he brought to a successful conclusion. Afterward he obtained the signature of the treaty of Segauli (1816), which dictated the subsequent relations of the British with Nepal. For this success Ochterlony was created G.C.B., the first time that honour had been conferred on an officer of the Indian army. In the Pindari War (1817–18) he was equally successful. He was appointed resident in Rajputana in 1818, with which the residency at Delhi was subsequently combined. When Durjan Sal revolted in 1825 against Balwant Singh, the infant raja of Bharatpur, Ochterlony, acting on his own responsibility, supported the raja by proclamation and ordered out a force to support him. Lord Amherst, however, repudiated these proceedings. Ochterlony, who was bitterly chagrined by this rebuff, resigned his office and retired to Delhi. He died at Meerut on July 15, 1825. The Ochterlony column at Calcutta commemorates his death.

See Major Ross of Bladensburg, *The Marquess of Hastings* (Oxford, 1893).

OCHTMANN, LEONARD (1854–1934), American painter, was born in Zonnemaire, Zeeland, the Netherlands, on Oct. 21, 1854. His family removed to Albany, N.Y., in 1866. In 1882 he began to exhibit landscapes at the National academy, and he became a National Academician in 1904. His most characteristic pictures, which recall the work of Inness, are scenes on Long Island sound and on the Mianus river.

OCKLEY, SIMON (1678–1720), English orientalist, was born at Exeter in 1678. He was educated at Queen's college, Cambridge, became fellow of Jesus college and vicar of Swavesey, and in 1711 was made professor of Arabic at Cambridge. The pecuniary embarrassments of his later days form the subject of a chapter in D'Israeli's *Calamities of Authors*. The preface to the second volume of his *History of the Saracens* is dated from Cambridge castle, where he was imprisoned for debt. Ockley maintained that a knowledge of oriental literature was essential to the proper study of theology, and in the preface to his first book, the *Introductio ad linguas orientales* (1706), he urges the importance of the study. In 1707 he published a translation of Leon Modena's *History of the Present Jews throughout the World;* and in 1708 *The Improvement of Human Reason, exhibited in the Life of Hai Ebn Yokdhan.* His chief work is *The History of the Saracens* (1708–18), of which a third volume was published posthumously in 1757. Unfortunately Ockley took as his main authority a ms. in the Bodleian of the pseudo-Wakidi's *Futuh al-Sham,* which is rather historical romance than history. He also translated from the Arabic the *Second Book of Esdras* and the *Sentences of Ali.* Ockley died at Swavesey, Aug. 9, 1720.

O'CLERY, MICHAEL (1575–1643), Irish chronicler, grandson of a chief of the sept of O'Clery in Donegal, was born at Kilbarrow on Donegal bay, and was baptized Tadhg (or "poet"), but took the name of Michael when he became a Franciscan friar. He had already gained a reputation as a student of Irish history and literature, when he entered the Irish college of St. Anthony at Louvain. In 1620, through the initiative of Hugh Boy Macanward (1580–1635), warden of the college, and himself a famous Irish historian and poet, and one of an old family of hereditary bards in Tyrconnell, he began to collect Irish manuscripts and to transcribe everything he could find of historical importance; he was assisted by other Irish scholars, and the results were his *Reim Rioghroidhe* (Royal List) in 1630, *Leabhar Gabhala* (Book of Invasions) in 1631, and his most famous work, called by John Colgan (d. 1659), the Irish biographer, the "Annals of the Four Masters" (1636). Subsequently he produced his *Martyrologium* of Irish saints, based on various ancient manuscripts, an Irish glossary and other works. He lived in poverty, and died at Louvain.

O'CONNELL, DANIEL (1775–1847), Irish statesman, known as "the Liberator," was born on Aug. 6, 1775, near Cahirciveen, a small town in Kerry. He was sprung from a race the heads of which had been Celtic chiefs, had lost their lands in the wars of Ireland, and had felt the full weight of the harsh penal code which long held the Catholic Irish down. His ancestors in the 18th century had sent recruits to the famous brigade of Irish exiles in the service of France, and those who remained at home either lived as tenants on the possessions of which they had once been lords, or gradually made money by smuggling. While a boy he was adopted by his uncle, Maurice O'Connell of Derrynane, and sent to a school at Queenstown, and then to the colleges of St. Omer and Douai in France.

In 1798 O'Connell was called to the bar of Ireland, where he came rapidly to the front. In examining witnesses, he had no rival at the Irish bar. He was, however, a thorough lawyer besides, inferior in scientific learning to two or three of his most conspicuous rivals, but well read in every department of law, and especially a master in all that relates to criminal and constitutional jurisprudence; as an advocate, too, he stood in the very highest rank.

From early manhood O'Connell had turned his mind to the condition of Ireland and the mass of her people. The worst severities of the penal code had been, in a certain measure, relaxed, but the Catholics were still in a state of vassalage, and they were still pariahs compared with the Protestants. The rebellion of 1798 and the union had dashed the hopes of the Catholic leaders, and their prospects of success seemed very remote when, in the first years of the 19th century, the still unknown lawyer took up their cause. Up to this juncture the question had been in the hands of Grattan and other Protestants, and of a small knot of Catholic nobles and prelates; but they aimed only at a kind of compromise, which, while conceding their principal claims, would have placed their church in subjection to the state. O'Connell gave the Catholic movement an energy it had not before possessed. He formed the bold design of combining the Irish Catholic millions, under the superintendence of the native priesthood, into a vast league against the existing order, and of wresting the concession of the Catholic claims from every opposing party in the state by continuous agitation, embracing almost the whole of the people, but maintained within constitutional limits, though menacing and shaking the frame of society. The Catholic Association, at first small, but slowly assuming larger proportions, was formed; attempts of the government and of the local authorities to put its branches down were skilfully baffled by legal devices of many kinds; and at last, after a conflict of years, all Catholic Ireland was arrayed in a powerful organization. O'Connell stood at the head of this great national movement which, controlled from first to last by himself and the priesthood, was essentially conservative in character. His election for Clare in 1828 proved the forerunner of the inevitable change, and the Catholic claims were granted the next year.

O'Connell joined the Whigs on entering parliament, and gave effective aid to the cause of reform. The agitation, however, on the Catholic question had quickened the sense of the wrongs of

Ireland, and the Irish Catholics were engaged ere long in a crusade against tithes and the established church, the most offensive symbols of their inferiority in the state. It may be questioned whether O'Connell was not rather led than a leader in this; the movement, at least, passed beyond his control, and the country for many months was terrorized. Lord Grey proposed measures of repression which O'Connell opposed with extreme vehemence. This caused a breach between him and the Whigs; but he gradually returned to his allegiance to them when they practically abolished Irish tithes, cut down the revenues of the established church and endeavoured to secularize the surplus. In the British house of commons O'Connell stood in the front rank as a debater; and his oratory, massive and strong in argument, made a powerful impression. O'Connell steadily supported Lord Melbourne's government, gave it valuable aid in its general measures, and repeatedly expressed his cordial approval of its policy in advancing Irish Catholics to places of trust and power in the state, though personally he refused a high judicial office. He sincerely advocated the rights of conscience, the emancipation of the slave and freedom of trade. But his rooted aversion to the democratic theories imported from France grew stronger with advancing age. His conservatism was most apparent in his tenacious regard for the claims of property. He actually opposed the Irish Poor law, as encouraging a communistic spirit; he declared a movement against rent a crime, though he advocated a reform of the precarious tenure enjoyed by the Irish peasant.

O'Connell changed his policy as regards Ireland when Sir Robert Peel became minister in 1841. He declared that a Tory régime in his country was incompatible with good government, and he began an agitation for the repeal of the union. He had denounced the union in early manhood as an obstacle to the Catholic cause; he had spoken against the measure in parliament; he believed that the claims of Ireland were set aside or slighted in what he deemed an alien assembly; and, though he had ceased for some years to demand repeal, and regarded it as rather a means than an end, he was throughout life an avowed repealer. In his judgment the repeal of the union would not weaken the real bond between Great Britain and Ireland. The Catholic association of 1828–29 was recreated for the new project. Enormous meetings convened by the priesthood, and directed or controlled by O'Connell, assembled in 1842–43, and probably nine-tenths of the Irish Catholics were unanimous in the cry for repeal. O'Connell seems to have thought success certain; but he had not perceived the essential difference between his earlier agitation and this. The enlightened opinion of the three kingdoms for the most part approved the Catholic claims, and as certainly it condemned repeal. After some hesitation Peel resolved to put down the repeal movement. A vast intended meeting was proclaimed unlawful, and in Oct. 1843 O'Connell was arrested and held to bail, with 10 or 12 of his principal followers. He was convicted (Feb. 1844) after the trials that followed, but the judges were biased, and the sentence of imprisonment for a year and a fine of £2,000 was reversed on a writ of error by the house of lords (Sept. 1844), and he and his colleagues were again free. The spell, however, of O'Connell's power had vanished; his health had suffered much from a short confinement; he was verging upon his seventieth year; and he was disturbed by the growth of a party in the repeal ranks who scoffed at his views, and advocated the revolutionary doctrines which he had always feared and abhorred. Before long famine had fallen on the land, and under this visitation the repeal movement, already paralyzed, collapsed. O'Connell died on May 15, 1847, at Genoa, while on his way to Rome. His body was brought back to Dublin and buried in Glasnevin cemetery.

Catholic Ireland calls O'Connell its "Liberator" still; he possessed the wisdom, the caution and the tact of a real statesman. But the battle in which he fought was not to be won in his generation. O'Connell married in 1802 his cousin Mary O'Connell, by whom he had three daughters and four sons, Maurice, Morgan, John (1810–1858), known as the "Young Liberator," and Daniel, all of whom sat in parliament.

BIBLIOGRAPHY.—His son John's *Life* (1846) and *Recollections and Experiences* (1849), the biographies by W. Fagan (1847), M. F. Cusack (1872), J. O'Rourke and O'Keefe (1875), and J. A. Hamilton (1888); also R. Dunlop, *Daniel O'Connell and the Revival of National Life in Ireland* (1900), R. Houston, *Daniel O'Connell: his Early Life and Journal, 1795–1802* (1906), and A Zimmermann, *Daniel O'Connell der Befreier und seine politische Bedeutung für Irland und England* (Paderborn, 1909).

O'CONNOR, FEARGUS EDWARD (1794–1855), Chartist leader, was the son of the Irish Nationalist politician Roger O'Connor. He entered parliament as M.P. for Cork and a follower of Daniel O'Connell in 1832; but three years later the "Liberator" had him unseated, by petition, for his indiscipline. He turned to radical agitation in England and on the publication of the Charter in 1838 became one of the best-known Chartist leaders. Owing to his rough humour, his energy and his invective he became their most popular speaker, and the circulation of his journal, the *Northern Star,* outstripped all others. He advocated physical force, generally, however, with the proviso that moral force must be tried first, and at the Chartist convention of 1839 acquiesced in William Lovett's "moral force" leadership. Although not concerned in the insurrection of 1839 he was imprisoned for a year upon another charge. In 1841 he reorganized the movement by the foundation of the National Charter association, and attained a position of such power that he was able practically to expel or silence Lovett and all others who advocated compromise with the middle class. But though he raised Chartism to its greatest power he was unable to direct it to victory. He permitted the general strike of 1842; in the midst of it his fears overcame him and he condemned it, securing its immediate defeat. After this fiasco he diverted Chartist energies to the support of his land company scheme for settling town workers on small holdings. For a while this appeared successful, and a first settlement, named O'Connorville, was opened at Herringsgate, Bucks. He was also elected M.P. for Nottingham in 1847. Next year, however, the company was found to be bankrupt, and the ignominious collapse of the revolutionary agitation of that year, to which he had pinned his hopes, made O'Connor's behaviour, already eccentric, plainly maniacal. He was, very belatedly, declared insane in 1852 and died in 1855. His funeral procession, 50,000 strong to Kensal Green, may be regarded as the last Chartist demonstration.

O'Connor was a tall, loud-voiced, handsome man, of unlimited devotion and energy and great oratorical powers; he was, however, vacillating, excessively vain, jealous and of small intellectual powers. (*See* CHARTISM.) (R. W. P.)

OCONOMOWOC, a city of Waukesha county, Wis., U.S., on federal highway 16; 33 mi. W. of Milwaukee; served by the Chicago, Milwaukee, St. Paul and Pacific railway. Pop. (1950) 5,345.

Oconomowac is located in a region of lakes. The city was founded about 1837 and incorporated in 1875. Its name is an Indian word said to mean "home of the beaver."

O'CONOR, CHARLES (1804–1884), U.S. lawyer, was born in New York city on Jan. 22, 1804. He was admitted to the bar in 1824. From 1853 to 1854 he was United States district attorney for New York. After the Civil War he became senior counsel for Jefferson Davis on his indictment for treason, and was one of his bondsmen. He took a prominent part in the prosecution of William M. Tweed and members of the "Tweed Ring" and published *Peculation Triumphant, Being the Record of a Five Years' Campaign against Official Malversation, A.D. 1871–1875* (1875).

O'Conor moved to Nantucket, Mass., in 1881, and died there on May 12, 1884.

OCONTO, a city of northeastern Wisconsin, U.S.A., on the W. shore of Green bay (Lake Michigan) at the mouth of the Oconto river; the county seat of Oconto county. It is on federal highway 41, and is served by the Chicago and North Western and the Chicago, Milwaukee, St. Paul and Pacific railways. Pop. (1950) 5,055. It has a large fishing industry and several manufacturing plants. It was founded in 1846 and chartered in 1882.

OCORONAN, a small group of tribes of South American Indians, provisionally regarded as constituting an independent linguistic stock. The Ocoronas live or lived in eastern Bolivia along the upper Mamore river, at the missions of San Ignacio,

BY COURTESY OF UFA

OCTOPUS OR DEVIL FISH

This underwater photograph of an octopus shows the animal crawling on the bottom supported by three of its eight arms. The arms are sucker bearing and are used in capturing crustaceans, the animal's chief food, which have been previously paralyzed with a poison secreted by its salivary glands. Octopods also feed on bivalve molluscs and fishes

San Martin and Santa Rosa de Moxos. Apart from brief references to them by the early missionaries, little is known concerning their culture. Rivet believes that the Ocoronas are merely a sub-group of the Chapacuran (*q.v.*) stock.

See G. de Crequi-Montfort and P. Rivet, "La Famille linguistique Capakura" (*J. Soc. Américanistes de Paris* [n.s.] vol. x., pp. 119–173).

OCOTILLO (*Fouquieria splendens*), a North American shrub of the candle-wood family (Fouquieriaceae), called also coachwhip, Jacob's-staff and vine-cactus. It is a characteristic shrub of rocky deserts from western Texas to southern California and southward in Mexico. Near the base the stem divides into several slender, erect, furrowed, intensely spiny branches, usually from 8 to 20 ft. high. It bears small rounded leaves, the midribs of which harden into the spines, and showy bright-scarlet flowers in terminal clusters. The ocotillo is sometimes grown as a hedge plant; in Mexico the branches are woven into fences.

OCTAHEDRON: *see* SOLIDS, GEOMETRIC.

OCTAVE, a period or series of eight members. In ecclesiastical usage the octave is the eighth day after a particular church festival, the feast day itself and the "octave" being counted. The octave thus always falls on the same day of the week as the festival, and any event occurring during the period is said to be "in the octave." In music, an octave is the eighth full tone above or below any given note. It is produced by double or half the number of vibrations corresponding to the given note. In the interval between a note and its octave is contained the full scale, the octave of a note forming the starting-point of another scale of similar intervals to the first. The interval between a note and its octave is also called an octave. The name is also applied to an open metal stop in an organ, and to a flute (more usually known as the piccolo) one octave higher in pitch than the regular flute. It is also a term for a "parade" in fencing. The "law of octaves" was a term applied in 1865 to a relationship among the chemical elements enunciated by J. A. R. Newlands.

In literature an octave is a form of verse consisting of eight iambic lines, and complete in itself. From its use by the poets of Sicily, the form is usually called the Sicilian octave. It is distinguished from a single stanza of *ottava rima* by having only two rhymes, arranged *abababab*. In German literature the octave has been used not infrequently since 1820, when Ruckert published "Sicilianen," as they are called in German, for the first time. The word is often used to describe the eight opening lines of a sonnet.

OCTAVIA, the name of two princesses of the Augustan house. (1) Octavia, daughter of Gaius Octavius and sister of the emperor Augustus, was the wife of Gaius Marcellus, one of the bitterest enemies of Julius Caesar. In 41 B.C. her husband died, and she was married to Marcus Antonius, with the idea of bringing about a reconciliation between him and her brother. Her efforts were at first successful, but in 36 Antony left for the Parthian War and renewed his intrigue with Cleopatra. Though Octavia took out troops and money to him (35), he refused to see her and formally divorced her in 32. (2) OCTAVIA, daughter of the emperor Claudius, was the wife of Nero, by whom she was put to death. A Latin tragedy on her fate is attributed, though wrongly, to Seneca.

OCTOBER, the eighth month of the old Roman year, which began in March. In the Julian calendar, while retaining its old name, it became the tenth month, and had 31 days assigned to it. Several attempts were made to rename the month in honour of the emperors. Thus it was in succession temporarily known as Germanicus, Antoninus, and Herculeus, the last a surname of Commodus. The senate's attempt to christen it Faustinus in honour of Faustina, wife of Antoninus, was equally unsuccessful. By the Slavs it is called "yellow month," from the fading of the leaf; to the Anglo-Saxons it was known as Winterfylleth, because at this full moon (*fylleth*) winter was supposed to begin.

OCTOPUS, the name given in zoology to a single genus of eight-armed Cephalopoda (*q.v.*), one of whose distinguishing characters is the presence of two rows of suckers on each arm. As a less strictly defined term the name may be given to all the eight-armed Cephalopoda, of which some 36 genera have been described (*e.g., Eledone, Cirroteuthis, Argonauta*). The genus *Octopus* is a large one containing upwards of 140 species. Its representatives occur in nearly all seas (though it is poorly represented in Arctic and Antarctic waters) and some are found at great depths. *Octopus vulgaris* is found on British coasts (principally in the south), but it has a limited distribution in these waters, and is not often taken, the allied *Eledone cirrosa* being more common.

The sucker-bearing arms, strong jaws and sinister appearance of these animals have conferred on them a name for ferocity which is not undeserved. The stories of their attacks on man are sufficiently well attested, though they are often exaggerated.

The octopus moves about by means of its arms on the sea bottom, and is not habitually free-swimming, though like other Cephalopods, it can propel itself through the water by means of the funnel (*see* CEPHALOPODA). *Octopus* and the related genus *Eledone* live on the sea-bottom and are mainly found in shallow coastal water. According to Lo Bianco the common octopus in the Gulf of Naples prefers rocky situations for its lair during its early years. Certain forms (*e.g., Benthoctopus*) are found in very deep water, the greatest depth from which a member of the genus *Octopus* has been obtained being 1,875 fathoms. Other Octopods, however, are inhabitants of the open sea and are found swimming or floating at the surface (*Argonauta*) or at greater depths (*Eledonella, Cirroteuthis*). A species of *Eledonella* has been taken at a depth of 2,900 fathoms. Those which live permanently in very deep water are usually highly modified, having gelatinous tissues, large medusiform webs and reduced gills and dentition.

The common octopus feeds principally on crabs. Lo Bianco has shown that before killing its victims it paralyses them with a poison secreted by its salivary glands. The same observer has recorded that the common octopus in captivity will devour its own arms even if it is amply supplied with its normal food. Certain species of octopus attain a considerable size. The common octopus, *O. vulgaris,* sometimes spans over six feet with its arms and the giant *O. apollyon* of the western coast of the United States has been known to have a diameter of 28 feet.

Most species of this genus lay eggs in grapelike clusters. Lee states that the female *O. vulgaris* broods over the clusters, holding them in the membranous expansion of its arms and syringing them with jets of water from its funnel (*see* CEPHALOPODA).

Octopods are eaten fresh or dried by the natives of many parts of the world. The flesh of young *O. vulgaris* is still considered a delicacy in Naples.

It has been mentioned above that the true octopus (*Octopus vulgaris*) is usually rare on the English coast. In 1899 and 1900, however, they became so abundant on the south coast as to attract general notice, and to constitute a veritable plague.

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OCTOSTYLE, in architecture, a portico with eight columns or a building with such a portico in front; *e.g.,* Parthenon at Athens.

OCTROI, an indirect or consumption tax levied by a local political unit, normally the commune or municipal authority, on certain categories of goods on their entry into its area (Fr. *octroyer,* from Low Lat. *auctorizare,* to confer, authorize, empower; *i.e.,* in this relation, the empowering of the subordinate political unit to impose certain taxation within its precincts; hence by extension the taxation system itself). The institution of such tax in Italy goes back to Roman times, when it bore the title of *portorium,* and in France to the 13th century. Suppressed in the latter country under the Revolution in 1791, the tax was re-established five years after; and until the close of the first quarter of the 20th century was operative very generally throughout the land. It was abolished in Belgium in 1870 and in Egypt in 1903; after World War II it still persisted in France, Italy, Spain, Portugal and Austria, but a marked tendency toward radical reduction in its total area of operation, or even its general suppression, had long been manifest.

France provides an outstanding example of this evolution. Pub-

lic opinion in that country—critical for generations of a tax system highly irksome, inconvenient in its mode of collection and unduly costly in relation to its yield (the levy process sometimes absorbed 50%)—was turned decisively against the system by the phenomenal increase of motor traffic: from 108,000 passenger cars in 1913 to 1,300,000 in 1932 and from 80,000 commercial vehicles in 1920 to 435,000 in 1932 (by the beginning of 1948 there were 1,650,000 vehicles circulating on the roads of France).

Commodities that might be subjected to this tax in France were prescribed by law and were divided into the following six classes: (1) liquids (artificial gaseous drinks, nonalcoholic beverages; vinegar; vegetable oils); (2) foods (meats, poultry, game, fish, butter, eggs, cheese, jams, fruits, etc.); (3) fuel (wood, coal, coke, candles, mineral oil, etc.); (4) fodder (fresh oil cakes, dog biscuits, etc.); (5) building materials (plaster, lime, stone, bricks, slates, metals, sanitary appliances, woods, glass, etc.); and (6) miscellaneous (soaps, polishes, varnishes, paints, etc.). For all the separate commodities within these six groups maximum rates of tariff were promulgated by presidential decree, specific rates being fixed for the three (until the law of Jan. 1941, six) separate sorts of octroi area, established on the basis of population, namely, communes having (1) less than 10,000 inhabitants, (2) from 10,000 to 50,000 and (3) more than 50,000. The maximum rates applicable in 1945 in these three groups were fixed as follows: for meat at 30 fr., 40 fr. and 50 fr., for butter at 24 fr., 40 fr. and 60 fr. and for coal at 0.90 fr., 1.50 fr. and 2 fr. per 100 kg. respectively.

The Paris octroi yielded from 200,000,000 fr. to 250,000,000 fr. yearly in the 1920s, nearly 600,000,000 fr. in 1938 but only 314,000,000 fr. in 1942, the shrinkage being caused mainly by the nonarrival of supplies in the area. As from Aug. 1943 the tax was suppressed for the city and for the 60 suburban communes. Important provincial towns (*e.g.,* Lyons, Bordeaux, Clermont-Ferrand, Troyes, Perpignan, etc.) had abolished the system many years before World War II. In May 1945 only 200 octroi areas, holding a total population of less than 1,000,000, were still existing in France; there had been 1,491 in 1918 and approximately 1,050 (with a total population of 14,500,000) in 1926.

The tax was finally suppressed from Jan. 1, 1949, because of the excessive formalities and the cost of its collection and control.

See M. Tardit and A. Ripert, *Traité des octrois municipaux* (Paris, 1904); L. Hourcade, *Manuel encyclopédique des contributions indirectes des octrois* (Poitiers, 1925).

O'CURRY, EUGENE (1796–1862), Irish scholar, was born at Dunaha, county Clare, in 1796, the son of a farmer who was a man of unusual intelligence. After being employed for some time in the topographical and historical section of the Irish ordnance survey, O'Curry earned his living by translating and copying Irish manuscripts. The catalogue of Irish manuscripts in the British Museum was compiled by him. On the founding of the Roman Catholic University of Ireland (1854) he was appointed professor of Irish history and archaeology. His lectures were published by the university in 1860. Three other volumes of lectures were published posthumously, under the title *On the Manners and Customs of the Ancient Irish* (1873). His voluminous transcripts, notably eight huge volumes of ancient Irish law, testify to his unremitting industry.

O'Curry died in Dublin in 1862.

ODAENATHUS or ODENATUS (Gr. *'Οδαίναθος*, "palm," אחינר , "little ear"), the Latinized form of ODAINATH, the name of a famous prince of Palmyra in the second half of the 3rd century A.D. who succeeded in recovering the Roman east from the Persians and restoring it to the empire. He belonged to the leading family of Palmyra, which bore, in token of Roman citizenship, the *gentilicium* of Septimius; hence his full name was Septimius Odainath. It is practically certain that he was the son of Septimius Hairan, the "senator and chief of Tadmor," the son of Septimius Odainath, "the senator."

The year when he became chief of Palmyra is not known, but already in an inscription dated A.D. 258 he is styled *vir consularis, i.e.,* of consular rank. He possessed the characteristic vigour and astuteness of the old Arab stock from which he sprang; and in his wife, the renowned Zenobia (*q.v.*), he found an able supporter of his policy.

The defeat and captivity of the emperor Valerian (A.D. 260) left the eastern provinces largely at the mercy of the Persians; the prospect of Persian supremacy was not one which Palmyra or its prince had any reason to desire. At first, it seems, Odainath attempted to propitiate the Persian monarch Shapur (Sapor) I; but when his gifts were contemptuously rejected he decided to throw in his lot with the cause of Rome. Odainath initiated that active policy which, while it added to his own fame, in a short time brought his native city to its ruin. He fell upon the victorious Persians who were returning home after the sack of Antioch, and before they could cross the Euphrates inflicted upon them a considerable defeat.

Then, when two usurping emperors were proclaimed in the east (A.D. 261), Odainath took the side of Gallienus the son and successor of Valerian, attacked and put to death the usurper Quietus at Emesa (Homs), and was rewarded for his loyalty by the grant of an exceptional position (A.D. 262).

Odainath may have assumed the title of king before; but he now became *corrector totius Orientis,* not indeed joint ruler, nor Augustus, but "independent lieutenant of the emperor for the East" (Theodor Mommsen, *Provinces,* ii, p. 103)[1]. In a series of rapid and successful campaigns, during which Odainath left Palmyra under the charge of Septimius Worod, his deputy, he crossed the Euphrates and relieved Edessa, recovered Nisibis and Carrhae and even took the offensive against the power of Persia and twice invested Ctesiphon, the capital, itself; probably also he brought back Armenia into the empire.

These brilliant successes restored the Roman rule in the east; and Gallienus did not disdain to hold a triumph with the captives and trophies which Odainath had won (A.D. 264).

While observing all due formalities toward his overlord, there can be little doubt that Odainath aimed at independent empire; but during his lifetime no breach with Rome occurred. He was about to start for Cappadocia against the Goths when he was assassinated, together with Herodes his eldest son, by his nephew Maeonius; there is no reason to suppose that this deed of violence was instigated from Rome.

After his death (A.D. 266–267) Zenobia succeeded to his position, and practically governed Palmyra on behalf of her young son Wahab-allath or Athenodorus. (*See* PALMYRA.)

(G. A. C.; X.)

ODDFELLOWS, ORDER OF, a secret benevolent and social society and, subsequently, a friendly benefit society also, having mystic signs of recognition, initiatory rites and ceremonies and various grades of dignity and honour. Great antiquity has been claimed for the order of Oddfellows, but the members themselves now generally admit that the institution cannot be traced back beyond the first half of the 18th century and explain the name as adopted at a time when the severance into sects and classes was so wide that persons aiming at social union and mutual help were a marked exception to the general rule. Mention is made by Defoe of the society of Oddfellows, but the oldest lodge of which the name has been handed down is the Loyal Aristarcus, no. 9, which met in 1745 "at the Oakley Arms, Borough of Southwark; Globe Tavern, Hatton Garden; or the Boar's Head in Smithfield, as the noble master may direct." The earliest lodges were supported by each member and visitor paying a penny to the secretary on entering the lodge, and special sums were voted to any brother in need. If out of work he was supplied with a card and funds to reach the next lodge, and he went from lodge to lodge until he found employment. The lodges gradually adopted a definite common ritual and became confederated under the name of the Patriotic Order. Toward the end of the century many of the lodges were broken up by state prosecutions on the suspicion that

[1] The Roman chronicler Trebellius Pollio goes further and asserts "Odenatus rex Palmyrenorum optinuit totius Orientis imperium. . . . Gallienus Odenatum participato imperio Augustum vocavit," *Hist. Aug.,* xxiii, 10 and 12. This is not borne out by the evidence. The highest rank claimed for him by his own people is recorded in an inscription dated 271 (Cooke, *North Semitic Inscrs.,* no. 130) set up by the two generals of the Palmyrene army; Odainath is styled "king of kings and restorer of the whole city"; but this does not mean that he ever held the title of Augustus, and the inscription was set up after his death and during the revolt of Palmyra.

their purposes were "seditious," but the society continued to exist as the Union Order of Oddfellows until 1809. In 1813, at a convention in Manchester, was formed the Independent Order of Oddfellows, Manchester Unity, which now overshadows all the minor societies in England. Oddfellowship was introduced into the United States from the Manchester Unity in 1819, and the grand lodge of Maryland and the United States was constituted on Feb. 22, 1821. It now rivals in membership and influence the Manchester Unity, from which it severed its connection in 1842. In 1843 it issued a dispensation for opening the Prince of Wales Lodge No. 1, at Montreal, Canada. The American society, including Canada and the United States, has its headquarters at Baltimore. Organizations connected either with the United States or England have been founded in France, Germany, Switzerland, Denmark, The Netherlands, Norway, Sweden, Poland, Czechoslovakia, the British dominions and elsewhere.

The most complete and trustworthy account of the institution is that in *The Complete Manual of Oddfellowship, its History, Principles, Ceremonies and Symbolism*, privately printed (1879). (*See* also FRIENDLY SOCIETIES.)

ODE, a form of stately and elaborate lyrical verse. The original signification of an ode was a chant, a poem arranged to be sung to an instrumental accompaniment. There were two great divisions of the Greek *melos* or song. One of them, in the hands of Alcaeus, Anacreon and Sappho, came close to what modern criticism knows as lyric. On the other hand, the choir-song, in which the poet spoke for himself, but always supported, or interpreted, by a chorus, led up to what is known as ode proper. It was Alcman who first gave to his poems a strophic arrangement, and the strophe (*q.v.*) has come to be essential to an ode. Stesichorus, Ibycus and Simonides of Ceos led the way to the two great masters of ode among the ancients, Pindar and Bacchylides. The form and verse-arrangement of Pindar's great lyrics have regulated the type of the heroic ode. It is now perceived that they are consciously composed in very elaborate measures. So far from being, as critics long supposed, utterly irregular, they are more like the *canzos* and *sirventes* of the mediaeval troubadours than any modern verse. The Latins lost the secret of these complicated harmonies, and made no serious attempt to imitate the odes of Pindar. The ode, as it was practised by the Romans, returned to the lyrical form of Sappho and Alcaeus. This was exemplified, in the most exquisite way, by Horace and Catullus.

The earliest modern writer to perceive the value of the antique ode was Ronsard, who attempted to recover the fire and volume of Pindar; his principal experiments date from 1550 to 1552. The poets of the Pléiade recognized in the ode one of the forms of verse with which French prosody should be enriched, but in their use of Greek words crudely introduced, and in their quantitative experiments, they offended the genius of the French language. The ode died in France almost as rapidly as it had come to life. Early in the 19th century the form was resumed, and we have the *Odes* composed between 1817 and 1824 by Victor Hugo, the odes of Lamartine, those of Victor de Laprade (collected in 1844), and the *Odes funambulesques* of Théodore de Banville (1857).

The earliest odes in English, using the word in its strict form, were the *Epithalamium* and *Prothalamium* of Spenser. Ben Jonson introduced a kind of elaborate lyric to which he gave the name of ode; and some of his disciples, in particular Randolph, Cartwright and Herrick, followed him. The "Hymn on the Morning of Christ's Nativity," begun by Milton in 1629, may be considered an ode, and his lyrics "On Time" and "At a Solemn Music" belong to the same category. But it was Cowley who introduced into English poetry the ode consciously built up, on a solemn theme and as definitely as possible on the ancient Greek pattern. He was no more perspicacious than others, however, in observing what the rules were which Pindar had followed. He published his "Pindaric" odes in 1656. These shapeless pieces became very popular after the Restoration, and enjoyed the sanction of Dryden in three or four irregular odes which are the best of their kind in the English language. In 1705 Congreve published a *Discourse on the Pindarique Ode*, and he wrote odes, in strophe, antistrophe and epode, which were the earliest of their kind in English; unhappily they were not very poetical. The attempts of Gilbert West (1703–56) to explain the prosody of Pindar (1749) inspired Gray to write his "Progress of Poesy" (1754) and "The Bard" (1756). Collins, meanwhile, had in 1747 published a collection of odes devised in the Aeolian or Lesbian manner. The odes of Wordsworth, Coleridge and Tennyson are entirely irregular. Shelley desired to revive the pure manner of the Greeks, but he understood the principle of the form so little that he began his "Ode to Naples" with two epodes, passed on to two strophes, and then indulged in four successive antistrophes. Coventry Patmore, in 1868, printed a volume of irregular *Odes*. Swinburne, although some of his odes, like those of Keats, are really elaborate lyrics, written in a succession of stanzas identical in form, cultivated the Greek form also, and some of his political odes follow very closely the type of Bacchylides and Pindar. Neither Sir William Watson nor Laurence Binyon, each of whom wrote memorable odes, adopted the Pindaric form.

See Philipp August Böckh, *De metris Pindari* (1811); Wilhelm Christ, *Metrik der Griechen und Römer* (1874); Edmund Gosse, *English Odes* (1881).

ODENKIRCHEN, former German town, 21 mi. by rail S.W. of Düsseldorf, and at the junction of lines to Munich, Gladbach and Stolberg. Pop. was 19,194. Odenkirchen became a town in 1856 and united with Gladbach-Rheydt in 1929. It carried on cotton spinning and weaving, tanning and dyeing.

ODENSE, a city of Denmark, the chief town of the *amt* (county) of its name, which forms the northern part of the island of Fyn (Fünen). Pop. (1950) 100,940. Odense, or Odinsey, originally Odinsoe, *i.e.*, Odin's island, is one of the oldest cities of Denmark. St. Canute's shrine was a great resort of pilgrims throughout the middle ages. In the 16th century the town was the meeting-place of several parliaments, and down to 1805 it was the seat of the provincial assembly of Fyn. The city lies 4 mi. from Odense fjord on the Odense Aa, the main portion on the north side of the stream, and the industrial Albani quarter on the south side. It has a station on the railway route between Copenhagen and Jutland and Schleswig-Holstein via Korsør. A canal, 15½ ft. to 21 ft. deep, gives access to the town from the fjord. St. Canute's cathedral is one of the largest and finest buildings of its kind in Denmark. It is constructed of brick in a pure Gothic style. Originally dating from 1081–93, it was rebuilt in the 13th century. Under the altar lies Canute (Knud), the patron saint of Denmark, who intended to dispute with William of Normandy the possession of England, but was slain in an insurrection at Odense in 1086; Kings John and Christian II. are also buried within the walls. Our Lady's church, built in the 13th century and restored in 1851–52 and again in 1864, contains a carved altar-piece (16th century) by Claus Berg of Lübeck. Odense castle was erected by Frederick IV., who died there in 1730. Exports, mostly agricultural produce (butter, bacon, eggs); imports, iron, petroleum, coal, yarn and timber.

ODENWALD, a wooded mountain region of Germany, almost entirely in Hessen, with small portions in Bavaria and Württemberg-Baden. It stretches between the Neckar and the Main, and is 50 mi. long by 20 to 30 broad. Its highest points are the Katzenbuckel (2,054 ft.), the Neunkircher Höhe (1,985 ft.) and the Krähenberg (1,965 ft.). The wooded heights overlooking the Bergstrasse are studded with castles and mediaeval ruins.

ODER (Lat. *Viadua;* Slavonic *Vjodr*), a European river, 550 mi. long, which rises in the Odergebirge (Lower Carboniferous rocks of the Bohemian massif). After flowing southeast it quickly turns northeast and after a short distance northwest enters upon the Silesian plain, which general direction it maintains across the recent deposits of the lowlands in a wide valley and with low banks. In its lower course it frequently bifurcates, forming many islands, and its main channel passes Stettin into the Grosses Haff, which is connected with the Baltic sea by three arms, the Peene, Swine and Dievenov forming the islands of Usedom and Wollin. The Swine in the middle is the main channel for navigation.

Rising in Czechoslovakia it touches the Upper Silesian coalfield

and enters Germany above Ratibor, after forming the frontier between Germany and Poland from Bohumin. It receives a number of left-bank tributaries from the gneisses and granites of the Bohemian massif, the chief being the Glatzer Neisse, Katzbach, Bober and Lausitzer Neisse, but the biggest affluents are those on the right-bank, the Warthe with its tributaries the Netze (Notéc) and the Obra, the Malapane and Bartsch, all of which rise in Poland. The most important towns on the river banks are Ratibor, Oppeln, Brieg, Breslau, Glogau, Frankfort-on-Oder, Küstrin, Stettin and Swinemünde. The river forms an important highway into eastern Germany, Poland and Czechoslovakia. It is utilized by three main currents of traffic, traffic between Stettin and Berlin, goods transported to or from the mining area of Upper Silesia (this traffic was reduced by the partition of Upper Silesia between Germany and Poland) and the traffic to and from Poland by the Warthe and its connections. The river begins to be navigable for barges at Ratibor, when it is about 100 ft. wide, and for larger vessels at Breslau where constant dredging is always necessary. Several parts of the main stream have been canalized, especially in the low-lying reaches, in its upper courses and between Stettin and the sea. It is now possible for sea-going vessels, drawing 24 ft. of water to reach Stettin. In addition navigation is possible on the Warthe, Netze and Obra, and the river is connected by canals with the Vistula, the Havel and the Spree.

By the Treaty of Versailles (1919) Poland extended her territory westwards to include the province of Posen (Posnania) but, although the boundary nowhere touches the Oder, long portions of its right-bank are now in Poland. The treaty also declared international the Oder and all navigable portions of its system which provide natural access to the sea for more than one State, and also appointed a commission consisting of three representatives of Prussia, and one each of Poland, Czechoslovakia, Great Britain, France, Denmark and Sweden to prepare an Act of Navigation. The work of this commission was by no means easy, for unforeseen difficulties arose upon the question of the right of the commission to legislate for the upper reaches of the Warthe, the Netze and the Old Netze.

ODESSA, a seaport of the Ukrainian S.S.R., in 46° 29′ N., 30° 44′ E., on the southern shore of a semi-circular bay, at the north-west angle of the Black sea. Pop. (1939) 604,223. It has five harbours; the Quarantine, New Harbour, Pratique and Cabotage harbours are sheltered by two breakwaters, 4,020 ft. and 2,120 ft. in length. The Petroleum harbour is sheltered by a breakwater 840 ft. in length. There is very good anchorage in the inner roads and a floating crane with a capacity of 40 tons. There are two patent slips and a double-sided floating dock, lifting power 4,800 tons. The harbours freeze for a few days in each year, and the bay occasionally freezes. Navigation is interrupted on an average for 16 days per annum, though the powerful ice breaker now installed lessens this time. The climate is influenced by its proximity to the steppe, and is continental. Average January temperature 23·2° F, July 72·8° F, average rainfall 14 in. per annum. The exports are mainly grain, linseed, wool, cattle, sugar and timber, and the imports coal, naphtha, iron, machinery, agricultural implements, raw cotton, tobacco, manufactured goods and tea, coffee and other colonial goods. Coal cargoes are discharged in the new harbour, several travelling steam cranes being fitted for the purpose. The Cabotage harbour is reserved for Russian coasting vessels. A repairing yard with a pontoon and fitting out basin is situated near the petroleum harbour. Improvements to the port are now being carried out, with a view to providing quayside and berths for 21 steamers, with warehouses and railway lines along the quay.

The town is picturesquely situated on a plateau 150 ft. above sea-level, which is intersected by ravines and forms the limit of the steppe region. The climate is milder than that of the rest of the Ukraine and in the vicinity of Odessa are numerous health resorts along the *limans*. In these limans, or former river mouths now cut off from the sea by the silting up of the rivers, are waters containing concentrated salt solutions, with high proportions of magnesium and calcium salts, iodine and bromine. Their mud is strongly impregnated with sulphuretted hydrogen and is highly beneficial to sufferers from rheumatism, nervous disorders and skin diseases. Spring gives the environs of Odessa a brief glory of brightly coloured blossoms but summer heat and drought soon parch the vegetation. The broad streets of the town have been planted with trees, peculiarly grateful in the brief intense heat of summer and in contrast with the general treeless condition of the surrounding steppe. The population is exceedingly mixed even for a seaport, and includes Great Russians, Ukrainians, Jews, Poles, Germans, Greeks, Armenians, Tatars and Turks, among others.

History.—The bay of Odessa has had a chequered history; it was colonised by Greeks at a very early period, but their ports Istrianorum Portus, Isiacorum Portus and Odessus at the mouth of the Tiligul liman disappeared in the 3rd and 4th centuries.

In spite of its favoured position between the Dniester and the Dnieper estuaries, no further settlements were made until the 14th century, when a Tatar chief Khaji Beg or Bey founded a fort on the present site of Odessa. Olgerd, prince of Lithuania, captured the fort in 1396 and it remained alternately in the power of Lithuania and Poland until its capture by Tatars in the 16th century. During the whole of this period it continued to be an important export centre for grain, salt and fish. The Turks captured it from the Tatars in the 16th century and built a fortress Yeni-Dunia to protect the harbour. In 1774 during the Russo-Turkish War, the Russians captured the town, but returned it to the Turks, finally occupying it and the whole territory between the Dniester and the Bug in 1789. A French captain, de Ribas, who had led the Russians in their assault on the town, was afterwards entrusted with the planning, in consultation with the French engineer Voland, of a military and commercial port, and a finely laid out Russian city replaced the former Turco-Tatar settlement.

In 1803 Odessa became the chief town of a separate municipal captaincy under Armand, duc de Richelieu, who developed its trade and importance. In 1824 it became the seat of the governors of Novorossia (New Russia) and Bessarabia and, as a free port, became very prosperous. Railway communication with Kiev and Kharkov and with Jassy in Rumania was established in 1866. The free port was closed in 1859. The town successfully resisted a Turkish attack in 1876–77. A numerous floating population began to be attracted, abundant work being available in years of good harvest, but unemployment became rife in years of bad harvest. In the 1905 revolution the workers, supported by the insurrectionary battleship "Potemkin," of the Black sea fleet, took active part in the revolutionary movement. The rising was suppressed, but broke out with renewed vigour in October of the same year and was again suppressed.

After the overthrow of the Kerensky government in October 1917, the Ukrainian Rada (Petlura) occupied the town. In January 1918 the Bolshevik workers of the town, aided by troops from the former Rumanian front and from the Black sea fleet expelled the followers of Petlura and proclaimed a soviet republic. In mid-March German and Austro-Hungarian troops occupied the town, and later the Ukrainian government, installed under German protection, called in the Entente troops, who occupied the greater part of the town. The French fleet bombarded the wretched inhabitants and French, Serbian, Polish and later Greek troops were landed. Eventually, however, a second soviet government was set up in April 1919, but was overthrown by General Denikin in August 1919. In February 1920 the soviet finally captured the town.

During this disastrous period a third of the houses were destroyed and numbers of the population were killed, while others fled into the surrounding villages. During 1921 and 1922 famine and famine diseases further devastated the town and lack of fuel caused the inhabitants to pull down many wooden buildings. But in 1923 conditions became somewhat easier and since then trade has slowly returned. Another difficulty, however, faced the town. Formerly much of its trade came via the Dniester river and Akkerman (now Cetatea Alba) from Bessarabia and in the absence of diplomatic relations between Rumania and Russia, a state of

armed neutrality existed on that river and trade was practically nonexistent. However, in spite of all these adverse conditions, the population in 1926 had reached normal size, increasing in 1937 to 534,000 and in 1939 to 604,223, thus showing an increase of about 40% as compared with 1926. The city gradually returned to normal conditions and trade and shipping were flourishing, making Odessa the principal seaport and commercial centre on the Black sea.

In the course of World War II Odessa played a very considerable role. The enormous strategic and economic importance of Odessa, not only for the Ukraine but for the entire U.S.S.R., made it quite necessary for the invading Germans to take possession of it in the shortest possible time in order to secure their flank and to use it as a basis for expansion over the Ukrainian industrial and mining area and the North Caucasian region. Besieged by the German and Rumanian troops Odessa fell after a gallant defense on Oct. 16, 1941, and was liberated only in the course of the great German retreat in 1943–44.

Industry.—In addition to its trading, port and shipbuilding activities Odessa has numerous industrial enterprises, among which the production of salt takes an important place. There are also glass, metal and brick works and factories for producing machinery, especially for agricultural purposes, and munitions, superphosphates, tin, cork, glue and oil from oleaginous seeds are produced. Recently introduced industries are the manufacture of cinematograph apparatus, of water gauges, of twine and of preserved foods. There is also an aeroplane factory and a regular air service has been established between Odessa and Kharkov, with intermediate stations at Poltavo and Zinovievsk. The water supply of the town is obtained from the Dniester river. The town has several theatres and museums. The former University of South Russia has been converted into a Technical institute, and there are Medical and Agricultural institutes, a State Public library and a Jewish Academical library. The medley of languages has encouraged the use of Esperanto and there is an Esperanto institute.

There is a zoological garden, laid out chiefly for purposes of acclimatization, and animals destined for the more severe conditions of the north are kept there for some time. The Bacteriological station was the first of its kind in Russia.

ODESSA, a town in west central Texas, U.S., and the county seat of Ector county. It is about 110 mi. N.W. of San Angelo at the junction of U.S. highway 80 and state highway 51, and is served by the Texas and Pacific railroad and by air lines and buses. The altitude is 2,890 ft. and the mean annual temperature 63°. The population was 29,495 in 1950; it was 9,573 in 1940, of whom 9,038 were native white; and 2,407 according to the census of 1930.

Odessa is an important retail and shipping centre for petroleum and livestock. It is also one of the largest U.S. producers of oil well supplies such as derricks and welding equipment. There are chemical plants, brass and iron works, oil wells and a large carbon black plant constructed in 1944. Other products include explosives, pressure vessels, tool boxes, mattresses, furniture, bottles, concrete and tile. Agricultural pursuits are limited chiefly to stock raising.

The town is regulated by a manager-council form of government chosen in direct nonpartisan elections for two-year terms. The sewage treatment plant and waterworks are municipally owned and operated and the total property valuation of Odessa was assessed at $26,866,080 in 1950. There are two hospitals of which the oldest was established in 1933.

Odessa is set against a background of desert plains and oil country. It was settled by Methodists in 1881. Of geological interest is the Odessa meteor crater, ten miles to the southwest, which is said to be the second largest in the U.S. It is about 600 ft. in diameter, is composed of iron, and was located by surveyors as being 164 ft. below the earth's surface.

ODIN or **OTHIN,** the chief god of the northern pantheon, is represented as an old man with one eye. Frigg is his wife, Thor and Balder, among other gods, are his sons. He is also said to have been the father of several legendary kings. His exploits and adventures are a common theme in the poetic and prose Eddas. Here his character is distinguished rather by wisdom than martial prowess, and reference is frequently made to his skill in poetry and magic. In *Ynglinga Saga* he is represented as reigning in Sweden. In notices relating to religious observances Odin appears chiefly as the giver of victory or as the god of the dead. He receives the souls of the slain, who in his palace, Valhalla (*q.v.*), live a life of fighting and feasting, similar to that which has been their desire on earth. Human sacrifices were frequently offered to Odin, especially prisoners taken in battle. In the poem *Hávamál* the god himself is represented as sacrificed. The worship of Odin seems to have prevailed chiefly, if not solely, in military circles. To the Anglo-Saxons he was known as Woden (*q.v.*) and to the Germans as Wodan (Wuotan). Owing to the peculiar character of this god and the prominent position which he occupies, the mythology of the north presents a striking contrast to that of Greece. *See* Teutonic Peoples, *ad fin.;* and Woden.

ODO or Eudes (d. 898), king of the Franks, a son of Robert the Strong, count of Anjou (d. 866), is sometimes referred to as duke of France and also as count of Paris. For his resistance to the attacks of the Normans Odo was chosen king by the western Franks when the emperor Charles the Fat was deposed in 887, and was crowned at Compiègne in February 888. He defeated the Normans at Montfaucon and elsewhere, but was soon involved in a struggle with powerful nobles, who supported the claim of Charles, afterwards King Charles III, to the Frankish kingdom. To gain support Odo owned himself a vassal of the German king, Arnulf, but in 894 Arnulf declared for Charles. Eventually, after a struggle of three years, Odo was compelled to come to terms with his rival, and to surrender to him a district north of the Seine. He died at La Fère on Jan. 1, 898.

See E. Lavisse, *Histoire de France,* vol. ii (1903); and E. Favre, *Eudes, comte de Paris et roi de France* (1893).

ODO or Eudes (d. *c.* 736), king, or duke, of Aquitaine, obtained this dignity about 715, and his territory included the southwestern part of Gaul from the Loire to the Pyrenees. In 718 he appears as the ally of Chilperic II, king of Neustria, who was fighting against the Austrasian mayor of the palace, Charles Martel; but after the defeat of Chilperic at Soissons in 719 he probably made peace with Charles by surrendering to him the Neustrian king and his treasures. Odo was also obliged to fight the Saracens who invaded the southern part of his kingdom, and inflicted a severe defeat upon them at Toulouse in 721. When, however, he was again attacked by Charles Martel, the Saracens renewed their ravages, and Odo was defeated near Bordeaux; he was compelled to crave protection from Charles, who took up this struggle and gained his momentous victory at Poitiers in 732. In 735 the king abdicated, and was succeeded by his son Hunold.

ODOACER or Odovacar (*c.* 434–493), the first barbarian ruler of Italy, son of Aedico or Idico, was born in the district bordering on the middle Danube about the year 434. He was probably one of the tribe of Scyrri who had invaded Pannonia about 430. It is said that as a tall young recruit for the Roman armies, dressed in a sordid vesture of skins, on his way to Italy, he entered the cell of St. Severinus, to ask his blessing. The saint had an inward premonition of his future greatness, and in blessing him said, "Fare onward into Italy. Thou who art now clothed in vile raiment wilt soon give precious gifts unto many."

Odoacer was probably about 30 years of age when he thus entered the imperial service. By the year 472 he had risen to some eminence. In the year 475 the emperor Nepos was driven into exile, and the successful rebel Orestes was enabled to array in the purple his son, a handsome boy of 14 or 15, who was named Romulus after his grandfather, and nicknamed Augustulus, from his inability to play the part of the great Augustus. Before this puppet emperor had been a year on the throne the barbarian mercenaries rose in mutiny, demanding to be made proprietors of one-third of the soil of Italy. To this request Orestes returned a peremptory negative. Odoacer now offered his fellow-soldiers to obtain for them all that they desired if they would seat him on the throne. On Aug. 23, 476, he was proclaimed king; five days later Orestes was made prisoner at Placentia and beheaded. Augustulus was compelled to descend from the throne, but his

life was spared.

Odoacer was 42 years of age when he thus became chief ruler of Italy, and he reigned 13 years with undisputed sway. The administration was conducted as much as possible on the lines of the old imperial government. The settlement of the barbarian soldiers on the lands of Italy probably affected the great landowners rather than the labouring class. To the herd or *coloni* and *servi* it probably made little difference whether the master whom they served called himself Roman or Rugian.

In 477 or 478 the dethroned emperor Nepos sent ambassadors to Zeno, emperor of the east, begging his aid in the reconquest of Italy. These ambassadors met a deputation from the Roman senate, sent nominally by the command of Augustulus, really no doubt by that of Odoacer, to declare that they did not need a separate emperor. The senate had chosen Odoacer, and they therefore prayed Zeno to confer upon him the dignity of patrician, and entrust the "diocese" of Italy to his care. Zeno returned a harsh answer to the senate, requiring them to return to their allegiance to Nepos. In fact, however, he did nothing for the fallen emperor, but accepted the new order of things, and even addressed Odoacer as patrician. On the other hand, the latter sent the ornaments of empire to Constantinople as an acknowledgment of the fact that he did not claim supreme power. Information as to the actual title assumed by the new ruler is somewhat confused. He does not appear to have called himself king of Italy, but only king of the tribes of barbarians that followed him. By the Roman inhabitants of Italy he was addressed as "dominus noster," but his right to exercise power would in their eyes rest, in theory, on his recognition as patricius by the Byzantine Augustus. At the same time he marked his own high pretensions by assuming the prefix Flavius. His internal administration was probably, upon the whole, wise and moderate, and he may be looked upon as a not altogether unworthy predecessor of Theodoric.

In the history of the papacy Odoacer figures as the author of a decree promulgated at the election of Felix II in 483, forbidding the pope to alienate any of the lands or ornaments of the Roman Church, and threatening any pope who should infringe this edict with anathema.

The chief events in the foreign policy of Odoacer were his Dalmatian and Rugian wars. In the year 480 the ex-emperor Nepos, who ruled Dalmatia, was traitorously assassinated in Diocletian's palace at Spalato by the counts Viator and Ovida. In the following year Odoacer invaded Dalmatia, slew the murderer Ovida, and reannexed Dalmatia to the western state. In 487 he appeared as an invader in his own native Danubian lands. War broke out between him and Feletheus, king of the Rugians. Odoacer entered the Rugian territory, and defeated and captured Feletheus. In the following year Frederick, son of the captive king, endeavoured to raise again the fallen fortunes of his house, but was defeated by Onulf, brother of Odoacer, and took refuge at the court of Theodoric the Ostrogoth.

This Rugian war was probably an indirect cause of the fall of Odoacer. His increasing power rendered him too formidable to the Byzantine court. At the same time, Zeno was embarrassed by the formidable neighbourhood of Theodoric the Ostrogoth. In these circumstances arose the plan of Theodoric's invasion of Italy, the details of which belong properly to the life of Theodoric. It is sufficient to state here that he entered Italy in August 489, defeated Odoacer at the Isontius (Isonzo) on the 28th of August, and at Verona on the 30th of September. Odoacer then shut himself up in Ravenna, and there maintained himself for four years, with one brief gleam of success, during which he emerged from his hiding place and fought the battle of the Addua (Aug. 11, 490), in which he was again defeated. A sally from Ravenna (July 10, 491) was again the occasion of a murderous defeat. At length, the famine in Ravenna having become almost intolerable, and the Goths despairing of ever taking the city by assault, negotiations were opened for a compromise (Feb. 25, 493). It was stipulated that Ravenna should be surrendered, that Odoacer's life should be spared, and that he and Theodoric should be recognized as joint rulers of the Roman state. The arrangement was evidently a precarious one, and was soon terminated by the treachery of Theodoric. He invited his rival to a banquet in the palace of the Lauretum on the 15th of March, and there slew him with his own hand. "Where is God?" cried Odoacer when he perceived the ambush into which he had fallen. "Thus didst thou deal with my kinsman," shouted Theodoric, and clove his rival with the broadsword from shoulder to flank. Thelan, his son, was not long after put to death by order of the conqueror. Thus perished the whole race of Odoacer.

Bibliography.—The chief authorities for the life of Odoacer are the so-called "Anonymus Valesii," generally printed at the end of Ammianus Marcellinus; the *Life of Severinus*, by Eugippius; the chroniclers, Cassiodorus and "Cuspiniani Anonymus" (both in Roncalli's collection); and the Byzantine historians, Malchus and John of Antioch. A fragment of the latter historian, unknown when Gibbon wrote, is to be found in the fifth volume of Müller's *Fragmenta Historicorum Graecorum*. There is a thorough investigation of the history of Odoacer in R. Pallmann's *Geschichte der Völkerwanderung*, vol. ii (Weimar, 1864). *See* also T. Hodgkin, *Italy and Her Invaders*, vol. iii (Oxford, 1885).

ODOFREDUS, Italian jurist of the 13th century. He was born at Bologna and studied law under Balduinus and Accursius. After having practised as an advocate both in Italy and France, he became professor at Bologna in 1228. The commentaries on Roman law attributed to him are valuable as showing the growth of the study of law in Italy, and for their biographical details of the jurists of the 12th and 13th centuries. Odofredus died at Bologna on Dec. 3, 1265.

Over his name appeared *Lecturae in codicem* (Lyons, 1480), *Lecturae in digestum vetus* (Paris, 1504), *Summa de libellis formandis* (Strasbourg, 1510), *Lecturae in tres libros* (Venice, 1514) and *Lecturae in digestum novum* (Lyons, 1552).

ODONATA, an order of insects (*q.v.*) comprising the dragonflies and damselflies (*see* Dragonfly).

O'DONNELL, the name of an ancient and powerful Irish family, lords of Tyrconnel in early times, and the chief rivals of the O'Neills in Ulster. Like the family of O'Neill (*q.v.*), that of O'Donnell was descended from Niall of the Nine Hostages, king of Ireland at the beginning of the 5th century; the O'Neills, or Cinel Owen, tracing their pedigree to Owen (Eoghan), and the O'Donnells, or Cinel Connell, to Conall Gulban, both sons of Niall. Tyrconnel, the district named after the Cinel Connell, where the O'Donnells held sway, comprised the greater part of the modern county of Donegal except the peninsula of Inishowen; and since it lay conterminous with the territory ruled by the O'Neills of Tyrone, who were continually attempting to assert their supremacy over it, the history of the O'Donnells is for the most part a record of tribal warfare with their powerful neighbours, and of their own efforts to make good their claims to the overlordship of northern Connaught.

The first chieftain of mark in the family was Goffraidh (Godfrey), son of Donnell Mor O'Donnell (d. 1241). Goffraidh, who was "inaugurated" as "The O'Donnell," *i.e.*, chief of the clan, in 1248, successfully raided Tyrone and Connaught, and was severely wounded in the battle of Roscede (1257). In the following year he defeated Brian O'Neill, but died soon after from his old wounds. He was succeeded in the chieftainship by his brother Donnell Oge.

In the 16th century, when the English began to make determined efforts to bring the whole of Ireland under subjection to the crown, the O'Donnells of Tyrconnel played a leading part, co-operating at times with the English, especially when such co-operation appeared to promise triumph over their ancient enemies the O'Neills, at other times joining with the latter against the English authorities.

Manus O'Donnell (d. 1564), son of Hugh Dubh O'Donnell, was left to rule Tyrconnel during his father's pilgrimage to Rome about 1511; and retained the chief authority when Hugh Dubh returned. A family quarrel ensued, but with the help of the O'Neills, Manus established his hold over Tyrconnel. In 1522, however, the O'Neills and O'Donnells were again at war. Conn Bacach O'Neill, 1st earl of Tyrone, determined to subjugate the O'Donnells. Supported by several septs of Munster and Connaught, and assisted by English contingents and the MacDonnells

of Antrim, O'Neill took the castle of Ballyshannon, and after devastating a large part of Tyrconnel encamped at Knockavoe, near Strabane. Here he was surprised at night by Hugh Dubh and Manus O'Donnell, and severely defeated. The war continued, however, and in 1531 O'Donnell applied to the English government for protection, giving assurances of allegiance to Henry VIII. In 1537 Lord Thomas Fitzgerald and his five uncles were executed for rebellion in Munster, and the English government made every effort to lay hands also on Gerald, the youthful heir to the earldom of Kildare, a boy of 12 years of age who was in the secret custody of his aunt Lady Eleanor McCarthy. This lady, in order to secure a powerful protector for the boy, accepted an offer of marriage by Manus O'Donnell, who on the death of Hugh Dubh in July 1537 was inaugurated The O'Donnell. Conn O'Neill was a relative of Gerald Fitzgerald, and this event accordingly led to the formation of the Geraldine League, a federation which combined the O'Neills, the O'Donnells, the O'Briens of Thomond, and other powerful clans; the primary object of which was to restore Gerald to the earldom of Kildare, but which afterwards aimed at the complete overthrow of English rule in Ireland. In Aug. 1539 Manus O'Donnell and Conn O'Neill were heavily defeated by the lord deputy at Lake Bellahoe, in Monaghan.

In the west Manus continued to assert the supremacy of the O'Donnells in north Connaught, where he compelled O'Conor Sligo to acknowledge his overlordship in 1539. In 1542 he went to England and presented himself, together with Conn O'Neill and other Irish chiefs, before Henry VIII. In his later years Manus was harassed by his son Calvagh, who imprisoned him in 1555, and deposed him from all authority in Tyrconnel. He died in 1564. Manus O'Donnell is also described by the Four Masters as "a learned man, skilled in many arts, gifted with a profound intellect, and the knowledge of every science." At his castle of Portnatrynod near Strabane he supervised if he did not actually dictate the writing of the *Life of Saint Columbkille* in Irish, which is preserved in the Bodleian library at Oxford. Manus was several times married. His first wife, Joan O'Reilly, was the mother of Calvagh, and two daughters, both of whom married O'Neills; the younger, Margaret, was wife of the famous rebel Shane O'Neill. His second wife, Hugh's mother, by whom he was ancester of the earls of Tyrconnel (*see* below), was Judith, sister of Conn Bacach O'Neill, 1st earl of Tyrone, and aunt of Shane O'Neill. He died in 1564.

CALVAGH O'DONNELL (d. 1566), eldest son of Manus O'Donnell, in the course of his above-mentioned quarrel with his father and his half-brother Hugh, sought aid in Scotland from the MacDonnells, who assisted him in deposing Manus and securing the lordship of Tyrconnel. Hugh then appealed to Shane O'Neill, who invaded Tyrconnel at the head of a large army in 1557 to secure supremacy over Ulster, and encamped on the shore of Lough Swilly. Calvagh surprised the O'Neills in their camp at night and routed them. Calvagh was then recognized by the English government as lord of Tyrconnel; but in 1561 he and his wife were captured by Shane O'Neill in the monastery of Kildonnell. His wife, Catherine Maclean, who had previously been the wife of the earl of Argyll, was kept by Shane O'Neill as his mistress and bore him several children, though grossly ill-treated by her savage captor; Calvagh himself was subjected to atrocious torture during the three years that he remained O'Neill's prisoner. He was released in 1564 on conditions which he had no intention of fulfilling; and crossing to England he appealed to Queen Elizabeth. In 1566 Sir Henry Sidney marched to Tyrconnel, and restored Calvagh to his rights. Calvagh, however, died in the same year, and as his son Conn was a prisoner in the hands of Shane O'Neill, his half-brother Hugh MacManus was inaugurated The O'Donnell in his place. Hugh, who in the family feud with Calvagh had allied himself with O'Neill, now turned round and combined with the English to crush the hereditary enemy of his family; and in 1567 he utterly routed Shane at Letterkenny, compelling him to seek refuge with the MacDonnells of Antrim, by whom he was put to death. In 1592 Hugh abdicated in favour of his son Hugh Roe O'Donnell (*see* below); but Niall Garve, second son of Calvagh's son Conn, resented the passing of the chieftainship to the descendants of Manus O'Donnell's second marriage. His elder brother was Hugh of Ramelton, whose son John, an officer in the Spanish army, was father of Hugh Baldearg O'Donnell (d. 1704), known in Spain as Count O'Donnell, who commanded an Irish regiment as brigadier in the Spanish service. This officer came to Ireland in 1690 and raised an army in Ulster to be used in the service of James II, afterwards deserting to the side of William III, from whom he subsequently accepted a pension.

NIALL GARVE O'DONNELL (1569–1626), grandson of Calvagh, made terms with the English government, to whom he rendered valuable service both against the O'Neills and against his cousin. But in 1601 he quarrelled with the lord deputy, who, though willing to establish Niall Garve in the lordship of Tyrconnel, would not permit him to enforce his supremacy over Cahir O'Dogherty in Inishowen. Charged with complicity in Cahir O'Dogherty's rebellion in 1608, Niall Garve was sent to the Tower of London, where he remained till his death in 1626. He married his cousin Nuala, the sister of Hugh Roe and Rory O'Donnell. When Rory fled with the earl of Tyrone to Rome in 1607, Nuala, who had deserted her husband when he joined the English against her brother, accompanied him, taking with her her daughter Grania. She was the subject of an Irish poem, of which an English version was written by James Mangan from a prose translation by Eugene O'Curry.

HUGH ROE O'DONNELL (1572–1602), eldest son of Hugh MacManus O'Donnell, and grandson of Manus O'Donnell by his second marriage with Judith O'Neill, was the most celebrated member of his clan. His mother was Ineen Dubh, daughter of James MacDonnell of Kintyre; his sister, the second wife of Hugh O'Neill, 2nd earl of Tyrone. These family connections with the Hebridean Scots and with the O'Neills made the lord deputy, Sir John Perrot, afraid of a powerful combination against the English government, and induced him to establish garrisons in Tyrconnel and to demand hostages from Hugh MacManus O'Donnell, which the latter refused to hand over. In 1587 Perrot conceived a plan for kidnapping Hugh Roe (Hugh the Red), now a youth of 15, who had already given proof of exceptional ability. A merchant vessel laden with Spanish wines was sent to Lough Swilly, and Hugh Roe with some youthful companions was enticed on board, when the ship immediately set sail and conveyed the party to Dublin. The boys were kept in prison for more than three years. In 1591 young O'Donnell escaped; and after enduring terrible privations he made his way to Tyrconnel, where in the following year his father handed the chieftainship over to him.

Red Hugh then led an expedition against Turlough Luineach O'Neill, who was at war with his kinsman Hugh, earl of Tyrone, with whom O'Donnell was in alliance, at the same time assuring the lord deputy of his loyalty. Determined to vindicate the traditional claims of his family in north Connaught, he aided Hugh Maguire against the English, though on the advice of Tyrone he abstained for a time from committing himself too far. When, however, in 1594 Enniskillen castle was taken and the women and children flung into the river from its walls by order of Sir Richard Bingham, the English governor of Connaught, O'Donnell sent urgent messages to Tyrone for help; and while he himself hurried to Derry to withstand an invasion of Scots from the isles, Maguire defeated the English with heavy loss at Bellanabriska (The Ford of the Biscuits). In 1595 Red Hugh again invaded Connaught, putting to the sword all above 15 years of age unable to speak Irish; he captured Longford and Sligo, which placed north Connaught at his mercy. In 1596 he agreed in conjunction with Tyrone to a cessation of hostilities with the English, and met the government commissioners near Dundalk.

The terms he demanded were, however, refused. He hoped for help from Philip II of Spain, with whom he and Tyrone had been in correspondence. In the beginning of 1597 he raided Connaught, where O'Conor Sligo had been set up by the English as a counterpoise to O'Donnell. He devastated the country and returned to Tyrconnel with rich spoils; in 1598 he helped to defeat the English at the Yellow Ford on the Blackwater; and

in 1599 he defeated an attempt by the English under Sir Conyers Clifford, governor of Connaught, to succour O'Conor Sligo in Collooney castle, which O'Donnell captured, forcing Sligo to submission. The government now sent Sir Henry Docwra to Derry, and O'Donnell entrusted to his cousin Niall Garve the task of opposing him. Niall Garve, however, went over to the English, making himself master of O'Donnell's fortresses of Lifford and Donegal. While Hugh Roe was besieging Donegal in 1601, he heard that a Spanish force had landed in Munster. He marched rapidly to the south, and was joined by Tyrone at Bandon, but a night attack on the English besieging the Spaniards in Kinsale having utterly failed, O'Donnell, who attributed the disaster to the incapacity of the Spanish commander, took ship to Spain on Jan. 6, 1602, to lay his complaint before Philip III. He was favourably received by the Spanish king, but he died at Simancas on Sept. 10 in the same year.

Rory O'Donnell, 1st earl of Tyrconnel (1575–1608), second son of Hugh MacManus O'Donnell, and younger brother of Hugh Roe, accompanied the latter in the expedition to Kinsale; and when his brother sailed for Spain he transferred his authority as chief to Rory. In 1602 Rory gave in his allegiance to Lord Mountjoy, the lord deputy; and in the following summer he went to London with the earl of Tyrone, when James I created him earl of Tyrconnel. In 1605 he was made the king's lieutenant in Donegal. But the arrangement between Rory and Niall Garve insisted upon by the government displeased both O'Donnells, and Rory, like Hugh Roe before him, entered into negotiations with Spain. His country had been devastated by famine and war, and his own extravagance had plunged him in debt. These circumstances and the fear that his designs were known to the government induced him to leave Ireland. In Sept. 1607 "the flight of the earls" (*see* O'Neill) took place, Tyrconnel and Tyrone reaching Rome in April 1608, where Tyrconnel died on July 28. His wife, the beautiful daughter of the earl of Kildare, was left behind in the haste of Tyrconnel's flight, and lived to marry Nicholas Barnewell, Lord Kingsland. By Tyrconnel she had a son Hugh; and among other children a daughter Mary Stuart O'Donnell, who, born after her father's flight from Ireland, was so named by James I after his mother. This lady, after many romantic adventures, married a man called O'Gallagher and died in poverty on the continent.

Rory O'Donnell was attainted by the Irish parliament in 1614, but his son Hugh, who lived at the Spanish court, assumed the title of earl; and the last titular earl of Tyrconnel was this Hugh's son Hugh Albert, who died without heirs in 1642, and who by his will appointed Hugh Baldearg O'Donnell (*see* above) his heir, thus restoring the chieftainship to the elder branch of the family. To a still elder branch belonged Daniel O'Donnell (1666–1735), a general of the famous Irish brigade in the French service, whose father, Turlough, was a son of Hugh Dubh O'Donnell, elder brother of Manus, son of an earlier Hugh Dubh mentioned above. Daniel served in the French army in the wars of the period, fighting against Marlborough at Oudenarde and Marlplaquet at the head of an O'Donnell regiment. He died in 1735.

The famous Cathach, or Battle-Book of the O'Donnells, was in the possession of General Daniel O'Donnell, from whom it passed to more modern representatives of the family, who presented it to the Royal Irish academy, where it is preserved. This relic, of which a curious legend is told (*see* P. W. Joyce, *A Social History of Ancient Ireland,* 1903, vol. i p. 501), is a Psalter said to have belonged to St. Columba, a kinsman of the O'Donnells, which was carried by them in battle as a charm or talisman to secure victory. Two other circumstances connecting the O'Donnells with ancient Irish literature may be mentioned. The family of O'Clery, to which three of the celebrated "Four Masters" belonged, were hereditary Ollaves (doctors of history, music, law, etc.) attached to the family of O'Donnell; while the "Book of the Dun Cow" (*Lebor-na-h Uidhre*), one of the most ancient Irish mss., was in the possession of the O'Donnells in the 14th century; and the estimation in which it was held at that time is proved by the fact that it was given to the O'Connors of Connaught as ransom for an important prisoner, and was forcibly recovered some years later. *See* O'Neill, and the authorities there cited.

O'DONNELL, LEOPOLD (1809–1867), duke of Tetuan, Spanish general and statesman, was born at Santa Cruz, Teneriffe, on January 12, 1809. General of division in the army of Queen Christina, he accompanied her into exile in 1840; attempted unsuccessfully a rising in her favour at Pamplona in 1841, helped in the overthrow of Espartero (1843) and from 1844–48 served the new government in Cuba. War minister (1854) under Espartero, he plotted successfully against his chief in 1856 and became head of the cabinet from the July revolution until October, and again in July 1858. He took command of the expedition to Morocco (Dec. 1859) and was made duke after the surrender of Tetuan. He resigned office in 1863 until 1865, resumed it and resigned again in favour of Narvaez in 1866. He died at Bayonne, Nov. 5, 1867.

O'DONNELL, PATRICK (1856–1927), cardinal archbishop of Armagh, Ireland, was born of humble parents at Kilraine, Donegal, on Nov. 28, 1856, and was educated locally, then at the Catholic university at Dublin, and finally at Maynooth, where he took priest's orders in 1880. Eight years later he became bishop of Raphoe, a see which he held for 34 years, during which he transformed the diocese set in the wild highlands of Donegal. Dr. O'Donnell was a strong constitutional nationalist and one of the wisest men in the party. Perhaps his supreme gift to Ireland was his sense of the importance of substituting peace for the violent religious hatred prevailing in northern Ireland. He believed in good will for the modification of existing differences due to territorial and religious conditions. He was a member of the Irish convention 1917–18.

In 1923 the pope nominated him coadjutor to Cardinal Logue, archbishop of Armagh, whom he succeeded in the primacy in the following year. In 1925 he received the cardinalate. In 1927 he held a plenary synod of the Irish hierarchy, at which far-reaching reforms were undertaken. The cardinal spoke Gaelic from his childhood and promoted the use of the vernacular. He died on Oct. 22, 1927, at Carlingford.

ODONTOGLOSSUM, a genus of epiphytic plants of the orchid family (Orchidaceae), comprising about 100 species native to the mountains of tropical America. Many species are well known in greenhouse cultivation, including numerous hybrids. *O. grande,* the baby orchid, has showy yellow flowers, barred with cinnamon-brown, 5 in. to 6 in. across. (*See* Orchids.)

ODONTORNITHES, the term proposed by O. C. Marsh for North American fossil birds possessed of teeth (Gr. ὀδούς, tooth, ὄρνις, ὄρνιθος bird), notably the genera *Hesperornis* and *Ichthyornis* from Cretaceous deposits. In 1875 he divided the "subclass" into Odontolcae, with the teeth standing in grooves, and Odontotormae, with the teeth in separate alveoles or sockets. The Odontornithes are now called the Superorder Odontognathae, or the new world toothed birds. (*See* Hesperornis and Ichthyornis).

ODO OF BAYEUX (*c.* 1036–1097), Norman bishop and English earl, was a uterine brother of William the Conqueror, from whom he received, while still a youth, the see of Bayeux (1049). But his active career was that of a warrior and statesman. He found ships for the invasion of England and fought in person at Senlac; in 1067 he became earl of Kent, and for some years he was a trusted royal minister. At times he acted as viceroy in William's absence; at times he led the royal forces to chastise rebellions. But in 1083 he was suddenly disgraced and imprisoned for having planned a military expedition to Italy. He was accused of desiring to make himself pope; more probably he thought of serving as a papal condottiere against the emperor Henry IV. The Conqueror, when on his death-bed, reluctantly permitted Odo's release (1087). The bishop returned to his earldom and soon organized a rebellion with the object of handing over England to his eldest nephew, Duke Robert. William Rufus, to the disgust of his supporters, permitted Odo to leave the kingdom after the collapse of this design (1088), and thenceforward Odo was the right-hand man of Robert in Normandy. He took part in the agitation for the first crusade, and started in the duke's company for Palestine, but died on the way, at Palermo

(Feb. 1097). Little good is recorded of Odo. His vast wealth was gained by extortion and robbery. His ambitions were boundless and his morals lax. But he was a patron of learning and, like most prelates of his age, a great architect. He rebuilt the cathedral of his see, and may perhaps have commissioned the unknown artist of the celebrated Bayeux tapestry.

Odo must be distinguished from two English prelates of the same name and also from an English earl. Odo or Oda (d. 959), archbishop of Canterbury, was bishop of Ramsbury from 927 to 942, and went with King Aethelstan to the battle of Brunanburh in 937. In 942 he succeeded Wulfhelm as archbishop of Canterbury, and he appears to have been an able and conscientious ruler of the see. He had great influence with King Edwy, whom he had crowned in 956. Odo (d. 1200), abbot of Battle, was a monk of Christ church, Canterbury, and was prior of this house at the time when Thomas Becket was murdered. In 1175 he was chosen abbot of Battle, and on two occasions the efforts of Henry II alone prevented him from being elected archbishop of Canterbury. Odo or Odda (d. 1056), a relative of Edward the Confessor, during whose reign he was an earl in the west of England, built the minster at Deerhurst in Gloucestershire.

See the authorities cited for WILLIAM I and WILLIAM II, the biographical sketch in *Gallia Christiana*, xi, 353–360; H. Wharton, *Anglia Sacra*, i, 334–339 (1691); and F. R. Fowke, *The Bayeux Tapestry* (1898). (H. W. C. D.)

ODORIC (*c.* 1286–1331), styled "of Pordenone," one of the chief travellers of the later middle ages, and a *Beatus* of the Roman Church, was born at Villa Nuova, a hamlet near the town of Pordenone in Friuli, in or about 1286. According to the ecclesiastical biographers, in early years he took the vows of the Franciscan order and joined their convent at Udine, the capital of Friuli.

Friar Odoric was despatched to the east, where a remarkable extension of missionary action was then taking place, about 1316–18, and did not return till the end of 1329 or beginning of 1330. He was in western India soon after 1321 (pretty certainly in 1322) and he spent three years in China between the opening of 1323 and the close of 1328. His route to the east lay by Trebizond and Erzerum to Tabriz and Sultanieh, in all of which places the order had houses. From Sultanieh he proceeded by Kashan and Yázd, and turning thence followed a devious route by Persepolis and the Shiraz and Baghdad regions, to the Persian gulf. At Hormuz he embarked for India, landing at Thana, near Bombay. After visiting many parts of India he sailed in a junk to Sumatra, visiting various ports on the northern coast of that island, and thence to Java, to the coast (it would seem) of Borneo, to Champa (South Cochin-China), and to Canton, at that time known to western Asiatics as *Chin-Kalan* or Great China (Mahachin). He travelled extensively in China, and visited Hangchow, then renowned, under the name of *Cansay, Khanzai*, or *Quinsai* (*i.e., Kingsze* or royal residence), as the greatest city in the world, of whose splendours Odoric gives details.

At Peking he remained for three years, attached, no doubt, to one of the churches founded by Archbishop John of Monte Corvino, at this time in extreme old age. Returning overland across Asia, through the Land of Prester John and through Casan, the adventurous traveller seems to have entered Tibet, and even perhaps to have visited Lhasa. He then returned to Venice *via* Persia and Asia Minor. During a part at least of these long journeys the companion of Odoric was Friar James, an Irishman. After his return Odoric went to the Minorite house attached to St. Anthony's at Padua, and there, in May 1330, he related the story of his travels, which was taken down in homely Latin by Friar William of Solagna. Odoric died at Udine on Jan. 14, 1331. The fame of his vast journeys appears to have made a much greater impression on the laity of his native territory than on his Franciscan brethren.

Popular acclamation made him an object of devotion, the municipality erected a noble shrine for his body, and his fame as saint and traveller had spread far and wide before the middle of the century, but it was not till four centuries later (1755) that he was formally beatified. Odoric's credit was not benefited by the liberties which Sir John Mandeville took with it. The substar of that knight's alleged travels in India and Cathay is stolen fr Odoric, though amplified with fables from other sources and fr his own invention, and garnished with his own unusually cle astronomical notions. There are many details in Odoric's narı tive which prove its genuineness.

The best editions of Odoric are by G. Venni, *Elogio storico a gesta del Beato Odorico* (Venice, 1761); H. Yule in *Cathay and t. Way Thither* (1866), vol. i, pp. 1–162, vol. ii, appendix, pp. 1–4 and H. Cordier, *Les Voyages . . . du . . . frère Odoric . . .* (189. (edition of Old French version of *c.* 1350). The edition by T. Domen chelli (Prato, 1881) may also be mentioned; likewise those texts Odoric embedded in the *Storia universale delle Missione Franc scan* iii, 739–781, and in Hakluyt's *Principal Navigations* (1599); ii, 39–6 *See* also John of Viktring (Joannes Victoriensis) in *Fontes reru Germanicarum*, ed. J. F. Boehmer; vol. i, ed. by J. G. Cotta (Stuttgar 1843), p. 391; Wadding, *Annales Minorum*, A.D. 1331, vol. vii, pı 123–126; Bartholomew Albizzi, *Opus conformitatum . . . B. Francis . . .*, bk. i, par. ii, conf. 8 (fol. 124 of Milan ed. of 1513); John o Winterthur in Eccard, *Corpus historicum medii aevi*, vol. i, col 1894–97, especially 1894; C. R. Beazley, *Dawn of Modern Geograph* (1897, etc.), iii, 250–287, 548–549, 554, 565–566, 612–613, etc.

O'DUFFY, EOIN (1892–1944), Irish military leader, wa born on Oct. 30, 1892, near Castleblayney, County Monaghan Eire. He joined Michael Collins' Irish rebels in 1917, but wa captured and imprisoned in Belfast as leader of a rebel division After release, he rejoined Collins in 1921, became chief of staf (1921–22) and then general officer commanding the Irish Free State forces (1924–25). He was also chief commissioner of the Civic guard (1922–23) but was removed from this post by Eamon De Valera. O'Duffy then joined the opposition which he helped weld into the United Ireland party with the avowed purpose of fighting communism; he became its president in 1933. During this period, he also headed the Blue Shirts, a fascist offshoot organization of the U.I. party with a one-time boasted membership of 120,000. O'Duffy, however, was a poor politician and the U.I. disintegrated under his leadership. He himself resigned in 1934. To revive his waning prestige, he recruited 1,400 volunteers who joined Francisco Franco's "holy crusade against bolshevism" in Spain in 1936. But the O'Duffy brigade lost heart after a taste of battle and returned home in disgrace after six months in Spain. With this fiasco, O'Duffy lost what was left of his prestige. He died in Dublin on Nov. 30, 1944.

ODYSSEUS (also ODYSEUS, OLYS[S]EUS, Lat. VLIXES, whereof ULYSSES is a mis-writing), one of the best-known Greek heroes.

(1). In Homer, he is son of Laërtes, king of Ithaca, and Anticleia his queen; he succeeds his father as king, is husband of Penelope (*q.v.*) and father of Telemachus. During the Trojan War (*Iliad*) he is prominent as a brave and skilful fighter, but still more as a giver of shrewd counsel and for his daring and cunning enterprises, alone or with Diomedes. After the war he starts to go home, but driven off his course by unfavourable winds (*Odyssey*), successively visiting numerous unknown regions, (*see* CIRCE, CYCLOPES, LAESTRYGONES, LOTUS-EATERS, SCYLLA), till, losing all his ships and men, he arrives alone on the island of Calypso (*q.v.*). After eight years he is let go, and is wrecked on the coast of the Phaeacians, who receive him hospitably and send him home in one of their ships. All these places are out of the known world, although later writers in antiquity identified them with various regions known to them and have been followed by some moderns. Arrived home, he finds his wife Penelope beset with a number of suitors who are devouring his substance. With the help of Athena, Odysseus and Telemachus, aided by two faithful thralls, kill them all.

(2) After Homer, the character of Odysseus degenerates from a cunning to a wholly unscrupulous and dishonourable man. He tries to shirk service at Troy by pretending to be mad; but Palamedes discovers the trick. In revenge, Odysseus brings about his ruin and death (*see* PALAMEDES). He and Diomedes steal the Palladium (*q.v.*) and in some accounts he tries to murder Diomedes, to get all the credit for himself. After the death of Achilles, Odysseus and Ajax contend for his armour, which is adjudged to the former (*see* AJAX I). He is at length accidentally killed by

Telegonus, his son by Circe or Calypso; this story is worked up from hints in the *Odyssey*. A common legend makes Odysseus son of Sisyphus (*q.v.*), thus bringing the two notorious rogues together.

There is no need whatever to suppose Odysseus other than a real man, renowned for his skill and resource, about whom in the course of centuries numerous fictions have gathered. The plot of the *Odyssey* is a well-known *märchen*, however, and not a saga; *see* M. P. Nilsson, *History of Greek Religion*, p.38. His name is not Greek, and probably belongs to a prehellenic speech.

Bibliography.—J. Schmidt in Roscher's *Lexikon;* P. O. Gruppe, *Griechische Mythologie*, II., 624, 705 ff. (1906); L. Preller and H. Ritter, *Griechische Mythologie*, II. (1865); V. Bérard, *Les Phéniciens et l'Odyssée* (1902–03), and edition of the Odyssey (1924–25) contains the most ingenious attempt to localize his wanderings.

(H. J. R.)

OECOLAMPADIUS, JOHN (1482–1531), German Reformer, whose real name was Hussgen or Heussgen[1], was born at Weinsberg, a small town in Württemberg, but then belonging to the Palatinate. He went to school at Weinsberg and Heilbronn, and then, intending to study law, he went to Bologna, but soon returned to Heidelberg and betook himself to theology. He passed from the study of Greek to that of Hebrew, taking his bachelor's degree in 1503. He became cathedral preacher at Basle in 1515, serving under Christopher von Uttenheim, the evangelical bishop of Basle. From the beginning the sermons of Oecolampadius centred in the Atonement, and his first reformatory zeal showed itself in a protest (*De risu paschali*, 1518) against the introduction of humorous stories into Easter sermons. In 1520 he published his *Greek Grammar*. The same year he was asked to become preacher in the high church in Augsburg. Germany was then ablaze with the questions raised by Luther's theses, and his introduction into this new world, when at first he championed Luther's position especially in his anonymous *Canonici indocti* (1519), seems to have compelled Oecolampadius to severe self-examination, which ended in his entering a monastery for a short time. But in Feb. 1522 he made his way to Ebernburg, near Creuznach, where he acted as chaplain to the little group of reformers who had settled there under the leadership of Franz von Sickingen.

The second period of Oecolampadius's life opens with his return to Basle in Nov. 1522, as vicar of St. Martin's and (in 1523) reader of the Holy Scripture at the university, and after more than a year of earnest preaching and four public disputations in which the popular verdict had been given in favour of Oecolampadius and his friends, the authorities of Basle began to see the necessity of some reformation. They began with the convents, and Oecolampadius was able to refrain in public worship on certain festival days from some practices he believed to be superstitious. Basle was slow to accept the Reformation; the news of the Peasants' War and the inroads of Anabaptists prevented progress; but at last, in 1525, it seemed as if the authorities were resolved to listen to schemes for restoring the purity of worship and teaching. In the midst of these hopes and difficulties Oecolampadius married, in the beginning of 1528, Wilibrandis Rosenblatt, the widow of Ludwig Keller, who proved to be *non rixosa vel garrula vel vaga*, he says, and made him a good wife. After his death she married Capito, and, when Capito died, Bucer. She died in 1564. In Jan. 1528 Oecolampadius and Zwingli took part in the disputation at Berne which led to the adoption of the new faith in that canton, and in the following year to the discontinuance of the Mass at Basle. The Anabaptists claimed Oecolampadius for their views, but in a disputation with them he dissociated himself from most of their positions. He died on Nov. 24, 1531.

Oecolampadius was not a great theologian, like Luther, Zwingli or Calvin, and yet he was a trusted theological leader. With Zwingli he represented the Swiss views at the unfortunate conference at Marburg. His views on the Eucharist upheld the metaphorical against the literal interpretation of the word "body," but he asserted that believers partook of the sacrament more for the sake of others than for their own, though later he emphasized it as a means of grace for the Christian life. To Luther's doctrine of the ubiquity of Christ's body he opposed that of the presence and activity of the Holy Spirit in the church. He did not minutely analyse the doctrine of predestination as Luther, Calvin and Zwingli did, contenting himself with the summary "Our Salvation is of God, our perdition of ourselves."

[1]Changed to Hausschein and then into the Greek equivalent.

See J. J. Herzog, *Leben Joh. Oecolampads u. die Reformation der Kirche zu Basel* (1843); K. R. Hagenbach, *Johann Oecolampad u. Oswald Myconius, die Reformatoren Basels* (1859). For other literature *see* W. Hadorn's art. in Herzog-Hauck's *Realencyklopädie für prot. Rel. u. Kirche.*

OECUMENICAL, a word chiefly used in the sense of belonging to the universal Christian Church. It is thus specifically applied to the general councils of the early church (*see* Council) In the Roman Church a council is regarded as oecumenical when it has been summoned from the whole church under the presidency of the pope or his legates; the decrees confirmed by the pope are binding. The word has also been applied to assemblies of other religious bodies, such as the Oecumenical Methodist Conference, which met for the first time in 1881.

OEDIPUS, the central figure of the Theban saga (Gr. *Oidipous*, probably "Swell-foot"). In Homer we are told that he unwittingly killed his father and married his own mother, Epikaste (the Jocasta of later writers), and that she hanged herself when the matter became known. Oedipus continued, though in great tribulation, to reign in Thebes, apparently until his death. (*Odyssey* xi. 271 *et seq., Iliad*, xxiii, 679). According to the post-Homeric story, Laius, king of Thebes, received an oracle that his son should slay him; therefore, when his wife Jocasta bore a son, he exposed him on Mt. Cithaeron, with a spike driven through his feet. He was saved, however, and was adopted by the childless Polybus, king of Corinth. Reaching manhood, he had occasion to visit Delphi, where he was told that he would slay his father and wed his mother. Departing in great horror, and resolving never to return to Corinth, he met Laius, whom he did not recognize, and killed him in a quarrel. Coming to Thebes, he found the city plagued by the Phix or Sphinx, a winged monster, usually represented with the head of a woman, who asked all passers-by a riddle, killing them if they could not answer. Oedipus solved the riddle, the Sphinx killed herself in disgust, and he was rewarded, according to the promise made by the regent, Creon, son of Menoeceus, with the kingdom and the hand of his sister, the widowed queen. They had two sons, Eteocles and Polyneices, and two daughters, Antigone and Ismene. But later, the whole story came to light; Jocasta hanged herself, Oedipus put out his own eyes, and then lived shut up in a room of the palace (ordinary version), or went into exile, ultimately dying at Colonus and becoming a protecting hero of Attica (Athenian version, *see* Sophocles, *Oedipus Coloneus*). His sons proved undutiful and he cursed them. Therefore they quarrelled over the kingship, finally agreeing to reign alternately. Eteocles' turn came first; Polyneices went into temporary exile, and married Argeia, daughter of Adrastus, king of Argos, whose other daughter, Deiphyle, married Tydeus of Calydon. The latter had gone into exile for homicide; he and Polyneices met and quarrelled, and Adrastus recognized them, by their dress or their shield-devices, as the lion and boar to whom the gods had bidden him betroth his daughters. At the end of a year, Polyneices claimed to rule Thebes in his turn; Eteocles refused, and Adrastus gathered an army to restore his son-in-law. The chieftains, besides the three already named, were Capaneus, Amphiaraus (*q.v.*), Eteoclus, and Parthenopaeus, son of Atalante. Of these, known as the Seven against Thebes, only Adrastus returned. Tydeus would have been made immortal for his valour, but Athena saw him gnaw the head of a slain enemy as he lay dying, and in disgust withheld the intended gift. Amphiaraus was swallowed up in the ground, and in later times was much revered as an oracular hero or god. Polyneices killed Eteocles and was killed by him. Creon now became king; he ordered the bodies of the dead Argives to be left unburied, but Antigone secretly buried her brother, Polyneices. For this, despite the entreaties of his son, Haemon, to whom she was betrothed, Creon walled her up in a tomb (a form of ordeal; the gods might save her if they approved of her conduct). She

hanged herself, Haemon, who had broken into the tomb, killed himself, and so did Creon's wife Eurydice, on hearing the news (so Sophocles; in Euripides, Antigone escaped and lived happily with Haemon, at least for several years; *see* the fragments of his *Antigone* in Nauck). According to an Attic legend, Theseus (*q.v.*) attacked Thebes at the prayer of the mothers of the slain, and forced the Thebans to bury them; Creon was killed by Theseus in the battle. Another story represents him as surviving for many years, to be ultimately killed by the usurper Lycus (so Euripides, *Herc. Fur.,* 33). Oedipus died before, or not long after, the end of the war.

Adrastus bided his time, and when the sons of the Seven (known as the Epigoni, or second generation; hence the application of the word to successors of the Diadochi (*q.v.*), the immediate successors of Alexander the Great) came to manhood, he once more attacked the city. On the advice of Teiresias (*q.v*) the Thebans evacuated by night. Adrastus led his army back, but died on the way, at Megara, from grief at the death of his son Aigialeus, only one of the Epigoni to fall in the campaign.

There is no reason to doubt that this legend has a historical basis, probably in the events of Minoan-Mycenaean times. Gems from Thisbe show incidents strongly resembling the fight between Oedipus and Laius, and the former's encounter with the sphinx. Several incidents, such as the prophecies and the incestuous marriage, are patently folk tales.

Mediaeval Legends.—In the *Golden Legend* of Jacobus de Voragine (13th century) and the *Mystère de la Passion* of Jean Michel (15th century) and Arnoul Gréban (15th century), the story of Oedipus is associated with the name of Judas. The main idea is the same as in the classical account. The Judas legend, however, never really became popular, whereas that of Oedipus was handed down both orally and in written national tales (Albanian, Finnish, Cypriote). The Theban legend, which reached its fullest development in the *Thebaïs* of Statius and in Seneca, reappeared in the *Roman de Thèbes* (the work of an unknown imitator of Benoît de Sainte-More). Oedipus is also the subject of an anonymous mediaeval romance (15th century), *Le Roman d'Oedipus, fils de Layus,* in which the sphinx is depicted as a cunning and ferocious giant. The Oedipus legend was handed down to the period of the Renaissance by the *Roman* and its imitations, which then fell into oblivion. The legend has survived amongst the modern Greeks, without any traces of the influence of Christianity (B. Schmidt, *Griechische Märchen,* 1877). The works of the ancient tragedians (especially Seneca, in preference to the Greek) came into vogue, and were followed by modern imitators down to the 17th century.

See L. Constans, *La Légende d'Oedipe dans l'antiquité, au moyen âge, et dans les temps modernes* (1881); D. Comparetti's *Edipo* and Sir Richard Jebb's introduction to his edition of Sophocles, *Oedipus Tyrannus.* (H. J. R.)

OELS or ÖLS, a town in the former Prussian province of Silesia, Ger., on the Oelsbach, 20 mi. N.E. of Breslau by rail. Pop. (1939) 18,183; (1946) 4,246. Oels was founded about 940, and became a town in 1255. It appeared as the capital of an independent principality at the beginning of the 14th century. The principality, with an area of 700 sq.mi. and about 130,000 inhabitants, passed through various hands and in 1884 it lapsed to the crown of Prussia. The chateau, dating from 1558, was restored in 1891–94, and became after 1918 the residence of Frederick William, the former crown prince of Prussia. The inhabitants are chiefly engaged in making shoes, furniture and machines. Following World War II, Oels was annexed by Poland and became Olesnica in Wroclaw province.

OELWEIN, a city of Fayette county, Iowa, U.S., in the northeastern part of the state; served by the Chicago Great Western and the Rock Island railways. Pop. (1950) 7,858; (1940) 7,801. It is in a farming, dairying, poultry and stock-raising region; has railroad shops and various other manufacturing industries. The city was founded in 1873, by August Oelwein; was incorporated in 1888, and chartered as a city in 1897.

OENOMAÜS in Greek legend, son of Ares and Harpinna, king of Pisa in Elis and father of Hippodameia. It was predicted that he should be slain by his daughter's husband. His father gave him winged horses and Oenomaüs promised daughter to the man who could carry her off in a chariot; himself was to drive after, and spear the suitor if he could ca him. This may be founded on some marriage rite of simula capture. Thirteen aspirants having thus perished, Pelops (*q.* arrived, and won, having winged horses which Poseidon had gi him. He is usually said to have bribed Oenomaüs' chariot Myrtilus to take out his master's linchpins and substitute w dummies; Oenomaüs was thus thrown and killed.

See Diod. Sic. iv, 73; Pausanias vi, 21, and elsewhere; Sophoc *Electra,* 504, with Sir Richard Jebb's note; Hyginus, *Fab.* 84, 253.

OENONE, in Greek legend, daughter of the river god Cebı and wife of Paris, who deserted her to kidnap Helen (*q.v.*). Ju before the capture of the city, Paris, wounded by Philoctet sought the aid of Oenone, who had told him that she alone cou heal him if wounded. She refused to help him, and Paris r turned to Troy and died of his wound. Oenone soon repent and hastened after him, but finding that she was too late to sa him slew herself from grief at the sight of his dead body.

OENOTHERA, the generic name of the evening primro and sundrops, several species of which are favourite garde plants. The genus, comprising numerous species, is confine to America and belongs to the family Onagraceae. The commo evening primrose (*O. biennis*) is often a troublesome weed bot in North America and Europe; the form known as var. *grand flora* or *O. lamarckiana* is a showy plant, sometimes cultivated fo its flowers. Other species grown in gardens are *O. missouriens* and *O. speciosa,* the latter with white flowers, grading to pink The evening primrose acquired importance in connection wit Hugo Devries' theory of mutations. (*See* PRIMROSE; HEREDITY.)

OESEL: *see* SAAREMAA.

OESOPHAGUS, DISEASES OF. (*See* ALIMENTARY CANAL.) The human oesophagus is liable to certain accidents and diseases, from its function and its situation. One of the commonest accidents is the lodgment of foreign bodies. An impacted substance may be removed by the oesophageal forceps, or a coin-catcher or may be pushed down into the stomach. A purgative should never be given, but soft food such as porridge. Should gastric symptoms develop operation may be necessary. Charring and ulceration of the oesophagus may occur from the swallowing of corrosive liquids, strong acids or alkalis, or even of boiling water. Stricture of the oesophagus may be spasmodic, fibrous or malignant. *Spasmodic stricture* usually occurs in young hysterical women; under an anaesthetic a bougie will slip down easily. *Fibrous stricture* is usually situated behind the cricoid cartilage, and results from swallowing corrosive fluids or the healing of a syphilitic ulcer. Occasionally it is congenital. The ordinary treatment is repeated dilatation by bougies. *Malignant strictures* are usually squamous cell carcinoma (*see* TUMOUR) and chiefly occur in males between the ages of 40 and 70 years. An X-ray photograph taken after the patient has swallowed a preparation of bismuth will show the situation of the growth, and G. Killian and Brünig have introduced the oesophagoscope, which makes direct examination possible. Dilatation by bougies must not be attempted, the oesophagus being so softened by disease that perforation might take place. Radium treatment, so far, has not been successful. The method of transpleural approach to the thoracic oesophagus and insertion of radium into the wall of the tube has been introduced, but as yet it is too early to evaluate the results. The most satisfactory treatment is the operation of gastrotomy, a permanent artificial opening being made into the stomach through which the patient can be fed.

OETA (mod. Katavothra), a mountain in Greece, 7,080 ft. high, to the S. of Thessaly (Thessalia), between the valleys of the Spercheius and the Boeotian Cephissus. Its east end, Callidromus, overhangs the sea at the famous pass of Thermopylae (*q.v.*). There was also a high pass W. of Callidromus into the upper Cephissus. In mythology Oeta is the scene of the death of Heracles.

OFFA (757–796), king of Mercia, is the central figure in English history in the second half of the 8th century. A civil war gave him the Mercian kingdom in succession to his cousin

Aethelbald (716–757) who in his later years had been overlord of all the English peoples south of the Humber. The first part of Offa's reign was spent in the re-establishment of the Mercian supremacy. He was strongly resisted in several of the smaller kingdoms, notably Kent, but he succeeded in creating what was in effect a single state covering the whole country between the Humber and the channel. He treated the lesser kings of this country as his subjects, exacting their formal submission, insisting that their grants of land to their own retainers or to churches needed his consent, confirming their charters and requiring them to attend his court. He married one of his daughters to Beorhtric, king of Wessex (789), and another to Aethelred, king of Northumbria (792), thereby extending his direct influence beyond the Humber. His reign marks by far the greatest advance hitherto made toward the political unification of England.

His position was recognized on the continent. His younger contemporary Charlemagne, king of the Franks, regarded him as the outstanding English ruler of his time. Their relations were often uneasy and a personal dispute led to a suspension of cross-channel traffic shortly before 790. Its renewal was followed by a commercial treaty (796) which shows Charlemagne and Offa dealing with each other on equal terms. The closeness of their previous association is illustrated by a rumour current at Rome to the effect that Offa had proposed to Charlemagne the deposition of Pope Adrian I and the election of a Frankish churchman in his place. The pope himself disbelieved the story, but its circulation proves at least the reality of Offa's fame.

Offa, in fact, was on terms with Pope Adrian which enabled him to carry through a remarkable, if temporary, change in the organization of the English church. The archbishop of Canterbury, whose authority covered the whole of southern England, had his seat in the kingdom where Offa's political domination was most strongly resented. To free the churches of his own country from the control of an archbishop belonging to an unfriendly province, Offa induced Pope Adrian to send the pallium which was the symbol of metropolitan authority to Hygebeorht, bishop of Lichfield. It was certainly with Offa's good will, and probably at his request, that in 786 the pope sent two legates to England, who secured the acceptance of a program of reform by the clergy and nobility of both the northern and southern provinces.

It is probable that Offa used this unprecedented mission as a means of acquainting the Roman court with his design of creating an archbishopric of Lichfield. He may well have taken the same opportunity of securing the papal approval for the consecration of Egfrith, his son, as king of the Mercians which took place in 787 and is the first recorded ceremony of the kind in English history.

There still survives a memorial of Offa's effective power in southern England in the remains of the great earthwork known as Offa's dike which he caused to be drawn between his own kingdom and the Welsh tribes beyond his border. It was the object of the dike to draw a boundary line between English and Welsh settlements from the estuary of the Dee in the north to that of the Wye in the south. The line is not now continuous, partly because it has been worn down in the course of 12 centuries, but also because in forest country such as the Herefordshire plain the forest itself was regarded as a sufficient barrier. But on open ground and in the high places of the mountain zone its remains are most impressive. Its line is always drawn so as to command the country to the west and the trackways leading from Welsh into English territory. Throughout its course it shows the activity of a directing mind.

The most permanent achievement of Offa's reign was the establishment of a new form of currency composed of silver pennies bearing the king's name and title and also the name of the moneyer responsible for their quality. They are remarkable for a delicacy of execution and a refinement of portraiture which set the best examples apart from all other coins in the Old English series. Amid infinite varieties of design, the principles governing Offa's coinage were maintained by later kings, and until recent times there has never been any break in the continuity of the English currency since his day. His own attitude toward the currency as an advertisement of the royal dignity is shown by the issue of coins closely resembling his own in type, but bearing the name and portrait of Cynethryth his queen.

No contemporary account of Offa has survived, and the history of his reign is a collection of fragmentary references. The laws which he is known to have issued have long disappeared. There are no adequate materials for a picture of his character. He was a patron of learning and a notable benefactor to many churches, but his rule was arbitrary and he was ruthless to all who opposed him. What can be said is that he left a deeper impression on English history than any other king before Alfred.

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OFFA, the most famous hero of the early Angli. He is said by the Anglo-Saxon poem *Widsith* to have ruled over Angel, and the poem refers briefly to his victorious single combat, a story which is related at length by the Danish historians Saxo and Svend Aagesen Offa (Uffo) is said to have been dumb or silent during his early years, and to have only recovered his speech when his aged father Wermund was threatened by the Saxons, who insolently demanded the cession of his kingdom. Offa undertook to fight against both the Saxon king's son and a chosen champion at once. The combat took place at Rendsburg on an island in the Eider, and Offa succeeded in killing both his opponents. According to *Widsith* Offa's opponents belonged to a tribe or dynasty called Myrgingas, but both accounts state that he won a great kingdom as the result of his victory. A somewhat corrupt version of the same story is preserved in the *Vitae duorum Offarum,* where, however, the scene is transferred to England. It is very probable that the Offa whose marriage with a lady of murderous disposition is mentioned in Beowulf is the same person; and this story also appears in the *Vitae duorum Offarum,* though it is erroneously told of a later Offa, the famous king of Mercia. Offa of Mercia, however, was a descendant in the 12th generation of Offa, king of Angel. It is probable from this and other considerations that the early Offa lived in the latter part of the 4th century.

See H. M. Chadwick, *Origin of the English Nation* (1907), where references to the original authorities will be found.

OFFALY, a county of Ireland in the province of Leinster, bounded north by Meath and Westmeath; west by Roscommon, Galway and Tipperary (the boundary with the first two counties being the Shannon river); south by Tipperary and Leix county; and east by Kildare. The area of the county is 493,636 ac. or about 772 sq.mi. Pop. (1951) 52,544. The greater part of the county is included in the Carboniferous Limestone plain of central Ireland. In the southeast the Slieve Bloom mountains, composed largely of Old Red Sandstone, form the boundary between Offaly county and Leix county and run into the former county from southwest to northeast for a distance of about 20 mi. consisting of precipitous crags through which there are two narrow passes, the Black gap and the Gap of Glandine. In the northeast, basic volcanic rocks rise in Croghan hill to a height of 768 ft. In the centre of the county from east to west a large portion is occupied by the Bog of Allen. Here and there drier deposits of esker gravels rise as green hills above the clay soils and bogs of the plain. The county shares in the advantage of the navigation of the Shannon, which skirts its western side. The Brosna, which issues from Loch Ennell in Westmeath, enters the county near the town of Clara, and joins the Shannon after receiving the Clodagh and the Broughill. A small portion of the northeastern extremity is skirted by the upper Boyne. The Barrow forms the southeastern boundary with Leix. The Little Brosna, which rises in the Slieve Bloom mountains, forms the boundary of Offaly county with Tipperary and flows into the Shannon.

Offaly county, with portions of Tipperary, Leix county and Kildare, at an early period formed one kingdom under the name of Offaly, a title which it retained after the landing of the English. Subsequently it was known as Glenmallery, Western Glenmallery corresponding closely to the present Offaly county and Eastern Glenmallery to Leix county. These two divisions were formed into shires in 1556, being then known as King's county and Queen's county respectively.

In the Slieve Bloom mountains is a pyramid of white stones called the Temple of the Sun or the White Obelisk. There are many Danish raths, and a chain of moats commanding the passes of the bogs extended throughout the county. On the borders of Tipperary is an ancient causeway leading presumably to a crannog or lake dwelling. The most important ecclesiastical ruins are those of the seven churches of Clonmacnoise (*q.v.*) on the Shannon in the northwest of the county, where an abbey was founded by St. Kieran in 648 and where the remains include those of churches, two round towers, crosses, inscribed stones and a castle. Other famous religious houses were Durrow abbey, founded by St. Columba in 550; Monasteroris founded in the 14th century by John Bermingham, earl of Louth; and Seirkyran abbey, founded in the beginning of the 5th century. The principal old castles are Rathmore, probably the most ancient in the county; Banagher, commanding an important pass on the Shannon; Leap castle, in the Slieve Bloom mountains; and Birr or Parsonstown.

The whole of the county would appear to have been covered formerly by a vast forest, and the district bordering on Tipperary is still richly wooded. The soil is generally either a deep bog or a shallow gravelly loam. On the borders of the Slieve Bloom mountains there are some very rich pastures, and there are also extensive grazing districts on the borders of Westmeath, chiefly occupied by sheep. Along the banks of the Shannon there is good meadowland. With the exception of the tract occupied by the Bog of Allen, the county is nearly all under tillage, the most productive portion being that to the northwest of the Hill of Croghan.

Oats, barley and rye, potatoes and turnips, are all considerably grown. Cattle, sheep, pigs and poultry are widely bred; dairies are numerous in the north of the county, and the sheep are pastured chiefly in the hilly districts.

The county is traversed from southeast to northwest by the Portarlington, Tullamore, Clara and Athlone line of the Great Southern railway, with a branch from Clara to Banagher; other branches run from Roscrea (County Tipperary) to Parsonstown (Birr), from Enfield (County Kildare) to Edenderry and from Streamstown (County Westmeath) to Clara. The Grand canal runs through the county from

east to west, entering the Shannon at Shannon harbour.

The administrative counties of Leix and Offaly together return five members to *dail eireann.*

OFFENBACH, JACQUES (1819–1880), French composer of *opéra bouffe,* was born at Cologne, of German-Jewish parents, on June 20, 1819. In 1833 he was sent to Paris to study the violoncello at the Conservatoire. As a member of the orchestra of the Opéra-Comique he turned his opportunities to good account and eventually was made conductor at the Théâtre Français. His first complete work, *Pepito* (1853), was followed by a crowd of light dramatic pieces which effected a complete revolution in the popular taste of the period. Offenbach obtained a lease of the Théâtre Comte in the Passage Choiseul, reopened it in 1855 under the title of Les Bouffes Parisiens and produced a succession of brilliant, humorous trifles. Among many other librettists Ludovic Halévy was associated with him from the first, but still more after 1860, when Halévy obtained Henri Meilhac's collaboration. The series culminated in 1867 with *La Grande Duchesse de Gérolstein,* perhaps the most popular *opéra bouffe* ever written, not excepting even his *Orphée aux enfers,* produced in 1858 and refashioned in 1874, and *La Belle Hélène* of 1864. In 25 years Offenbach produced more than 100 complete dramatic works, including two ballets. Offenbach died at Paris on Oct. 4, 1880. *Mamzelle Moucheron* was produced posthumously in 1881. *Les Contes d'Hoffmann,* his only opera as distinct from operettas and other light pieces, became the most popular of all his works. He left it unfinished, and it was completed and orchestrated by Ernest Guiraud.

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OFFENBACH, a town of Germany, in the *Land* of Hesse, on the left bank of the Main, 5 mi. E.S.E. of Frankfurt-on-Main, with which it is connected by the railway to Bebra and by a local electric line. Pop. (1950) 89,030. The earliest mention of Offenbach is in a document of 970. In 1486 it came into the possession of the counts of Isenburg, and in 1816, when their lands were mediatized, it was assigned to Hesse. French Protestant refugees settled there at the end of the 17th and the beginning of the 18th century and brought prosperity which increased with the accession of Hesse to the German Zollverein in 1828. The most interesting building in the town is the Renaissance château of the counts of Isenburg. Offenbach is the principal industrial town of the *Land,* and manufactures include chemicals, boilers, machines, wire goods and celluloid. Its characteristic industry, however, is the manufacture of fancy goods in leather.

OFFENBURG, a town of Germany, in the territory of Baden, 27 mi. by rail S.W. of Baden, on the Kinzig river. Pop. (1939) 20,521. Offenburg is first mentioned about 1100. In 1223 it became a town; in 1248 it passed to the bishop of Strassburg; and in 1289 it became an imperial free city. Soon this position was lost, but it was regained about the middle of the 16th century, and Offenburg remained a free city until 1802, when it became part of Baden. The chief industries are dyeing and the making of cotton, linen, silk, cement, machinery, cigars and glass.

OFFICE, a duty or service, particularly the special duty cast upon a person by his position; also a ceremonial duty, as in the rites paid to the dead, the "last offices." The term is thus especially used of a religious service, the "daily office" of the English Church or the "divine office" of the Roman Church (*see* BREVIARY). It is also used in this sense of a service for a particular occasion, as the Office for the Visitation of the Sick, etc. For the "Holy Office" *see* INQUISITION.

OFFICE MACHINES AND APPLIANCES. For a variety of reasons the work load of the modern business office increased in striking fashion during the 20th century. Much of this work is repetitive and routine, and development and use of office machinery has been the natural result.

The decision to shift from manual to machine operation is, of course, determined by a comparison of costs incurred with costs saved. Specifically, the following items are important in assessing the desirability of mechanizing office tasks:

1. The desirability of saving labour. This is basically a matter of determining estimated savings in office direct labour charges over the life of the equipment, and comparing these savings with estimated machine costs.

2. The desirability of saving time. Time saved in office routine may greatly improve operations elsewhere in the enterprise. On the other hand no advantage may derive from time saving. The latter is usually true where the volume of work in the office is so small that the machine under consideration is likely to stand idle most of the time.

3. The importance of accuracy. Although accuracy is always desirable the consequences of error, in terms of cost, vary considerably in different situations.

4. The effects upon personnel. Mechanization involves important changes in job requirements. Training and morale problems must also be anticipated. Difficulties in this area may create an unfavourable cost situation which will nullify the savings discussed under 1.

The major office machines in current use are described below. They are classified according to the relationships of the operations that they most commonly perform.

Writing and Reproducing Machines.—The majority of office machines fall into this category, and the bulk of the office work load is handled by them. Thousands of accessories are available to permit performance of various detail operations.

The typewriter, most common of office machines, produces text material on a page in type similar to printer's type. On the manual typewriter this is accomplished mechanically when the operator strikes keys arranged on a keyboard. Type bars, containing raised characters and actuated by the keys, strike the page. Printing is accomplished by the automatic interposition of an inked ribbon between the type bar and the page. The page is held in position against a movable cylindrical rubber roll or platen. The platen, in turn, is mounted in a carriage which travels transversely. This arrangement permits vertical and horizontal spacing.

Electric typewriters use electrical power to multiply the energy of the operator's touch. Noiseless typewriters utilize a special type bar to reduce the noise of the impact of the type bar upon the page. Correspondence typewriters employ a specific type face, letterspacing and line spacing. Special-purpose typewriters utilize a variety of special attachments to achieve variation in type face and spacing. The Vari-Typer, in appearance and operation a typewriter, is actually an office type-composing machine permitting production of copy in any of hundreds of type faces. Completely flexible letterspacing produces copy on this machine closely resembling typeset material. Automatic typewriters are power-driven machines which operate from a "player piano" type roll which has been cut on a standard typewriter. These machines are used for mass production of material with a hand-typed appearance. Special inserts can be made manually at predetermined points in the copy.

The typewriter when used in conjunction with a computing machine functions as a bookkeeping machine. This type is best considered as a variety of accounting machine, discussed below.

Dictating and transcribing machines provide for storage, and later reproduction, of spoken messages. Dictating machines, by a combination of electronic and mechanical means, record the voice on a variety of mediums, including wax cylinders, plastic disks, wire and coated tape. These materials can be removed from the machine after dictation and transported (even by mail) to the point of transcription. The transcribing machine, in a manner similar to the dictating machine, reproduces the voice. By use of these machines stenographic transcription tasks can be fitted into the working time of both the executive and the stenographer in much better fashion than when dictation is taken directly by the stenographer.

A large variety of duplicating machines has been developed. Regardless of variation in process, all of these machines utilize a master copy prepared manually, from which duplicate copies are made by the machine. Before describing these specific processes, note should be made of the fact that the use of carbon paper inserts makes the typewriter into a duplicating machine. Used extensively when a small number of copies is desired, this process has a practical limit of about 12 copies on the manual and about 18 copies on the electric typewriter.

The stencil method of duplicating employs a coated fibre sheet

(the stencil). Use of a typewriter (without ribbon) or a hand stylus places the copy on the stencil by simply pushing aside the coating and exposing the fibre base where contact is made with the stencil. The exposed portion will transmit ink. The stencil is fastened to the outer surface of a hollow rotating cylinder. The padded interior surface of the cylinder is saturated with ink. The ink flows to the stencil through the pad as the cylinder rotates. Simultaneously sheets of paper are passed under the cylinder and applied to the stencil under light pressure. Up to 5,000 copies can be made in this fashion from a single stencil. Stencils can be stored for reuse for considerable periods of time.

The hectographic method of duplicating uses a paper master sheet. In the liquid process the master is prepared with a special carbon paper behind it. This results in a reversed carbon image. The master sheet is then fastened to a rotating drum. Copy sheets, slightly moistened by a special liquid, are applied in the same fashion as for the stencil method. A minute amount of the carbon is thus transferred to the copy sheet.

The gelatin process requires the use of a special master paper upon which the copy is typed or written. This sheet is then pressed, face down, against a prepared moist gelatin surface and the image is transferred to the gelatin in reverse form. Copy sheets pressed against this gelatin receive an image impression. The impression process can be accomplished on a machine similar to that used in the stencil method. The practical limit on hectographic copies is about 300. It is possible to preserve the master copy in the liquid process only.

Offset processes of duplicating require chemical fixing of copy on a metal sheet or, in more recent developments, preparation of a paperlike master copy. This master impression is inked and brought against an intermediate composition agent (usually rubber) to which the image is transferred. The image is immediately transferred to a copy sheet. This operation is performed by a power-driven machine. Many thousands of copies can be produced and masters can be stored for indefinite periods.

Raised-image duplicating processes use a variety of techniques for producing a master form on which the text stands in relief. Typesetting machines closely resemble those used in the printer's office. Another machine, commonly used for production of form letters or for addressing envelopes, uses a soft metal strip or plate upon which the text is embossed. When used for addressing, the machine feeds the plates into place in rapid succession. This machine has also been adapted to pay-roll printing work.

A group of various photographic processes have been devised for producing copies of drawings or written material. The contact processes operate without use of a camera or lens. The most commonly used processes in this category are blueprint and dye line. In the first process the master (typed, drawn or printed upon a translucent paper or cloth sheet) is placed upon sensitized paper and exposed to light. The paper is then developed by wetting in a chemical solution and washing in clear water. Dye line operates in similar fashion, but avoids washing in clear water. A dry-line process uses ammonia fumes rather than liquid to develop the image and thus obviates problems of paper shrinkage. In both blueprint and dye line, machines have been developed which perform all operations automatically.

In contrast with the contact processes are the camera processes, wherein cameras are used to "take pictures" of the material to be reproduced. In most processes a negative results from which positive copies in various sizes may be produced. A modern development is the microfilm process, which uses a special camera to produce a direct positive copy, in greatly reduced size, upon 16-mm. or 35-mm. movie film. This process is invaluable in saving space when storing documents of all sorts. Documents are read by projecting the microfilm image upon a screen.

A host of specialized reproducing machines exist. The most widely used are cheque-writing machines which print names on cheques so that they cannot be altered; and cheque-signing machines. Numbering, dating, receipting machines are small devices manually operated, the names of which are largely self-descriptive. The machines, which use rubber or metal type form, are preset to produce correct impressions.

Computing and Accounting Machines.—These machines, widely varied in form, handle the arithmetical tasks common to most offices. They are frequently combined with certain other writing and reproducing machines mentioned and, in such form, produce a high volume of work with a minimum of error.

Adding and subtracting machines perform the arithmetical operations indicated by the name. Some varieties list figures on a paper tape; some do not. Keys on the machine are depressed in proper order to set the mechanism in operation. Key-driven machines operate the mechanism directly upon pressing the keys. Crank-driven machines need the additional operation of pulling a lever. In many cases electric motors, actuated by depressing a bar, perform the bulk of the work of operation. Full keyboard machines provide a column of ten keys for each digit position. Ten-key machines have only ten keys with digit position being shifted to the left successively with each depression of a key. This latter type keyboard is especially useful when large numbers are involved.

Registering machines are listing-type adding machines designed for special tasks. Cash registers simultaneously record cash transactions on a tape, produce printed slips and operate cash drawers. These machines keep running totals of the transactions, classified into a number of categories. Calculating machines are designed to perform multiplication and division operations. They are also used for addition and subtraction. Commonly electrically powered, these machines may be of a printing (listing) or non-printing type. Keyboards, again, may be either full or ten-key type.

Note should be taken here of the development of electronic-mechanical calculators capable of performing extremely complex computations. These are beyond reach of the typical office because of cost and the high skill required of operators. The services of these machines are available in some areas on a fee basis.

Accounting machines (or bookkeeping machines) are complex machines combining features of the computing machines already described with some provision for writing. These machines take over much of the labour of bookkeeping. Billing machines, for example, are designed to write (with the built-in typewriter) name, address and description, to multiply and extend, to figure discounts and to add net total.

Accounting machines typically post to several accounts simultaneously and frequently accumulate in the manner of cash registers to permit summarizing and distributing accounts. The window-posting accounting machine is in common use in banks, hotels and retail stores. Customer statements or books are inserted into the machine. The transaction is printed on these forms as well as on an audit sheet. After automatically calculating new balances the machine prints these balances on the forms described.

Classifying, and Selecting Machines.—These machines are characterized by use of cards upon which coded data is recorded; their function is to facilitate sorting and tabulation of numerous diverse data. A common use in the office is preparation and presentation of accounting data.

The simplest card systems function by notching the perforated perimeter of the card according to some code. These systems are limited to performance of sorting tasks. They are operated by a simple machine or device (frequently merely a metal rod) which is inserted in a specific perimeter location of a stack of cards. It will thus penetrate both notched and unnotched holes. When the rod is lifted those cards with notched holes will fall out.

The punched-card system uses a card which can be punched throughout its area. Data is punched into these cards according to a specific code. When the cards are passed through any of various machines the punched holes cause transmission, by mechanical or electrical means, of impulses to other functioning parts of the machines. Basic machines are the punching machine which punches data into the cards, the sorting machine, which sorts out cards according to various classifications, and the tabulating machine which prepares printed reports from the sorted cards.

The punched-card system is extremely flexible and permits sorting and tabulation of an immense number of items. In addition to accounting uses, the system is very useful in market research work,

production planning, materials ordering, etc.

Coin-Handling Machines.—In some offices large quantities of coins must be handled. To facilitate this job a variety of machines have been developed to sort, count, wrap or dispense coins.

Sorting is accomplished by the simple process of "sifting" the various size coins. Trip counters count the coins. Wrapping machines wrap a standard number of coins in a standard paper wrapper. The coin-dispensing machine releases a specific sum in coin, upon depression of the appropriate key on a keyboard similar to that of an adding machine. The coins are stacked in the machine in trays.

Mail-Handling Machines.—These are designed to expedite handling of large quantities of incoming and outgoing mail. The bulk of the work occurs in handling outgoing mail and most machines, consequently, are designed to aid in the mailing task.

Folding machines, inserting machines and envelope sealers, with self-explanatory titles, perform the tasks of placing letters in envelopes. Stamp-affixing machines mechanically separate stamps from a roll, moisten them and apply them to envelopes. Postage meters print stamp charges directly on a dry or moistened adhesive strip. The machines are set by postal employees to yield a number of impressions according to the amount of deposit paid.

Intercommunicating Systems.—The modern office is frequently of such size that efficient communication becomes a key item in maintaining the flow of work. Equipment described in this section is utilized to speed and improve communication between specific posts (desks, counters, etc.) or persons in the office; it includes, of course, the public telephone system.

Paging systems are used in conjunction with the telephone system for locating persons not accessible at their usual posts. One such system involves dialling of a special number (a portion of which is specific to the individual being sought), whereupon a special audible signal is sounded. The person being paged may, upon hearing the signal, pick up any telephone, dial another special number and be connected with his caller. Other paging systems use the amplified human voice to request an individual to call a given number.

Two-way voice systems operate on the telephone principle. In a commonly used version, the individual may call any one or any combination of a limited number of stations by depressing appropriate keys on the receiver-transmitter box. When he speaks into the box his voice, amplified electrically, is broadcast from similar boxes at the various stations. Others may then reply in similar fashion from their stations.

Telewriting and teletype systems provide written or typed communications between two or more points. Messages are received and recorded even though no person is in attendance at the receiving machine. These systems are especially valuable for rapid intercommunication among a number of widely separated offices. Teletype systems, for example, frequently span the entire country.

Conveying systems are available for very rapid transmission of small materials. Pneumatic tubes are frequently used in retail department stores for movement of sales tickets, cash, etc.

Paper Processing Machines.—To aid in changing the form or size of large quantities of paper, paper cutters, paper punches, binding equipment and folding equipment are available in a wide range of sizes. The names are nearly self-explanatory.

Document destroying equipment disposes of outdated paper documents by shredding or chopping. Collating equipment provides mechanical aid in assembling pages of printed matter in a specific order. As is frequently the case with office machines, the equipment designed for high-volume output is motorized, while smaller models are manually operated.

Time-Recording Machines.—Machines in this category combine a clock mechanism with a recording device. The objective is to provide a quick, correct recording of the time of occurrence of certain routine events.

Time stamping machines are manually actuated machines which stamp the correct time (at stamping) upon letters, documents, etc., which are inserted in the machine. Time-recording clocks record the times of arrival and departure of employees from the office (or other workplace.) This is accomplished by the employee's inserting a special card into the machine at the time he arrives, and again upon departure. Job recording clocks function in identical fashion to record time of beginning and finishing particular tasks.

(W. H. Le.; H. E. Wp.)

OFFICE MANAGEMENT. The office is that part of an enterprise which is devoted to the direction and co-ordination of the various activities of the enterprise. It is characterized by the gathering, classification and preservation of data of all sorts; the making, using and preservation of all kinds of records; the analysis and utilization of these data in planning, executing and determining the results of operation; the preparation, issuing and preservation of instructions and orders and the composition, copying and filing of written messages.

Though clerks and clerical work have existed for centuries and large groups of clerks for decades, it is only in recent years that the management of clerks or office management, has become a problem of importance. This is wholly due to the rapidity of industrial change, which is best shown in the United States. In 1880, when there were but 172,575 clerks in that country, mostly bookkeepers and accountants, the problem might be considered as practically non-existent; but in 1920, when the number of clerical workers of all kinds had grown to 2,951,008, it assumed proportions that could not be ignored. In 1920, one in ten of all persons engaged in "gainful occupations" was a clerical worker. The change was necessitated by the exigencies of an ever-growing large-scale industry. While business organizations were small, and direct contact existed between producer and consumer, beyond simple bookkeeping few records were required, there was little written communication between sections of an organization, and consequently few clerks were needed. All this has changed, and to-day the office has attained a position of major importance in business.

Many offices employ more than 100 clerks each and a considerable number employ several thousands. Evidently the employment of such numbers of workers requires management of a high order, yet it is only recently and among the most progressive companies that the subject has received the attention it deserves. Ingenious systems of record keeping and filing have been invented, scores of clever appliances and marvellous office machines are available (*see* OFFICE MACHINES AND APPLIANCES), but the problem of securing the greatest result for the least expenditure of effort has not been given the attention in the office that it has in other lines of endeavour. This is due to the newness of the problem, but there are signs that this condition is sure to change as time passes.

Frederick Winslow Taylor (*q.v.*), the "father of scientific management," was himself probably the first person to apply—at least in a limited measure—scientific principles to office work. In Copley's biography of Taylor is shown a "Time Note," dated about 1885, giving "piece-work" rates on 17 clerical operations, the implication being that Taylor had at least studied these operations, found the best method of performing them and controlled them to the extent that he offered an incentive wage for their accomplishment.

THE HUMAN ELEMENT

The major divisions of office work are given herewith, but not necessarily in the order of their importance.

Organization.—The most essential factor here is clearly defined lines of authority, and its lack is the greatest defect to be found in many companies. In the struggle for advancement it seems difficult to prevent officers from claiming more authority than is granted them, and where confusion of this kind exists, loss of morale invariably results. Functionalization—one of the leading principles of scientific management—is as efficacious in the office as elsewhere. The office manager himself holds a functional position—that of managing clerks, wherever placed. Where this principle is fully carried out, work, instead of being departmentalized, will be functionalized, and therefore performed much more effectively. Thus, a stenographer employed exclusively in taking notes and transcribing letters, will do much more effective work than one who also keeps and files records, answers telephone calls

and performs other miscellaneous work. Functionalization, however, is to its fullest extent only feasible in large offices. It is uneconomical to have too many departments under the charge of one officer. A chart of the organization, and an organization diagram, both giving not only the position of each individual in the office but his duties and relation to others, are necessities. Also there should be standard methods for performing each task, and written standard practice instructions so that the carefully devised methods may be perpetuated. Otherwise great loss of output will result.

Personnel Methods.—Progressive records of each employee's performance are necessary as they serve as a basis for future advancement. Special tests for ascertaining the ability of new employees will prevent to a large extent the great wastage of continuous hiring and discharging. Many psychological tests, special ability and trade tests have been prepared, extensively used and found advantageous. (*See* PSYCHOLOGICAL TESTS.) While there are many clerical positions which demand the very highest intelligence, all clerical work does not, and much of the simpler clerical work is found irksome when allotted to those capable of a higher grade of activity. Training is extremely important, though often sadly neglected. In some offices the various lines of promotion are laid down and made known to all employees, so they can prepare themselves for advancement. Some offices also have officers who devote their activities wholly to employment, and all persons who are to be discharged are referred for final adjudication to this officer—the employment manager. The advantage here is that competent employees are not lost to the organization solely because of the personal pique of some hasty or temperamental officer. The employment manager also ascertains by tactful questioning the reasons why employees leave, and by a careful, classified record of such reasons is enabled to check bad practices, and to determine any other causes for dissatisfaction.

Turnover.—The "rate of turnover," that is, the ratio of employees leaving to those on the pay roll, is a most important factor in good office management. An average cost of over $100 is represented in the training of a new employee who replaces one who has left, so that it is evidently desirable to retain employees for long periods. Turnover is dependent upon many factors. If employees are not properly selected, many replacements will be needed; if salaries are not right, physical conditions bad, or the relations of officers not as they should be, there will be many voluntary separations. A minimum turnover is considered to be about 10% annually. Length of service depends upon much the same conditions as rate of turnover.

Routines and Methods.—A routine is a collection of separate operations through which a piece of work successively passes. Division of labour has been highly developed in office work, and few operations are complete in themselves. Routines as a rule are seldom consciously developed but come into existence gradually through the use of machinery combined with hand-work. As a result, operations wholly or partially useless and of little or no value to the "finished product"—the result desired—are frequently found. Methods also have generally speaking a similar evolution, and yield great results from scientific research. Unless both routines and methods are carefully studied, there is apt to be much waste.

Control of Output.—To secure maximum results for minimum effort, a continuous and uninterrupted flow of work is necessary, and this is one of the most difficult achievements in office work. In the manufacturing of any material commodity the work can be precisely scheduled, step by step, and the maintenance of a steady flow is largely a mechanical problem, as every piece of similar character goes through precisely the same steps. But in the office there is the added difficulty that office work of similar character does not always take the same course; and even in some work of exactly the same nature, the flow is governed by conditions beyond the control of the office manager. Because of this fact it was, until very recently, considered impossible to plan and schedule office work. Peaks, that is, periods demanding intensified and additional work, were handled either by overtime work, or by the permanent maintenance of a sufficient force of clerks to handle them, both plans being evidently wasteful. Analysis of this matter, however, showed that in many cases they could be adequately met by pre-planning. The office force should be well balanced, and sufficiently large to handle average conditions; but a sufficient number of clerks should be trained in several operations. Then by utilizing the idea of the "flying squadron"—a selected group of clerks that can be used almost anywhere in an emergency—most of the minor peaks can be handled without difficulty. Major peaks can be dealt with by a re-adjustment of working force and the employment of extra clerks for positions which require only a minimum of training.

Clerical Output.—On this subject all the major factors of office management converge, and all have a bearing upon it. Under conditions where all factors have been scientifically studied, clerical output is invariably much greater than in organizations in which they are largely ignored. Thus in the office of the latter character the average output of a stenographer will rarely exceed 100 sq.in. per hour, while in a scientifically managed office this particular output will be increased to an average of 200 sq.in. per hour. The maintenance of the latter rate does not depend alone upon the skill and application of the stenographer—for 200 sq.in. per hour is but 30 words a minute, while the world's typewriting record is over 800 sq.in. per hour—but largely upon other factors outside the control of the operator and decidedly within that of the office manager. As with typewriting, so it is with all other clerical operations; the output usually depends much more upon the efforts of the management than upon those of the individual clerk. The effort should not be to obtain the highest possible output from any individual, but that which should be expected from a first-class worker.

The Incentive Wage.—Still another factor which aids in obtaining a high clerical output is an incentive wage of some kind, wherever it is possible to measure the work. The various methods of incentive wage used in other lines of business endeavour have all been tried in the office, some with considerable success, others with disastrous results. In the cases of failure the main causes generally are that (1) work was not properly standardized; (2) not properly measured; (3) steady flow not obtained; (4) work not properly controlled; and (5) no adequate check upon its quality. Piece-work in the office is not so generally applicable, because the worker must have a guaranteed minimum wage, and it is not always possible to supply him with sufficient work to make that wage on a piece-work basis.

THE MECHANICAL SIDE

The preceding factors deal almost wholly with the management of the human element, and now other factors must be considered—those physical factors without which efficient management is not possible.

Arrangement.—The physical arrangement of an office affects all other factors of management. As most offices are in large cities, rentals are high and therefore space must be conserved. For this reason the cubicles of the old-fashioned office are giving way to the open office. Departments having relations with each other should be contiguously situated, and the seating of the workers in each department be regulated also on this principle. Work should flow in straight lines. Adequate light, both daylight and artificial, should be provided, the standard of the latter being placed by experts at not less than 10 foot-candles. (*See* ILLUMINATING ENGINEERING.) The completely indirect system, in which the light is thrown from its source to the ceiling, and thence reflected down, is considered the best. Ventilation is an important matter also. Experiments show that the best ventilating system is that which brings in fresh air from the outside without altering it in any way, this being superior to the elaborate washed and heated air systems. (*See* HEATING AND VENTILATION.) Excessive noise is also detrimental to good work, and noisy machines, if numerous, should be segregated.

Equipment.—Under this head are included desks, tables, chairs, filing cabinets and similar furnishings. The old-fashioned roll-top desk has disappeared, and as the present tend-

ency is to the extended use of small loose-leaf books and cards, the high-standing book-keeper's desk is seldom seen. At present the usual office desk is too large and contains too many drawers, and as clerks have little need for more than one or two drawers, a table is generally preferable. The size of a desk depends naturally upon the character of the work, but a desk larger than 54×30 in. is rarely needed, though no desk should be smaller than 40×30 inches. Chairs to be comfortable require designing to fit the human anatomy in an upright seated position. A few good anatomical chair types are available, but most of the others are uncomfortable.

Office Machinery.—Here the greatest development has taken place, office appliances being now available for almost every occasion. (*See* OFFICE APPLIANCES.) There was a tendency to use machines to the exclusion of competent brainwork, but office managers are beginning to see that this is a mistake.

Correspondence.—This is naturally an extremely important part of office management, not only between the company and outside correspondence, but within the organization itself. The present tendency is toward brevity and clarity, and the florid style and redundant expressions of the so-called "business English" are in process of elimination.

Filing.—The vertical system of filing has almost entirely superseded the old-fashioned flat file, and elaborate systems have been greatly simplified. Its greatest present misuse is the filing of valueless and superfluous material. The filing problem requires not only adequacy in equipment and system, but also accuracy, which necessitates adequately trained operators, for misfiled papers may easily cause great loss.

Stock-keeping.—In a large office the maintenance and issue of an adequate stock of all forms in use becomes a problem in scientific stock-keeping. Order and neatness are necessary, and an adequate location system, so that material can be found with a minimum loss of time. Stores should be classified according to some well-devised system, and there should be a perpetual inventory and a systematic method of issuing stores to, or on the order of, authorized persons.

Intercommunications.—This factor is a most important one in large offices. The telephone is of course the most common method, but there is usually a large transfer of papers from one part of the organization to another, and this must be taken care of by well-organized messenger systems with regularly scheduled trips. In many offices automatic belt systems or other forms of conveyors are used. Mechanical devices of other kinds are automatic signalling systems, automatic telephones and so forth.

Forms.—Most office work is performed by writing upon some kind of blank form, whether they be detached or loose-leaf forms. The quality of paper selected for any form should be governed by the use to which it is put. If it is to be written upon with pencil it is wasteful to use a high-grade paper designed for writing with ink. When forms have a temporary value only, the paper should be of a cheaper quality than that of forms to be kept for a number of years. Selecting standard qualities of paper for these various purposes requires considerable study. A large variety of colours should not be used, as many of them—particularly the reds and blues with their varying shades—are difficult to read under artificial light. Not more than nine standard sizes of forms are usually needed.

Salary Standards.—In most offices salaries vary widely and often unreasonably, clerks doing similar work frequently receiving widely different salaries. Some of the best-managed organizations have made a careful gradation of salaries, with a maximum and minimum for each class of worker. The minimum is that salary which a clerk is entitled to as soon as he is assigned his position, and the maximum the highest salary which the company can afford to pay for that type of work. Such gradation eliminates gross inequalities, gives more equitable payment for results and minimizes dissatisfaction among the office force.

SUMMARY

Office management is highly complicated, and requires a specialist—a manager of high order who at the same time thoroughly understands clerical work. The scientific approach to the factors of office management may be briefly defined. First it is necessary to define thoroughly the purpose of any work about to be undertaken, for if this is neglected the path of the subsequent investigation is likely to follow incorrect lines. Then the problem should be carefully analysed by dividing it into its factors. These preliminary steps, though simple in a statement, are by no means so simple in fact. The next step involves a careful search for all the facts in the situation which govern each and every factor in the analysis. It is a very common oversight to gather an abundance of facts on one part of a problem, and ignore or minimize other parts. To infer, without investigating, is a most prolific source of error, the method of actual test being by far the best. These three steps are precisely those of experimental science, and may be called the scientific method of thinking out a problem. By its use, the office manager can correctly approach each problem and devise the right method, otherwise known in management as "the one best way." With the best method secured, it is then necessary to select the person best fitted to perform it, for all cannot be equally proficient in the same things. The person best fitted for any particular task will invariably produce better results than the so-called "average" person. When found, it then becomes necessary to teach the person who has been thus selected.

These six steps constitute the basic procedure in any form of scientific management and lead up to the seventh, which is planning. Without careful planning, all the scientifically designed work which has gone before will be wasted. Finally, to secure the best results it is vitally important to win the co-operation of the workers. An office force labouring without interest or enthusiasm will accomplish some results, but certainly not of the type desired by a competent office manager. The management which does not and cannot secure co-operation is necessarily defective. These eight steps cover the basic principles of scientific management in all activities.

There is also a considerable tendency toward the simplification of office methods and the entire elimination of much that has been done in the past, on the ground that it is either superfluous or not worth the effort expended. These tendencies are continuously accelerated by economic conditions. Scientific management will be the principal means of reducing the numerical growth of office workers. (W. H. LE.)

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OFFICERS, a term designating persons holding army, navy, and air force commissions, and differentiating them from the enlisted military and naval manpower of a nation. The term "officers" usually refers to commissioned men and women on active, or full-time, duty and indicates that there is a contractual arrangement between them and the state. These persons devote themselves to their country's defense as a principal and regular means of gaining a livelihood. Reserve officers and commissioned militiamen are also included as officers when on active duty, though social custom maintains the use of the term for them when on inactive duty. In a way, this is recognition of the all-inclusive nature of universal service in the age of total warfare. The large group of reserve and militia officers in all nations qualifies in some measure under the term officer, since they give part-time service to the state under less binding contractual agreements. However, their military profession is secondary to business and professional pursuits. Therefore, the term officer in the following context will usually refer to the commissioned members of the regular, active armed forces.

What is the function of officers? They are, in effect, the third side of the triangle of preparedness. Armed forces exist for the primary purpose of defending their nation First the forces must be recruited, organized and equipped. Secondly, they must be trained; thirdly, leaders must be developed.

The art of military leadership for war is based on uncertainty.

The officer may prepare for the day of battle for many years, but the exercise of his leadership in war occupies a relatively brief period. Admittedly, the officer cannot gain experience in the profession of arms during peacetime, which will assure good leadership in war. What he has learned by study and experience may be outdated before he is called upon for wartime leadership. Therefore, the great emphasis among the officer corps of all armed forces is upon training. Theory is the basis of training. Even though theory, when compared to practical experience, is often considered less important, it remains the sole method of disciplining the minds of military leaders. Knowledge is important; the ability to take positive action still more so. The officer must be thoroughly trained, must acquire a knowledge of the principles of war, and retain a certain flexibility in their application to a particular situation.

Leadership has always been a vital requirement of all officers. Their position is one of responsibility, one which carries with it authority over the action of others. The term is used widely in fields other than the military, but there is less conflict in civil life over the connotation of the term. This may well be because there is no such long tradition of leadership by the nobility as has been true of military leaders. Military leadership in modern armies is based upon ability, not social position.

Yet, unfortunately, the social status of officers in history, when they were members of the nobility, was carried over by some misguided individuals into the 20th century. False ideas of the prerogatives of the officer position at times created friction between the enlisted and commissioned ranks.

Accordingly, the primary endeavour in armed forces worldwide was to bring the two groups closer together. All major nations drew their military officers from a cross section of their people, made it possible for the enlisted man to achieve officer status by rising through the ranks, and stressed a form of cooperative discipline born of mutual confidence and assisted by moral incentives for all members of the military and naval professions.

HISTORICAL DEVELOPMENT

Ancient and Mediaeval.—The armies of ancient times were normally commanded by members of the nobility, particularly in Egypt, where members of the military profession were ranked as the second of seven castes. Later in Assyria, the nobility were not only the military leaders but also the top social group in the nation. In neither of these cases could the nobility who commanded this group be considered officers in the sense that their livelihood was primarily military. Moreover, they were not bound to the state by a contract.

The citizen-soldiers of both Greece and Rome were officered by those from among their number who exhibited qualities of leadership. However, in both states, the citizen-soldiers eventually resigned their position as amateurs to professional, long-service, regular soldiers. As a result, citizens in Greece and Rome who had a liking for the military remained in service as officers. Usually they commanded lower-class citizens of their nations, mercenaries and barbarians. Marius opened the officer ranks to Roman citizens regardless of their position. Naturally the sons of prominent men had an easier road to an officer's commission though they had to prove themselves in the frontier battles. In a sense these officers of the later Roman empire days came as close to the modern sense of professional leaders as it was known until the French Revolution.

The feudal period knew no general, long-service military profession and as a result had no officers of the modern stamp. Each nobleman had his serfs for military duties in the short-lived campaigns of the dark ages and the early middle ages. The main business of the knights in the feudal age was to earn their livelihood by overseeing the tilling of their lands. The 40 days of service which the serfs owed their lords prevented warfare from being more than a desultory occupation and in no way qualified the feudal nobles as officers in a professional military system. Furthermore, the obligation to the lord above him was not for regular service but rather an "on call" service.

The professionalization of war appeared in the 15th century when free companies of Swiss, Italian and German soldiers sold their services by company wherever they were needed. These mercenary troops were a thoroughly international class and their captains, both able leaders of men and freebooters. They made a business of fighting, contracting with various princes or dukes for so much professional service; they earned their livelihood by warring, and in a way their captains qualified as the first officers in the modern sense.

Their mercenary business passed out of existence about the middle of the 17th century when the dynastic standing armies came into being. Free companies had been responsible for the designations of rank in the lower grades of officers, particularly that of captain.

17th and 18th Centuries.—Before the period was reached in the 18th century when kings obtained their forces by recruitment and paid them, there existed for a time, after feudalism and free companies became obsolete, a proprietary system. In effect the colonel was the proprietor of the regiment formed by himself, and the captain the proprietor of his company. This practice continued even after the kings formed their standing armies and was common in the United States in the Revolutionary War. General George Washington, as commander in chief, was accepted by the militia of the various colonies even though the latter were made up of elected officers whose authority and position stemmed largely from the fact that they had brought so many men in an organized form to become freely a part of their state militia, and as such, a legal portion of the larger forces of the united colonies.

The proprietary system gave to military office not only responsibilities, but also certain profits. The officer, particularly in European armies, was paid for the number of men that he mustered and was furnished other funds for their arms and food. As a result commissions became of great value, particularly in Britain. As late as 1871, commissions had to be purchased in the British army, the cost of a second lieutenancy of infantry being about a year's pay or approximately $2,000. The purchase of the commission of a lieutenant colonel in a first-class regiment might cost as much as $30,000 in Britain. Besides the profit in the discharge of proprietary rights, the officer could sell his proprietary interest when he retired.

To return for the moment to the Thirty Years' War of the 17th century, there was a great development of the grades or ranks of regimental officers in the well-organized army of Gustavus Adolphus. He established the idea of the regiment with its colonel, and the battalion commanded by a lieutenant colonel, assisted by a major as the administrative chief and by an additional officer, a captain who arranged for supplies. The companies were commanded by captains as a continuation of the free company method, while the subordinate officers in the unit were lieutenants.

The general terminology for the grades of regimental officers having been established, it remained largely for the French to develop during the next century the ranks of the higher positions, above the grade of colonel.

Usually the king or prince was the "general" of a standing army, being supported by a nobleman as lieutenant general in command of the aristocratic cavalry. A professional officer usually commanded the infantry and was variously known as the "sergeant major general" or simply "major general." It was his duty to form the army for battle, and to take care of other administrative matters for the king or prince. The title of sergeant major was carried through the regiments and battalions where the second-in-command was the sergeant major or "major," and adjutant as well. The regimental sergeant major was usually drawn from among the best qualified lieutenants and not from among the proprietary captains of companies.

A new title gradually came into being in the French army, that of "marshal" or "field marshal." These titles were given regardless of the actual command which the officer held—the reverse of the usual practice of that period. For in the 16th century, the general and major general were the commanders of a particular army, and each of the subordinates was a captain

or lieutenant of a particular regiment. As a result the officers, other than the marshals, were tied to a specific army or unit. When the unit was disbanded, they lost their positions, thus being required either to find a vacancy and become a member of another regiment or to retire.

In France, the introduction of the distinctive military grade of marshal brought about the gradual development of a list of all officers by order of rank, the list encompassing officers through the regimental grades until it became the army list common in modern times. Thus the proprietary system was gradually undermined until it passed out of existence in the 18th century. Marshals were at first any and all officers of grade higher than colonel and were eligible for appointment as generals, lieutenant generals, and major generals. Gustavus Adolphus had six or eight field marshals as subordinate generals. However, as armies grew larger and their operations took place over greater areas, more subordinate commanders were needed. In time, a lieutenant general, which had been the designation for the second-in-command of an army, was placed in the rank immediately below that of marshal. The next grade was that of the *maréchal-de-camp,* the sergeant major general, or as it was shortened, the major general. The lowest grade of general officer was that of brigadier, created by Louis XIV.

French Revolution to Mid-20th Century.—During this period the most significant development was that officer status was gradually opened to qualified soldiers in the ranks. Significantly, too, officer status was not limited to combat commanders but opened to a great number of technical positions unknown in warfare before the industrial revolution: for instance, the officer whose sole job was to supervise the production of guns, the man who piloted an aeroplane. As a result the numbers of officers in modern armies grew out of all proportion to that known in previous wars. In World War II, the combined United States army and air force had almost 900,000 officers. The total included the small, prewar regular corps of approximately 14,000 officers, a reserve group of just over 100,000, the remainder being commissioned from the ranks, or directly from civil life.

In the British army, officers normally were paid so little that only persons of some wealth could afford to seek commissions. The custom in many well-to-do British families was for the older sons to become clergymen and officers in the army and navy, leaving business and agriculture to the younger sons. It was not until 1938 that the British government opened up its officer grades to the rank and file of English youth, both from inside and outside the services. The reforms were sweeping and did away with such disabilities as the low pay which required augmentation from personal income, and also eliminated the inactive status during which a regular officer had sometimes found himself on half pay. Consequently, the British army officer class became more representative of the nation as a whole, merit determining promotion. Even the social barriers were broken down so that service as a British officer more closely paralleled that in the U.S. army than it did that in the German army.

In Germany there developed a military society which elevated war to a position of glory. Army officers were drawn from German citizens with a college education, 60% of the regular army officers having been reservists on active service who were recommended by their colonels. The remainder were commissioned upon graduation from cadet schools. Candidates for commissions not only had to qualify themselves militarily but also had to be acceptable to all other officers in the regiment, much as if they were being elected to an exclusive club or fraternity. Because the German system of universal liability made every physically able man an officer or enlisted soldier, there developed the regular and reserve officer classifications as an integral part of German society. Compulsory military service combined with the mobilization requirements made it the ambition of young men to become army or navy officers. The entire system was strongly supported by the landholding aristocracy, who made certain that members of their group, the *Junkers,* rose to high command and staff positions in the army. The arrogance of the Prussian officer was communicated to the rest of the German army, giving it a false sense of officer evaluation which often put form and an exaggerated military bearing above knowledge and ability. Efficiency in a mechanical vein was one of the fetishes of the Prussian officer caste, detracting from the human qualities so essential in the making of good officers in democratic armies.

The French nobility had largely been eliminated from influential military positions in the Napoleonic era. Men who might never have been more than sergeants in the armies of Louis XIV rose to field marshals under Napoleon. Against this background, the selection of officers in France during the 19th century was probably more democratic than in any other nation. Two schools were maintained for the training of officers, the majority of the candidates gaining admission from civil life through competitive examinations. Noncommissioned officers in the regular army were also eligible to compete for cadetships. Throughout the 19th century and to the mid-20th century, French officers were well schooled and able men, though officer positions declined in standing mainly because of the low pay and the fact that men of wealth were rarely attracted to service including stations in overseas colonies.

In the far east the Japanese army was largely officered by the nobility. Descendants of the traditional samurai class generally attained highest rank in both command and staff in the Japanese army. A certain similarity developed between Germany and Japan in the rise of a military society in which the officers became the high priests. Japanese officers developed much of the same arrogance and patronizing airs not uncommon in the German army of the 19th century.

Russia, under the tzars, gave officer status almost entirely to the nobility. The position was often more social than military and provided many plots for Russian literature. Upon the bolshevist revolution, Vladimir Lenin created an army from the proletariat, taking his leaders from among labourers and revolutionists.

During the interim between the World Wars I and II the soviet army developed slowly, with special attention paid to raising the military to a position of the élite among the soviet hierarchy. In World War II, the initial commanders were the leaders of the old bolshevist forces, men like Klementiy Voroshilov, Semyon Timoshenko, and the Cossack leader, Simeon Budenny. They were not quite up to the demands of modern warfare, except in defensive combat, and gave way to younger officers when the Red army turned to the offensive. The new officers had been trained in the various military district schools and had demonstrated their leadership on the battlefield. Many women became officers in the Soviet army and took their place on an equal basis with the men.

Officers in the U.S. army continued to represent a cross section of the population and were obtained by varied systems of selection. During the Revolutionary War, men ignorant of military affairs became officers through political influence. Massachusetts offered a captaincy to any man who raised a company of 59 men, and a colonel's commission to anyone who raised ten such companies. The evils of the system were great since history mentions companies electing captains on the condition that they share their pay with the other men. The story is told that one captain acted as the barber for his company. The experience of the Revolutionary War was duplicated to a smaller degree in the Civil War when governors of states appointed officers in the volunteer forces, often without regard to their experience. Many of the small nucleus of regular officers who had been trained at the U.S. Military academy got their chance in the war by obtaining volunteer appointments from state governors at ranks far beyond the permanent ones they held. The experience of General Philip Sheridan, who fought as a captain in the regular army for a full year before he was elevated to a colonelcy of volunteers, was common among the regulars.

After a similar experience in the Spanish-American War, the U.S. made a strong effort in both World Wars I and II to select and promote officers on the basis of merit. In these wars, positions in the higher command and staff were given most often to regular officers, while the other grades were filled with civilians brought into uniform, many of whom had military duties almost

identical with their civilian work. U.S. practice through all its wars was democratic in that it was possible for a man from any walk of life to rise to high command. However, a man of some prominence admittedly had a better chance to obtain a commission than his less influential fellow man.

Historically, the development of the officer position was pertinent to only armies and navies until World War I, at which time the air officer, usually a pilot, was added to the commissioned officer group. Commissioned air officers were formed into a coequal service, the air force, in Britain and Germany between the World Wars I and II, but were maintained as part of the army in other major nations until after the close of World War II, when the soviet and the U.S. air forces became separate entities.

GRADES OF ARMY AND AIR FORCE OFFICERS

General Officer Grades.—In the period after World War II, the general grades (ranks being of enlisted men) of officers were as follows:

Field Marshal.—In the soviet army, the term applied not only to Stalin as commander in chief but also to several of his highest ranking field commanders. In the soviet army the rank was not given to any particular arm, such as infantry, but generally denoted the command of an army or more often a group of armies. In Britain, the chief of the imperial general staff and the top field commanders, without regard to arm of the service, were given this title. In France, the term *maréchal* was an honorary title in recognition of long and outstanding service by a general officer.

General of the Army.—This title was created in the United States after World War II, and conferred by the congress on several high commanders, such as Generals Dwight D. Eisenhower and Douglas MacArthur. The precedent had been established after World War I when General John J. Pershing was given the title "general of the armies."

General.—This grade is normally identified with the commander of a field army, though it was also used for occasional high staff positions. This was the rank which Gen. George C. Marshall held throughout the war and which was conferred on Gen. Omar Bradley as the commander of an army group near the end of the war.

Lieutenant General.—This title is generally used in all the major armies except the French for the commander of a corps of two or more divisions. The relative rank in France is *général-de-corps.*

Major General.—The commander of a division in war or peace or the commander of a military district is given this rank in practically all armies of the world. In France the designation is *général-de-division.* Also most of the high general staff positions are given this rank, and only rarely is a higher rank given for any staff officer other than the chief of staff of a theatre command.

Brigadier General.—This term comes from the position of the commander of two regiments, when organized as a brigade. Though that organization had disappeared at mid-20th century, except in the British army, the term was still used in most armies to designate the second-in-command of a division, the commander of the divisional artillery, or the commander of a task force comprising a number of combined arms. In Britain the term is brigadier; in France, *général-de-brigade;* and in the U.S., brigadier general. The soviet army did not adopt the term brigadier.

Air force officers in most countries followed the same general system of ranking their higher commanders, though in Britain the royal air force gave its high commanders the titles of: Marshal of the royal air force (equivalent to field marshal); air chief marshal (general); air marshal (lieutenant general); and air vice-marshal (major general). For the brigadier grade, the British royal air force borrowed from the navy and utilized the title air commodore.

Field Officer Grades.—The second large grouping of officers, below the general officers in seniority, is the field officers, comprising the ranks of colonel through major. In France this group is known as the *officiers supérieurs.* The field officers are as follows:

Colonel.—A grade denoting the commander of a regiment in all armies of the world with the exception of the British, which has no infantry regiments. However, the title was adopted as an honorary one in the British service and during World War II was given increasingly to staff officers who occupied staff positions comparable to those of U.S. colonels.

Lieutenant Colonel.—In practically all armies at mid-20th century the commander of a battalion of infantry, cavalry or tanks, second-in-command in a regiment, and the grade of the majority of officers on the general staff was lieutenant colonel.

Major.—In many of the armies, the major as second-in-command of a battalion had acquired some of the functions of the historical sergeant major. In the U.S. and soviet armies, the major practically never commands a combat unit though in the French army the major, called a commandant, often commands a battalion, while in Great Britain the junior majors sometimes command companies.

In the U.S., U.S.S.R. and France, where the air force had been a part of the army for a longer period than in countries like Britain, the titles for field officers became identical for both the air and ground force officers. The British equivalents were group captain for colonel, wing commander for lieutenant colonel, and squadron leader for major.

Company Officer Grades.—The third grouping of officers is the company grade, which in France is called *subaltern.* The grades are as follows:

Captain.—In all armies, commander of an infantry company, the title which goes back through the days of the proprietary and mercenary companies.

Lieutenant.—In the U.S., this officer is known as a first lieutenant, and in Belgium the platoon chief, which is indicative of the office he often holds. The lieutenant may, however, be second-in-command of a company in all armies except the British, where a captain is second-in-command to a major when the latter commands a company.

Second Lieutenant.—This officer is usually a platoon commander and is known by this title in most armies, except in France where he is called *sous-lieutenant.*

Aspirants or Cadets.—Practically all armies have young officers on a probationary status who reach commissioned status when they have satisfactorily completed their military studies.

Again, as with field grade officers, the same company officer grades are given to air as well as ground officers. The British, however, give a captain the title flight lieutenant, the lieutenant is called flying officer, and the second lieutenant, pilot officer.

SOURCE OF OFFICER MATERIAL

Frederick the Great and Napoleon set the standard of military academy education as a primary method of obtaining officers for the regular army. In Great Britain, France, the United States, and the U.S.S.R., this method of obtaining a commission requires completion of schooling and competitive examinations before a commission is granted. Military academies are open generally to youths between the ages of 17 and 22 years of age. The curricula feature a general military education. One of the invariable requirements for entrance is that the candidates be unmarried.

Entry into the air officer status is attained also through cadet air training schools. Air academies were slow to arise, as a supplement to military academies, because of the late attainment of equal status by the air force. Moreover, in the desire to make officers mutually cognizant of the responsibilities of the army, navy and air force in their co-operative aims, the suggestion was made that military academies might be utilized as post-graduate schools for all three armed forces. Their candidates would be drawn from civilian colleges, or from the enlisted ranks, a minimum educational equivalent being required. The system of selection for the various military academies is briefly explained below.

U. S. Officer Candidates.—Officers in the United States army have been obtained from three different sources: from graduates of the United States Military academy; from graduates of

civilian colleges, either by direct commission or by competitive tours of one year; and from among reserve officers up to the age of 45, by integration on the basis of equivalent years of service. Both the navy and air force have obtained their regular officer complement from the same sources, except that the navy has its own Naval academy, and the air force obtains officers from the Naval as well as the Military academy.

Army and air force officer candidates are educated at the U.S. Military academy, West Point, N.Y., and for the naval and air services, at the U.S. Naval academy, Annapolis, Md. The student body for both schools is filled by congressional appointments, each congressman at mid-20th century being given four appointments for West Point, and five for Annapolis. Selection of cadets is by competitive examination, for which may be substituted successful completion of the college board tests given to preparatory school students, or better-than-average grades in previous college work. The president has a number of appointments, often used for sons of deceased veterans, and the regular services and the national guard also were given rights of appointments—open to all enlisted men on a competitive basis. However, most of the students at the academies have not had previous military service.

Both schools offer a typical, four-year, college curriculum at government expense, leading to a bachelor of science degree. Supplementing the academic subjects are courses in military and naval matters. The objective of the schools is to produce officers who have the qualities and character essential to their continuing development as leaders. The academies generally seek to implant a high sense of duty and patriotism, while assuring mental and physical fitness.

Upon the successful completion of the four-year course, the graduate is commissioned a second lieutenant in the army or air force, or an ensign in the navy. At mid-20th century West Point and Annapolis had not furnished even a majority of regular officers in the services, since far larger numbers had been commissioned from U.S. colleges, or had been inducted from the reserve officer group.

British Officer Candidates.—Great Britain, on the other hand, has obtained practically all its regular officers from its military schools. Medical and legal officers have of necessity been obtained from graduates of civilian universities. Prior to World War II, Britain maintained two cadet schools: the Royal Military college at Sandhurst; and the Royal Military academy at Woolwich. Sandhurst was a school for officers of the infantry, tank corps and other line elements, while Woolwich trained artillery, engineer and signal officers.

Prior to 1938, entry into these schools was confined almost solely to the sons of upper-class citizens, though a few cadetships were open to noncommissioned officers from the ranks. The reform of 1938 made it possible for an English youth who was successfully qualified to obtain military training at government expense. Assurance of a secure career after graduation was given to all cadets. These two schools had a two-year course and were open to men 18 years of age. Both schools differed considerably from the U.S. Military academy in that emphasis was upon military training, no effort being made to obtain for the cadets a college degree. These two schools furnished about three-fourths of the total number of regular officers, the remainder coming from graduates of colleges, from the army, and from the commonwealth nations.

In the post-World War II period, Sandhurst and Woolwich were consolidated into a single Royal Military academy, located at Sandhurst.

French Officer Candidates.—Like the British, the French maintained two schools for candidates for commissions in the French army: École Spéciale Militaire at St. Cyr and École Polytechnique in Paris. Again like the British military schools, they featured a two-year course. St. Cyr, like Sandhurst, trained men for the infantry and the tanks, while Polytechnique, like Woolwich, trained technical men for the engineers, artillery, and other services. Candidates for both schools at mid-20th century had to be between the ages of 18 and 22 years, of French citizenship, and unmarried. Most of the cadets w of civilian origin and obtained their admission through co petitive examination. Both schools also maintained a cert number of noncommissioned officers selected from the regu army as candidates for commissions. Their educational standa were high. only the most brilliant students in the nation bei able to qualify for admission to the Polytechnique school. The was no board or tuition, the cadet being paid by the governme as in the U.S. The course of instruction in the schools w a blend of the academic and military. These two schools h furnished most of the regular officers in the French army.

Soviet Officer Candidates.—Prior to World War II t U.S.S.R. had no cadet schools for military commissions simil to those of western nations. However, in each of the military districts there were infantry schools and sometim artillery schools for the training of candidates for commission Schools for the other branches were concentrated in Europea Russia, but usually there was only one school for each branch.

Candidates entering the schools were required to be betwee the ages of 17 and 21, after having served from one to thre years in the Red army, or having been graduated with distinctio from a high school. Competition was keen for vacancies an the calibre of the cadets quite high. The curricula for the schoo were normally two years of higher education, including som military tactics and history, and the third year given ove primarily to military training. While the graduates undoubted had less academic education than cadets of the western nation they were well grounded militarily and had a basic intensity o purpose which compensated for some of their lack of education After World War II military education in the soviet army an air force was greatly expanded, a number of new schools bein opened, all of them named after Russian heroes.

OFFICER TRAINING

All modern armies lay great stress upon the training of officers World War II experience was proof that the tactical and staff schools paid great dividends. Moreover, the method of training an officer in alternative troop command and school assignments during his early career, and in alternative staff, command, school and instruction of reserve officer groups, in his later career, proved eminently satisfactory.

Most important, officers tend to serve for much longer periods than enlisted men, their careers measuring 30 or 40 years. Preparedness for defense of the country is their primary objective, though defense in modern warfare includes requirements for commanders, staff officers and technical specialists.

Because peacetime experience can never duplicate that of war, what is learned in the normal officer duties is insufficient to produce the calibre of officers needed in war when officers are promoted quickly through several ranks. In peace, seniority is the rule; in war, promotion is based largely on merit. Because experience in peacetime becomes outdated, and because it does not adequately fit the officer for wartime demands, the essential requirement is training. Officers are schooled in the theories of tactics and strategy and in the principles of war. Flexibility of mind is the goal in military education. However, this usually means trained minds, not learned ones. An officer who is mentally competent, a student of warfare, and a man of action is preferable in the hard necessities of the military art to an academic-minded officer who sees too many imponderables, and is therefore hesitant to act.

The army officer recently graduated from a military academy is usually given two or three years in command of a platoon of soldiers to acquaint him with the problems of leadership and to impress upon him the necessity of knowing the small-unit tactics as they apply to soldiers in the ranks. Moreover, in such experience, the young officer is physically capable of accomplishing each soldier's job, so that he can show a rifleman or machine gunner how to handle his weapon. After a period of command, the officer may go to the school of his arm, such as infantry or artillery, to obtain a basic knowledge of its tactics and techniques. In some armies, this training of the early years

is reversed on the theory that the junior officer is better qualified to command men if he has had the benefit of tactical schooling. Other than this difference, however, the training of officers seems to run to a pattern. The sequence includes service in the military academy, command, basic school of his arm, command, advanced school of his arm, command, staff college, staff assignment, war college and the remainder of his career either command or staff, whichever field seems best to suit the individual.

It is understandable that much of his training is concentrated on learning tactics and staff procedures by application so that the individual is able to do them practically blindfolded. This is not to say that schooling is unthinking nor that it is adjusted to the unintelligent but rather that it is based upon the requirements of service. Most officers have occasion during their careers to train younger regular officers and reservists. Close adherence to military doctrine is the surest guarantee of obtaining the best trained men.

United States.—Officer training in the U.S. army and air force at mid-20th century included schooling at regular intervals throughout the first 20 years of service. Every officer looked forward to attending both basic and advance courses in his infantry, artillery or tank school. In addition he would have had alternate command assignments, so that by the time he was a major he would have proceeded through the company commands and thus be prepared for training at the staff college. There the emphasis was upon staff procedures and the functions of the staff, rather than upon tactics. The officer-student was concerned with the work of each staff section in divisions, corps, and armies. Subsequently a U.S. army or air officer was usually assigned to duty in a city with the reserve corps or national guard, or in a university with the reserve officers' training corps. Later he might expect duty on the general staff, and about the time of promotion to a colonelcy to become a student at the War college, if in the upper few percent of his contemporary group.

During the first ten years officers who began their service in the infantry or artillery might have become specialists in ordnance, signal communications, engineering and the like. Some of them were eventually transferred to those branches, with further training in civilian schools and universities and at the Industrial college.

Great Britain.—The British army officer at mid-century, like the American, entered into the duties of platoon commanding a short time after he was commissioned. He was expected after two years of service to be capable of commanding a company, to have a knowledge of its interior management, conomy, and discipline. Subsequently, he was required to pass professional examinations at each step up to and including the rank of lieutenant colonel. Advanced training in the British army included certain outside activities such as the reading of articles on military science and attendance at special lectures arranged by the higher commands. By such methods, including examinations, officers were kept abreast of the development of modern combat methods. Eventually, selected officers were sent to staff colleges such as Camberly. After graduation they would be eligible for employment on the staff, either the general staff or a divisional staff. Above the Staff college was the Imperial General Staff college, an equivalent of the National War college in the U.S., where colonels and brigadiers study political-military problems, similar to those which confront the high command in peace and war.

France.—The French training system was the model upon which both British and U.S. training had been developed. Great emphasis was placed upon qualification both in education and military training. Education was continuously and progressively brought to each officer; his training was developed at schools for specialists and at the school of each arm.

The staff college, École Supérieure de Guerre, was designed to teach the higher art of war as opposed to a pure study of staff duties. The school was open at mid-century to French officers between the ages of 28 and 38, after which there was another course at the War college for colonels at about age 45.

Soviet Union.—Officers of the Red army at mid-century were trained at branch service schools, much as in the western democracies. Also the more capable officers were sent to staff schools and eventually to the War college. The pattern of development in the soviet army gave great emphasis to two items: political beliefs of the individual, and his ability to command troops. There was an increasing amount of specialization, efforts being made to teach officers transportation, engineering, and other technical specialties needed both in the army and in industrial life.

THE OFFICERS' SERVICE

While training requirements were somewhat fixed for officers in all armies, there were great differentiations in the kind of duty they performed when not in school, and the places where they served. The usual expectancy in every army was that officers would command troops from one-fourth to one-half of their careers. However, this requirement was constantly lowered in the 20th century because of the complexity of war, which increased the demands for staff officers and technical specialists.

Once having left a command and having entered into either staff or technical work, the officer may still have contact with the soldiers of the army, but the relationship is never the same as in the command of a company or battalion of troops. The spirit of unity, the *esprit de corps,* of the line outfit is never quite achieved in other fields where the individual is thinking of his paper work or interested in science. However, the latter two fields are necessary parts of a modern army and the staff officer must quickly learn the functions of personnel, intelligence, plans, operations, training or supply. In each field, the knowledge that he brings with him of the men in ranks assists him in determining whether his policy on paper can be carried out by men. In the general staff field, many of the problems extend into the field of political-military affairs and grand strategy. The training of the ordinary officer is not sufficient to equip him adequately for this requirement. Consequently such jobs are assigned to officers who have maintained a lively interest in world affairs and have attained a sense of proportion regarding them.

The third grouping of duties for officers is the technical or supply services. The capable technical officer may possibly be a graduate of an engineering school, as well as a graduate of a military academy. His work in signal communication, ordnance, or procurement of supplies, will bring him into constant contact with business and industrial men. Mutual understanding by these groups is essential since they have the task of rapid industrial mobilization in the event of war.

The high command in most armies is normally given to the line officer, with a background in infantry, artillery, or tanks, who has alternated his command experience with general staff duties. These officers will in time have taken a very divergent path from those of the technical experts, qualifying themselves more as executives and administrators in the later years of their service, rather than as specialists in technical fields.

The duties of officers in all countries require a certain amount of overseas service, in colonies, occupation of conquered countries, or in strategic outposts. Accordingly the officer is alternately moving from an army post to an overseas garrison or militia units. The duties are varied and in many cases stimulated by new interests and new places.

Discipline.—Not only must the officer be disciplined in his own mind and body, but he must also have an understanding of the disciplinary customs of his own people serving in the armed forces. The Prussian system of unthinking obedience from mechanical soldiers is not attuned to the requirements of the democracies, or to the needs of modern warfare.

Machine weapons compelled the troops to disperse on the battlefield. In the isolation of the individual soldier in his foxhole, there was an incessant demand for the moral and physical courage which only an understanding system of discipline could foster.

Officers to be successful leaders must associate themselves with the troops. Diligence in the care of the men in ranks, resolute justice, creative intelligence, respect for the dignity of

the position of other soldiers are essential. Knowledge of the military art, flexibility, and all the other requirements of leadership are undermined if the officer does not understand the human aspect of dealing with fellow men over whom he holds a position of power. The object of the relationship between officer and soldier is the strengthening of the will of the latter. Only when the enlisted man is so motivated will he take voluntary actions on the battlefield, which in the aggregate are the difference between victory and defeat. The officer-leader stands or falls in the decision of those rare moments when the result is in the hands of the men he has trained and lived with.

Methods of Promotion.—In modern armies, four methods of promotion within the officer grades have been utilized—election, selection by merit, competitive examination and seniority. The second and fourth means—selection and seniority—are the most commonly used methods of advancing officers in grade. The system of selection varies considerably in all armies but must be construed in the narrow sense. For instance, most selection systems require a certain seniority before an individual can be pushed forward ahead of his contemporaries. Also the requirements for selection in years of service may be expanded or decreased to pull out the number of officers it is desired to promote. In times of peace, when vacancies are few, the service requirements for promotion may be increased. Seniority in a promotion system has its good and bad points. It is usually confined to the grades of colonel or less, generals often being selected without strict regard to seniority.

In peacetime, promotion is normally a permanent advancement while in wartime tremendous expansion is usually handled by temporary promotion, regular officers retaining, simultaneously, a permanent grade. In World War II, there were many cases of permanent captains who held the rank of brigadier and even major general, though rapid advancement was more common in the air force than in the army.

One method of determining whether promotions are earned is by a qualification report. This is a normal requirement in all armies, though administered differently. In the U.S. army such reports, known as "efficiency reports," were submitted annually at mid-century for lieutenant colonels and those of higher rank, but semiannually for all other officers. The report was prepared by the immediate senior of the officer named, and indorsed by the next higher senior, before being forwarded to the department of the army. The reports were evaluated by modern electrographic means, and each report given a rating. The average of an officer's rating over a period of years determined largely whether he would qualify for the Staff and War colleges.

The British and soviet armies utilized a system of promotion which included temporary advances on the basis of service, and other promotions which were a perquisite of a certain assignment. During World War II, a hypothetical British captain might have held a temporary, or substantive, grade of lieutenant colonel, and a position grade of colonel. When he vacated the latter assignment, he reverted to his substantive grade.

CONCLUSION

Officers in a modern army, air force, or navy, have a responsible task. The lives of many of the nation's citizens depend upon their integrity, judgment and knowledge. Probably in no other field of endeavour are leaders thrust so quickly into positions of great responsibility as officers are in time of war. The competence of his training and character are, in part, the responsibility of his peacetime superiors. That charge on senior officers is difficult to meet, because war's realities cannot be fully comprehended, particularly as they pertain to the training and development of a single subordinate officer.

The complexity of modern war is reflected in the requirements on the officer. Not only must he study the usual academic subjects and his military tactics, but also psychology, leadership and scientific subjects. From his inner knowledge, he must be able to tell the modern soldier what is expected of him, and to discuss with him why he fights. The tremendous developments in modern weapons compelled troops to disperse on the battlefield; if the lone soldier armed with a rocket launcher is to do his part in battle, his commanding officer must have laid the groundwork long before the day of battle. The soldier must be confident in his leadership, know for what he is fighting, and know how to fight. The demands upon officers are therefore not only military and educational but also reach down into the social nature of mankind. To be a good officer he must understand men, and know how to get the most out of them in a spirit of co-operation rather than by driving.

The officer is the product of his own nation's social system. But his colleagues in other armies share the difficulties of the increasing complexity of modern warfare. It is said that an infantry officer must know how to fire 20 weapons. When he is promoted from company to field grade, he is expected to know the capabilities and limitations of artillery, tanks and of support aircraft. For in combined warfare, the officer commanding a battalion or regiment must know what are reasonable and what are impossible demands upon other arms and services. These two facts—the complexity of modern war and the equality of all men in uniform—are never-ending problems which the capable officer will realize that he must study constantly, knowing full well that complete understanding is an unattainable goal.

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OFFICIAL SECRETS. At common law there was, and is, no such offense as espionage in time of peace. In time of war, however, the act of communicating information useful to an enemy state was always punishable under the head of treason. In 1889, by the first Official Secrets act this gap in the law was filled by making it a felony to obtain or communicate any "sketch," information, or "document" concerning the country's defenses which "might be useful to an enemy" for "any purpose prejudicial to the safety of the state." This very necessary statute was, however, almost completely diverted from its original purpose by successive acts of 1911 and 1920, into a statute for the better protection of the bureaucracy against well-informed criticism. Entirely new sections were introduced making it an offense, punishable with two years' hard labour, for anyone who has ever served the crown to communicate to "any person" any "information" whether prejudicial to the state or not which he has acquired in his official capacity. It is sufficient for a conviction that the "information" was acquired when the person communicating it was serving the crown and the accused is not allowed to plead, or prove, that publication was "in the public interest." Truth is also no defense; it is, in fact, essential to a conviction. If the accused can prove that the "information" he communicated was false, he will be acquitted. Any person connected with a newspaper, director, editor or leader-writer, receiving the information is also liable to conviction. It is unnecessary for the prosecution to prove *mens rea* (guilty intent), on the part of such recipient. Search warrants may be issued, for the purpose of such prosecution, by any superior police officer without the usual authorization of a magistrate; any newspaper office may be raided and any member of the staff who refuses, or omits, to give information to the police is guilty of a statutory offense. These extraordinary departures from the rules of law prevailing in England are the result of these statutes and their interpretation in *Rex* v. *Crisp and Homewood*, 83 J. p. 121, and *Rex* v. *Blake* (Times Law Report, Dec. 16, 1926). The acts have been the subject of deservedly severe criticism, and the Newspaper Proprietors association agitated for their drastic amendment. (J. H. Mo.)

OFFSET, a term expressing the distance between two parallel planes, or between two parallel axles in a machine; also used in plumbing work to describe a connection between a large and a

small pipe, in which the opening of the smaller pipe is eccentrically placed, so that the axes of the pipes, although parallel, are not in the same line. In architecture, an offset is a slanting plane, forming a transition between a thin wall above and a thick wall below, or between varying depths of a buttress; an offset buttress is one deeper at the bottom than at the top, with the difference between the upper and lower faces taken up by one or more offsets.

OFFSET PRINTING: *see* PRINTING.

OGASAWARA-JIMA (BONIN ISLANDS, OGASAWARA-SHOTO, OGASAWARA-GUNTO), a group of about 20 small islands, 27 sq.mi. in area, lying about 500 mi. S.E. of the Japanese mainland. The population was about 7,500 in 1940; in 1950 only one island was inhabited (pop. 146). The principal island is Chichi-Jima (Peel Island), which is of some strategic importance, having a good deep-water anchorage at Futami. Eastern Asia is fringed by island arcs, the innermost consisting of the large islands of Japan, Formosa and the Philippines, and the outermost of small islands alone. The Ogasawara islands form part of one outer festoon which stretches from the central volcanic zone of Japan through the Volcano, Mariana, Mackenzie, Yap and Palau Islands to the Moluccas and which, originating in the latter stages of the "alpine" fold movements, is still unstable. The northern end of the arc passes into central Honshu, that part of Japan where earthquakes are most frequent, and in the Ogasawara group tiny islands appear and disappear. The arc has an important strategic position with regard to the Pacific approaches of the far east.

Although known to several explorers, each of whom gave the group a different name, these islands, originally called Bonin, were not permanently settled until 1830. The term "Bonin" is a corruption of the Japanese "Munin" meaning "empty of men," but the Japanese themselves term them "Ogasawara-Gunto" after Ogasawara, their alleged discoverer in 1593. Vague claims by Britain and the United States were not pursued, and Japan formally annexed them in 1876. Only about 11% of the total area is good arable land, the remainder being hilly and forest-covered. The valuable timber includes cedar, rosewood, ironwood, boxwood, sandal and white oak.

After World War II the Ogasawara Islands were placed under U.S. military administration. Under the peace treaty signed at San Francisco, Calif., on Sept. 8, 1951, Japan agreed to accept any U.S. proposals to place the Ogasawara Islands under trusteeship of the United Nations.

OGDEN, a city of Utah, U.S.A., 35 mi. N. of Salt Lake City, at the confluence of the Ogden and the Weber rivers and the foot of the Wasatch mountains; the county seat of Weber county and the second city of the state in size. It is on federal highways 30S, 89 and 91 and is served by the Denver and Rio Grande Western, the Southern Pacific, the Oregon Short Line, the Union Pacific and the Bamberger electric railways; also by United and Western air lines. The population was 57,112 in 1950, 43,688 in 1940 and 40,272 in 1930 by the federal census.

Ogden lies 4,310 ft. above sea level on an alluvial fan or semicircular delta, formed under the waters of the ancient Lake Bonneville. Mt. Ogden (9,685 ft. high), from which the entire shoreline of the ancient lake, covering 19,750 sq.mi., may be clearly seen, and Ben Lomond (9,985 ft. high) rise abruptly on the east and north, and between them the Ogden river makes its way through one of the most picturesque canyons in America. In a broad valley 10 mi. up the canyon, Pine View dam created Pine View lake, impounding 44,000 sq.ft. of water. This water is used primarily for irrigation, although it serves recreationally for boating, swimming and fishing. Immediately south of this reservoir, accessible by a paved highway, is Snow Basin, a 6,000-ac. area for summer and winter sports, serviced by ski lifts, shelters and other facilities.

The city's manufacturing and industries are important; chief among them are flour milling, meat packing, vegetable canning, candy, tin cans, cement, dairy and ice cream products, boxes and crates, knitted goods and custom-tailored clothing. Ogden serves as the marketing centre for the livestock of the intermountain west. More livestock are handled annually through the Ogden Union Stockyards than at any other point west of Colorado. The annual Ogden livestock show is held there.

Ogden was settled by the Mormons in 1847, was laid out under the direction of Brigham Young in 1850 and was incorporated in 1851.

The first official name was Brownsville, but it was changed in honour of the trapper Peter Skene Ogden, who had located there in 1826. The northern end of the city was a grassy meadow, where the Indians met for games and races and to trade with the white men.

OGDENSBURG, a city of St. Lawrence county, N.Y., U.S., on the St. Lawrence river at the mouth of the Oswegatchie, 50 mi. from Lake Ontario. It is served by the New York Central and the Rutland railways and lake and river steamers, and is connected by passenger and car ferry with the Canadian Pacific and the Grand Trunk railways at Prescott, Ont., on the opposite bank of the St. Lawrence.

The population of Ogdensburg in 1950 was 16,166; by the federal census of 1940 it was 16,346.

The city lies on high ground above the river, which is a mile wide there. It has a fine harbour, open throughout the year, and is an important shipping and transfer point, especially for lumber, grain and coal.

With the completion of the Welland canal in 1930 it became accessible to the largest lake vessels. Ogdensburg is a port of entry and headquarters of the St. Lawrence customs district. The city's manufactures include shade rollers, paper and pulp, office supplies, matches and containers.

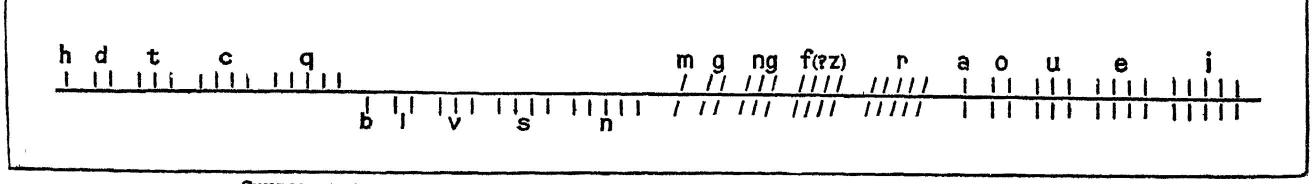
Ogdensburg is the seat of a state hospital for the insane; a state armory; and the Remington Art memorial, containing the collection of Indian relics and many of the paintings and statuettes of Frederic Remington, who was born in Canton, the county seat. The Thousand Islands of the St. Lawrence lie about 30 mi. S.W.

Ogdensburg was the site of the Indian settlement of La Présentation, founded in 1749 by the Abbé François Picquet for converted Iroquois, and of Fort Presentation, built by the British at the outbreak of the Revolution and held by them until 1796. The settlement that grew up about the fort was named after Abraham Ogden (1743–98), a New Jersey lawyer who bought land there. During the early part of the War of 1812 it was an important point on the American line of defense, and on Feb. 22, 1813, both fort and village were captured and partly destroyed by the British.

Ogdensburg was incorporated as a village in 1817 and as a city in 1868.

OGEE, in architecture, a curve of double curvature, concave below and convex above. Thus an ogee arch is a pointed arch in which each side has an ogee curve; also applied to the moulding (*q.v.*) more commonly known as a *cyma reversa.*

OGHAM LANGUAGE. The language of the Ogham inscriptions is the oldest form of Goidelic with which we are acquainted. Some 300 inscriptions have been discovered in this alphabet, the majority of them hailing from the southwest of Ireland (Kerry and Cork). In Scotland 22 are known, while in Eng-



SYMBOLS OF THE OGHAM ALPHABET, ORIGINALLY USED BY THE CELTS IN BRITAIN AND IRELAND

land and Wales about 30 have turned up. Most of the latter are in south Wales, but odd ones have been found in north Wales, Devon and Cornwall, and one occurs in Hampshire. The Isle of Man possesses two. The letters in the oldest inscriptions are formed by strokes or notches scored on either side of the edge of an upright stone. Thus we obtain the alphabet on the preceding page.

This system, which was eked out with other signs, would seem to have been framed in the southwest of Ireland by a person or persons who were familiar with the Latin alphabet. Some of the inscriptions probably go back to the 5th century and may even be earlier. The simplest forms of Ogham inscriptions are: *Doveti maqqi Cattini, i.e.* "(the stone) of Dovetos son of Cattinos"; *Trenagusu Maqi Maqi-Treni* is rendered in Latin *Trenegussi Fili Macutreni hic jacit; Sagramni Maqi Cunatami,* "(the stone) of Sagramnos son of Cunotamos"; *Ovanos avi Ivacattos,* "(the stone) of Ovanus descendant of Ivacattus."

In the oldest of these inscriptions *q* is still kept apart from *k* (*c*), and the final syllables have not disappeared (cf. *maqqi,* O.Ir. *maicc*); but it appears certain that in Oghamic writing stereotyped forms were used long after they had disappeared in ordinary speech. Several stones contain bilingual inscriptions, but the key to the Ogham alphabet is supplied by a treatise on Oghamic writing contained in the Book of Ballymote, a manuscript of the late 14th century.

See R. R. Brash, *The Ogham Inscribed Monuments of the Gaedhil* (1879); R. A. Stewart Macalister, *Studies in Irish Epigraphy,* 3 vols. (1897–1907), and *Archaeology of Ireland* (1928). Welsh inscriptions are given in J. Rhys, *Lectures on Welsh Philology* (1879). The Scottish stones have also been treated by Rhys in the *Proceedings of the Scottish Society of Antiquaries* (Edinburgh, 1892). *See* also G. M. Atkinson for the tract in the Book of Ballymote, *Kilkenny Journal of Archaeology* (1874). The Irish Christian inscriptions were published by Margaret Stokes as the annual volumes of the Roy. Hist. and Archaeol. Association of Ireland (1870–77), and have been republished by R. A. Stewart Macalister.

OGIER THE DANE, a hero of romance, identified with the Frankish warrior Autchar (Autgarius, Auctarius, Otgarius, Oggerius) of the old chroniclers. In 771 or 772 Autchar accompanied Gerberga, widow of Carloman, Charlemagne's brother, and her children to the court of Desiderius, king of the Lombards, with whom he marched against Rome. In 773 he submitted to Charles at Verona.

He finally entered the cloister of St. Faro at Meaux, and Mabillon (*Acta SS ord. St. Benedicti,* Paris, 1677) left a description of his monument there, which had figures of Ogier and his friend Benedict or Benoît, with smaller images of Roland and La Belle Aude and other Carolingian personages. In the chronicle the *Pseudo-Turpin* it is stated that innumerable *cantilenae* were current on the subject of Ogier, and his deeds were probably sung in German as well as in French. The Ogier of romance may be definitely associated with the flight of Gerberga and her children to Lombardy, but it is not safe to assume that the other scattered references all relate to the same individual. Colour is lent to the theory of his Bavarian origin by the fact that he, with Duke Naimes of Bavaria, led the Bavarian contingent to battle at Roncevaux.

In the romances of the Carolingian cycle he is, on account of his revolt against Charlemagne, placed in the family of Doon de Mayence, being the son of Gaufrey de "Dannemarche." The *Enfances Ogier* of Adenès le Rois, and the *Chevalerie Ogier de Dannemarche* of Raimbert de Paris, are doubtless based on earlier chansons. The *Chevalerie* is divided into 12 songs or branches. Ogier, who was the hostage for his father at Charlemagne's court, fell into disgrace, but regained the emperor's favour by his exploits in Italy. One Easter at the court of Laon, however, his son Balduinet was slain by Charlemagne's son, Charlot, with a chessboard (cf. the incident of Renaud and Bertholais in the *Quatre Fils Aymon*). Ogier in his rage slew the queen's nephew Loher, and would have slain Charlemagne himself but for the timely intervention of the knights, who connived at his flight to Lombardy. In his stronghold of Castelfort he resisted the imperial forces for seven years, but was at last taken prisoner by Turpin, who incarcerated him at Reims, while his horse Broiefort, the sharer of his exploits, was made to draw stones at Meaux. He was eventually released to fight the Saracen chief Bréhus or Braihier, whose armies had ravaged France, and who had defied Charlemagne to single combat. Ogier consented to fight only after the surrender of Charlot, but the prince was saved from his barbarous vengeance by the intervention of St. Michael. The giant Bréhus, despite his 17 ft. of stature, was overthrown, and Ogier, after marrying an English princess, the daughter of Angart (or Edgard), king of England, received from Charlemagne the fiefs of Hainut and Brabant.

A later romance in Alexandrines (Brit. Mus. MS Royal 15 E vi) contains marvels added from Celtic romance. Six fairies visit his cradle, the sixth, Morgan le Fay, promising that he shall be her lover. He has a conqueror's career in the east, and after 200 years in the "castle" of Avalon returns to France in the days of King Philip, bearing a firebrand on which his life depends. This he destroys when Philip's widowed queen wishes to marry him, and he is again carried off by Morgan le Fay. The prose romance printed at Paris in 1498 is a version of this later poem.

The fairy element is prominent in the Italian legend of *Uggieri il Danese,* the most famous redaction being the prose *Libro dele bataglie del Danese* (Milan, 1498), and in the English *Famous and renowned history of Morvine, son to Oger the Dane,* translated by J. M. (London, 1612).

The Spanish Urgel was the hero of Lope de Vega's play, the *Marques de Mantua.* Ogier occupies the third branch of the Scandinavian Karlamagnus saga; his fight with Brunamont (*Enfances Ogier*) was the subject of a Danish folk song; and as *Holger Danske* he became a Danish national hero, who fought against the German Dietrich of Bern (Theodoric "of Verona"), and was invested with the common tradition of the king who sleeps in a mountain ready to awaken at need. Whether he had originally anything to do with Denmark seems doubtful. The surname le Danois has been explained as a corruption of l'Ardennois and Dannemarche as the marches of the Ardennes.

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OGILBY, JOHN (1600–1676), British writer, was born in or near Edinburgh in Nov. 1600. He accompanied Thomas Wentworth, earl of Strafford, when he went to Ireland as lord deputy, and became tutor to his children. Strafford made him deputy-master of the revels, and he built a little theatre in St. Werburgh Street, Dublin, which was very successful. The outbreak of the Civil War ruined his fortunes, and in 1646 he returned to England. Finding his way to Cambridge, he learned Latin from kindly scholars who had been impressed by his industry. He then ventured to translate Virgil into English verse (1649–50), which brought him a considerable sum of money. Ogilby learned Greek from David Whitford, who was usher in the school kept by James Shirley the dramatist. *Homer his Iliads translated . . .* appeared in 1660, and in 1665 *Homer his Odysses translated . . .* Anthony à Wood asserts that in these undertakings he had the assistance of Shirley. At the Restoration Ogilby received a commission for the "poetical part" of the coronation. His property was destroyed in the great fire of 1666, but he rebuilt his house in Whitefriars, and set up a printing press, from which he issued many magnificent books; the most important were a series of atlases by Hollar and others. He died in London on Sept. 4, 1676.

Ogilby also translated the fables of Aesop, and wrote three epic poems. His bulky output was ridiculed by John Dryden in *MacFlecknoe* and by Alexander Pope in the *Dunciad.*

OGILVIE (or OGILBY), **JOHN** (*c.* 1580–1615), English Jesuit, was born in Scotland and educated mainly in Germany, where he entered the Society of Jesus, being ordained priest at Paris in 1613. As an emissary of the society he returned to Scotland in this year disguised as a soldier, and in Oct. 1614 he was

arrested in Glasgow. He defended himself stoutly when he was tried in Edinburgh, but he was condemned to death and was hanged on Feb. 28, 1615.

A True Relation of the Proceedings against John Ogilvie, a Jesuit (Edinburgh, 1615), is usually attributed to Archbishop Spottiswoode. *See* also James Forbes, *L'Église catholique en Ecosse: martyre de Jean Ogilvie* (Paris, 1885); and W. Forbes-Leith, *Narratives of Scottish Catholics* (1885).

OGILVY, the name of a celebrated Scottish family of which the earl of Airlie is the head. The family was probably descended from a certain Gillebride, earl of Angus, who received lands from William the Lion. Sir Walter Ogilvy (d. 1440) of Lintrathen, lord high treasurer of Scotland from 1425 to 1431, was the son of Sir Walter Ogilvy of Wester Powrie and Auchterhouse, a man, says Andrew of Wyntoun, "stout and manfull, bauld and wycht," who was killed in 1392. Sir Walter built a castle at Airlie in Forfarshire, and left two sons. The elder of these, Sir John Ogilvy (d. *c.* 1484), was the father of Sir James Ogilvy (*c.* 1430–*c.* 1504), who was made a lord of parliament in 1491; and the younger, Sir Walter Ogilvy, was the ancestor of the earls of Findlater. The earldom of Findlater, bestowed on James Ogilvy, Lord Ogilvy of Deskford, in 1638, was united in 1711 with the earldom of Seafield and became dormant after the death of James Ogilvy, the 7th earl, in Oct. 1811.

Sir James Ogilvy's descendant, James Ogilvy, 5th Lord Ogilvy of Airlie (*c.* 1541–1606), a son of James Ogilvy, master of Ogilvy, who was killed at the battle of Pinkie in 1547, took a leading part in Scottish politics during the reigns of Mary and of James VI. His grandson, James Ogilvy (*c.* 1593–1666), was created earl of Airlie by Charles I at York in 1639. A loyal partisan of the king, he joined Montrose in Scotland in 1644 and was one of the royalist leaders at the battle of Kilsyth. The destruction of the earl's castles of Airlie and of Forther in 1640 by the earl of Argyll, who "left him not in all his lands a cock to crow day," gave rise to the song "The bonny house o'Airlie." His eldest son, James, the 2nd earl (*c.* 1615–*c.* 1704), also fought among the royalists in Scotland; in 1644 he was taken prisoner, but he was released in the following year as a consequence of Montrose's victory at Kilsyth. He was again a prisoner after the battle of Philiphaugh and was sentenced to death in 1646, but he escaped from his captivity at St. Andrews and was afterward pardoned. Serving with the Scots against Cromwell he became a prisoner for the third time in 1651, and was in the Tower of London during most of the years of the Commonwealth. He was a fairly prominent man under Charles II and James II, and in 1689 he ranged himself on the side of William of Orange. This earl's grandson, James Ogilvy (d. 1731), took part in the Jacobite rising of 1715 and was attainted; consequently on his father's death in 1717 he was not allowed to succeed to the earldom, although he was pardoned in 1725. When he died his brother John (d. 1761) became earl *de jure,* and John's son David (1725–1803) joined the standard of Prince Charles Edward in 1745. He was attainted, and after the defeat of the prince at Culloden escaped to Norway and Sweden, afterward serving in the French army, where he commanded *le régiment Ogilvy* and was known as *le bel Ecossais.* In 1778 he was pardoned and was allowed to return to Scotland, and his family became extinct when his son David died unmarried in April 1812. After this event David's cousin, another David Ogilvy (1785–1849), claimed the earldom. He asserted that he was unaffected by the two attainders, but the house of lords decided that these barred his succession; however, in 1826 the attainders were reversed by act of parliament and David became 6th earl of Airlie. He died on Aug. 20, 1849, and was succeeded by his son, David Graham Drummond Ogilvy (1826–81), who was a Scottish representative peer for more than 30 years.

The latter's son, David William Stanley Ogilvy, the 8th earl (1856–1900), served in Egypt in 1882 and 1885, and was killed on June 11, 1900, during the Boer War while at the head of his regiment, the 12th Lancers. His titles then passed to his son, David Lyulph Gore Wolseley Ogilvy, the 9th earl (b. 1893).

A word may be said about other noteworthy members of the Ogilvy family. John Ogilvy, called Powrie Ogilvy, was a political adventurer who professed to serve King James VI as a spy and who certainly served William Cecil in this capacity. Mariota Ogilvy (d. 1575) was the mistress of Cardinal Beaton. Sir George Ogilvy (d. 1663), a supporter of Charles I during the struggle with the Covenanters, was created a peer as lord of Banff in 1642; this dignity became dormant, or extinct, on the death of his descendant, William Ogilvy, the 8th lord, in June 1803. Sir George Ogilvy of Barras (d. *c.* 1679) defended Dunnottar castle against Cromwell in 1651 and 1652, and was instrumental in preventing the regalia of Scotland from falling into his hands; in 1660 he was created a baronet, the title becoming extinct in 1837.

See Sir R. Douglas, *Peerage of Scotland,* new ed. by Sir J. B. Paul (1904 fol.).

OGIVE, in architecture, the diagonal ribs of a Gothic vault; in French usage applied to any pointed arch. As a result Gothic architecture is frequently termed in France *le style ogival.*

OGLESBY, a city of La Salle county, Illinois, U.S.A., 100 mi. S.W. of Chicago, on the Illinois river at the mouth of the Vermilion, opposite La Salle and Peru. It is on federal highway 51, and is served by the Chicago, Milwaukee, St. Paul and Pacific and the Illinois Central railways. Pop. (1950) 3,922; (1940) 3,938 by federal census.

It is part of a tri-city industrial district, engaged chiefly in the manufacture of cement and coal mining. There are extensive deposits of limestone. The city was founded in 1856 and incorporated in 1902. Until 1913 it was called Portland.

OGLETHORPE, JAMES EDWARD (1696–1785), English general and philanthropist, the founder of the state of Georgia, was born in London on Dec. 21, 1696, the son of Sir Theophilus Oglethorpe (1650–1702) of Westbrook Place, Godalming, Surrey. He entered Corpus Christi college, Oxford, in 1714, but in the same year joined the army of Prince Eugène. He became aide-de-camp to the prince, and served in the campaign against the Turks, 1716–17, more especially at the siege and capture of Belgrade. After his return to England he was in 1722 elected member of parliament. With the idea of providing an asylum for persons who had become insolvent, and for oppressed Protestants on the continent, he projected the settlement of a colony in America between Carolina and Florida (*see* GEORGIA). In 1745 Oglethorpe was promoted to the rank of major-general. His conduct in connection with the Scottish rebellion of that year was the subject of a court-martial, but he was acquitted. In 1765 he was breveted general. He died at Cranham Hall, Essex, in 1785.

Sir Theophilus Oglethorpe, the father, had four sons and four daughters, James Edward being the youngest son, and another James having died in infancy. Of the daughters, Anne Henrietta, Eleanor and Frances Charlotte (Bolingbroke's "Fanny Oglethorpe") may be specified as having played rather curious parts in the Jacobitism of their time; their careers are described in the essay on "Queen Oglethorpe" by Miss A. Shield and A. Lang, in the latter's *Historical Mysteries* (1904). *See* also Lives by Harris (1841), Wright (1867), Bruce (1890), and Harriet C. Cooper (1904).

OGOOUÉ, a river of west central Africa, about 750 mi. long, rising in 3° S. in the highlands known as the Crystal range, and flowing northwest and west, reaches the Gabun coast of the Atlantic by Cape Lopez, a little south of the equator. There it forms a considerable delta. In its upper course the Ogooué is much obstructed by rapids as it descends the successive steps of the tablelands. It breaks through the outer chains of the mountainous zone, between 10¾° E. and 11¾° E. In its lower course the river passes through a lacustrine region in which it sends off secondary channels. These channels, before reuniting with the main stream, traverse a series of lakes, one north, the other south, of the river. These lakes are natural regulators of the river when in flood. Of its tributaries the chief are the Lolo, which joins on the south bank in 12° 20′ E., and the Ivindo, which enters the Ogooué a few miles lower down. Below the Ivindo the largest tributaries are the Ofooué, 400 yd. wide at its mouth (11° 47′ E.), but unnavigable except in the rains, and the Ngunye, the largest southern tributary, navigable for 60 mi. to the Samba or Eugénie falls. Apart from the narrow coast plain the whole region of the lower Ogooué is densely forested and the predominant industry of the region is the timber trade. The fauna includes the gorilla and chimpanzee.

The Ogooué rises in March and April, and again in October and November; it is navigable for steamers at low water as far as the junction of the Ngunye, and at flood time for a distance of 235 mi. to N'Jole. The first person to explore the valley of the Ogooué was Paul du Chaillu, who travelled in the country during 1857–59. The Ogooué lies wholly in French Equatorial Africa (*q.v.*).

For a vivid account of life on the lower Ogooué *see* A. Schweitzer, *On the Edge of the Primeval Forest* (1922).

O'GRADY, STANDISH JAMES (1846–1928), Irish man of letters, was born at Castletown, County Cork, on Sept. 18, 1846, the son of a Protestant clergyman, studied at Trinity college, Dublin, and after taking his degree in 1868 was called to the bar in 1872. He died at Shanklin, Isle of Wight, on May 18, 1928. O'Grady was one of the pioneers of the Celtic renaissance in Ireland. His interest in Irish antiquities was roused by the reading of O'Halloran's *History of Ireland,* and he set himself to awaken living interest in the Irish past by telling over again the Irish legends of the heroic age. He himself believed in the historical existence of the heroes of Irish epic, being convinced that primitive singers could not have invented them. His first work, *History of Ireland: the Heroic Period* (Dublin, 1878), was republished, in part, under the title of *Cuculain: an Epic,* in London (1882), and was succeeded by *History of Ireland: Cuculain and his Contemporaries* (Dublin, 1880). From these he developed his cycle of romantic histories: *Finn and his Companions* (1892), *The Coming of Cuculain* (1894), *In the Gates of the North* (Kilkenny, 1901), and the *Passing of Cuculain* (Dublin, 1917). He began a *History of Ireland, Critical and Philosophical,* of which the first volume only was written (Dublin, 1881). He also wrote *Ulrick the Ready* (1896); *The Bog of Stars* (1893); *Red Hugh's Captivity* (1889).

See Standish O'Grady, *Selected Essays and Passages* (Dublin, 1918).

OGRE, the name in fairy tales and folklore of a malignant monstrous giant who lives on human flesh. The word is French, and occurs first in Charles Perrault's *Histoires ou contes du temps passé* (1697). The first English use was in the translation of a French version of the *Arabian Nights* in 1713, where it was spelled *hogre.* Attempts have been made to connect the word with *Ugri,* the racial name of the Magyars or Hungarians, but it is generally accepted that it was adapted into French from the O. Span. *huerco, huergo, uergo,* cognate with Ital. *orco* (*i.e., Orcus*), the Latin god of the dead and the infernal regions (*see* PLUTO), who in Romance folklore became a man-eating demon of the woods.

OGYGES or **OGYGUS,** in Greek mythology, the first king of Thebes. During his reign came a great deluge (*see* DEUCALION); this is one of the two Greek versions of the widespread flood-legend. Ogyges is variously described as a Boeotian autochthon, as the son of Cadmus, or of Poseidon.

O'HAGAN, THOMAS O'HAGAN, 1ST BARON (1812–1885), lord chancellor of Ireland, was born at Belfast on May 29, 1812. He was educated at Belfast Academical institution, and was called to the Irish bar in 1836. In 1850 he removed to Dublin, where he appeared for the repeal party in many political trials.

His advocacy of a continuance of the union with England, and his appointment as solicitor general for Ireland in 1861 and attorney general in the following year, lost him the support of the Nationalist party, but he was returned to parliament as member for Tralee in 1863. In 1865 he was appointed a judge of common pleas, and in 1868 became lord chancellor of Ireland in Gladstone's first ministry.

He was the first Roman Catholic to hold the chancellorship since the reign of James II, an act throwing open the office to Roman Catholics having been passed in 1867. In 1870 he was raised to the peerage, and held office until the resignation of the ministry in 1874. In 1880 he again became lord chancellor on Gladstone's return to office, but resigned in 1881. He died in London on Feb. 1, 1885, and was succeeded by his eldest son, Thomas Towneley (1878–1900), and then by another son, Maurice Herbert Towneley (b. 1882).

O'HARA, THEODORE (1820–1867), U.S. lawyer, soldier, journalist and poet, was born Feb. 11, 1820. He served with distinction in the U.S. army in 1846–48 during the Mexican War, took part in the filibustering expeditions to Cuba, and was with the Confederate army during the U.S. Civil War. He wrote the well-known poem "The Bivouac of the Dead," in memory of soldiers who died at the battle of Buena Vista.

O'HIGGINS, BERNARDO (1776–1842), one of the foremost leaders in the Chilean struggle for independence and head of the first permanent national government, was a natural son of the Irishman Ambrosio O'Higgins, governor of Chile (1788–95), and was born at Chillán on Aug. 20, 1776. He was educated in England, and after a visit to Spain he returned to Chile in 1802 where he lived quietly on his estate until the revolution broke out in 1810.

Joining the nationalist party led by Martínez de Rozas, he distinguished himself in the early fighting against the royalist troops despatched from Peru, and was appointed in Nov. 1813 to supersede J. M. Carrera in command of the patriot forces. The rivalry that ensued, in spite of O'Higgins' generous offer to serve under Carrera, eventually resulted in O'Higgins being isolated and overwhelmed with the bulk of the Chilean forces at Rancagua in Oct. 1814.

O'Higgins with most of the patriots fled across the Andes to Mendoza, where José de San Martín (*q.v.*) was preparing a force for the liberation of Chile and Peru. San Martín espoused O'Higgins' part against Carrera, and O'Higgins, recognizing the superior ability and experience of San Martín, readily consented to serve as his subordinate. The loyalty and energy with which he acted under San Martín contributed not a little to the organization of the liberating army, to its transportation over the Andes, and to the defeat of the royalists at Chacabuco (Feb. 1817) and Maipú (April 1818).

After the battle of Chacabuco O'Higgins was entrusted with the administration of Chile, and he ruled the country firmly and well, maintaining close connection with Argentina, co-operating loyally with San Martín in the preparation of the force for the invasion of Peru, and seeking, as far as the confusion and embarrassments of the time allowed, to improve the welfare of the people. After the overthrow of the Spanish supremacy in Peru had freed the Chileans from fear of attack, an agitation set in for constitutional government. O'Higgins at first tried to maintain his position by calling a congress and obtaining a constitution (1822) which invested him with dictatorial powers. But popular discontent grew in force; risings took place in Concepción and Coquimbo, and on Jan. 28, 1823, O'Higgins resigned his post of director general, without attempting to retain it by force. He retired to Peru, where he was granted an estate and lived quietly till his death on Oct. 24, 1842. In 1839 the Chilean senate restored him to his honours and his military rank.

See B. Vicuña Machenna, *Vida de O'Higgins* (Santiago, 1882), and M. L. Armunàtegni, *La Dictadura de O'Higgins* (Santiago, 1853); both containing good accounts of O'Higgins' career. Also P. B. Figueroa, *Diccionario biográfico de Chile, 1550–1887* (Santiago, 1888), and J. B. Suarez, *Rasgos biográficos de hombres notables de Chile* (Valparaiso, 1886).

O'HIGGINS, KEVIN CHRISTOPHER (1892–1927), Irish statesman, youngest son of Dr. T. Higgins (who was murdered by unknown men in 1923), of Stradbally, Queen's county, was born in 1892 at Stradbally and educated at Clongowes and St. Patrick's college, Carlow, and in the National University of Ireland. He was articled to his uncle Maurice Healy, a solicitor in Cork. After the Easter rebellion in 1916 he joined the Sinn Fein movement, and was interned. While still in jail he was elected member for Queen's county (1918). He acted as assistant minister for local government to Mr. Cosgrave, and in 1922 became a member of the provisional government as minister of justice and vice president of the executive council. As minister of justice he established the civic guard, and put down disorder with a strong hand. He was called to the Irish bar in 1923, and in June 1927 added to his existing duties those of minister for external affairs.

In the midst of the controversy with De Valera over the taking

of the oath in the Dail he was waylaid by three armed men while on his way to mass at Booterstown, outside Dublin, and shot dead (July 10, 1927). It was believed that the crime was connected with the fact that, as minister of justice, O'Higgins had been largely responsible for the 77 executions which were carried out in the course of the civil war. He married Bridget Mary Cole, of Dublin, in 1921, who, with the two children of the marriage, survived him.

O'HIGGINS, an inland province of central Chile, bounded north by Santiago, east by Argentina, and south and west by Colchagua. Area, 2,746 sq.mi.; population (1950), 212,492. Named after Bernardo O'Higgins, the first president of the republic of Chile, the province was included with that of Colchagua from 1928 to 1933, inclusive. Most of the western half of the province lies in the central valley of Chile, whose surface is interrupted in many places by the alluvial piedmont slopes of the Andes and the transverse valleys of perennial streams which have their sources in the snow-capped summits of the cordillera. The climate of the western part of the province is typically Mediterranean, with summers that are hot and rainless, and winters that are mild and rainy. Eastward the climate reflects the control of increasing altitude; temperatures are lower, rainfall is heavier and much of the precipitation which falls in the winter is in the form of snow. The streams which give life to the central valley during the long, dry summer are fed by the melting snows of the high Andes. Under irrigation the valley lands are highly productive, although only a small fraction of the total area is under cultivation.

The principal crops on irrigated lands are wheat, corn, barley, oats, alfalfa, clover, legumes and grapes; the bulk of the non-irrigated land is pasturage having a low carrying capacity. Mining is carried on in the eastern highlands, the province being widely known for its production of copper.

Rancagua, the capital of the province (population 31,018 in 1940), is in central O'Higgins, 51 mi. south of the nation's capital on the State railways. Rengo, the second largest city (6,730 in 1940), is about 20 mi. S.S.W. of Rancagua. Both cities are centres of commerce for the surrounding agricultural districts. The province is particularly noted for its hot springs and mineral waters, and many popular health resorts are within relatively short distances from the capital. Termas de Cauquenes (Cauquenes hot springs), significant in the history of the emancipation of Chile, and the most important centre of mineral waters in the country, is slightly more than 80 mi. by car E.S.E. from Rancagua. Also famous are the mineral waters of El Teniente and Baños de Cachantun, the latter being only 15 mi. from the provincial capital. (R. W. Rd.)

O'HIGINN, TADHG DALL (O'Higgin, Teague) (*d.* 1616), Irish poet, also known in Irish writings as Tadhg dall Ua hUiginn, was born at Magh Nenda, the plain between the rivers Erne and Drobhais on the southern boundary of Ulster. He was blind most of his life, and this accounts for his Irish sobriquet "dall."

O'Higinn advocated Irish nationalism in his poems, exhorting the Irish to unite their nations or clans and resist the English. His earliest extant poem was written before 1554. It was a work of 50 stanzas written to Eoghan óg MacSuibhne na dtuath to urge him to make friends with Shane O'Neill and Manus O'Donnell. He wrote a 52-verse panegyric on the O'Neills in 1573 entitled "Imda sochar ag cloinn Neill" ("Many the privileges belonging to the children of Niall"). He praised the residence of Shane O'Neill in a poem "Lios greine as Emhain dUlltaibh" ("A sunny fort is an Emania to Ulstermen"). In this poem he compared it to Emhain Macha, or Emania, which was the residence of the ancient kings of Ulster.

About 1588 he wrote an address of 70 stanzas to Sir Brian na Murtha O'Rourke advising him to take the offensive against the English. Between 1566 and 1589 he wrote a 39-stanza poem "Mairg fhechus ar inischeithleann" ("Woe for him that looks on Enniskillen").

His last poem was "Sluagseisir tainic dom thig" ("A band of six men came into my house"). This was a satire on the six O'Haras who looted his house. A translation by S. H. O'Grady was printed with the original poem. O'Higinn died shortly before 1617.

OHIO, popularly known as the "Buckeye state," is a north central state of the United States of America, lying approximately between 38° 25′ and 41° 58′ N. and 80° 31′ and 84° 49′ W. It is bounded north by Michigan and Lake Erie, east by Pennsylvania and by the Ohio river, which separates it from West Virginia, south by the Ohio river which separates it from West Virginia and Kentucky and west by Indiana. The state is nearly square in shape, its extremes from north to south and from east to west being about 210 mi. and 220 mi. respectively. The total area is 41,222 sq.mi., of which 222 sq.mi. are inland water surface.

Physical Features.—The state lies on the borderland between the prairie plains and the Allegheny plateau. The disturbances among the underlying rocks of Ohio have been slight, and originally the surface was a plain only slightly undulating; stream dissection changed the region to one of numberless hills and valleys; glacial drift then filled up the valleys over large broken areas, forming the remarkably level till plains of northwestern Ohio; but at the same time other areas were broken by the uneven distribution of the drift, and southeastern Ohio, which was unglaciated, retains its rugged hilly character, gradually merging with the typical plateau country farther southeast. The average elevation of the state above the sea is about 850 ft. but extremes vary from 425 ft. at the confluence of the Great Miami and Ohio rivers in the southwest corner, to 1,550 ft. on the summit of Hogues hill about 1½ mi. E. of Bellefontaine in the west central part.

The main water parting is formed by a range of hills which are composed chiefly of drift and extend west-southwest across the state from Trumbull county in the northeast to Drake county, or about the middle of the west border. North of this water parting the rivers flow into Lake Erie; south of it into the Ohio river. Passing the village of Cuyahoga Falls the Cuyahoga river descends more than 200 ft. in 3 mi.; a part of its course is between walls of sandstone 100 ft. or more in height, and near its mouth, at Cleveland, its bed has been cut down through 60 ft. of drift.

In the middle north part of the state the Black, Vermilion and Huron rivers have their sources in swamps on the water parting and flow directly to the lake through narrow valleys. The till plains of northwestern Ohio are drained chiefly by the Maumee and Sandusky rivers, with their tributaries.

In the southwest the Great Miami and Little Miami rivers have uniform falls through basins that are decidedly rolling and contain the extremes of elevation for the state. The central and south middle part is drained by the Scioto river and its tributaries. Its basin is about 40 mi. wide and only moderately rolling, but toward the mouth of the river the basin becomes narrow and is shut in by high hills. In the eastern part of Ohio the Muskingum river and its tributaries drain an area of about 7,750 sq.mi. or nearly one-fifth of the entire state. The Ohio flows for 436 mi. through a narrow valley on the southern border of the state, and Lake Erie forms the northern boundary for a distance of 230 mi. At the west end of the lake are Sandusky and Maumee bays, each with a good natural harbour. There are several small lakes on the water parting, especially in the vicinity of Akron and Canton.

Fauna and Flora.—Opossums, skunks and raccoons are plentiful in some parts of the state, and rabbits and squirrels are still numerous.

Most of the songbirds and birds of prey of the temperate zone are plentiful. Whitefish, bass, trout and pickerel are important as food from the waters of Lake Erie, and the land streams and lakes are stocked with game fish.

Ohio is known as the "Buckeye state" from the prevalence of the buckeye chestnut (*Aesculus glabra*). The state was originally covered with a dense forest mostly of hardwood timber, and although the merchantable portion of this has been almost entirely cut away, there are still undergrowths of young timber and a great variety of trees. The white oak is the most common, but there are 13 other varieties of oak, 6 of hickory, 5 of ash, 5 of poplar, 5 of pine, 3 of elm, 3 of birch, 2 of locust and 2 of cherry.

Beech, black walnut, butternut, chestnut, catalpa, hemlock and tamarack trees are also common. Wild flowers are well represented. Of native ferns there are many.

Climate.—The mean annual temperature of Ohio is about 51° F.; in the north 49.5° and in the south 53.5°. But except where influenced by Lake Erie the temperature is subject to great extremes; at Coalton, Jackson county, in the southeast part of the state, the highest recorded range of extremes is from 104° F. to −38°, or 142°; at Wauseon, Fulton county, near the northwest corner, it is from 104° to −32°, or 136°; while at Toledo, on the lake shore, the range is only from 99° to −16°, or 115°. July is the warmest month, and in most parts of the state January is the coldest; in a few valleys, however, February has a colder record than January. The normal annual precipitation for the entire state is about 39 in. It is greatest in the southeast and least in the northwest. At Marietta, for example, it is 42.1 in., but at Toledo it is only 30.8 in. The prevailing winds in most parts are westerly, but sudden changes, as well as the extremes of temperature, are caused mainly by the frequent shifting of the wind between northwest and southwest.

Soil.—In the driftless area, the southeast part of the state, the soil is largely a decomposition of the underlying rocks, and its fertility varies according to their composition; there is considerable limestone in the east central portion, and this renders the soil very productive. In the valleys also are strips covered with a fertile alluvial deposit. In the other parts of the state the soil is composed mainly of glacial drift, and is generally deep and fertile. It is deeper and more fertile, however, in the basins of the Great Miami and Little Miami rivers, where there is a liberal mixture of decomposed limestone and where extensive areas with a clay subsoil are covered with alluvial deposits.

History.—Ohio was the pioneer state of the old Northwest territory, which embraced also what are now the states of Indiana, Illinois, Michigan and Wisconsin and the northeast corner of Minnesota. When explored by Europeans, late in the first half of the 17th century, the territory included within what is now Ohio was a battleground of Indian tribes. From the middle to the close of the 17th century the French were establishing a claim to the territory between the Great Lakes and the Ohio river by discovery and occupation.

About 1730 English traders from Pennsylvania and Virginia began to visit the eastern and southern parts of the territory and a conflict approached as a French Canadian expedition under Céleron de Bienville took formal possession of the upper Ohio valley by planting leaden plates at the mouths of the principal streams. This was in 1749 and in the same year George II chartered the first Ohio company, formed by Virginians and London merchants trading with Virginia, for the purpose of colonizing the west. This company, in 1750, sent Christopher Gist down the Ohio river to explore the country as far as the mouth of the Scioto river, and four years later the erection of a fort was begun in its interest at the forks of the Ohio. The French drove the English away and completed the fort (Fort Duquesne) for themselves. The Seven Years' War ensued, and this ended in the cession of the entire northwest to Great Britain. The former Indian allies of the French, however, immediately rose up in opposition to British rule in what is known as the conspiracy of Pontiac (*see* PONTIAC), and the suppression of this was not completed until Col. Henry Bouquet made an expedition (1764) into the valley of the Muskingum and there brought the Shawnees, Wyandots and Delawares to terms. With the northwest won from the French, Great Britain no longer recognized those claims of its colonies to this territory which Great Britain had asserted against France, but in a royal proclamation of Oct. 7, 1763, the granting of land west of the Alleghenies was forbidden and on June 22, 1774, parliament passed the Quebec act which annexed the region to the province of Quebec. This was one of the grievances which brought on the Revolutionary War, during which the northwest was won for the Americans by George Rogers Clark (*q.v.*). During that war also, those states which had no claims in the west contended that title of these western lands should pass to the union and when the Articles of Confederation were submitted for ratification in 1777, Maryland refused to ratify them except on that condition. The result was that New York ceded its claim to the United States in 1780, Virginia in 1784, Massachusetts in 1785 and Connecticut in 1786. Connecticut, however, excepted a strip bordering on Lake Erie for 120 mi. and containing 3,250,000 ac. This district, known as the Western Reserve, was ceded in 1800 on condition that congress would guarantee the titles to land already granted by the state. Virginia reserved a tract between the Little Miami and Scioto rivers, known as the Virginia Military district, for its soldiers in the Revolutionary War. When the war was over and these cessions had been made, a great number of war veterans wished an opportunity to repair their broken fortunes in the west, and congress, hopeful of receiving a large revenue from the sale of lands there, passed an ordinance on May 20, 1785, by which the modern national system of land surveys into townships 6 mi. square was inaugurated in what is now southwest Ohio in the summer of 1786. In March 1786 the second Ohio company (*q.v.*), composed chiefly of New England officers and soldiers, was organized in Boston, Mass., with a view to founding a new state between Lake Erie and the Ohio river. The famous Northwest ordinance was passed by congress on July 13, 1787. This instrument provided a temporary government for the territory with the understanding that, as soon as the population was sufficient, the representative system should be adopted, and later that states should be formed and admitted into the union. There were to be not less than three nor more than five states.

On the adoption of the Northwest ordinance the work of settlement made rapid progress. There were four main centres. The Ohio company founded Marietta at the mouth of the Muskingum in 1788, and this is regarded as the oldest permanent settlement in the state. An association of New Jersey people, organized by John Cleves Symmes, secured a grant from congress in 1788–92 to a strip of 248,540 ac. on the Ohio, between the Great Miami and the Little Miami, which came to be known as the Symmes Purchase. Their chief settlements were Columbia (1788) and Cincinnati (1789). The Virginia Military district, between the Scioto and the Little Miami, reserved in 1784 for bounties to Virginia continental troops, was colonized in large measure by people from that state. Their chief towns were Massieville, now Manchester (1790), and Chillicothe (1796). A small company of Connecticut people under Moses Cleaveland founded Cleveland in 1796 and Youngstown was begun a few years later, but that portion of the state made very slow progress until after the opening of the Ohio and Erie canal in 1832.

During the territorial period (1787–1803), Ohio was first a part of the unorganized Northwest territory (1787–99), then a part of the organized Northwest territory (1799–1800) and later the organized Northwest territory (1800–03) from which Indiana territory had been detached on the west in 1800. The first territorial government was established at Marietta in July 1788, and Gen. Arthur St. Clair, the governor, arrived in that month. His administration was characterized by the final struggle with the Indians. The Revolutionary War was succeeded by a series of Indian uprisings. Two campaigns, the first under Gen. Josiah Harmar (1753–1813) in 1790 and the second under General St. Clair in 1791, failed on account of bad management and ignorance of Indian methods of warfare, and in 1793 Gen. Anthony Wayne (*q.v.*) was sent out in command of a large force of regulars and volunteers. The decisive conflict, fought on Aug. 20, 1794, near the rapids of the Maumee, is called the battle of Fallen Timbers, because the Indians concealed themselves behind the trunks of trees which had been felled by a storm. Wayne's dragoons broke through the brushwood, attacked the left flank of the Indians and soon put them to flight. In the treaty of Greenville (Aug. 3, 1795) the Indians ceded their claims to the territory east and south of the Cuyahoga, the Tuscarawas, and an irregular line from Fort Laurens (Bolivar) in Tuscarawas county to Fort Recovery in Mercer county, practically the whole of eastern and southern Ohio. The Jay treaty was ratified in the same year, and in 1796 the British finally evacuated Detroit and the Maumee and Sandusky forts. By cessions and purchase in 1804, 1808 and 1817–18, the state secured all the lands of the Indians except

their immediate homes, and these were finally exchanged for territory west of the Mississippi. The last remnant migrated in 1841. General Wayne's victory was followed by an extensive immigration of New Englanders, of Germans, Scotch-Irish and Quakers from Pennsylvania and of settlers from Virginia and Kentucky, many of whom came to escape the evils of slavery. This rapid increase of population led to the establishment of the organized territorial government in 1799, and to the admission of the state into the union in 1803.

The congressional Enabling act of April 30, 1802, followed that alternative of the Northwest ordinance which provided for five states in determining the boundaries, and in consequence the Indiana and Michigan districts were detached. A rigid adherence to the boundary authorized in 1787, however, would have resulted in the loss to Ohio of 470 sq.mi. of territory in the northwestern part of the state, including the lake port of Toledo. After a long and bitter dispute—the Toledo War (*see* TOLEDO)—the present line, which is several miles north of the south bend of Lake Michigan, was definitely fixed in 1837, when Michigan came into the union. (For the settlement of the eastern boundary, *see* PENNSYLVANIA.) After having been temporarily at Marietta, Cincinnati, Chillicothe and Zanesville, the capital was established at Columbus in 1816.

Since congress did not pass any formal act of admission there has been some controversy as to when Ohio became a state. The Enabling act was passed April 30, 1802, the first state legislature met March 1, 1803, the territorial judges gave up their offices on April 15, 1803, and the federal senators and representatives took their seats in congress Oct. 17, 1803. Congress decided in 1806, in connection with the payment of salaries to territorial officials, that March 1, 1803, was the date when state government began. During the War of 1812 the Indians under the lead of Tecumseh were again on the side of the British. Battles were fought at Fort Meigs (1813) and Fort Stephenson (Fremont, 1813), and Commodore Oliver Hazard Perry's naval victory on Lake Erie in 1813 was on the Ohio side of the boundary line.

Owing to the prohibition of slavery, the vast majority of the early immigrants to Ohio came from the north, but, until the Mexican War forced the slavery question into the foreground, the Democrats usually controlled the state, because the principles of that party were more in harmony with frontier ideas of equality. The Whigs were successful in the presidential elections of 1836 and 1840, partly because of the financial panic and partly because their candidate, William Henry Harrison, was a "favourite son," and in the election of 1844 because of the unpopularity of the Texas issue. Victory was with the Democrats in 1848 and 1852, but from the organization of the Republican party in 1854 until 1932 the state gave to the Republican presidential candidates its electoral votes, except in 1912 and 1916 when a split in the dominant party (Republican) allowed the Democrats to win. In the Civil War Ohio loyally supported the union, furnishing 319,659 men for the army. Dissatisfaction with the president's emancipation program resulted in the election of a Democratic congressional delegation in 1862, but the tide turned again after Gettysburg and Vicksburg; Clement L Vallandigham, the Democratic leader, was deported from the state by military order, and the Republicans were successful in the elections of 1863 and 1864. A detachment of the Confederate cavalry under Gen. John Morgan invaded the state in 1863, but was badly defeated in the battle of Buffington's Island (July 18).

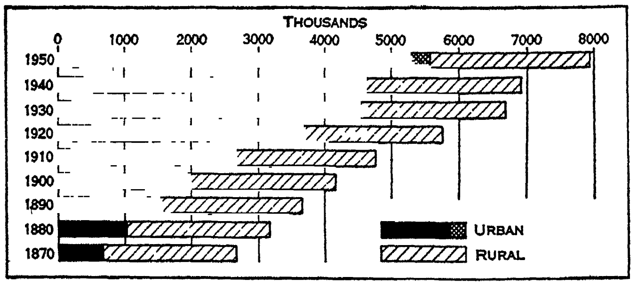
Distinctive advance was made in adapting the constitution and the system of administration to the new needs of the state. At the election in 1910, a general constitutional convention was approved by a large majority. Delegates were chosen in Nov. 1911, and the convention sat from January to June 1912. The delegates, of whom the majority were Democrats, represented the progressive elements of both major parties. Forty-two amendments were submitted to the voters on Sept. 3, 1912, of which 34 were ratified; among those defeated were the abolition of capital punishment, woman suffrage and a $50,000,000 bond issue for a state system of roads. The tax reformers secured for the general assembly the power to impose inheritance, income and franchise taxes as well as taxes upon the production of coal, oil, gas and other minerals. Several of these sources of taxation were later adopted. In 1929 an amendment to the constitution was adopted authorizing classification of property for taxation. Under this amendment the classified tax was enacted in 1931, providing low rates for intangible personal property. In 1934 another amendment was adopted, fixing a limitation of 1% on real property except by vote of the people. Other laws fixed debt limitations which cannot be increased except by vote of the people. The League for Direct Legislation secured the initiative and referendum. Civil service was adopted in Ohio in 1912. In 1933 a retirement system was created for state employees. This was expanded in 1937 to include county, city and other local employees.

After 1930 political power in Ohio tended to fluctuate between the two major parties. In 1944 the voters elected a Democratic governor and a Republican majority in the general assembly; in 1946 a Republican governor and a Republican majority; in 1948 a Democratic governor and a Democratic majority; in 1950 a Democratic governor and a Republican majority.

Southern Ohio has suffered at various times from floods. During the great flood of 1884, the Ohio river at Cincinnati reached the highest flood stage ever recorded at that place (more than 71 ft. above normal), and throughout the Ohio valley millions of dollars worth of damage was done. Another disastrous flood in 1913, affecting especially the inhabitants of the Miami, the Scioto and the Muskingum river valleys, led to a measure for the protection of the river valley from future damage of the kind. This was made possible by the adoption of a constitutional amendment on conservation in 1912, which authorized, among other things, "laws providing for the formation of drainage and conservation districts." A third great flood occurred in 1937. The protective system, consisting of a series of dry reservoir dams, was undertaken by two conservancy districts—the Miami and the Upper Scioto—at a cost of $34,700,000 and $306,300 respectively. Later the Mahoning valley sanitary district was completed at a cost of about $17,000,000, and the Muskingum watershed conservancy district at an estimated cost of $34,000,000.

Population.—The population of Ohio in 1800 was 45,365; in 1830 it was 937,903; in 1870, 2,665,260; in 1910, 4,767,121; in 1940, 6,907,612; and in 1950, 7,946,627. This last figure represented an increase of 15.0% over the population in 1940. The population per square mile in 1950 was 193.8, as compared with 168.0 in 1940 and with 50.7 for the U.S. in 1950.

Of the 1950 population, 5,273,206, or 66.4%, lived in incorporated places of 2,500 or more, as compared with 66.8% in 1940, when these places constituted the urban area. The entire urban



BY COURTESY OF THE U.S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF OHIO: 1870 TO 1950

The crosshatched part of the 1950 bar represents the population of the additional areas counted as urban under the new 1950 definition

population, under a new definition set up for 1950, which included also the thickly settled suburban area, or "urban fringe," adjacent to the 12 cities which had a population of 50,000 or more in 1940 and 5 unincorporated places of 2,500 or more outside this fringe, amounted to 5,578,274, or 70.2% of the state total.

The number of households in 1950 was 2,314,557, as compared with 1,897,796 in 1940. The average population per household had declined from 3.6 in 1940 to 3.4 in 1950.

The population of the state was distributed by colour and nativity in 1950 as follows: 87.9% native white; 5.6% foreign-born white; and 6.5% nonwhite, practically all Negro. There

were 97.8 males per 100 females in the 1950 population, as compared with 100.4 in 1940; 8.9% of the population was 65 years old or over; and 53.5% of the population 14 years old and over was in the labour force.

TABLE I.—*Population of Ohio and Its Principal Cities*

Area	Population			Per cent of increase	
	1950	1940	1930	1940–50	1930–40
The state.	7,946,627	6,907,612	6,646,697	15.0	3.9
Urban	5,578,274*	4,612,986	4,507,371	20 9	2.3
Rural	2,368,353*	2,294,626	2,139,326	3.2	7.3
Per cent urban	70 2	66.8	67.8	..	..
Principal cities					
Cleveland	914,808	878,336	900,429	4.2	−2.5
Cincinnati	503,998	455,610	451,160	10.6	1.0
Columbus	375,901	306,087	290,564	22.8	5.3
Toledo.	303,616	282,349	290,718	7.5	−2 9
Akron	274,605	244,791	255,040	12.2	−4.0
Dayton	243,872	210,718	200,982	15.7	4.8
Youngstown	168,330	167,720	170,002	0.4	−1 3
Canton	116,912	108,401	104,906	7.9	3.3
Springfield	78,508	70,662	68,743	11.1	2 8
Lakewood	68,071	69,160	70,509	−1.6	−1.9
Cleveland Heights	59,141	54,992	50,945	7 5	7 9
Hamilton	57,951	50,592	52,176	14.5	−3 0
Lorain.	51,202	44,125	44,512	16 0	−0.9

*Final figures for 1950 based on new definition. *See* comment in text.

Of the total number of employed males, 8.8% was engaged in agriculture, 6.9% in construction, 40.2% in manufacturing, 9.3% in transportation, communication and other public utilities, 15.7% in wholesale and retail trade and 14.3% in service activities of all kinds, including public administration.

Government.—Ohio is governed under the constitution of 1851 as revised by a constitutional convention in 1912 and subsequently amended. An amendment may be proposed at any time by either branch of the general assembly, and if after being approved by three-fifths of the members of both branches it is also approved at a general election by a majority of those voting on the question, it is declared adopted. Under the constitutions of 1802 and 1851 the suffrage was limited to "white male" citizens of the United States, but by an amendment approved in 1923 these words were stricken out and the constitution was made to conform with the 15th and 19th amendments to the federal constitution. The right of suffrage is bestowed on every United States citizen 21 years of age or over (with certain restrictions), provided he or she has resided within the state one year, in the county 30 days and in the voting precinct 28 days previous to the election. A system of permanent registration was established in 1929. Under this law registration is mandatory in all cities of 16,000 or more population. Any municipality of less than 16,000 may by ordinance become a registration municipality. Voters once registered are not required to register again except in case of removal, change of name, etc.

Registration may be required in territory adjacent to a registration city when deemed necessary to prevent fraud in elections. The constitution requires that all elections be by ballot. Constitutional amendments approved in 1912 provide for the use of the initiative and referendum in legislation.

The executive department consists of a governor, lieutenant governor, secretary of state, auditor, treasurer and attorney general. All are elected in November of even-numbered years for a term of two years; an exception is the auditor, who serves for four years. The right of veto was not given the governor until the adoption of a constitutional amendment in 1903. Bills must be vetoed in their entirety, except that in appropriation bills specific, individual items may be vetoed; a three-fifths vote of all the members of each house is required for repassage. The governor has full power to grant pardons and reprieves except for treason or conviction after impeachment by the general assembly. If he should die in office, resign or be impeached and removed from office, the officers standing next in succession are the lieutenant governor, the president of the senate and the speaker of the house of representatives in the order named. By an administrative reorganization act, passed in 1921, 37 departments, commissions, etc., were combined into 8 departments—finance, commerce, highways and public works, agriculture, health, industrial relations, education and public welfare—in which the former departments are known as divisions. Each department has at the head a director who is appointed by the governor and serves during his pleasure; each departmental director receives an annual salary of $8,600. In 1927 the division of public works was separated from the department of highways and made the ninth department with a director at its head. The system of administration thus established is closely analogous to that of the federal government.

The general assembly consists of a senate and a house of representatives, the members of which are elected for terms of two years. The ratio of representation in the senate is obtained by dividing the total population of the state by 35, the ratio in the house by dividing the population by 100. In 1950 there were 33 members of the senate and 135 members of the house. The constitution provided for a reapportionment every ten years, beginning 1861. Biennial sessions are held beginning the first Monday in January of odd-numbered years. The constitution prohibits special acts conferring corporate powers, retroactive legislation, legislation impairing obligation of contracts and legislation levying a tax on state, municipal and public-school bonds outstanding Jan. 1, 1913, and it limits the amount and specifies the character of public debts which the legislature may contract.

The judicial department is composed of a supreme court of seven judges, nine judicial courts of appeals of three judges each, courts of common pleas and probate, juvenile, justice of the peace and municipal courts. Under the constitution of 1802 judges were chosen by the legislature, but since 1851 they have been elected by direct popular vote, the judges of the supreme court being chosen at large. They are removable by a concurrent resolution approved by a two-thirds majority in each house of the general assembly, by impeachment and by special law.

The terms of supreme court judges, judges of the courts of appeals and of the courts of common pleas are six years; probate judges and justices of the peace, four years.

The principal units of local government are the county, the township, the city and the village. The chief county authority is the board of commissioners of three members elected for terms of four years. The other officials are the auditor and engineer, sheriff, treasurer, recorder, coroner, clerk of courts and prosecuting attorney, elected for four years. The county also has a board of education elected by the qualified voters of the county school district. This board appoints the county superintendent of schools, who has supervisory jurisdiction within the district. The county school district includes all rural and village districts within the county but excludes city and exempted village districts. The chief township authority is a board of trustees of three members, elected by popular vote for four years. The other township officials are the clerk, justices of the peace and constables. Under the constitution of 1802, municipal corporations were established by special legislation.

The constitution of 1851, however, provided for a general law, and the legislature in 1852 enacted a "general municipal corporation act," the first of its kind in the United States. The system was changed again in 1912 when the so-called "home-rule" amendment was put into the constitution. This allowed each municipality to make its own charter or constitution. As a result, a variety of charters exist. Municipalities with more than 5,000 population are cities; all others are villages.

State and county officials as well as U.S. senators and representatives are nominated at primaries held in even-numbered years.

Finances.—The Ohio constitution limited the bonded indebtedness of the state to $750,000. On Jan. 1, 1950, the state had no bonded debt under this limitation. In 1947, however, voters amended the constitution to permit the payment of about $300,000,000 in bonuses to veterans of World War II. Of this special issue of bonds there were outstanding on Jan. 1, 1949, $194,250,000. Chief sources of the general revenue fund were a 3% retail sales tax, cigarette excise, beer, wine and liquor taxes, a premium tax on insurance companies, corporation franchise tax, intangibles tax and inheritance tax. Thus the ordinary expenses of the state government were met almost entirely by indirect taxation. In

1950 $74,000,000 was spent for improvement of highways. In the fiscal year 1950 the state received $7,136,000 more in income than it had anticipated, much of it from the sales tax as volume of sales swelled. The state spent nearly $52,000,000 out of surplus for new buildings and other capital improvements and ended the 1950 fiscal year with a net cash balance of $68,769,035. The state budget for the 1949–51 biennium was $629,180,804. The valuation assigned to property in the state tax duplicate was $13,953,000,000 in 1950. At the close of 1949 there were 423 state and private banks in Ohio having combined resources of $4,282,576,357 and total deposits of $3,961,880,203. National banks in the state numbered 241 with combined resources of $3,482,064,000 and total deposits of $3,235,255,000. There were 486 state-chartered savings and loan associations with combined resources of $1,237,924,904 and 131 federal savings and loan associations with total assets of $680,569,750.

Education.—Ohio has an excellent system of public education extending from the kindergarten through college and university work. The basis of Ohio's educational system was laid by an act of congress in 1785 setting apart 1 sq.mi. in each township of 36 sq.mi. for the support of education. After the reorganization of the administrative departments in 1921, the superintendent of public instruction became the chief administrative officer of the department of education with the title director of education. The tax limitation amendment curtailed the revenues of the public schools and in 1935 the school foundation was established. Under this system the state gives to the local school districts each year, subject to definite restrictions, sufficient funds to bring the schools of the state up to certain standard specifications. The cost to the state is about $50,000,000 per annum.

Operating expenditures of the public schools in Ohio for 1948–49, according to the annual report of the director of education, were $210,654,043. Enrolment in public schools that year was 1,185,900 and the teaching staff numbered 42,356. Enrolment in parochial schools of the state was 181,924 and in private schools 4,017.

The institutions of higher education supported in whole or in part by the state are: Ohio university at Athens, founded in 1804 on the proceeds derived from two townships granted by congress to the Ohio company; Miami university (chartered in 1809) at Oxford, which received the proceeds from a township granted by congress in the Symmes purchase; Ohio State university (1873) at Columbus, which received the proceeds from the lands granted by congress under the act of 1862 for the establishment of agricultural and mechanical colleges, and reorganized as a university in 1878. Bowling Green State university and Kent State university were normal schools prior to 1935. Ohio Central college, at Wilberforce, formerly was a part of Wilberforce university. Akron, Cincinnati and Toledo support universities. Among the numerous denominational or privately endowed colleges and universities within the state are Western Reserve university and Case Institute of Technology at Cleveland, Oberlin college at Oberlin and Ohio Wesleyan university at Delaware.

Charities and Correction.—The director of public welfare has under his general control administration of poor relief; aid to the aged, the blind and dependent children; state hospitals for the insane, epileptics and tubercular patients; institutions for the feeble-minded; a soldiers' and sailors' home; industrial schools for boys and girls; reformatories for men and women; a prison farm and penal honour camps; and Ohio penitentiary. The total operating costs for all institutions under the supervision of the department of public welfare in 1949 were $26,372,000. For the first half of 1950 the average case load for poor relief was 116,356. Expenditure for aid for the aged in the first six months of 1950 was $35,643,439. On July 1, 1950, Ohio had 37,697 mental patients and 14,798 persons in penal or juvenile institutions or on parole.

Agriculture.—Ohio is important agriculturally as well as industrially. Usually it ranks among the first ten states in the total value of its agricultural products. The principal crops are corn, wheat, soybeans, oats, hay, potatoes, tobacco, apples, peaches, grapes, barley, rye, buckwheat, popcorn and sugar beets. The total harvested acreage of principal crops in 1949 was 10,850,000. Acreage devoted to the principal crops that year was as follows: corn, 3,617,000; wheat, 2,353,000; soybeans, 858,000; hay, 2,429,000; oats, 1,334,000; potatoes, 38,000; sugar beets, 24,000; tobacco, 20,900; barley, 16,000; rye, 15,000; buckwheat, 11,000; and popcorn 9,500.

Production of the leading crops in 1949 was as shown in Table II.

TABLE II.—*Agricultural Production in Ohio*

Crop	1949	Average, 1938–47
Corn, bu.	202,552,000	160,389,000
Wheat, bu.	60,002,000	43,274,000
Hay, tons	3,556,000	3,714,000
Soybeans, bu.	20,592,000	16,276,000
Oats, bu.	48,024,000	40,495,000
Potatoes, bu.	6,270,000	8,600,000
Sugar beets, tons	247,000	290,000
Tobacco, lb.	29,220,000	24,165,000
Barley, bu	464,000	774,000
Rye, bu.	270,000	869,000
Buckwheat, bu.	248,000	300,000
Popcorn, lb.	20,425,000	19,929,000
Apples, bu.	5,446,000	3,875,000
Peaches, bu.	1,194,000	843,000
Pears, bu.	272,000	322,000
Grapes, tons	15,800	15,650
Cherries, tons	2,280	3,193
Maple syrup, gal.	150,000	208,000

The agricultural trend in Ohio in the 1940–50 decade was toward smaller farms and more intensive cultivation with mechanical equipment and fertilization resulting in higher yields per acre. Average number of farm units (1930–49) was 220,000 having a total estimated value of $2,500,000,000.

Livestock and poultry products are of great importance. Normally the Ohio farmers receive more than twice as much cash income from livestock and products as they do directly from their crops.

Mineral Products.—The mineral wealth of Ohio is well distributed in both area and products. In 1950 pig iron, bituminous coal, coke, clay and natural gas were the chief products, but the state also had considerable production in cement, ferro-alloys, lime, petroleum, salt, sand and gravel and stone. The total production for 1948, exclusive of pig iron, ferroalloys and coke, was valued at $328,228,000, as compared with $291,960,000 in 1947, according to the U.S. bureau of mines.

The fire-clay mines of Tuscarawas, Jefferson, Columbiana, Stark and Carroll counties supply the raw material for the greater part of the state's pottery, tile and brick industry. The coal fields, comprising a total area of 10,000 sq.mi. or more, are in the eastern half of the state. In 1948, 36,104,000 short tons were mined, as compared with 37,548,204 in 1947 and 32,314,262 in 1946. Natural gas is found in the eastern, central and northwestern parts of the state; production in 1948 was 65,619,000,000 cu.ft. as compared with 68,946,000,000 cu.ft. in 1947 and 61,570,000,000 cu.ft. in 1946. This gas production was valued at $12,901,000 in 1948, $13,548,000 in 1947 and $11,280,000 in 1946.

The output of pig iron, Ohio's leading mineral in 1948, was 12,367,227 short tons valued at $469,653,906. Production of coke was 10,562,486 short tons valued at $128,843,686. Other important mineral products of the state in 1948 included: 10,020,198 bbl. of cement valued at $20,496,930; 259,271 short tons of ferro-alloys valued at $21,852,890; 1,936,211 short tons of lime valued at $21,473,000; 3,300,000 bbl. of petroleum valued at $13,733,000; 2,752,696 short tons of salt valued at $5,884,343; and 15,508,815 short tons of sand and gravel valued at $15,149,848.

Some of the best sandstone in the United States is obtained from Cuyahoga and Lorain counties. It is exceptionally pure in texture and durable. From the sandstone known as Berea grit, a large portion of the nation's grindstones and whetstones is obtained. Total output of Ohio quarries in 1948 was 20,274,570 short tons valued at $27,552,017. Total value of raw clay and clay products was $69,175,821.

Manufactures.—Ohio is pre-eminently a manufacturing state. The number of its manufacturing establishments rose from 9,543 in 1939 to 12,303 in 1947. Value added by manufacture was tripled in this period, from $2,116,434,000 in 1939 to $6,359,006,000 in 1947. Salaries and wages paid by the 12,303 manufacturing plants in 1947 to their 1,194,603 employees totalled $3,560,075,000. The

average number of employees covered by unemployment compensation in 1949 was 2,078,261.

The most important manufacturing industries are those working with iron and steel. The glow of the blast furnaces lights the skies of northern Ohio and at some spots along the Ohio river. Final products range from tiny shoelace tips to giant machines as high as a five-story building. In the 1947 United States census of manufactures these products accounted in a large measure for the five highest classifications in the value added by manufacture in the state. These classifications together with the value added by manufacture were: machinery (except electrical) $1,251,011,000; primary metal industries $852,772,000; fabricated metal products $634,746,000; transportation equipment $483,421,000; and electrical machinery $471,593,000.

Other leading manufactures in 1947 with the value added by manufacture were: food and kindred products $413,216,000; rubber products $381,215,000; chemicals, paints and allied products $347,226,000; printing and publishing industries $322,283,000; stone, clay and glass products $293,881,000; paper and allied products $199,107,000; furniture and fixtures $128,293,000; apparel and related products $127,753,000; petroleum and coal products $95,811,000; leather and leather products $68,293,000; textile mill products $58,183,000; instruments and related products $41,381,000; lumber and products, except furniture, $37,521,000; tobacco manufactures $14,504,000.

The great manufacturing centres are Cleveland, Akron, Cincinnati, Toledo, Youngstown, Dayton, Columbus, Canton and Springfield. A large portion of the iron and steel is manufactured in Cleveland, Youngstown, Steubenville, Lorain, Bellaire, Canton, East Youngstown and Ironton. Most of the transportation equipment is manufactured in Cleveland; most of the cash registers and calculating machines in Dayton; most of the motor tires and other rubber goods in Akron. Beginning in the middle of the 20th century there was a notable expansion in the chemical industries in the Cleveland-Ashtabula area along Lake Erie and also along the Ohio river.

Transportation and Commerce.—The most important natural means of transportation are the Ohio river on the southern border and Lake Erie on the northern border. One of the first great public improvements made within the state was the connection of these waterways by two canals—the Ohio and Erie canal from Cleveland to Portsmouth and the Miami and Erie canal from Toledo to Cincinnati. The Ohio and Erie was opened throughout its entire length (309 mi.) in 1832. The Miami and Erie was completed from Middletown to Cincinnati in 1827; in 1845 it was opened to the lake (250 mi. from Cincinnati). A flood in 1913 wrecked these canals.

The national government began in 1825 to extend the National road across Ohio from Bridgeport, opposite Wheeling, W.Va., through Zanesville and Columbus, and completed it to Springfield in 1837. Before the completion of the Miami and Erie canal to Toledo, the building of railways was begun in this region, and in 1836 a railway was completed from that city to Adrian, Mich. At the close of 1949 there was a total mileage of 8,400 as compared with 9,159 in 1915, this reduction being a part of a general shrinkage prevalent throughout the country during this period. As the building of steam railways lessened and then ceased, the building of suburban and interurban electric railways was begun. These railways were rapidly extended until a maximum of 4,236 mi. was reached in 1917, and all the more populous districts were connected by them; but by 1950 these lines had almost vanished as a result of the widespread growth in motor traffic.

In 1949 there were 85,517 mi. of highway in the state outside municipalities. Of this, 16,065 mi. were classified as rural, 28,798 mi. as county and 40,654 mi. as township.

Iron ore, coal, limestone, grain and automobiles are the principal cargoes handled by Ohio's chief Lake Erie ports of Cleveland, Toledo, Ashtabula, Sandusky, Conneaut, Lorain and Fairport. Iron ore shipments to Ohio ports in 1949 totalled 37,547,717 tons.

Foreign ship commerce had grown, with 25 ships of foreign registry making 71 sailings in and out of Cleveland in 1949. These vessels reach the Great Lakes by way of the St. Lawrence river and the Welland canal. Cincinnati is the state's principal port on the Ohio river. Ohio had 3,500 mi. of certificated air line routes within its boundaries and 360 airports and landing fields in 1950.

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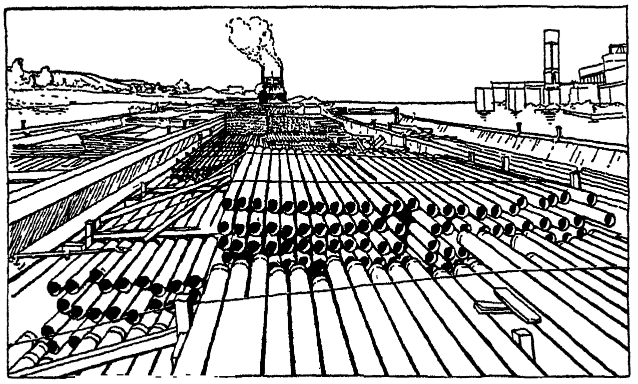
OHIO COMPANY, a name of two companies organized in the 18th century for the colonization of the Ohio valley. The first Ohio company was organized in 1749, partly to aid in securing for the English control of the valley, then in dispute between England and France, and partly as a commercial project for trade with the Indians. The company was composed of Virginians, including Thomas Lee (d. 1750) and the two brothers of George Washington, Lawrence (who succeeded to the management upon the death of Lee) and Augustine; and of Englishmen, including John Hanbury, a wealthy London merchant. In 1752 the company had a pathway blazed between the small fortified posts at Will's creek (Cumberland), Md., and at Redstone creek (Brownsville), Pa., which it had established in 1750; but it was finally merged in the Walpole company (an organization in which Benjamin Franklin was interested), which in 1772 had received from the British government a grant of a large tract lying along the southern bank of the Ohio as far west as the mouth of the Scioto river. The Revolutionary War interrupted colonization and nothing was accomplished.

The second company, the Ohio Company of Associates, was formed at Boston in 1786. The leaders in the movement were General Rufus Putnam, Benjamin Tupper (1738–92), Samuel Holden Parsons (1737–89) and Manasseh Cutler. Cutler was selected to negotiate with congress, and seems to have helped to secure the incorporation in the ordinance for the government of the Northwest territory of the paragraphs which prohibited slavery and provided for public education and for the support of the ministry. On Oct. 27, 1787, Cutler and Major Winthrop Sargent (1753–1820), who had joined him in the negotiations,

signed two contracts; one was for the absolute purchase for the Ohio company, at 66⅔ cents an acre, of 1,500,000ac. of land lying along the north bank of the Ohio river, from a point near the site of the present Marietta, to a point nearly opposite the site of the present Huntington, W. Va.; the other was for an option to buy all the land between the Ohio and the Scioto rivers and the western boundary line of the Ohio company's tract, extending north of the tenth township from the Ohio, this tract being preempted by "Manasseh Cutler and Winthrop Sargent for themselves and others"—actually for the Scioto company (*see* GALLIPOLIS). On the same day Cutler and Sargent "for themselves and associates" transferred to William Duer, then secretary of the Treasury board, and his associates "one equal moiety of the Scioto tract of land mentioned in the second contract," it being provided that both parties were to be equally interested in the sale of the land, and were to share equally any profit or loss. Colonists were sent out by the Ohio company from New England, and Marietta, the first permanent settlement in the present state of Ohio, was founded in April, 1788.

See E. J. Benton, ed., "Side Lights on the Ohio Company of Associates from the John May Papers," Western Reserve Hist. Soc. Tracts, No. 97 (Cleveland, 1917); A. B. Hulbert, ed., *The Records of the Original Proceedings of the Ohio Company* (Marietta, O., 1917); and Herbert T. Leyland, "The Ohio Company," *Hist. and Philos. Soc. of Ohio, Quart. Pub.*, vol. xvi., no. 1 (Cincinnati, 1921).

OHIO RIVER, the principal eastern tributary of the Mississippi river, U.S.A. It is formed by the confluence of the Allegheny and Monongahela rivers at Pittsburgh (Pa.), and flows north-west nearly to the west border of Pennsylvania, south-south-west between Ohio and West Virginia, west by north between Ohio and Kentucky, and west-south-west between Indiana and Illinois on the north and Kentucky on the south. It is the largest of all the tributaries of the Mississippi in respect to the amount of water discharged (an average of about 158,000cu.ft. per sec.), is first in importance as a highway of commerce, and in length (967m.), as well as in the area of its drainage basin (approximately 210,000sq.m.) it is exceeded only by the Missouri. The slope of the river at low water ranges from 1ft. or more per mile in the upper section to about 0·75ft. per mile in the middle section and 0·29ft. per mile in the lower section, and the total fall is approximately 500ft. The greatest falls are at Louisville, where the river within a distance of 2·25m. descends 23·9ft. over an irregular mass of limestone. The ordinary width of the upper



BY COURTESY OF THE CINCINNATI CHAMBER OF COMMERCE

A SHIPMENT OF STEEL TUBES AWAITING TRANSPORTATION DOWN THE OHIO RIVER

half of the river is uniform, from 1,200 to 1,500ft. Islands are numerous and vary in size from an acre or less to 5,000ac.

Besides its parent streams, the Allegheny and the Monongahela, the Ohio has numerous large branches. On the north it receives the waters of the Muskingum, Scioto, Miami and Wabash rivers, and on the south those of the Kanawha, Big Sandy, Licking, Kentucky, Green, Cumberland and Tennessee.

The drainage basin of the Ohio, in which the annual rainfall averages about 43in., is especially in the southern part of the river, of the "quick-spilling" kind, and as the swift mountain streams in that section are filled, the Ohio rises very suddenly and not infrequently attains a height of 30 to 50ft. or more above low water level spreads out 10 to 15 times its usual width, submerges the bottom lands, and causes great damage. In March 1913, an especially destructive flood reached the highest stages on record on that part of the river between Wheeling and Cincinnati and on the tributaries entering from the north.

Robert Cavelier, Sieur de La Salle, asserted that he discovered the Ohio and descended it until his course was obstructed by a fall (thought to be the falls at Louisville); this was probably in 1670, but until the middle of the next century, when its strategic importance in the struggle of the French and the English for the possession of the interior of the continent became fully recognized, little was generally known of it. By the treaty of 1763 ending the Seven Years' War the English finally gained undisputed control of the territory along its banks. By the treaty of 1783 the entire Ohio country became a part of the United States and by the famous Ordinance of 1787 the north side was opened to settlement. Most of the settlers entered the region by the headwaters of the Ohio and carried much of their market produce down the Ohio and Mississippi to New Orleans.

DEVELOPMENT

Until the successful navigation of the river by steamboats a considerable portion of the imports was carried overland from Philadelphia or Baltimore to Pittsburgh. The first steamboat on the Ohio was the "New Orleans," which was built in 1811 by Nicholas J. Roosevelt and sailed from Pittsburgh to New Orleans in the same year, but it remained for Capt. Henry M. Shreve (1785–1854) to demonstrate with the "Washington," which he built in 1816, the success of this kind of navigation on the river. From 1820 to the Civil War the steamboat on the system of inland waterways of which the Ohio was a part was a dominant factor in the industrial life of the Middle West. Cincinnati. Louisville and Pittsburgh on its banks were extensively engaged in building these vessels. Until the Erie canal was opened in 1825 the Ohio river was the chief commercial highway between the East and the West.

The Federal Government in the year 1827 undertook to remove the snags and to increase the depth of water on the bars by the construction of contraction works, such as dikes and wing dams, and appropriations for these purposes as well as for dredging were continued until 1844 and resumed in 1866; but as the channel obtained was less than 3ft. in 1870, locks with movable dams—that is, dams that can be thrown down on the approach of a flood—were then advocated, and five years later Congress made an appropriation for constructing such a dam, the Davis island dam immediately below Pittsburgh, as an experiment. This was opened in 1885 and was a recognized success. As a result of the activity of the Ohio Valley Improvement Association, Congress authorized the secretary of war to appoint a board of engineers to report on the merits of a channel 9ft. in depth. The board reported in 1908 in favour of such a channel.

In 1910 Congress adopted the report, and provision was made for a comprehensive project for canalizing the Ohio. By mid-20th century a system of 46 locks and dams was open to navigation. The entire length of the river was at least nine feet deep most of the time.

In order to maintain the nine-foot depth in areas with unfixed bars or shoals, dredging operations were carried on under the supervision of the U.S. army corps of engineers.

A number of the tributaries of the Ohio river also had a depth of at least nine feet.

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OHLAU, a town in the Prussian province of Silesia, Germany, 16 mi. by rail S.E. of Breslau, on the Oder. Pop. (1939) 12,710. It has a castle, became a town in 1291 and passed to Prussia in 1742. Ohlau is the centre of a tobacco-growing district.

ÖHLENSCHLÄGER, ADAM GOTTLOB (1779–1850), Danish poet, was born in Vesterbro, a suburb of Copenhagen, on

Nov. 14, 1779. His father, a Schleswiger by birth, was at that time organist, and later became keeper, of the royal palace of Frederiksberg. Through Edvard Storm, Adam received a nomination to the college called "Posterity's High School," of which Storm was the principal. Storm himself taught the class of Scandinavian mythology, and thus Öhlenschläger received his earliest bias towards the traditions of his ancestors. His studies were interrupted first by the death of his mother, and by the English attack on Copenhagen in April 1801, which, however, inspired a dramatic sketch (*April the Second 1801*).

In the summer of 1802, when Öhlenschläger had an old Scandinavian romance, as well as a volume of lyrics, in the press, the young Norse philosopher, Henrik Steffens, came back to Copenhagen after a long visit to Schelling in Germany, full of new romantic ideas. His lectures at the university, in which Goethe and Schiller were for the first time revealed to the Danish public, created a great sensation. Steffens and Öhlenschläger met, and after a conversation of sixteen hours the latter went home and wrote at a sitting his splendid poem *Guldhornene*, in a manner totally new to Danish literature. A volume of poems in the romantic style is now chiefly remembered as containing the lovely piece called *Sanct-Hansaften-Spil*. The next two years saw the production of the epic of *Thors Reise til Jotunheim*, the charming poem in hexameters called *Langelandsreisen*, and fantasy *Aladdin's Lampe* (1805).

At the age of twenty-six Öhlenschläger was universally recognized, even by the opponents of the romantic revival, as the leading poet of Denmark. He now collected his *Poetical Writings* in two volumes. He obtained a grant for foreign travel from the government, and joined Steffens at Halle in August 1805. Here he wrote the first of his great historical tragedies, *Hakon Jarl*. In the spring of 1806 he went on to Weimar, where he spent several months in daily intercourse with Goethe. The autumn of the same year he spent with Tieck in Dresden, and proceeded in December to Paris. Here he resided eighteen months, and wrote his three famous masterpieces, *Baldur hin Gode* (1808), *Palnatoke* (1809) and *Axel og Valborg* (1810). In the spring of 1809 Öhlenschläger went to Rome to visit Thorwaldsen, and in his house wrote (in German) his tragedy of *Correggio*.

He returned to Denmark in the spring of 1810 to take the chair of aesthetics at the University of Copenhagen. In 1811 he published the Oriental tale of *Ali og Gulhyndi*, and in 1812 the last of his great tragedies, *Staerkodder*. His talent culminated in the cycle of verse-romances called *Helge*, published in 1814. The tragedy of *Hagbarth og Signe*, 1815, showed a distinct falling-off in style. In 1817 he went back to Paris, and published *Hroars Saga* and the tragedy of *Fostbrödrene*. In 1818 he was again in Copenhagen, and wrote the idyll of *Den lille Hyrdedreng* and the Eddaic cycle called *Nordens Guder*. His next productions were the tragedies of *Erik og Abel* (1820) and *Vaeringerne i Miklagaard* (1826), and the epic of *Hrolf Krake* (1829).

In 1829 Öhlenschläger was publicly crowned with laurel in front of the high altar in Lund cathedral by Bishop Esaias Tegnér, as the "Scandinavian King of Song." His last volumes were *Tordenskjold* (1833), *Dronning Margrethe* (1833), *Sokrates* (1835), *Olaf den Hellige* (1836), *Knud den Store* (1838), *Dina* (1842), *Erik Glipping* (1843) and *Kiartan og Gudrun* (1847). On his seventieth birthday, Nov. 14, 1849, a public festival was arranged in his honour, and he was decorated by the king of Denmark. He died on Jan. 20, 1850, and was buried in the cemetery of Frederiksberg. Immediately after his death his *Erindringer* ("Recollections") were published in two volumes.

With the exception of Holberg, there has been no Danish writer who has exercised so wide an influence as Öhlenschläger. He awakened in his countrymen an enthusiasm for the poetry and religion of their ancestors, and his name remains to this day synonymous with Scandinavian romance. His plays, partly, no doubt, in consequence of his own early familiarity with acting, fulfilled the stage requirements of the day, and were popular beyond all expectation. The earliest are the best—Öhlenschläger's dramatic masterpiece being, without doubt his first tragedy, *Hakon Jarl*. In his poems and plays alike his style is limpid, elevated, profuse; his flight is sustained at a high pitch without visible excitement. His fluent tenderness and romantic zest have been the secrets of his extreme popularity. Although his inspiration came from Germany, he is not much like a German poet, except when he is consciously following Goethe; his analogy is rather to be found among the English poets, his contemporaries. With all his faults he was a great writer, and one of the principal pioneers of the romantic movement in Europe. (E. G.; X.)

The critical edition of Öhlenschläger's works is that by J. L. Lubenberg (32 vols., 1857–62). *See* B. Andersen, *Öhlenschläger et livs poesie* (3 vols., 1899).

OHLIGS, former German town known before 1891 as Merscheid, 17 mi. by rail N. of Cologne, on the railway to Elberfeld. Pop. was 29,812. It manufactured cutlery, surgical instruments and hardware and united with Solingen in 1929.

OHM, GEORG SIMON (1787–1854), German physicist, was born at Erlangen on March 16, 1787, and was educated at the university there. He became professor of mathematics in the Jesuits' college at Cologne in 1817, and in the polytechnic school of Nuremberg in 1833. In 1849 he was appointed conservator of the physical collection at Munich, and in 1852 professor of experimental physics in the high school of Munich, where he died of apoplexy on July 7, 1854. His writings were numerous, but, with one important exception, not of the first order. The exception is his pamphlet, published in Berlin in 1827, with the title *Die galvanische Kette mathematisch bearbeitet*. This work, the germs of which had appeared during the two preceding years in the journals of Schweigger and Poggendorff, has exerted a great influence on the whole development of the theory and applications of current electricity. (*See* ELECTRICITY.) The most important part of the pamphlet is summarized in what is now known as Ohm's Law. (*See* RESISTANCE, MEASUREMENT OF.) This work was so coldly received that Ohm's susceptibilities were hurt, and he resigned his post at Cologne. He eked out a precarious livelihood until appointed at Nuremberg. At this time his work began to be recognized, he was awarded the Copley medal of the Royal Society in 1841 and was made a foreign member of that society in 1842. In addition to a number of papers on mathematical subjects, Ohm wrote a memoir on interference in uniaxial crystals, and also a *Text Book of Physics* (1854).

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OHMMETER, an electrical instrument employed for measuring insulation-resistance or other high electrical resistances. The ohmmeter is described in INSTRUMENTS, ELECTRICAL: *Resistance Measuring Instruments*.

OHNET, GEORGES (1848–1918), French novelist and man of letters, was born in Paris on April 3, 1848. After the war of 1870 he became editor of the *Pays* and the *Constitutionnel* in succession. In collaboration with the engineer and dramatist Louis Denayrouze (b. 1848) he produced the play *Regina Sarpi*, and in 1877 *Marthe*. He was an admirer of George Sand and bitterly opposed to the realistic modern novel. He began a series of novels, *Les batailles de la vie*. The series included *Serge Panine* (1881) which was crowned by the Academy; *Le Maître de forges* (1882), *La Grande Marnière* (1885), *Volonté* (1888), *Dernier amour* (1891). Many of his novels have been dramatized with great success, *Le Maître de forges*, produced at the Gymnase in 1883, holding the stage for a year. He published in 1908 *La route rouge*, and in 1912 *La serre de l'aigle*. His last work was *Journal d'un bourgeois de Paris pendant la guerre de 1914* (1914–18).

OIL, MINERAL: *see* PETROLEUM.

OIL, PALM: *see* PALM OIL.

OIL, SHALE: *see* SHALE OIL.

OIL-BIRD or **GUACHARO** (*Steatornis caripensis*), the sole member of a family, *Steatornithidae*. As big as a crow, its plumage exhibits blended tints of chocolate-colour and grey, barred and pencilled with dark-brown or black, and spotted in places with white. The guacharo is nocturnal, slumbering by day in deep and dark caverns. Towards evening it arouses itself and, with croaking and clattering, which has been likened to that of casta-

nets, it approaches the exit of its retreat. In Trinidad the young are esteemed a great delicacy for the table.

OIL BUNKERING: *see* BUNKERING OF SHIPS.

OIL CAKE, a feeding stuff of great value, prepared from the residue resulting from the crushing of various oilseeds. For details *see* FEEDING STUFFS AND LIVESTOCK FEEDING; COTTONSEED; LINSEED; COCO-NUT OIL AND CAKE.

OIL CITY, a city of Venango county, Pennsylvania, U.S.A., on the Allegheny river, at the mouth of Oil creek, 75 mi. N. of Pittsburgh. It is served by the Erie, the New York Central and the Pennsylvania railways and has a municipal airport. The population in 1950 was 19,581; in 1940 it was 20,379, with as many more in near-by places.

The city lies 1,000 ft. above sea level, in a rolling and wooded country.

The central part is almost encircled by a deep bend of the river, and is connected with the south, west and east sides by several bridges.

Oil City is the metropolis and market of the Pennsylvania oil region; has large oil refineries and machine shops; and manufactures steel drums, steel tubing, tin cans, bottles, gas engines, pumping machinery and other oil well supplies and various other commodities. Natural gas is used for domestic and industrial purposes.

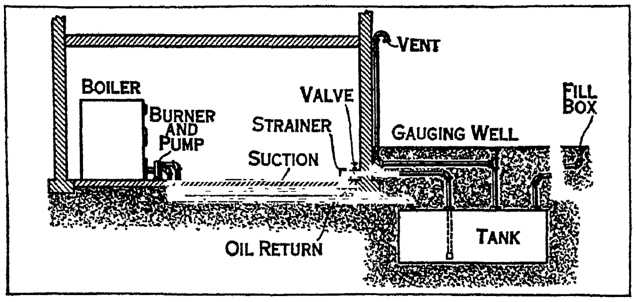
The city has a commission form of government.

Oil City was founded in 1860, following the drilling of the Drake well at Titusville (16 mi. N.) on Aug. 27, 1859. It was incorporated as a borough in 1863 and as a city in 1871. Between 1860 and 1870 there were 20 passenger boats and towboats and 3,000 flatboats plying the river, and 17,000,000 bbl. of oil were shipped to Pittsburgh. Trading in oil certificates led to the establishment of the Oil exchange, which for many years set the price of oil for the world.

OIL ENGINE: *see* INTERNAL COMBUSTION ENGINES.

OIL FUEL: see FUEL: A GENERAL SURVEY.

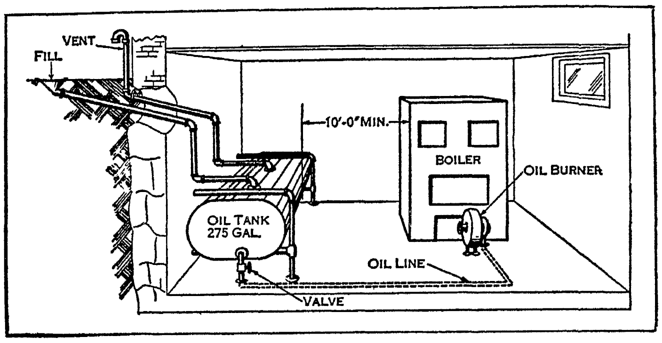
OIL HEATING, DOMESTIC, that branch of the heating of dwellings and other buildings in which the fuel burned is a mineral oil, such as shale oil or one of the heavier and less expensive grades of petroleum (*q.v., see* also KEROSENE). Oil has been used for fuel and for heating since the time of Moses; but the mechanical development of the oil burner dates from the middle



BY COURTESY OF THE DOMESTIC OIL HEATING INSTITUTE
CHARACTERISTIC UNDERGROUND TANK INSTALLED BELOW BURNER LEVEL

of the 19th century, and only after 1922, in the United States particularly, did it come into widespread use. "Oil heating" refers here only to the method of generating heat, without regard to the medium (steam, hot water or air) used to carry the heat throughout the building; "oil" refers here only to petroleum. Oil in its native state will burn, but not with maximum effect until it is atomized and mixed with air. The history of modern oil heating is the record of the search for simple and efficient methods of preparing heavy oils for complete combustion. In 1861 a mechanic named Werner, employed in one of the refineries of the Russian oil fields of the Caucasus, first suggested that what was then "refuse oil" be used as fuel; his burner, consisting of a series of griddles over which the oil trickled and burned was widely used though not patented until 1867. In 1862 two experimenters took out patents on an oil burner which solved the combustion problem by introducing the oil into the furnace in a gaseous state, the heavy oil first being heated and made to give off lighter oils. In 1863 Brydges Adams introduced into America the first spray burner, and in 1866 Ayden brought out a burner using hot air to atomize the oil and Spakorsky one using super-heated steam. Spakorsky's method was later embodied in an oil burner by Thomas Urquhart, an American at that time in the employ of a Russian railway.

Public interest was attracted by the possibilities of oil burning with a very considerable increase in the oil production of California and Texas about 1900. Small burners, suitable for heating forges, treating furnaces, drying ovens and melting furnaces were soon produced. Larger burners were designed for boilers producing steam for power and heat. In 1902 and 1903 the U.S. naval liquid fuel board conducted tests of all available burners to determine whether vessels of the U.S. navy should be equipped for oil burning. The report, completed in 1904, was so favourable that the newer vessels were immediately designed to burn oil fuel and many of the older ones were converted.



CHARACTERISTIC 275GAL. TANK INSTALLED IN BASEMENT

The first attempts at domestic oil burning were crude and, in the majority of cases, consisted primarily of a pipe from a tank dropping the oil on hot, refractory material in an open pan. These were followed by natural-draught vaporizing burners, which, however, did not provide the uniform combustion necessary for economical and reliable operation. A later development was the mechanical-draught automatic burner, the foundation of the modern, domestic oil heating industry. In 1919, following World War I, oil fuel began to enter the American home on a national scale.

The rapid rise of the oil burner was a result of its convenience; an oil fire can be built or banked by the turn of a switch. Through electrical control, all the processes of furnace tending were made automatic.

Another advantage is that oil may be conveniently stored in congested business districts. The labour required for attending oil-fired boilers is considerably less than that where coal is used, even when this is handled by modern equipment.

Types of Burners.—There are numerous varieties of oil burners, but all may be included under two distinct types: the natural draught and the mechanical draught burners. In the first type, sometimes called a gravity burner, there are no moving parts and the force of the draught depends on the size and height of the chimney, and on the differences in temperature and density between the outside air and the flue gases in the chimney. For this reason it is affected by changes in the weather, wind currents above the chimney and similar factors controlling variations in draught intensity. The natural draught burner is usually limited to heating on a small scale and requires lighter oils for efficient operation. In the second type, the air for combustion is supplied by a fan or blower. When a fan is used, the entire amount of air for combustion is usually supplied under pressure. The mechanical draught burner, since its air supply is controlled for the most part by the fan or blower, is more efficient than the natural draught burner, and maintains uniformly efficient combustion under all conditions.

Burners are also classified by the means employed to prepare the fuel for combustion. The oil may be atomized or vaporized. In the latter type, oil is prepared for combustion by first being heated. The vapour is mixed with the air just before or during

the combustion process. Burners of this type are especially flexible, with low oil capacities, and moving mechanical parts can be eliminated. In the atomizing burner, high or low pressure air or steam, mechanical pressure or rotating parts break up the fuel into small particles which are quickly vaporized by the heat of combustion. In commercial installations, where oil fuel is used in the heating of factories, office buildings, schools, theatres, apartments, etc., atomizing burners are used almost to the exclusion of other types because of their ability to burn the heavier and cheaper grades of fuel oils. The modern oil burner is automatic. A room thermostat electrically controls the burner so that the heat of the house can be kept constant within two degrees on either side of the desired temperature. A boiler or furnace control prevents overheating of the boiler and, in the case of a steam boiler, prevents abnormal pressures being developed. A burner safety control establishes a time limit within which the oil must be ignited every time the burner is started up; if the oil is not ignited the burner mechanism is shut down. When ignition is electric, it is accomplished by means of a spark from a high-tension transformer or by a hot resistance coil. The spark type of ignition is more widely used. Some burners require a gas pilot. An oil burner can be installed in practically any hot water or steam boiler, or in any warm-air heater.

The fuel oil used in automatic oil heating equipment varies in accordance with the needs of the individual burner; ranging from very light, untreated kerosene or distillate for burners that prepare the fuel for combustion by vapourization to heavier, straw-coloured distillates and dark coloured gas or Diesel oils for burners that employ atomization in preparing the fuel for combustion. The Commercial Standards Specifications for fuel oils as published by the U.S. Bureau of Standards are the most widely recognized specifications covering fuel oils. The grade numbers and names, together with their old designations and approximate A.P.I. (American Petroleum Institute) gravity range are:

Specification Number	Standard Name	Approximate Gravity Range	Old Designation Name
1	No. 1 Fuel Oil	40–36	Distillate
2	No. 2 Fuel Oil	36–30	Gas Oil
3	No. 3 Fuel Oil	30–22	Light Fuel Oil
5	No. 5 Fuel Oil	24–18	Medium Fuel Oil
6	No. 6 Fuel Oil	18–10	Heavy Fuel Oil

Oils number 1, 2, 3 are most generally used in automatic burners. Oils 5 and 6, because they generally require pre-heating, are used primarily in large commercial and industrial installations.

The utility of a fuel oil for domestic heating depends also upon its flash point. The flash point of any oil is the lowest temperature at which the vapours on the surface of the oil will ignite and burn momentarily on application of a spark or flame. About 20° F. above the flash point is the fire point of the oil. This is the temperature at which the oil will ignite and burn continuously.

It is desirable that this fire point should be sufficiently low so that the oil will ignite from a cold start without hesitation. A flash point as low as 100° F. or 110° F. is allowable, and an oil with a flash point above 230° F. should not be used with most burners because of the difficulty of initiating ignition.

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(H. F. T.)

OILLETS, the architectural term for the arrow slits in the walls of mediaeval fortifications, but more strictly applied to the round hole or circle with which the openings terminate; also applied to the small circles in the tracery head of the windows of the Decorated and Perpendicular periods which were sometimes varied with trefoils and quatrefoils.

OIL PAINTING, TECHNIQUE OF. As the musician must be taught, and the subtlest of harmonies are subject to material limitations, so the art of the painter must be learned, and he, more perhaps than any other artist, is bound by severe material necessities. It is not intended here to give instruction in the art of painting or to express individual preferences. The object in view is rather, taking as a basis the various methods employed by the great masters, to give an account of the technical considerations which all painters are obliged to bear in mind.

One thing to be noted in a consideration of painting is that there is a wider divergence in the techniques employed than in that of any other art. We should not find this diversity so extensive if, instead of discussing the technique of oil painting, we were analysing the technical methods of the Primitives who painted with wax, yolk of egg, or in fresco. Whatever difference there may be in the appearance of a painting by Cimabue and one by Mantegna, it will be very much less than the difference between the work of two artists painting after the invention of oil painting.

It may not be necessary to recall that all the colours used in painting, whether they are of mineral or vegetable origin, finally appear in the form of more or less soft stones which are ground to a powder in order to be used. These coloured powders require some binding vehicle in order to bring them to a sufficient consistency. The vehicle may be wax, mortar, glue, glycerine or resin. The brothers Van Eyck are generally believed to have been the first to mix their colours with oil. From the numerous controversies to which their discovery has given rise, it would seem that the principal achievement of the brothers Van Eyck was that they perfected, for the purpose of painting easel pictures, the results of the much earlier practice which had been to use oil for the painting of large surfaces, and especially for the painting of boats. The effect of oil in rendering colours durable had been observed previously; pictures painted with yolk of egg had been covered with a coating of oil which was hardened by drying in the sun and which at once protected and intensified the colours.

Once, however, the practical method of grinding colours with oil had been discovered, a vast field of technical research opened up before painters, and they were naturally tempted to explore the new possibilities which were provided. It was this possibility of variety in technical methods which, in combination with the individual genius of the great masters, enabled the art of oil painting strictly so called to rise to such great heights at the time of the Renaissance.

The Support.—Oil paint will adhere to a number of materials, and during the ages painters have experimented in painting on a number of metal and mineral grounds. Slate, marble and alabaster have been used, but comparatively rarely owing to their fragility. Copper has also been utilised, though, of course, only for works of small size. Paper deserves special mention. Far from being an inferior material as might be supposed, paper is perhaps the most suitable ground for works of a spontaneous character. It was used by Flemish painters, who glued it to wood panels or canvases by means of casein. Later, in the 18th and early 19th centuries, a large number of French painters used this process, which was of great value in setting off their brilliant execution. No other material gives such transparency to browns or so much depth to blacks.

Practical considerations have, however, led most painters to prefer two supporting materials: first, wood, and second, canvas. Up to the end of the Renaissance period wood was generally employed; but it would be an error to suppose that the change to canvas was a sudden one. There are a number of examples of wood panels upon which a fine canvas has been glued. Besides, although the use of canvas became very frequent after the Renaissance, it cannot be said to have been universal, since at all periods in the history of painting, including the present, many artists have painted on wood. In Italy the white poplar was generally used; in Flanders they used oak. To-day mahogany, which does not crack so easily as oak, is often used.

Canvas appears to be the most suitable material for pictures of a large size. There are, however, exceptions, even among painters,

who habitually used canvas for their large works. Thus Rubens' *Magi* in the Antwerp Museum, one of the largest as well as one of the most admired compositions of that master, is executed on an enormous wooden panel formed by several transverse sections. Rubens' choice of a panel in this case and in others is not a mere chance. It may be laid down as an axiom that everything counts in the execution of a picture, and the support is not the least important factor in the final appearance of the work. It is an even more important factor in its preservation. Too much stress cannot, therefore, be laid on the importance of seeing that the support of the painting is of the best quality.

The history of painting shows so many examples of fine works which have perished that we must take every possible precaution to prevent damage to those which may be painted in the future. If wood is used, it must be carefully seasoned, thoroughly dry and cut radially, as otherwise it will be affected by changes of temperature and the picture will warp or split. If canvas is chosen, it should be of hemp, or better still of pure, unbleached flax fibre, without any admixture of cotton; this will prevent its being too liable to suffer from changes of temperature. It will easily be understood that if the tissue is constantly expanding and contracting the priming or the paint itself will be likely to scale off.

Preparation of the Support.—There is, however, another important matter to consider; the wood or canvas may be treated with a priming or used without. The latter method, which is the simplest, may be dealt with first without regard to chronology; for though it was occasionally used by old masters, such as Rembrandt and Van Goyen, it is in the main a modern practice. Many present-day painters prefer to dispense with priming, and this often gives good results, especially in painting on wood. If canvas is used the method has certain disadvantages, for contact with the oil renders the canvas brittle, and it thus loses the flexibility which is one of its principal merits.

Canvas, therefore, needs to be covered with priming before it is used, and the priming is, of course, an important factor. It has been the subject of extensive research from the time when it was first used. The basis of all priming is either size or casein mixed with plaster or carbonate of lime, or else a thin coating of white lead over a coating of size. These simple elements can be combined in a great variety of ways. Experiments with different kinds of priming have been tried at all periods of the history of painting. The Primitives used plaster and carbonate of lime for tempera painting, and this practice was continued long after the invention of oil painting. It was principally in the 17th century that it became customary to use white lead, more or less strongly tinted with grey, red or brown. A transitional method, which the present writer regards as excellent, was to cover the canvas with a thin coat of carbonate of lime, and then to complete the priming with white lead. Later, painters contented themselves with sizing the canvas and then covering it with one or two thin coatings of white lead. This process has become almost universal at the present day, but some painters are tending to return to plaster priming. It should never be forgotten that the principal quality which should be possessed by the priming of canvases is flexibility. Consequently the first coating of size which is placed over the canvas in order to fill up the interstices in the fabric must not be too thick, and if subsequent coats of carbonate of lime or white lead, or both of those materials in succession, are put on, they also should be very thinly applied. If the canvas is to dry well, it is better to apply several thin coats of priming than one thick one. It is extremely important to make sure that the canvas has dried properly. This is not always done with sufficient care before a picture is begun, and yet nothing is more dangerous than to use a canvas which has not dried properly. The dark colours will inevitably crack sooner or later. Industrially prepared canvases are often prepared without paying pre-consideration to the artist's requirements and so expose the paintings to accidents of this kind. This can be proved by a very simple experiment; take a piece of wood or canvas, and cover it with a coat of white lead; then, instead of waiting several months, as would be necessary if a picture were to be painted, paint on it patches of brown, madder lake, ultramarine and emerald green. These colours will rapidly crack; the first cracks will be noticeable on the emerald green after a few days only.

Colours and Their Preparation.—Colours, in the state in which they reached the painter when he prepared them himself, and in the state in which they now reach the manufacturer, are in the form of blocks, either crystalline or powdery, but generally of the consistency of soft chalk. Their quality undoubtedly depends above all on the purity of the raw materials used. The chemist isolates the colouring matter from the crude materials which he receives. In some cases the material is earth, as in the case of ochres; the earth is in its natural state in the case of yellow and red ochre, and it can be calcined so as to obtain other colours such as burnt sienna. Other colours are obtained from elementary materials; thus different kinds of black are produced from lamp black, bone charcoal and charcoal obtained from vine stocks. Ultramarine is also a natural stone—lapis lazuli. But unlike the coloured earths, which are abundant, natural ultramarine is so rare that it is scarcely used. By means of laboratory research a fairly stable blue resembling natural ultramarine has been obtained from sodium sulphide and silicate of aluminium.

It would be desirable if painters could use only colours extracted from simple sources such as earths. A colourist can do a great deal merely with yellow ochre, red ochre and black. These materials are little subject to alteration. Even the most skilful artist, however, cannot go far without the use of white; and this is the first stumbling block. The white which is known as flake white (in French, *blanc d'argent*) is a carbonate of lead, or in other words a purified form of white lead. It turns black in the course of time. The least that can happen is that it will turn yellow. Zinc white has not this disadvantage, but it cracks, does not spread easily and dries slowly. Moreover, even if the problem of the stability of white were solved, there would remain that of other colours which are absolutely necessary to the painter, such as bright yellow, whether strontian or cadmium, red, such as vermilion or even madder lake, blue, green and brown. These colours are the product of chemical combination and are only relatively stable. Some turn black, others absorb the colours mixed with them, while others become opaque.

However, not all of the hundreds of colours at the painter's disposal are equally bad. In order to choose the lesser of two evils, the painter should only add to the tones obtained from earths the indispensable minimum of other less durable colours.

Prussian blue, which was discovered in 1710 and was used to excess in the early 19th century, is today almost abandoned. Unless it is laid on as a light glaze, or supported by a considerable admixture of white, it tends to turn black and to absorb the colours mixed with it. A green composed of Prussian blue and a yellow (especially if this is not one of the earth yellows) gradually turns blue; similarly a violet into which Prussian blue enters gradually loses its red elements. Cobalt blue has the serious defect of appearing violet by artificial light.

It is possible to make a verbal distinction and to say that Rubens and Rembrandt did not use bitumen; they used a bituminous colour, and so did all the Dutch and Flemish painters; indeed all painters of whatever school have used a transparent brown resembling bitumen and fulfilling the same function; but it was recognised that the use of this colour was subject to certain strict technical conditions. At the end of the 18th century an attempt was made to recover the exact tone of bitumen which was believed to be that used by Rembrandt; it was believed to be very durable, and most of the painters of the day made abundant use of it. The terrible consequences are well known at the present time. The worst of it is that the damage due to bitumen, which never dries, combined with varnish which dries rapidly, may not become apparent until after many years.

The industrialisation of the manufacture of colours thus gives rise to a number of problems and technical points with which modern painters are unacquainted. They ought themselves to try experiments on the power of resistance of colours by exposing them to sunlight, and to fumes containing sulphur, sulphuretted hydrogen and ammonia; and in addition it would be in their interest to simplify their palette. Experience has shown, for

example, that Naples yellow becomes dull and greenish; that umber darkens and rapidly alters the colours mixed with it; that cadmiums lose their brightness in time; that ultramarine becomes opaque; that bitumen should only be used as a light glaze; and that colours which may be highly recommended must pass the test of time, and cannot be used with certainty until they have done so. It is only possible to calculate their palettes by making a close study of the old masters' pictures in a good light. It is possible to train oneself in a study of this kind by beginning with modern pictures. If the painting of a picture is closely examined, it is almost always possible to discern, in a single brush stroke, particles of the pure colours of which it is composed. If a study of several pictures by the same painter gives the same results, they may be taken as accurate.

A simple example may be found in the works of Pissarro; in all his pictures painted between 1878 and 1885 approximately, a mixture of Veronese green and ultramarine can clearly be distinguished. The use of these two colours during the period in question is thus established. This example has been selected because Pissarro obtains highly characteristic effects by this means. The remainder of his palette could easily be ascertained by continuing the analysis. Although, however, analysis may be simple in the case of the Impressionist school, it becomes more difficult as we go further back in the history of painting. The present writer frankly confesses that he cannot himself read the palette of all painters from their works. It is, however, possible to derive one general conclusion from a close study of the works of the great masters: that it is not necessarily the number of colours used which makes the colourist.

The grinding of the colours is a long and somewhat difficult business. It consists in pounding the powder, moistened with oil, until the grains are so fine as to be imperceptible. (*See* COLOUR MILLS.) This is done with a heavy muller, the under surface of which is as smooth as the slab of granite, on which the colours are ground. From time to time the grinder adds a few drops of oil. He has to continue kneading the paste until it is of the requisite fineness and consistency. It should be noted that a colour which reaches different grinders in the same state of chemical purity may not be of equal quality when it leaves their hands; the cleanliness with which the operation is carried out and the quality of the oil used affect the final result. The manufacture of colours is not a simple operation. Great practice is for example necessary to bring cobalt blue to the right consistency. Oil alone will not bind the paste sufficiently, and wax has to be added. The kind of oil used has its importance; olive oil, which was formerly much used in Italy because of its abundance, has now been given up because it dries slowly. Linseed oil on the other hand dries rapidly; copal oil is much esteemed by certain manufacturers; but poppy oil, which is light and colourless, is by far the most frequently used.

The painter should be able to use the paints in the form in which they reach him. He may use a siccative to make them dry more rapidly, but he should remember that this is an evil, even if a necessary one. He may use the colours in a thick paste, or slightly diluted, or as a thin wash; they are diluted with a quantity of oil, or turpentine, or a mixture of the two. It may be explained that the thin wash or glaze is composed of a transparent colour for choice, very much diluted, and its purpose is to heighten the value or activity of a tone which has already been laid on and has dried. Delicate effects and fine harmonies may be obtained in this way. The colours which are in practice used for this purpose are as a rule transparent yellows (Indian yellow, yellow lake, raw sienna and sometimes dark cadmium), nearly all the reds, but principally the lakes, black, nearly all the browns, and particularly bitumen. Although they have immense advantages, glazes have the defect of being liable to damage by the hand of time. They are slow in drying, and there is a risk that they may become incorporated in the varnish if the latter is applied too soon; and it must be admitted as an axiom that a picture will sooner or later have to be devarnished, and the painting itself should not be liable to injury when this happens.

A great number of prepared colours are now available; and while it is not necessary to give a list of them, it may be of use to mention a small number of specially durable colours with which a great variety of effects may be obtained. These are: flake white, golden ochre, strontian yellow, deep cadmium yellow, Venetian red, burnt sienna, cadmium red or vermilion, dark madder lake, ultramarine, cobalt blue, emerald green and ivory black or blue black.

This palette is only given as an example, since it would be arbitrary and useless to attempt to establish a uniform palette suitable to all temperaments. Some colours, too, may in themselves be injurious, and should be avoided as far as possible, but nevertheless may assist in creating the effect which is desired if they are used in the right place and with the necessary skill. For the nature of the colour itself is not the only factor; the manner in which it is used matters perhaps even more.

Brushes.—There are two kinds in general use, very different from one another; those made of sable hairs and those made of hogs' bristles. The latter are the most generally used. They consist of a metal collar which is generally flattened and keeps flat the bundle of bristles which form the brush itself. (*See* BRUSH: *in Art.*) The change from the round brushes, which were used until the 19th century, to flat brushes is due to the almost universal desire of the modern school to paint in separate touches with a full brush. The shape of the brush undoubtedly affects the nature of the stroke; but though it is difficult to describe the subtle difference made by the use of a round or a flat brush, because everything depends on the hand which uses it, it is easy to distinguish between passages executed with a sable brush and those executed with a hogs' bristle brush. The sable brush is better where precision of detail is required. The touch can be impasted and yet smooth, where bristle would not follow the exact intention of the painter with the same docility. Sable brushes are best for painting small pictures on panels, and for compositions where emphasis on detail gives the work part of its character. On the other hand it would be difficult to paint a life-size portrait or a large landscape with sable. The softness of the hairs would make it difficult to deal with a considerable quantity of paint, and the touch would be greasy and soft while a firm hogs' bristle brush would enable the painter to lay on a broad and vigorous surface.

Painters have at all times used their fingers and this use of the finger as a sort of flesh-and-blood trowel gave Courbet the idea of using the palette knife as a partial substitute for the brush. By using a flexible steel knife it is possible to obtain a vigorous touch and great variety of technique. It would of course be impossible to do any delicate drawing with the palette knife, but no instrument can be compared with it for preserving the purity of tones which often leave the palette fresh but are impaired by the time they reach the canvas. The palette knife can be wiped clean with a rag after each stroke; it represents an absolutely clean means of transferring the paint from the palette to the canvas, while only too often the brush is insufficiently cleaned and contains traces of all sorts of other colours. This does not however mean that the palette knife can take the place of the brush. The knife can only be used for certain restricted purposes, and for general use nothing can replace the brush. But everyone knows how important cleanliness is in the composition of colours, and it is only too often forgotten that the palette, the vessel which contains the vehicle, and the brushes, need careful attention because they are the last recipients of the colours, and colours cannot be beautiful unless they are skilfully used.

DEVELOPMENT OF THE ACTUAL PAINTING

We often hear it said that a picture has darkened or turned yellow. We are not here referring to the changes to which the varnish is subject, since although varnish gives the colours their maximum intensity, it does not form an integral part of the picture and will be dealt with only at the end of the article. What we now have to consider is the development of the paint which actually constitutes the picture.

Preparation of the Groundwork.—It has already been said that artists should give the utmost personal attention to the prep-

aration of their canvases. Upon the preparation of the groundwork the final aspect of the finished picture may depend. The old masters varied the priming of their panels or canvases according to the nature of the picture which they intended to paint. Rubens used a ground-work which was sometimes grey, sometimes tinted with ochre, sometimes greenish, and sometimes plain white as in the "Miraculous draught of fishes." Poussin used a grey ground-work for his "Autumn," and Boucher a pink-tinted one for his "Three Graces."

There is no doubt that the ground-work affects the painting which is superimposed on it. Let us suppose that two replicas of the same picture are painted, one on a yellow and one on a red canvas. After a few years the two pictures will be seen to differ from one another, and their general colour harmony will change, becoming nearer to that of the ground-work. A painter can thus, to a limited extent, plan in advance the future development of his picture, and should not neglect a factor which may add to its beauty later.

The desire to obtain rich colour harmonies must however always be subordinated to the numerous and complex exigencies of paint. Many pictures painted on light grounds have preserved an astonishing freshness down to the present day, while others painted on red, brown and even black grounds have suffered; indeed such paintings have generally worn badly, even if they were painted by Tintoretto, Poussin or Courbet.

The red grounds which so many painters have found attractive certainly make it easy to obtain a vibrant and transparent tone. But such a ground is of no value unless the paint itself is very lightly applied over it. And although the results may be satisfactory at first and may remain so for a number of years, the thin layer of paint which covers the coloured ground nevertheless gradually tends to disappear, and the tone of the ground begins to prevail over the others, thus putting out the colour harmony of the picture and destroying the balance of values; for, as will readily be supposed, the only parts which resist will be the high lights, which are generally painted in strong colours and which last all the better because they have probably been applied with fairly vigorous impasto in order to hide more completely the dark ground on which they were painted.

From the last observations we may at once draw a general conclusion which is of the greatest consequence to the painter: it must never be thought that the colours of a picture can be neutralized by the final layers of paint which are applied over them. A proof of this may be found in the curious phenomena connected with what are known in France as *repentirs*. These are corrections of a part of a picture which has already been painted, made before the whole picture is complete. If for example, at one of the sittings for a portrait, the artist sees that the arm or leg of his subject would produce a more characteristic effect if its position were changed, he may merely repaint the arm or leg without scraping off the original paint. Or again, accessories which prove inconvenient in the composition of a picture may be covered over with a few strokes of the brush. It often happens that after a longer or a shorter period the original detail begins to show through, and sometimes becomes quite clearly visible. This can be seen in Velasquez' portrait of Philip IV. in the Prado, in Ingres' "Jesus among the doctors" at Montauban, and in Bonington's "View of Venice" and Gros' "Portrait of the Comte Fournier-Sarlovèze" in the Louvre, to mention a few examples chosen haphazard from hundreds of others equally striking.

Development of Colours.—It is difficult to praise too highly the fertility of invention in colour harmonies and the bold experiments in technique which are due to the painters of the present generation. Only too often, however, these inventions contain an element of risk, and only too often, quite apart from the quality of the work, technical considerations are sacrificed. The creation of a picture makes great demands on the intellect, and in its execution, strict discipline must be observed; otherwise the paint in time takes its revenge.

Some painters, having carefully studied portraits by Titian and important pieces of painting by Tintoretto, in which those masters obtained astonishing effects simply by the use of four durable colours, white, black, yellow ochre and red ochre, have tried to reduce their palette to that basis, adding the minimum of additional colours when necessary. Some very good work has certainly been done by this method in the last few years. At the same time there are a number of pictures painted in this way which are heavy even when freshly painted, and which soon afterwards become painfully opaque. And yet, even leaving aside the Italian Renaissance, even leaving aside Velasquez, it is easy to show what variety can be obtained with this sober palette. It is only necessary to look at what has been done by men such as Manet, Corot in some of his figure subjects, Whistler, and Cézanne in his first manner.

There is however one often tested axiom which will give us one of the keys of the enigma: When the same colour, with the same value, is applied twice in the same place, the second application becomes opaque. It is owing to skilful organisation of their work that painters are able to include other colours in their palette besides the ochres, which, incomparably valuable as they are, have their limitations. For it has been proved that the best colours, if not cleanly applied, may lose their qualities, while others, which are not usually used, may be so employed that they will stand the test of time. No more typical example could be found than that of Veronese green. Too many painters use this colour in all circumstances, for it is very attractive owing to the variety of tones which can be derived from it. Unfortunately the effects which it gives do not last, and the subtlest harmonies, the most delicate greys, turn to a muddy and leaden black. Yet Gauguin constantly uses Veronese green without ill results. It should however be noted that Gauguin only employs this dangerous colour either pure or mixed with strontian yellow. Another example is that of vermilion, which loses its freshness and intensity in a few days unless it is applied boldly and without retouching.

Colours have characteristics of their own and however gifted an artist may be, he cannot dispense with patient observation of the difficult technical side of his art. In this respect, the best example in modern times is set by the Impressionists. If we take their best period, arbitrarily selecting 1890 as the final date, we shall find that their palette does not by any means consist of the most stable colours. The cadmiums and the madders play a much greater part than the earth colours, which the Impressionists did not use very frequently; but what admirable technical knowledge was shown by these painters, who were so long criticised for their revolutionary ideas! In their pictures we may note a light and luminous outline; the spots of colour are interlaced, but yet remain distinct. The colour effects are produced rather by the juxtaposition than by the mingling of tones, and it is left to the hand of time to blend and harmonise colours whose original bloom has been respected.

III. **Technique of Execution.**—A painter cannot with impunity retouch his picture whenever he feels inclined; a fact which only too many fail to realise, much to their detriment. The coloured paste which is transferred from the palette to the canvas is a fragile and capricious substance. To paint as inspiration and fancy dictate is not to paint soundly, especially if the work undertaken is on a large scale. Pictures completed at a sitting give the best account of the painter's talent. Everyone knows that studies for pictures are nearly always more brilliant than the completed work. A good example may be provided by a comparison between the female torso by Delacroix in the Musée d'Angers and the same passage as it appears in the "Sardanapalus" in the Louvre.

What can be done with a small picture, however, becomes much more difficult when it is desired to paint on a larger scale. Some masters have, nevertheless, in certain cases been able to paint large canvases without going back over what they had once begun; examples are Tintoretto's "End of the World" in the Madonna dell'Orto at Venice, and Franz Hals' "Banquet of the officers of the corps of archers at Saint-Georges," at Haarlem. By this means they attained an extraordinary vitality of colouring, and their works defy the passage of time. Spontaneous execution of this kind is, however, necessarily limited to certain effects; it is, for example, impossible to arrive all at once at all the pro-

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VARIETY OF TECHNIQUE IN EXECUTION AND COLOUR

1. "A Woman Bathing," by Rembrandt van Rijn (1606–1669), Dutch. Rembrandt used glazes to add to the richness and luminous depth of the picture. 2. "The Three Graces," by François Boucher (1703–1770), French. Boucher here used a pink-tinted ground-work. 3. "The Judgment of Paris," by Peter Paul Rubens (1577–1640), Flemish. Rubens used glazes freely to add to the brilliance and charm of his colour. 4. "The Sleep of Antiope," by Correggio (1494–1534), Italian. In the Louvre. The glazes and half-tones have largely disappeared because of poor restoration in the 18th century. 5. "Portrait of Mme. Recamier" (unfinished), by Jacques Louis David (1748–1825), French. In the Louvre

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VARIETY OF TECHNIQUE IN COLOUR AND LIGHT

1. Miracle of St. Mark (1548), by Tintoretto (Jacopo Robusti, 1518–94), Venetian School (The Academy, Venice). This artist was one of the first to project vast canvases in oil. He covered gigantic surfaces with rich oil colour, where fresco (on the fresh plaster) had been previously used as a medium
2. Landscape, by Nicolas Poussin (1594–1665), French. (The Prado, Madrid). Poussin used a canvas with a brown priming. His paintings have suffered accordingly and his landscapes are badly faded
3. The Bay of Baiae, with Apollo and the Sibyl, by J. M. W. Turner (1775–1851), English. Turner was fascinated with light, and uses colour with fluidity and brilliance. He greatly influenced the Impressionists
4. Adoration of the Magi, by Peter-Paul Rubens (1577–1640), Flemish. (Musée Royale des Beaux-Arts, Antwerp). This achievement unparalleled from the technical point of view is one of the largest and most admired of the master's compositions. It is executed on a large wooden panel, made up of several sections, directly over a ground-sketch in brown. Signs of the removal by the restorer of the vermilion and the old varnish appear below, right
5. Two Gentlemen, portrait of George Huddesford and of Codrington Warwick Brampfylde, by Sir Joshua Reynolds (1723–92), English. Reynolds worked with very long brushes, being thus enabled to see the effect of his work from some distance while laying on the colour. He often blocked in his pictures in *impasto* or *grisaille,* then coloured it and carried it further with glazes. His paintings evaporated, turned yellow, cracked, and perished even during his life time

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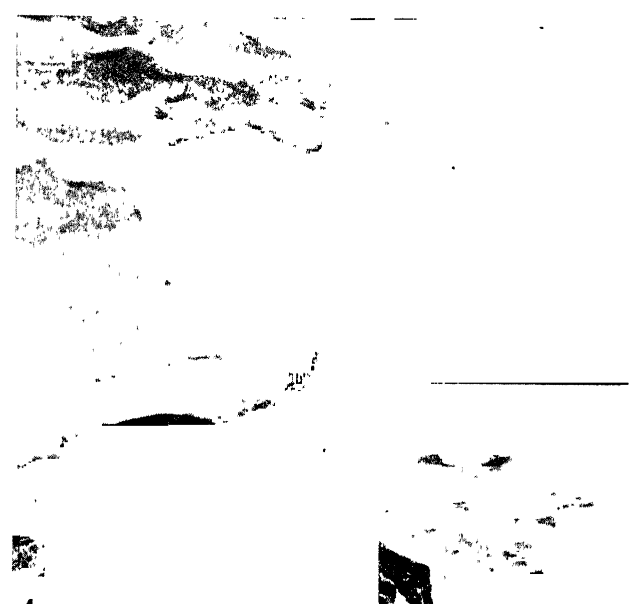

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BY COURTESY OF (1) JULES S BACHE, (2, 3, 4) THE METROPOLITAN MUSEUM OF ART, NEW YORK

VARIETY IN TECHNIQUE OF EXECUTION

1. "The letter" (*Le billet-doux*) by Jean-Honoré Fragonard (1732–1806), French. This illustrates dexterity of handling. Fragonard was one of the most brilliant sketchers ever known, equally notable for the virtuosity of his facile swift brushwork and for his pure, delicate colouring. He was a master of the sketch as a thing complete in itself
2. "Young woman with a jug" by Jan Vermeer of Delft (1632–75), Dutch. A great colourist, famous for his light effects, Vermeer achieved his smooth even handling with a round soft brush
3. "The Isle of Shoals" by Childe Hassam (1859–1935), American. Childe Hassam, as an Impressionist and a follower of Monet, frequently paints in the *pointilliste* method, with separate points or touches of pure colour, applied in conformity with the configuration of the surface to get the modelling. The whole scene vibrates with light
4. "Cannon Rock" by Winslow Homer (1836–1910), American. This painting of the Maine Coast series, sometimes called Homer's "Ocean Symphony," illustrates the artist's technical command of palette-knife and brush in the use of thick and thin paint

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FAULTS AND DEFECTS OF PAINTINGS—ENLARGED VIEWS SHOWING DETAILS OF TECHNIQUE

1. "Head of a Girl," by Jan Vermeer of Delft (1632–75), Dutch. In the Royal Picture Gallery at The Hague. The cracks are caused by painting over a smooth priming. 2. "Portrait of M. Leblanc," by Jean Auguste Dominique Ingres (1780–1867), French. The cracks due to "Siccatif" are clearly visible. 3. "The Harvesters," by Pieter Bruegel the Elder (1525?–69), Flemish. Underpainting showing through an overpainted correction is known as a *pentimento.* Here the underpainting shows through, owing to the fact that the colours have become transparent from age. The tree trunk shows through the hat. 4. "Portrait of Philip IV," by Diego Velazquez (1599–1660), Spanish. In this famous portrait the original detail is beginning to show through and is clearly visible in places. In the Prado, Madrid

fundities of technique and observation which go to make up a Rembrandt; in such cases sketches must be made first.

Several methods of preparation have been and still are adopted. In order to retain as far as possible the impression of a picture executed without repainting, some masters have first sketched in their picture with a thin wash of a single colour, very much diluted. They thus mass in the lights and shadows and lay down the main lines of their subject, after which they attempt the final painting. This system was used for a great many 18th-century pictures in which the colours work in admirably with the original sketch executed in a reddish brown wash. An example is Fragonard's "Music Lesson," which has all the spontaneity of a rapid sketch.

Even before the 18th century Rubens, whose genius delighted in the overcoming of difficulties, was naturally attracted by this method. Not content with studies or simple compositions, he painted his "Kermesse" in the Louvre and his great "Adoration of the Magi" in Antwerp directly over a ground-sketch in brown. The latter work is an unparalleled *tour de force* from the technical point of view. But not all artists are Rubens, and a painter who does not possess his incomparable technical mastery cannot execute large-scale canvases by this method. There is, moreover, a danger; however vigorously the picture is painted, the colour in which the preliminary sketch is executed gradually tends to prevail in the general harmony. The result of this is indeed sometimes admirable; the "Portrait of Helène Fourment and her children" in the Louvre owes to its warm-tinted ground sketch a golden tone which is independent of the thick coat of varnish which has been applied.

Thus this attractive, but difficult and sometimes dangerous method, can only be used for limited purposes. It is more usual for painters to make use of all the materials at their disposal for sketching in their pictures; they use all the colours of their palette for the first groundwork, which matters so much to the success of the picture and still more to how it will develop in the future, and they gradually work up to the desired colour harmony. Great masters, such as Raphael, Chardin and Delacroix, have painted in this way. But they have never lost sight of the discipline which must be observed if a painting is to keep its pristine qualities. Like the sound technicians that they were, they did not forget the twofold danger which has to be avoided in the painting of a picture: overdone brushwork and muddy overlaid colour. A canvas painted without method is doomed to perish. If a sketch is painted over while it is only half dry, the paint will become muddy and dead; if solid colours, such as ochres, are applied over fragile groundwork painted with madders, or if a dark tone is put in over a light ground which is still fresh, cracking will result. What most often happens, however, is that one part of the canvas is painted over again to correct it without sufficient care; then all the dark parts become opaque black, while the lights lose their brilliance.

In order to avoid these dangers and to ensure good and solid quality in their paint, many painters work according to a system of division of labour. They use grisaille in the form of an undiluted paste for the preparation of their works, following a method first used by Italian Renaissance artists. Their pictures are sketched in with two colours, white and black or white and brown, as in a chalk and charcoal drawing. The painter can then, without any danger of working over the colour too much, work on a particular passage or modify the composition until the balance of the whole is satisfactory. The colour can then be put in on this solid foundation of grisaille; the final painting should be executed as rapidly as possible. This method has been used by Titian in his nudes and most of his portraits, El Greco and Rubens in many of their great works, Watteau in his "Gilles," Prud'hon in nearly all his pictures, and nearer to our own time Ricard and Gustave Moreau. Some painters go so far as to obtain their final harmony simply with glazes and a few touches of impasto over a monochrome ground; a typical example of this method carried to an extreme is to be found in Reynolds' "Portrait of Master Hare" in the Louvre. It will be observed that with this method the paint never becomes heavy, the colour may in some cases fade if it is put on too lightly, but no method of work does more to protect the delicate effects of a colourist or to preserve the unity of execution.

The Varnish.—The part played by varnish is twofold. In the first place it protects the picture from impurities in the air. In the second place it restores freshness to the picture when this has been lost, for as it dries, the oil which enters into the composition of the colours penetrates to the lower layers, as well as evaporates, leaving the colours dimmed. Varnish restores them to their original vigour, and it has the property of remaining transparent when it hardens. The theoretical value of varnish is thus simple and obvious. Its application is, however, often criticised. When painters leave the varnishing of their pictures to their colour dealers, and it is curious to note how many of them do, the dealer frequently puts on the varnish too thickly and irregularly. Pictures varnished in this way are painfully shiny, and as many modern painters give as much emphasis to their dark tones as to their high lights, it often happens that all the intersections of the dark strokes shine to such an extent that the picture cannot be properly seen. The first results of bad varnishing soon show themselves in the form of large stains on the picture corresponding to the irregularities in the application of the varnish.

Not only is varnishing sometimes badly done, but it is done too soon and at the wrong moment. Since varnish solidifies very quickly, it is quite obvious that it should not be applied until a painting is perfectly dry. This will prevent it from softening the paint even to the slightest extent, and thus causing it to crack by drying differently. Care should also be taken never to varnish a picture while it has dust on it; otherwise impurities will remain between the paint and the varnish and will in time spoil the picture. The coat of varnish should be extremely thin and applied firmly and regularly, since it loses its qualities and dries cloudy if it is put on thickly. Varnishing should not be done on a wet day, or moisture will be imprisoned between the varnish and the canvas. If this precaution is neglected, there will be a bluish film over the picture.

One of the most frequent stumbling-blocks for the painter is the result known as "matt" effect. The dulling of the paint, which has already been mentioned as one of the reasons for which varnish has to be used, may be produced while the picture is being painted, and will be especially marked if the first sketch is painted over before it is properly dry. The oil of the second coat may be absorbed so rapidly that the last touches which are put on appear to be of a dull grey nothing like the real colour. The "matt" effect at once disappears if any liquid is passed over the picture; but it often causes worse damage in the end, for the repeated imprisonment of moisture between the various layers of paint constituted by retouching will slowly but surely destroy the picture.

Siccatives, heavy oils and mixtures of all kinds are really responsible for much of the damage which is attributed to varnish. It is a matter of common knowledge that Delacroix was not always as strong on the technical side as he was lofty in his conceptions. It is difficult to say which did most to destroy his paintings—the curious mixtures of liquids which he used, or the disastrous qualities of the materials which entered into the composition of the colours with which he habitually painted. We can obtain some idea of the splendour which his works ought to have retained by looking at those canvases which he executed simply, such as the "Algerian Women," "The Artist's Studio" and the "Still Life" in the Moreau-Nélaton collection in Paris. And very often that delicate artist Prud'hon made excessive use of heavy oil and bitumen, which caused immense cracks to form in his pictures, as for example in his "Christ" in the Louvre.

How then, it will be asked, is it possible to correct a passage which is seen in the course of painting a picture to be unsatisfactory? And once the picture is painted, how can it be made fit for exhibition if it cannot yet be varnished without danger, and if the colours have a "matt" effect.

There are on the market a number of varnishes known as retouching varnishes, the merits or demerits of which cannot be discussed here. It may, however, be said that the lighter and more transparent the liquid to be applied over the piece which it

is desired to repaint, the less danger there is that it will impair its freshness in time to come.

When the painting is completed, the general effect can be clearly seen if it is washed over with a mixture of white of egg, water and sugar. This preparatory varnish does not affect the colours in any way, and it can be sponged off with water when the time comes, about a year later, to apply the final coat of varnish which it has by this means been possible to defer.

Some have thought that varnish can be replaced by glass, and many have followed the example of the British picture galleries by glazing oil paintings. Glass is an effective protection against damp, especially if the back of the picture is felted. This is the reason why it is used in London, where the air is very damp. At the same time glass protects the picture from the fingers of clumsy visitors to public galleries, and from smoke in private houses. But it can never be a substitute for varnish; indeed it often makes it impossible to see and appreciate a picture properly. Not only is glass no substitute for varnish, but it transforms the picture into a mirror, so that the spectator sees a reflection of himself rather than the painting.

The disadvantages of glass are not so serious in the case of pictures in which the general tone is light. The difficulty still exists, but it is lessened because white does not transform a sheet of glass placed in front of it into a mirror. Many modern painters who paint in light tones have refrained from varnishing their pictures, as it does not help very much to bring out light tones. The objection to varnish dates, naturally enough, from the Impressionist period. The Impressionists wished their colours to produce as vibrant an effect as possible, and they therefore took care not to cover the paint with a foreign substance which was liable to develop in a way which they did not like.

It was inevitable that as painters gave up the use of varnish, they should gradually come to use turpentine to dilute their colours, and at the same time to paint on absorbent canvas. Mat painting has the technical advantage of avoiding the difficulty of "bloom" which was mentioned above; a deliberate attempt is made to obtain harmonies by the use of colours which do not shine because they contain less oil, either on account of their having been mixed with turpentine or on account of the oil having been absorbed by the canvas. So many admirable works have been produced by this method that we cannot fail to rejoice at a new discovery in the technique of painting. It must, nevertheless, be asked in all impartiality how a painting from which for one reason or another varnish has been excluded will stand the effects of time. If pictures were always to be exhibited under favourable circumstances, in a dry climate, not exposed to changes of temperature, and sheltered from dust, smoke and fumes of all kinds, we could allow varnish to be an unnecessary protection. All persons who have had occasion to see a large number of paintings will, however, have met with cases, somewhat rare, it is true, of 18th century decorative panels which have never been varnished. As a general rule about one centimetre of the edge of the painting is concealed by a frame or beading. The painting has not turned yellow as it would have done if it had been too heavily varnished, but at the same time it has not kept its original brilliance; it is covered, as it were, with a veil of warm grey except under the frame, where it has been protected from the light and from the impurities in the air and has preserved its original freshness. The worst feature is that there is no way of cleaning pictures of this kind. The dust fixed on the paint by the moisture in the air has become incorporated with it; but still more, the very body of the colour has been affected. Simple tones such as light greys have remained comparatively luminous, but the reds have become purplish, the yellows have turned brown, and the browns have lost their transparency. The dirt produced by dust fixed on the picture by the moisture of the air has worked right into the grain of the canvas. Such attacks by foreign bodies would not have had so much effect on varnish, and even if owing to circumstances the varnished picture had suffered an accumulation of dirt, it would still be possible to remove the varnish and find underneath the picture as the painter conceived it.

It is most desirable to protect these mat pictures with glass, unless a coating of wax is put over them to preserve their nonshiny appearance. The merits of wax for this purpose have always been known; it is one of the best means of preserving paintings, and it isolates them from injury from without in the same way as varnish.

(*See* PAINTING; LANDSCAPE PAINTING; PORTRAIT PAINTING; STILL-LIFE PAINTING; MURAL PAINTING; FLOWER PAINTING.)

(J. G. G.)

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OIL PALM, a genus of palms (*Elaeis*) botanically allied to the coconut palm (*Cocos*). The more widely known of the two species belonging to the genus *Elaeis*, *E. guineensis*, is indigenous to tropical West Africa, where it has attained considerable economic importance as a source of palm oil and palm kernels, but it is also cultivated as a plantation crop in Indonesia and Malaya and, on a small scale, in some Central and South American countries. The oil palm in Africa is confined mainly to a 300-mi.-wide region along the coast from the Gambia to Angola, although it is also found in the forest regions of the middle Congo and British East Africa. It is a light-demanding species but grows well on a variety of deep, well-drained, neutral or alkaline soils. In maturity it may attain a height of 60 ft. but normally has a stem of no more than 30 ft., which bears at the summit an irregular crown of feathery leaves, each of from 10 ft. to 15 ft. in length and pinnately divided into 50 or more lance-shaped leaflets. The numerous flowers are crowded on a short spadix and develop into a large ovate fruit cluster which may contain more than 1,000 drupes, varying in colour from a deep yellow to a dark red-brown. Mature palms bear from two to six bunches of fruit, each normally weighing between 10 lb. and 35 lb., approximately one-third of which consists of stems or bracts.

The individual fruit is between 1 in. and 2 in. in length and ¾ in. and 1 in. in diameter, its weight varying from 3 g. to 25 g. The fibrous pericarp, or outer fleshy portion of the fruit, consists, as to between 30% and 70% of its weight, of palm oil, while the kernels in the endocarp are approximately 50% by weight of palm kernel oil.

The weight ratio of pericarp to kernels varies considerably but the *dura* and *tenera* varieties cultivated in Malaya and Indonesia consist largely of pericarp, unlike the wild palms (var. *macrocarya*) of West Africa; production of palm oil in the Asian countries is consequently of much greater importance than that of palm kernels (*see* PALM OIL). Research into the improvement of *E. guineensis* strains has been concentrated mainly upon the thick pericarp varieties and, in particular, upon dwarf varieties which facilitate harvesting of the fruit.

See West African Institute for Oil Palm Research, *Quarterly Progress Report* (Benin City, 1953). (H. F. C. G.)

OIL REFINING: *see* PETROLEUM.

OIL RESERVES SCANDALS (U.S.). Certain oil-

bearing lands in the state of California—reserve no. 1 (Elk Hills) and reserve no. 2 (Buena Vista)—had been designated by the U.S. government in 1912 as naval oil reserves. Three years later reserve no. 3 (Teapot Dome, Wyo.) was established.

The navy department was authorized in 1920 to exploit and use those lands on the reserves on which there were no prior claims pending. Although the navy department retained the right to set general policy, jurisdiction over the reserves was later transferred by executive order to the department of the interior.

In 1922 the secretary of the interior, Albert B. Fall, and the secretary of the navy leased the Elk Hills reserve to Edward L. Doheny of the Pan American Petroleum company, and the Teapot Dome reserve to Harry F. Sinclair of the Mammoth Oil company. The negotiations were carried on in secrecy on the advice of the navy department, which held that military plans and security were involved since the construction of oil tanks at Pearl Harbor, T.H., and other strategic matters were part of the agreements.

Senate investigating committees, however, discovered that Fall had received a "loan" of $100,000 from Doheny and was further involved in financial dealings with Sinclair.

A joint resolution was passed by the U.S. congress on Feb. 8, 1924, directing the president "to institute and prosecute suits to cancel certain leases of oil lands and incidental contracts, and for other purposes."

The resolution stated: ". . . the said leases and contract are against the public interest and . . . the lands embraced therein should be recovered and held for the purpose to which they were dedicated." It was further resolved that "the President of the United States be, and he hereby is, authorized and directed immediately to cause suit to be instituted and prosecuted for the annulment and cancellation of the said leases and contract and all contracts incidental or supplemental thereto, to enjoin further extraction of oil from the said reserves under said leases or from the territory covered by the same, to secure any further appropriate incidental relief, and to prosecute such other actions or proceedings, civil and criminal, as may be warranted by the facts in relation to the making of the said leases and contract."

After a great deal of litigation, the courts held the leases invalid. In criminal actions Doheny and Sinclair were acquitted of charges of bribery and conspiracy, but Fall was convicted and served a prison term.

(*See* also SECRET SERVICE, U.S.; UNITED STATES: *History: After World War I—To 1926*.)

OILS, FATS AND WAXES. The term "oils" is loosely used as a generic term for substances having the common property of being greasy fluids, either at the ordinary temperature, or at temperatures below the boiling-point of water. Formerly, when substances were principally classified by obvious characteristics, the word included such a body as "oil of vitriol" (sulphuric acid), which has, of course, nothing in common with what is now understood under the term oils.

In its most comprehensive ordinary acceptation the word embraces at present the fluid, "fixed," or fatty oils (*e.g.,* olive oil), the soft fats which may be fluid in their country of origin (*e.g.,* coconut oil, palm oil), the hard fats (*e.g.,* tallow), the still harder vegetable and animal waxes (*e.g.,* carnaüba wax, beeswax), the odoriferous ethereal (essential) oils and the fluid and solid volatile hydrocarbons—mineral hydrocarbons—found in nature or obtained from natural products by destructive distillation, (petroleum, shale oils, oils from the low-temperature distillation of coal).

The importance of fatty and mineral oils to the life and industry of a nation is a commonplace of everyday observation; the exigencies arising from the World War did but emphasize human dependence on these raw materials for food and power, and stimulated development and research in all branches of the industries connected with them. Great advances have been made in the utilization of mineral (petroleum [*q.v.*]) oils. The last two decades have seen great developments in oil-fuelled internal combustion engines and the widespread adoption of oil as a fuel for steam-raising, both in stationary boilers and for shipping, and more especially for battleships, where high power output combined with economy in fuel-storage space and stokehold labour are of primary importance. Improvements in the production of lubricating oils have been necessitated by the advances in modern machinery, which involve higher working temperatures and pressures. We may note in passing the development, especially in Germany, probably as a direct result of war-time isolation from supplies of mineral oils, of the production of oils by the distillation of lignites and by synthesis from producer gas.

The fatty oils, ever of paramount importance as food, acquired an increased significance during the War as sources of glycerine, the basis of explosives of the dynamite class. In England, strict government supervision was exercised over soap manufacture, and all industries involving the hydrolysis of fats, to ensure the maximum recovery of glycerine (about 10–14% of the weight of a fresh oil). Towards the end of the War period a process was mooted to replace the glycerol in edible fats by mannitol or a similar sugar, in order to obtain both the glycerine and a product equal in nutritive value to the original fat.

The shortage of edible oils in all countries during the War led to great advances in the technique of oil-refining; oils hitherto regarded as purely industrial became available for food as a result of improved methods of purification, and it may be said that to-day almost all fats, with the exception of those possessing marked physiological action, such as castor, curcas and chaulmoogra oils, can be utilised as food. Especially in the Central European countries, where, as a result of the blockade, the shortage of fats became acute, every effort was made to stimulate the investigation and production of synthetic fats. In some cases processes were put into actual operation; and in Germany attempts were made to supplement available resources with fat obtained from yeast under intensive cultivation. Synthetic fatty acids can be prepared by the oxidation of paraffin wax and other hydrocarbons, and glycerides have been synthesised on the large scale by heating these acids, under pressure, with glycerol, which may be obtained by the fermentation of non-crystallisable sugars. In view, however, of the enormous expansion of which the natural production of the fats is capable, it is extremely improbable that these methods will be commercially successful under normal economic conditions.

The common characteristic of all the "oils" is that they consist principally, in some cases exclusively, of compounds of carbon and hydrogen. They are all readily inflammable and are practically insoluble in water. The mineral hydrocarbons found in nature, or obtained by destructive distillation do not come within the range of this article (*see* NAPHTHA, PARAFFIN, PETROLEUM), which is restricted to the following two large groups of bodies, formed naturally within the vegetable and animal organisms, viz. (1) Fixed oils, fats and waxes, and (2) Essential, ethereal or volatile oils.

FIXED [FATTY] OILS, FATS AND WAXES

The substances to be considered under this head divide themselves naturally into two large classes, viz., fatty (fixed) oils and fats on the one hand, and waxes on the other, the distinction between the two classes being based on a most important chemical difference. The fixed oils and fats consist essentially of *glycerides, i.e.,* esters formed by the union of three molecules of fatty acids with one molecule of the trihydric alcohol *glycerol* (glycerine, *q.v.*).

In a class of glycerides known as the phosphatides or phospholipines one or more of the fatty acid radicles is replaced by a grouping containing nitrogen and phosphorus, as, for example, lecithin.

The waxes consist of esters formed by the combination of one molecule of fatty acid with one molecule of a monohydric alcohol, such as cetyl alcohol, cholesterol, etc. Only in the case of the wax *coccerin* are two molecules of fatty acids combined with a dihydric alcohol. It must be pointed out that this distinction does not find ready expression in common parlance; thus *Japan wax* is a glyceride and should be more correctly termed Japan tallow, whereas *sperm oil* is, chemically speaking, a liquid wax. Although these two classes of substances have a number of physical properties in common it is better, for some purposes, to consider them

under separate heads. The true chemical constitution of oils and fats was first expounded by the classical researches of Chevreul, embodied in his work, *Recherches sur les corps gras d'origine animale* (1823, reprinted 1889).

Occurrence.—The oils and fats cannot be looked upon as definite chemical individuals, but as representatives of natural species which vary, although within narrow limits, according to the climate and soil in which the plants producing them are grown, or, in the case of animal fats, according to the climate, the race, the age of the animal and especially the food as well as the idiosyncrasy of the individual animal. The oils and fats are distributed throughout the animal and vegetable kingdom, from the lowest organisms to the highest, and are found in almost all tissues and organs. The vegetable oils and fats occur almost exclusively in the seeds and fruits; the waxes appear usually as thin films covering leaves and fruits. In animals the fats are enclosed mainly in the cellular tissues of the intestines and of the back, although a certain amount of fat is present in all the organs; in the lower animals fat is also stored in the liver, muscles, etc. There are a few liquid waxes known, occurring in the blubber and head cavity of sperm whales and stored in the stomach of certain arctic and antarctic birds (*e.g.*, Australian mutton-bird [*see* SHEARWATER]); other waxes occur as insect secretions, while wool-wax is the natural grease found in sheep's wool.

Physiology of the Fats.—The most evident function of the fats in animal organisms is that of food-reserve, to supply, by subsequent oxidation, energy for the growing and working tissues. The storage of fats and oils in vegetable seeds can be similarly explained as food-reserve for the embryo; it is difficult, however, to account for the presence of oil in large quantities in the pericarp of fruits such as the olive and palm, which is probably destroyed before germination of the seed. The fats, and especially the waxes, can fulfil other valuable service by virtue of their physical properties, *e.g.*, insolubility in water, and their chemical inertness. For instance, subcutaneous fat deposits protect the organism from cold; beeswax prevents dilution of the concentrated sugar solutions of the comb by external moisture; the waxes, and in some cases the fats, secreted in the leaves of plants preserve the underlying tissues from loss or access of water. It is probable that the resistant powers of the tubercle bacillus are largely attributable to the protective effect of the wax coating in which it is encased; this waxy secretion is remarkably inert and resists the action of the usual hydrolysing measures. It is probable that the fats fulfil still other, though more recondite, essential functions, quite distinct from their office as fuel supply for the cells.

It is only within the last few years that the importance of the animal fats as sources of the fat-soluble vitamins has been recognised: the discovery that vitamins (*q.v.*) may be produced in some non-active vegetable oils by the action of light is among one of the most recent advances of biochemistry. These bodies, of vital physiological importance as accessory growth factors, appear in minute proportions in the unsaponifiable (non-glyceridic) fraction of natural oils probably as a result of their physical solubility in these media; nevertheless the recognition of the part played by these substances attaches a new significance to the rôle played by the fats in animal metabolism.

Synthesis and Oxidation of Fats in Living Organisms.—The fat of the flesh-eating animals appears to be mainly derived from the fats consumed in the food; it has been demonstrated, however, by the classical researches of Lawes and Gilbert, that animal fats can be derived from carbohydrate food, while it is probable, although the proof is not so clear, that carbohydrates are the source of the fats in herbivorous animals and plants. In the case of vegetable seeds and fruits the formation of fats occurs late in the ripening process; in the unripe condition carbohydrates (sugars, starches, etc.) are to be found in the fruits and sap, but no fatty acids (or oils) and it is likely that the former are broken up and converted into fatty acids and subsequently into glycerides during the maturing process. In the case of almonds it has been observed that carbohydrates disappear as fat is formed.

It is a noteworthy fact that, almost without exception, only acids with an even number of carbon atoms in the molecule occur in the natural fats. The preponderance of C_{18} acids suggests the hypothesis that the fats are derived from the C_{18} nucleus of the polysaccharides, or, perhaps, from three molecules of glucose. Secondary oxidations and condensations are necessitated to explain the formation of C_{16} and the higher acids C_{20}, C_{22} and C_{24}. To account for the formation of milk fats and fats of the coconut class, which are distinguished by the presence of the lower fatty acids, a second type of synthesis has been postulated, involving a building-up process of the acids, one from another, and originating from simple sugars instead of the more complex polysaccharides. Yet other theories have been propounded to account for the formation of the unsaturated link in the middle of the oleic acid chain. It is possible that fats can be formed from protein material.

The utilisation of the stored fat by the plant embryo has been but little studied; it seems that the fat is hydrolysed by lipolytic (fat-splitting) enzymes and broken down, possibly into simpler fatty acids, with the ultimate production of carbohydrates (*cf.* conversion of fat into sugars in animals under abnormal conditions of glucosuria).

In the animal body the fats of the food are emulsified and hydrolysed by enzymes in the intestine; the glycerol and fatty acids are absorbed through the intestinal epithelium, recombined to form glycerides characteristic of the animal in question and transported *via* the blood and chyle to the connective tissues for storage. It may be noted that the fat of an individual animal can vary according to the fatty food supplied; for instance, the milk-fat of cows fed on a diet rich in coconut-oil simulates the latter in its properties; the fat of the Eskimo possesses an abnormally high iodine value, and resembles blubber oil.

The way in which the fat reserves are circulated to the organs in which combustion of the fat with the liberation of energy occurs, is scarcely understood. It is established that when mobilisation of reserve fat takes place the stream is primarily directed to the liver, where the fatty acids are desaturated, *i.e.*, unsaturated linkages are introduced into the fatty acid molecules. It is uncertain whether unsaturated acids so produced are distributed to the working cells as glycerides; it is possible that compounds of the fatty acids with nitrogen and phosphorus (the phospholipines, which are found in the liver and other organs) must be built up by the liver prior to transfer by the blood to the various organs. The unsaturated links introduced into the fatty acids by the liver appear to provide weak points for attack by the working cells in the process of combustion to the ultimate products of carbon dioxide and water.

FATTY OILS AND FATS

The fixed oils and fats form a well-defined and homogeneous group of substances passing through all gradations of consistency, from oils which are fluid even below the freezing point of water, up to the hardest fats which melt at about 50° C. Therefore, no sharp distinction can be made between fatty oils and fats. Nevertheless it is convenient to apply the term "oil" to those glycerides which are fluid below 20° C, and the word "fat" to those which are solid above this temperature. As a general inclusive term the expression "fat" is preferable, since this avoids confusion with mineral and essential oils.

Chemical Composition.—No oil or fat is found in nature consisting of a single chemical individual. Following on Chevreul's work, the fats were considered to consist in the main of mixtures of "simple triglycerides," this is, of *glycerides* in which each molecule of *glycerol* is combined with three molecules of the same acid, *e.g.*, tristearin, $C_3H_5(O{\cdot}CO{\cdot}C_{17}H_{35})_3$, the glyceryl ester of stearic acid, $C_{17}H_{35}COOH$; triolein, $C_3H_5(O{\cdot}CO{\cdot}C_{17}H_{33})_3$. Recently, however, it has been shown that "mixed glycerides," *i.e.*, compounds wherein one molecule of glycerol is united with two or three different fatty acid radicles, preponderate, *e.g.*, dipalmito-stearin, $C_3H_5(O{\cdot}CO{\cdot}C_{15}H_{31})_2(O{\cdot}CO{\cdot}C_{17}H_{35})$; palmito-oleo-stearin, $C_3H_5(O{\cdot}CO{\cdot}C_{15}H_{31})$ $(O{\cdot}CO{\cdot}C_{17}H_{33})$ $(O{\cdot}CO{\cdot}C_{17}H_{35})$. The natural fats, therefore, may differ, firstly in the fatty acids which they contain, and, secondly, by the different arrangement of the acids in simple and mixed glycerides. Fatty diglycerides only

occur occasionally as products of partial hydrolysis of the oil by ferment action.

Fatty Acids.—The most important and widespread of the fatty acids are *palmitic*, $C_{15}H_{31}COOH$ and *stearic*, $C_{17}H_{35}COOH$, acids (of the saturated series), and the unsaturated *oleic* acid, $C_{17}H_{33}COOH$.

The fatty acids are classified into related (homologous) series according to their degree of unsaturation, *i.e.*, the number of unsaturated or ethenoid bonds $>C=C<$, in the molecule of the acid. This classification is amplified in the list of examples which here follows.

Straight chain fatty acids.—The acids of the saturated (*acetic*, or *stearic*) series, general formula $C_nH_{2n+1}COOH$, include among the lower members butyric acid, C_3H_7COOH, characteristic of butter fat (*q.v.*), caproic, $C_5H_{11}COOH$, caprylic, $C_7H_{13}COOH$, capric, $C_9H_{19}COOH$, lauric, $C_{11}H_{23}COOH$, and myristic acids, present in butter and fats of the coconut class; stearic and palmitic acids are higher in the series. Acids of the oleic series, $C_nH_{2n-1}COOH$, (one pair of doubly-linked carbon atoms), of which oleic acid $C_{17}H_{33}COOH$, present in nearly all oils and fats, and erucic acid $C_{21}H_{41}COOH$, characteristic of rape and fish oils, are the most important. Acids of the linoleic series, $C_nH_{2n-3}COOH$ (two ethenoid bonds), include linoleic acid, $C_{17}H_{31}COOH$, present to a large extent in maize and cottonseed oils. The linolenic series acids, $C_nH_{2n-5}COOH$ (three double bonds) of which linolenic acid, $C_{17}H_{29}COOH$, the characteristic acid of linseed oil is very important, as the high degree of unsaturation of this acid is responsible for the "drying" power or oxidisability upon which the commer-

TABLE I.

Oil	Principal sources of raw material	Yield %	Iodine value	Principal applications
		Vegetable Oils		
Drying oils				
Linseed	Argentina, India, N. America, Russia	38–40	175–205	Paint, varnish, linoleum, soft soap.
Tung	China, Japan	40–41	150–165	„ „
Hempseed	W. Europe, N. America, India, Japan	30–35	148	„ „ soft soap, rubber substitute.
Poppyseed	Levant, India	41–50	123–143	Salad oil, artists' oil, soft soap.
Semi-drying oils				
Soya bean	China, Japan	13–17	122	Edible, burning.
Maize; corn	U.S.A., Argentina	6–10	113–125	„ soap.
Cottonseed	„ India, Egypt	30–32	116	Food, soap, steel-plate industry.
Sesame	India, etc., Egypt, Levant	24–26	108–110	„ „
Rape (Colza)	E. India, Europe	33–43	94–102	Food, lubricant, burning, wool oils, steel-plate industry.
Non-drying oils				
Almond	S. Europe, N. Africa	45–55	93–100	Perfumery, pharmacy.
Arachis (ground-nut)	India, W. Africa, China, U.S.A.	43–45	83–100	Edible, soap.
Olive	Mediterranean countries	40–60	79– 88	„ , soap, perfumery; lubricating, pharmacy.
Castor	E. India, Mediterranean, C. America	46–53	83– 86	Medicine, soap, lubricant, Turkey-red oil.
		Animal Oils		
Marine Animal Oils				
Fish oils:				
Menhaden	Atlantic coast of N. America	..	140–173	Leather currying, steel-plate industry, linoleum.
Herring	N. Sea, Japan	..	124–142	Leather currying
Liver oils:				
Cod liver	N. Sea, E. coast N. America	..	167	Medicine, leather currying.
Shark liver	Coasts of N. America	..	115	Leather currying.
Blubber oils:				
Seal	Arctic and Antarctic seas	..	127–147	Burning, leather currying.
Whale	„ „ „ „	..	121–136	„ soap, fibre dressing, margarine (after hardening), leather currying, screw oils, greases.
Dolphin, jaw and body oils	. . . .	..	33, 99–126	Lubricating oil for delicate machinery.
Porpoise „ „ „ „	. . . .	..	36, 119	
Terrestrial Animal Oils				
Neat's-foot	U.S.A., S. America, Europe	..	67–73	Lubricating, high-grade leather-dressing.
		Vegetable Fats		
Mahua (Illipé) butter	India, Malaya	50–55	53–67	Food, soap, candles, inferior chocolate fat.
Shea butter	W. Africa, Sudan	49–52	56	Food, soap, candles.
Palm oil	W. Africa	65–72	53	Candles, soap, tin-plate industry.
Cacao (cocoa) butter	W. Indies	32–41	32–41	Chocolate, pharmacy, perfumery.
Palm-kernel oil	W. Africa	45–50	13–14	Food, soap.
Coconut oil	E. Indies, Ceylon, Oceania, S. American coasts	20–25	8–10	„ „ , candles.
Japan wax	China, India, Japan	25	4–10	Polishes.
		Animal Fats		
Non-drying fats				
Lard	U.S.A., Central Europe	..	50–70	Food, soap, pharmacy, perfumery.
Bone	„ India, Europe	..	46–56	Soap, candles.
Tallow, beef	Argentina, U.S.A.	..	38–46	Food, soap, candles.
„ mutton	Australasia	..	35–46	„ „ „
Butter	N.W. Europe, Australasia, Canada	..	26–38	Food.

cial application of the oil in the paint industry depends. Still more unsaturated acids occur, such as clupanodonic acid, $C_{21}H_{33}.COOH$ (five ethenoid bonds), typical of fish, liver and blubber oils. The oxidation products of these oils, however, do not form such tenacious films as linseed oil, to which they are much inferior as paint oils. The hydroxylated acids of the ricinoleic series, $C_nH_{2n-2}(OH)COOH$, are typified by ricinoleic acid, $C_{17}H_{32}(OH)COOH$, the occurrence of which is responsible for the solubility of castor oil in alcohol.

The occurrence of *cyclic* (closed chain) acids is confined to oils of the chaulmoograc and hydnocarpus family. Acids with more than 22 carbon atoms in the molecule are rare among the fats, but are of fairly frequent occurrence among the waxes.

Unsaponifiable Matter.—Since the methods of preparing the vegetable and animal fats are comparatively crude, they usually contain certain impurities of one kind or another, such as colouring and mucilaginous matter, remnants of animal and vegetable tissues, etc. For the most part these foreign substances can be removed by processes of refining, but even after this purification the fats still retain small quantities of foreign bodies, such as traces of colouring matter, albumenoid and (or) resinous substances and other nonglyceridic compounds; these substances can be isolated only after saponification of the fat and are comprised in the term "unsaponifiable matter." Included among the unsaponifiable matter are the *sterols* (cyclic alcohols) —*phytosterol,* $C_{27}H_{46}O$, *sitosterol,* $C_{27}H_{46}O$, *stigmasterol,* $C_{30}H_{48}O$, *ergosterol,* $C_{27}H_{42}O$—and the animal sterols—*cholesterol,* $C_{27}H_{46}O$, *coprosterol,* $C_{27}H_{48}O$, etc. Phytosterol (*i.e.,* plant sterol) occurs in all oils and fats of vegetable origin; cholesterol is characteristic of all oils and fats of animal origin. This important difference affords a means of distinguishing by chemical methods vegetable oils and fats from animal fats. It is in the unsaponifiable fraction of oils that the bodies known as the fat-soluble vitamins (*q.v.*) have been located; these appear to be substances related to the sterols; for example, it was clearly demonstrated that vitamin D can be produced from inactive ergosterol by irradiation with ultra-violet light.

The amount of unsaponifiable matter in an oil or fat does not, as a rule, exceed 2%, but in the case of some shark-liver oils the proportion is abnormally high, as large quantities (up to 85%) of highly unsaturated hydrocarbons such as spinacene and squalene ($C_{30}H_{50}$?) are present; the relationship of these bodies to the glycerides normally occurring in oils, including fish-body oils, is a matter for research.

Classification.—Following subdivision into animal and vegetable oils and fats, a second guiding principle to classification is afforded by a consideration of the amount of iodine the various fats are capable of absorbing. This is a measure of the unsaturated acids present, since iodine is absorbed (under suitable conditions) at the ethenoid linkages of the molecule of fatty acid.

About 80 of the natural fats are commonly utilized to a greater or less extent; the annual world consumption of each of about 20 of these approaches or exceeds 100,000 tons, and in the case of about 6 is in the neighbourhood of 1,000,000 tons. They are classified as follows:

Solid Vegetable Fats.—These are found mainly in the kernels and seeds of tropical fruits. They melt at from 20° to 35° C. and contain in general but little combined oleic acid, the bulk of the component fatty acids being lauric, myristic and palmitic. Fruits of many of the palm family, notably coconut oil and palm kernel oil, contain very large amounts of combined lauric acid. Palm oil contains chiefly palmitic and oleic glycerides. All these fats, when suitably refined, are used for edible purposes, and many are used in the manufacture of the higher grades of toilet and other soaps.

Solid Animal Fats.—A most important group of animal fats is that of milk fats, which are used universally as butter. All milk fats are characterized by the presence of definite, if relatively small, quantities of fatty acids which are known respectively as butyric, caproic and caprylic acids.

Physical Properties.—The specific gravities of oils and fats range from 0.913 (rape oil) to 0.975 (Japan wax, myrtle wax); for the bulk of the fats the value is between 0.915 and 0.945. Some oils, notably those of the castor oil and chaulmoogra groups, rotate the plane of polarization of light.

The oils and fats are practically insoluble in water; with the exception of oils of the castor oil group they are insoluble in cold, and only sparingly soluble in boiling, alcohol. They are completely soluble in ether, carbon disulphide, chloroform, carbon tetrachloride, petroleum ether and benzene. Oils and fats have no distinct melting or solidifying point; this is not solely due to the fact that they are mixtures of several glycerides, for even pure glycerides exhibit the phenomenon of a "double melting point." The freezing points of the oils range from a few degrees above zero down to −28° C. (linseed oil). At low temperatures (*e.g.,* at 12° C. in the case of cottonseed oil), solid portions, usually termed "stearine," separate out from many oils. These solid portions can be filtered off; the filtrates constitute the commercial "demarginerated oils" or "winter oils" which will remain limpid at low temperatures.

Oils and fats can be heated to a temperature of 200° to 250° C. without undergoing any material change, provided prolonged contact with air is avoided. On being heated above 250° up to 300° C. some oils (*e.g.,* linseed oil, safflower oil, tung oil [*q.v.*] [Chinese or Japanese wood oil] and even castor oil) undergo a change, probably caused by polymerization, resulting in the formation of semisolid or solid products. Above 300° C. fats are decomposed; this is evidenced by the evolution of acrolein (a decomposition product of glycerin), which possesses the pungent odour of burning fat. Hydrocarbons are formed at the same time (*see* PETROLEUM).

On exposure to the air oils and fats gradually undergo certain changes. The *drying* oils absorb oxygen ("dry") somewhat rapidly, thin layers forming a skin or film. Extensive use of this property is made in the paint and varnish trades. The *semidrying* oils absorb oxygen more slowly than the drying oils and are, therefore, useless as paint oils; still, in course of time, sufficient oxygen is absorbed to produce distinct thickening. The oxidation of the semidrying oils is accelerated by spreading such oils over a large surface, notably over woollen or cotton fibres, when oxygen absorption may proceed so rapidly that spontaneous inflammation ensues. Many fires in cotton and woollen mills have been caused in this way. The *nondrying* oils, of which olive oil is typical, do not become oxidized readily on exposure to the air, although gradually changes take place, including slow hydrolysis (splitting to fatty acids and glycerol) and subsequent oxidation; the oils thicken slightly and acquire the peculiar disagreeable smell and acrid taste defined by the term "rancidity." The chemical reactions involved in the development of rancidity have not yet been fully explained. If the action of the air and moisture is allowed free play, the hydrolysis of the oils and fats may become so complete that only the insoluble fatty acids remain, the glycerol being washed away. This is exemplified by *adipocere* (corpse fat) and also by Irish bog butter, which consists chiefly of free fatty acids.

The property of the fats of being readily hydrolyzed is most important, and extensive use of it is made in the arts (soap making, candle manufacture, etc., and recovery of their byproducts). If treated with water alone under high pressure (corresponding to a temperature of about 220° C.), or in the presence of water with caustic alkalies, alkaline earths or basic metallic oxides (which act as catalyzers), at lower pressures, they are converted in the first instance into free fatty acids and glycerol; *e.g.,* if bases sufficient in amount to combine with the fatty acids be present, the corresponding salts of these acids are formed, such as the sodium salts of fatty acids (hard soap) or potassium salts (soft soaps), soaps of the alkaline earths (lime soap) or of the metallic oxides (zinc soap), etc. For detailed descriptions of the methods employed in commercial hydrolysis, *see* CANDLE; SOAP.

Extraction.—Since the oils and fats have always served the human race as one of the most important articles of food the oil and fat industry may well be considered to be as old as the human race itself. The methods of preparing oils and fats range

themselves under three heads: (1) Extraction by "rendering," *i.e.*, boiling out with water; (2) extraction by expression, and (3) extraction by means of solvents.

Rendering.—The crudest method of rendering oil from seeds, still practised in Central Africa, in Indo-China and on some of the South Sea Islands, consists in heaping up oleaginous fruits and exposing them to the heat of the sun, when the exuding oil runs off and is collected. In a somewhat improved form this process of rendering is practised in the preparation of palm oil (*q.v.*) and the rendering of the best (Cochin) coconut oil by boiling the fresh kernels with water. Naturally these processes can only be applied to those seeds which contain large quantities of fatty matter, such as coconuts and olives. The rendering process is, however, applied on a very large scale to the production of animal fats, such as tallow (*q.v.*), lard, bone fat and whale oil (*q.v.*). The method consists essentially in cutting up the fatty matter into small fragments, which are transferred to vessels containing water, wherein the comminuted mass is heated by steam, either under atmospheric pressure in open vats or under higher pressure in digesters. The fat gradually exudes and collects on top of the water, whilst the membranous matter, "greaves," falls to the bottom. The fat is drawn off the aqueous (gluey) layer and strained through sieves or filters. The greaves are placed in hair or woollen bags and submitted to hydraulic pressure, by which a further portion of fat is obtained (cf. *Pressing*). In the case of animal fats intended for edible purposes, such as lard, suet for margarine, etc., the greatest cleanliness must, of course, be observed, and the temperature kept as low as possible in order to obtain a perfectly sweet and pure material. To obtain a harder product, fats, such as tallow, are frequently subjected to pressing to squeeze out the more liquid portions, which are sold as oleo oil, lard oil, etc.

Pressing.—The boiling out process cannot be applied to small seeds, such as linseed, rapeseed, etc. Whilst, perhaps, the most primitive method of expression was to crush the seed in mortars until the oil should exude, in the East, where vegetable oils form an important article of food and serve also for other domestic purposes, various ingenious applications of lever and of wedge presses have been used from the remotest times. A detailed description is given by Pliny of the screw presses used by the Romans for the production of olive oil. At an early stage in history the Chinese employed the same series of operations which are followed in the most advanced mills of modern times, viz., bruising and reducing the seeds to meal under edge-stones, heating the meal in open pans and pressing out the oil in a wedge press. This primitive process is still carried out in Manchuria, in the production of soya bean cake and oil, one of the staple industries of that country. The Dutch or stamper press, invented in Holland in the 17th century, was almost exclusively employed in Europe for pressing oil-seeds until the early years of the 19th century; it yielded place to the hydraulic press which has practically superseded all other appliances for expression. The sequence of operations in treating oil-seeds, oil-nuts, etc., is as follows: As an important preliminary operation the seeds, etc., are freed from dust, sand, and other impurities by sifting; in the case of seeds amongst which are found pieces of iron (hammer heads among palm-kernels, etc.), the seeds are passed over magnetic separators. The seeds and nuts are then decorticated (where requisite), the shells removed and the kernels ("meats") converted into a meal by grinding between finely grooved rollers. The comminuted mass, forming a more or less coarse meal, is either expressed in this state, or subjected to preliminary heating according to the quality of product required. For the preparation of *edible* oils, the meal is packed in bags and expressed in hydraulic presses in the cold, under a pressure of 300 atmospheres or more. The cakes remain under pressure for about seven minutes. Oil expressed in the cold dissolves the least amount of colouring matter, etc., and hence has suffered least in quality; oils so obtained are known in commerce as "cold-drawn oils," "cold pressed oils," "salad oils," "virgin oils."

By pressing in the cold only part of the oil is recovered. A further quantity is obtained by pressing the meal at a somewhat elevated temperature, either after the cold-drawn oil has been taken off, or in the case of oleaginous seeds of low value, *e.g.*, cottonseed, coconut, where it is of importance to extract as much oil as possible in one operation, immediately after the meal has left the mill. The process, which is general in application to all oil-seeds is described in some detail, with illustrations of typical hydraulic presses, in the article Coco-Nut Oil and Cake. Oil obtained from heated meal is usually more highly coloured and harsher to the taste than cold-drawn oil, more of the extractive substances being dissolved and intermixed with the oil. Such oils are hardly suitable for edible purposes and are chiefly used in manufacturing processes. According to the care exercised by the manufacturer and the range of temperature to which the seed is heated, various grades of oil are obtained. The residual meal is used as cattle-food, or if from poisonous seeds such as castor beans, as manure.

Extraction by Solvents.—The cakes obtained in the foregoing process still retain considerable proportions of oil, usually about 10%. If it be desired to obtain larger quantities than are yielded by the methods described above, the extraction of the seeds must be performed by the use of volatile solvents. Extraction by carbon disulphide was first introduced in 1843 by Jesse Fisher of Birmingham. For several years the process made little advance, for the colour of the resulting oils was dark and the taste sharp. The oil retained traces of sulphur, causing a disagreeable smell in soaps made from it, and the blackening of substances with which it was used. The meal was so tainted with carbon disulphide that it was absolutely out of the question to use it as cattle-food. With improvement in the manufacture of carbon disulphide these drawbacks have been surmounted to a large extent, and the practice of extraction with this solvent has especially gained extension for waste olive marc in France, Italy and Spain. Modern methods largely use petroleum ether (shale naphtha is more usual for the oil extraction of bone-fat); benzene and the non-inflammable hydrocarbons such as trichlorethylene, have been used, but have not proved so satisfactory, and in the latter case the risk of physiological action on the workmen, has militated against their wider utilisation. The methods of operation have been improved so that losses of solvent do not amount to more than 1%. Good quality oils can be obtained, and the processes are able to compete with expression, the choice of method resting mainly on considerations of the particular seed to be treated and the type of meal desired.

The apparatus employed on the large scale depends on the temperature at which the extraction is to be carried out. In the main two types of plant are differentiated, viz., for extraction in the cold, and for hot extraction. The seed is prepared as for pressing, but the grinding is coarser. In cold extraction the meal is placed in a series of closed vessels, and the solvent allowed to percolate by displacement (upward, in a recent process) on the "counter-current" system. The solution of extracted fat is then transferred to a steam-heated still, where the solvent is driven off and recovered by condensation to be used again. The last remnants of volatile solvent in the oil are driven off by a current of steam blown through the oil in the warm state. The hot-extraction process is carried out in apparatus, the principle of which is exemplified in the well-known Soxhlet extractor. The comminuted seed, spread on trays, is placed inside a vessel containing the solvent and fitted with a reflux condenser. On heating the solvent by means of a steam-coil or jacket the vapours rise through and around the meal, passing into the condenser, whence the solvent drops back as liquid on to the hot meal, percolating through it, and reaches the bottom of the vessel as a more or less saturated solution of oil in the solvent. The solvent is again evaporated, leaving the oil behind, the process proceeding continuously until the extraction is deemed finished. The oil solution is run into a still and the oil freed from solvent as already described. The solvent remaining in the meal is removed by a similar steaming process. It is true that on the European continent extracted meal, especially rape meal from good Indian seed and palm kernel meal, is somewhat largely used as cattle-food in admixture with press-cake; in England extracted meal is not

so employed, but finds its proper use in manuring the land.

Refining and Bleaching.—The oils and fats prepared from fresh ("sweet") material by any of the methods detailed above are practically neutral. Carefully rendered or cold-drawn oils are, as a rule, sufficiently pure to be delivered to the consumer, after a preliminary settling has allowed any mucilaginous matter, animal or vegetable fibres, etc., to separate. The clarification process may be shortened by filtering the oils, or otherwise brightening them, *e.g.*, by blowing with air. In many cases these methods still suffice for the production of commercial fats. Oils intended for use as salad oils, or as lubricants, which deposit "stearine" in the cold are "demargerinated" (*see* p. 749).

In special cases, such as the preparation of edible oils and fats, a further improvement in colour and greater purity is obtained by filtering the oils over absorbent materials such as charcoal, fuller's earth, etc. As in the case of coconut and palm-kernel oils, a preliminary purification in a current of steam may be employed. For refining oils and fats intended for edible purposes, only the foregoing methods, which may be summarized by the name of physical methods, can be used; the only chemicals permissible are alkalies or alkaline earths to remove free fatty acids. The practice of refining by caustic soda has gained considerable extension; the fatty acids are neutralised by caustic soda and removed in the form of soaps by washing, but technically, the process is complicated by the formation of emulsions. Treatment with other chemicals renders the fats unfit for consumption. Hence, all bleaching and refining processes involving other means than those enumerated can only be used for technical oils and fats. There is no universal method of oil refining applicable to any and every oil and fat. Not only must each kind of fat be considered as a special problem, but frequently even varieties of one and the same fat are apt to cause the same difficulties as would a new individual. In many cases purification by sulphuric acid is still usefully applied. The oil is treated with a small proportion of concentrated sulphuric acid; this acts on the suspended impurities, carbonising them to some extent, and causes them to coagulate in the form of a flocculent mass, which settles out carrying with it mechanically other impurities that have not been acted upon. This method is chiefly used in the refining of linseed and rape oils. After treatment with sulphuric acid or caustic soda the oils must be thoroughly washed; the water is allowed to settle out and the oils finally filtered.

A large variety of reagents are in use for bleaching technical oils intended for soaps, lubricants, paints, etc. In general, besides treatment with absorbent media, or exposure to air and light (olive oil), bleaching methods involve the use of oxidising agents such as sodium dichromate and acid, permanganate, hypochlorites, metallic per-salts, peroxides, etc.

Fat-hardening.—There is great demand in the arts for hard fats, and a great development of the fats and oils industry took place in the early years of the present century as a result of the invention of a successful method for converting the liquid unsaturated fatty acids and glycerides into the corresponding solid saturated bodies. The change ("hardening," "hydrogenation") which consists in the addition of hydrogen to the unsaturated bonds, *e.g.*,

$$\underset{\text{oleic acid}}{CH_3(CH_2)_7HC = CH(CH_2)_7COOH} + \underset{\text{hydrogen}}{H_2} = \underset{\text{stearic acid}}{CH_3(CH_2)_7CH_2CH_2(CH_2)_7COOH}$$

proved to be difficult of practical realisation. Many attempts had been made; stearolactone had been prepared by the action of concentrated sulphuric acid on oleic acid, and palmitic acid by treatment with potash, while the conversion into stearic acid itself had been effected by heating oleic acid under pressure with small quantities of iodine, or by subjecting it to the action of hydrogen under the influence of the silent electric discharge. None of these processes, however, proved economically successful on the commercial scale. The problem was solved by the application of the general reaction discovered by Sabatier and Senderens, namely, that hydrogen could be assimilated by unsaturated compounds in the presence of a metallic catalyst. The principle was found to be readily applicable, not only to fatty acids, but also to the glycerides. The metal in general use is nickel; platinum and palladium are active catalysts, and by their use the reaction can be effected at much lower temperatures, but their high cost and susceptibility to poisoning by traces of impurities preclude their commercial use.

The usual process consists in passing hydrogen through the oil, which is intimately mixed with the catalyst; this consists of finely divided metallic nickel, which, as a rule, has been deposited on an inert support, such as kieselguhr or fuller's earth. The reaction is conducted at temperatures between 140° and 200° C, according to conditions. After hydrogenation the oil has to be filtered to free it from powdered catalyst; the nickel from the latter is recovered. A recent innovation, designed to allow of continuous working, and to obviate the tedious processes of filtration and recovery of the nickel from the oil-saturated residue, employs fine nickel turnings. The turnings are placed in perforated cages in the reaction vessel. The pre-heated oil and the hydrogen flow over them on the counter-current system. The oil delivered is free from nickel and does not require filtration; when the activity of the catalyst becomes reduced, as a result of gradual poisoning, it is easily regenerated by electrolytic oxidation and subsequent reduction. The mechanism of oil-hydrogenation, and the way in which the nickel assists the reduction, has not been fully explained; it appears that the reduction takes place in stages, the most unsaturated acids being first attacked. As the hardening process is always accompanied by a certain amount of deodorisation, more especially in the case of whale and fish oils, it has rendered possible the utilisation of these oils for the manufacture of hard soap, and has led to the substitution of cheaper vegetable oils, hydrogenated to the required consistency, for the more expensive tallow and lard.

The detection of hardened fats in a mixture is a difficult, if not an insoluble, problem. Indications may be furnished by the detection of fatty acids of high molecular weight, *e.g.*, behenic acid from hardened rape or marine animal oils, or of considerable proportions of iso-oleic acid, which is a transition product in the conversion of oleic into stearic acid.

Applications.—It is almost impossible to enumerate the many applications of the fats: in the table above the principal uses of some typical oils and fats are given. Almost all the best quality fats, including hardened whale oil, etc., can be used for edible purposes (margarine, cooking fats, salad oils, etc.), and some constitute a staple article of diet for native races, for instance, palm oil in W. Africa, soya bean oil in Manchuria.

In the arts the fats are used for soap-making, candle stearine manufacture (*see* CANDLE; SOAP) and leather-dressing; the latter industry provides an outlet for fish-oils and other low grade fats. Linseed oil, tung oil, and to a less extent other drying oils, are employed as the basis of paints, varnishes and for linoleum. Many of the non-drying oils (*e.g.*, neat's foot oil, sperm oil, etc.), are employed as lubricants, either alone or compounded with mineral oils (rape, castor oil), while lubricating greases are made from metallic soaps. Rape oil (colza) and other oils are still used as burning oils in remoter districts. Castor, and "tournant" olive oils provide the turkey-red oils used in dyeing textiles (*see* also GLYCERINE).

In medicine.—Some of the oils possess peculiar properties for which they are valued medicinally. Castor (*q.v.*) and curcas oils have a strong purgative action, while chaulmoogra oil, and others of the same group, have recently attracted attention as specifics for leprosy. Lard, olive, almond and other oils find application in pharmacy as vehicles for various medicaments (*see* also COD LIVER OIL).

Commerce.—In the table the principal countries of origin of the sources (seeds, etc.) of the fats are given. In a great many cases the oils are not extracted in their country of origin; the raw materials are shipped to European countries and America; thus Marseilles becomes the centre of the coconut oil trade, Liverpool and Hull centres of oil-seed expression, etc. Recent

development of industry in tropical countries, together with the war-time need for economy in freightage, has led, however, to increased production of oils and fats in the native countries; thus we find exports of copra from the Philippines decreasing, while the exports of oil increase. Statistics for the production of fats are very scanty; estimations based on available import and export returns take no account of the consumption in the countries of origin, which may be considerable, *e.g.*, coco-nut oil in the Philippines, palm oil in W. Africa. For the available data, the reader is referred to the trade returns (U.K., U.S.A., etc.) and to the publications of the International Institute of Agriculture, Rome—*Oleaginous Products and Vegetable Oils* and the *Year Book of Agricultural Statistics.*

Production.—The production of oils is liable to considerable fluctuation, but the following estimates may be taken as representative. On the whole the production and consumption of oils and fats has steadily augmented since World War I, the increase being especially marked in the case of soya-bean, coco-nut, palm-kernel and groundnut (peanut) oils.

TABLE II.

Production of Oil-seeds, Nuts, etc. (reduced to Oil-equivalent), and Oils

Oil	1924*	1926†	1937‡
	1,000 quintals	Tons	Tons
Cottonseed	19,260	931,963	1,044,000
Copra	13,000	733,431	940,450
Groundnut (peanut)	12,366	527,441	1,010,000
Linseed	10,000	694,292	750,000
Olive	7,653	626,000	800,000
Rapeseed	4,652	73,786	280,000
Soya	4,000	398,961	618,000
Sunflower	..	136,730	375,000
Palm and palmkernel	..	408,891	561,000
Other vegetable oils	..	..	228,000
Lard	..	..	400,000
Tallow	..	..	320,000
	Barrels	Barrels	Tons
Whale oil production	641,583	1,166,857	400,000

*From *"Oleaginous Products and Vegetable Oils."*
†From *"Review of the Oilseed and Oil Markets for 1927,"* issued by Frank Fehr & Co.
‡From Dr. Reginald Child, director, Ceylon Coco-nut Research Scheme.

WAXES

The *waxes* consist chiefly of the fatty acid esters of the higher monohydric alcohols, with which are frequently associated free alcohols as also free fatty acids. Important among the acids found are palmitic acid, occurring in beeswax and spermaceti (*q.v.*), cerotic acid, $C_{25}H_{51}COOH$, in beeswax, wool-wax and other waxes, and melissic acid, $C_{29}H_{59}COOH$, of beeswax.

The hydroxylated lanopalmic, $C_{15}H_{30}(OH)COOH$, and lanoceric, $C_{29}H_{57}(OH)_2COOH$, acids also occur in wool-wax. The alcohols cetyl alcohol, $C_{16}H_{33}(OH)$ ("ethal" of the older writers) of spermaceti, and myricyl (melissyl) alcohol, $C_{30}H_{61}(OH)$, of beeswax and carnaüba wax are the most important, while the cyclic sterols, cholesterol and isocholesterol, occur in considerable amounts in wool-wax.

Spermaceti consists practically of cetyl palmitate, Chinese wax of ceryl palmitate. The other waxes, especially wool-wax, are of more complex composition.

The waxes can be simply classified, similarly to the fats, as follows:—

I. Liquid waxes
II. Solid waxes
  A. Vegetable waxes
  B. Animal waxes.

The table enumerates the most important waxes (*see* also separate articles, SPERMACETI, etc.).

The occurrence and physiological importance of the waxes have been discussed above. In their physical properties the natural waxes resemble the fats. They behave similarly towards solvents, and in the liquid condition leave a grease-spot on paper.

TABLE III.

Wax	Occurrence	Iodine value	Principal use
Liquid waxes			
Sperm oil	Atlantic, Pacific	81–90	Lubricant
Arctic sperm oil	Arctic	67–82	"
Solid waxes			
Vegetable waxes:			
Carnaüba wax	Brazil	13	Polishes, phonograph mass
Sugar cane wax	..	60	Polishes
Montan wax (distilled from peat)	Germany, Ireland, etc.	12–16	" phonograph mass
Animal waxes:			
Wool-wax	As mutton-tallow	30–35 (Wijs)	Ointment ("lanolin")
Beeswax	General	8	Candles, polishes
Spermaceti	As sperm oil	0–4	Candles, surgery
Insect wax, Chinese wax	China	0–1.4	Candles, polishes, sizes

An important property is easy formation of emulsions with water, of which large quantities can be incorporated (lanolin [*q.v.*]).

Only a few vegetable waxes are found in sufficiently large quantities to be of commercial importance; so far carnaüba and sugar-cane waxes are practically the only plant waxes of importance in the world's markets. The most important animal wax is beeswax (*q.v.*), collected in almost all parts of the world. An exceptional position is occupied by wool-wax, the main constituent of the natural wool fat that covers the hair of sheep, which is obtained as a by-product in scouring raw wool. Wool-fat is purified on a large scale and brought into commerce, under the name *lanolin*, as an ointment, which is valued for its property of easy assimilation by the skin.

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See also ESSENTIAL OILS; SOAP; PAINTS, CHEMISTRY OF; etc., and articles on various fats and waxes, PALM OIL; COCO-NUT OIL AND CAKE; etc. (P. R. E. L.; G. H. W.; X.)

OIRAT (OR OIROT) AUTONOMOUS AREA, an autonomous administrative division of the Russian S.F.S.R., created in 1922, within the Siberian area, bounded by Kazakstan on the southwest and Mongolia, with the Mongolian Tannu Tuva republic on the south and east, and by the Siberian area on the north. Area 35,934 sq.mi. Pop. (1939) 161,431. It lies between 49° 5′ and 52° 4′ N. and 84° and 89° 55′ E., and is entirely rural. The administrative centre Oirat Tura is on Katun river. The area is mountainous, lying in the Altai region of West Siberia, which forms part of the Alpine highlands bordering the Mongolian plateau. Within it lies Mount Byelukha, whose summits rise to 14,890 ft. and 14,560 ft. respectively, and on which several glaciers exist. Numerous spurs strike from the Sailughem mountains toward the Siberian plain in all directions, among which are the Chuya Alps, average altitude 9,000 ft., with peaks rising to 12,000 ft., and at least 10 glaciers on the northern slope, and the snow-clad Katun Alps (10,000 ft.).

The Katun river rises in a glacier in a wild gorge on the southwest slope of Byelukha and, after making a wide curve, pierces the Katun range and flows to the north. The upper course of the Biya, which with the Katun later forms the Ob, lies in the Oirat area. The Biya flows from the beautiful alpine Lake Teletskoye, to the south of which are the high Bashkaus, Chulyshman and Chulcha valleys all draining into the lake. The Kok-su and the Argut are the chief among the numerous tributaries of

the Katun.

The climate is severe, average winter temperature $-13°$ to $-16°$ C, summer 16° to 18° C. The maximum rainfall is in the Chernevoi district of the northeast, on the right bank of the Katun river, thickly forested with Siberian cedar and fir. In the northwest the conifers are mixed with birch, poplar and aspen. The Chuya, Kurai and Chulyshman Alps lie above the tree limit and have much tundra. The soils are mainly bog, meadow, rubble and forest clays; their poor character, the short vegetation period and the drought of the region under the influence of winds from Mongolia make cultivation difficult. Wheat and oats, with a little barley, rye, millet, flax, hemp, buckwheat and potato are grown, but only a small part of the area is under cultivation.

Primitive irrigation channels had rendered crop production possible especially in the Uimonsk district in the bend of the Katun river. Besides many of the natives depend on transport in connection with the trade between Kobdo in Mongolia and Biisk in Siberia for supplementary income.

Forest fires and reckless exploitation for army purposes diminished the timber in accessible places and also reduced the number of fur-bearing animals, already diminishing in pre-war times through intensive hunting. Squirrel, bear, fox, ermine and sable are the chief fur-bearing animals of the region. The collection of cedar nuts for the oil pressing factories of Siberia, formerly an important occupation, was also affected by the causes given above. Timber, in any case, is difficult to exploit in the absence of transport facilities in a wild and rocky country. The chief occupation of the people is stock raising, horses, working and dairy cattle, sheep, goats and pigs being bred. War conditions, followed by a period when troops of bandits infested the region, not only destroyed many of the best breeds, but caused the herdsmen to cross into Mongolia, with their remaining cattle and flocks.

Epizootic diseases are prevalent, possibly because of their spread along the road from Mongolia. Milk and meat, with fermented mare's milk (kumiss) form the staple diet of the people. Raw leather with butter from the farms of the Russian settlers, are exported to a small extent. Meat and wool are used locally, for peasant industries have to supply local needs of homespun, felt, wooden and leather articles and flour and cheese. There is no factory industry.

Beekeeping is profitable among the Russian settlers, and is increasing. The maral deer, from whose horns a substance called *panty,* used as a medicine in China, is obtained, is kept by the natives.

Of the population about 50% are Russians, partly descendants of the Old Believers who took refuge here from religious persecution from 1761 onwards. Colonization began in the 19th century, the settlers being mainly peasants from the crown lands, but no attempt was made to organize Russian colonization until 1874–1879. The colonists have occupied the areas suitable for cultivation, especially the Uimonsk region. Disputes between the Russian tillers of the soil and the nomad herdsmen of the hills were frequent and sharp before the creation of the autonomous area. The etymology of the word Oirat or Uirad is uncertain. Remusat and Pallas considered the term Durben Uirad, by which name Chinese writers speak of the Kalmucks, to mean The Four Allies, referring to the confederacy of four Kalmuck tribes which existed in the middle ages. Schmidt states that the Volga Kalmucks call themselves Uirad or Mongol Uirad, and the term Uirad Buriat also occurs in the records. Howorth after at first inclining to the view of Pallas and Remusat and considering that the term had no racial significance, later decided that Uirad was an indigenous term among the Kalmucks. Marco Polo says that Jenghiz Khan allowed the Horiads, out of gratitude for a victory they had won for him, to share the milk of his private herd of white mares, and Yule identifies the Horiads with the Uirads. According to Vambéry the term means grey mare.

The Uirads are recorded as living in the region of the "eight rivers," *i.e.,* the sources of the Kem or Upper Yenisei, at the accession of Jenghiz Khan. Apparently they were Mongols with a Turkish admixture. They submitted to Jenghiz Khan without any struggle and their chieftain Kara Kiragho was one of the nine famous generals or *orloks* who commanded divisions of Jenghiz Khan's army. A long struggle afterwards ensued between the Uirads and the Mongols, and in the 15th century the greater part of the western Mongols were under Uirad overlordship. Towards the end of the 16th century the Uirad power decayed and the Mongols recovered their supremacy. The Dzungarians later overran the Uirad territory, but were themselves conquered by the Chinese in the 18th century, when many took refuge with the Kirghiz in Russian territory. The non-Russian population of the Oirat autonomous area is thus composed of the descendants of these various Turkish, Kalmuck and Mongol tribes and includes also some Kirghiz shepherds. These Altai hill tribes are all nomad herdsmen, supplementing their income by hunting and by undertaking transport along the road from Kobdo to Biisk which passes through the Oirat area. It should be noted that the Telengets of the district north of Kusnetsk, lying outside the Oirat area, call themselves Oirat and that their language and poetry is similar to that of the Altaians, Howorth suggests that they may have been closely allied. Another division of the Uirads in 1296 deserted the Khan of Persia and went to Damascus. Among Altai mountain peoples are the Mountain or Black Forest Tatars, living in the cedar forest region between the Katun and Lake Teletskoye and supplementing their semi-nomad herding by collecting cedar nuts and roots and hoeing the soil in a primitive way for wheat and barley cultivation. The Kumandins live on both banks of the Biya from the mouth of the Lebed downwards, and are taking to settled agriculture. Another Tatar group lives along the Lebed shores and is mainly occupied in hunting.

See Henry Howorth, *The History of the Mongols* (1876), and in Russian *Atlas of the U.S.S.R.* (1928).

OISE, a department of northern France, three-fourths of which belonged to Île-de-France and the rest to Picardy, bounded north by Somme, east by Aisne, south by Seine-et-Marne and Seine-et-Oise, and west by Eure and Seine-Inférieure. Pop. (1936) 402,569; area 2,273 sq.mi. As its name implies, the department includes a good deal of the lower basin of the Oise and its tributaries, forming a broad basin dissected from the outlying zone of the Eocene deposits. To the south-east of the Oise the Eocene forms a plateau with a considerable amount of forest, especially towards the north. To the north-west of the Oise the Eocene is capped along various south-east–north-west ridges by Pliocene, forming the hills of the Pays de Bray (770 ft.). The valley of the Oise itself is a sunny region, with less than 24 in. of rain per annum, and a range of seasonal averages of temperature from about 38° to 64° F.

Clay for bricks and earthenware, sand and building-stone are among the mineral products of Oise, and peat is also worked. Pierrefonds, Gouvieux, Chantilly and Fontaine Bonneleau have mineral springs. Wheat, oats and other cereals, potatoes and sugar beet are the chief agricultural crops. Cattle are reared especially in the western districts, where dairying is actively carried on. Bee-keeping is general. Racing stables are numerous in the neighbourhood of Chantilly and Compiègne. The chief industries of the department are manufactures of sugar and alcohol from beetroot. The manufacture of furniture, brushes (Beauvais) and other wooden goods and of toys, fancy-ware, buttons, fans and other articles in wood, ivory, bone or mother-of-pearl are important. There are also woollen and cotton mills, and manufactories of woollen fabrics, blankets, carpets (Beauvais), hosiery and lace (Chantilly and its vicinity). Creil and the neighbouring Montataire form an important metallurgical centre. Oise is served by the Northern railway, on which Creil is an important junction, and the Oise and its lateral canal and the Aisne afford about 70 m. of navigable waterway.

There are three arrondissements—Beauvais, Compiègne and Senlis—with 35 cantons and 701 communes. The department forms the diocese of Beauvais (province of Reims) and part of the region of the II army corps and of the *académie* (educational division) of Paris. Its court of appeal is at Amiens.

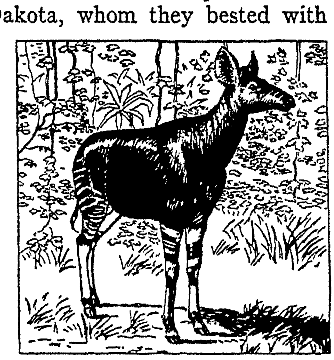
OISE, a river of northern France, 187 mi. long, flowing south-

west from the Belgian frontier to join the Seine 39 miles below Paris. It drains the north-eastern part of the Paris basin. Rising in Belgium, 5 m. S.E. of Chimay at a height of 980 ft., the river enters France after a course of little more than 9 m. It divides below Guise into several arms and is joined by the Serre (left), near La Fère. Thence as far as the Ailette (left), it flows through well-wooded country to Compiègne, above which it receives the Aisne (left). Skirting the forests of Compiègne, Halatte and Chantilly (all left), and receiving near Creil the Thérain and the Brèche (both right), the river flows past Pontoise to reach the Seine. Its channel is canalized (depth 6 ft. 6 in.) from Janville to its mouth. Above Janville a lateral canal continued by the Sambre-Oise canal accompanies the river to Landrecies. It is connected by canal with the canal system of Flanders and with the Somme and the Eastern canal systems. (*See* SEINE.)

OISIN (pronounced *Usheen*), reputed to be the son of Finn mac Cumhaill (*q.v.*), a heroic warrior and bard. He figures to but a small extent in the earlier literature of the Finn cycle, being eclipsed by his father and by his son Oscar. But in the later "Ossianic" literature he is prominent as the narrator of the events through which he claims to have lived. According to the legend, he remained alive after the Battle of Gabhra (Garristown, Co. Dublin) in which Cairbre Liffechair, son of Cormac mac Airt, destroyed Finn and his followers (A.D. 283), and survived long enough to meet St. Patrick (who arrived in Ireland in A.D. 432) and to tell him the ancient traditions of his youth. This prolonged existence was accounted for by his having been carried off by a fairy maiden to the Happy Otherworld; a tale not found in any ancient manuscript, but preserved orally, and successfully versified by the 18th-century Irish poet Michael Comyn. In a very valuable prose tract, *Agallamh na Senórach* ("The Colloquy of the Elders"), Patrick is described as making a circuit of Ireland, with Oisin and his old companion in arms, Caeilte, as *ciceroni.* The same formula was afterwards adopted in verse, but with the difference that whereas in the prose narrative the pagan warriors and the saint treat each other with courtesy, in the verses they argue with a petulance often descending to ribaldry on both sides. The poet's name, in the form "Ossian," was popularized by James Macpherson; but his version of the tales and poems is so much manipulated as to be practically a new work.

Agallamh na Senórach is published with a translation in O'Grady's *Silva Gadelica* (1890). For the chief Ossianic poems *see* the publications of the Ossianic Society (1856, 1858); also Eoin MacNeill, *Duanaire Finn* (Irish Texts Society, 1908). *See* also L. C. Stern, *Die Ossianischen Heldenlieder* (English Translation in *Transactions of the Gaelic Society of Inverness,* xxii., p. 257). (R. A. S. M.)

OJIBWA. The Ojibwa or Chippewa form a large, loosely knit group of Algonkin Indians, said to have held originally the northern shores of lakes Huron and Superior, but extending in the historic period also westward across northern Minnesota and into Manitoba as far as Turtle mountain. Their expansion was largely at the expense of the Dakota, whom they bested with firearms obtained from the French. They were friendly to the French, and later to the British against the Americans, but have never been aggressive in warfare, at least not unitedly so, although esteemed brave. They were a timber people, farming only in part, and subsisting largely on game and wild rice. They are a large and widely spread group, numbering 30,000 or more, about equally divided between Canadian and American soil. (A. L. K.)



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

MALE OKAPI (OKAPIA JOHNSTONI), FOUND MOSTLY IN THE CONGO DISTRICTS

OKAPI (ō-kah'pĭ), large animal allied to giraffes, inhabiting the Semliki forest between Lakes Albert and Albert Edward in Central Africa. First obtained by Sir H. H. Johnston, in 1900, the okapi (*Okapia johnstoni*) has shorter legs and neck than the giraffe, standing 5 ft. at the shoulder. In colour it is purplish, with the sides of the face puce and the limbs barred with black and white. The horns, only present in the males, are capped with a small polished tip which alone penetrates the covering skin. The skull is intermediate between that of the giraffe and that of the extinct *Samotherium* of the Lower Pliocene of Europe. The okapi dwells in the densest parts of the primeval forest, feeding on leaves of trees, shrubs and epiphytes. Its colouring renders it practically invisible at a short distance. It belongs to the family Giraffidae (*see* PECORA).

See for further details Ray Lankester, *Trans. Zool. Soc. of London* (xvi., 6, 1902).

OKEGHEM, JOANNES (also OCKEGHEM, OCKENHEIM, OKERGAN, JEAN DE) (early 15th cent.–*c.* 1495), was born early in the 15th century at Termonde, East Flanders. He was a chorister at Antwerp in 1443 and is generally supposed to have been a pupil of Binchois. The latter part of his life was spent at Tours, where he held the coveted post of treasurer to St. Martin's church under Louis XI. He stands out in the early history of music as one of the greatest of teachers and is by common consent regarded as the founder of the second Netherlands school of contrapuntists, covering the latter half of the 15th century. Josquin des Près and De la Rue were but two among the many famous pupils who carried his teaching into all countries. His skill and ingenuity in counterpoint were considered extraordinary even in that age of elaboration. He wrote, among others, a transposing mass, the *Missa cujusvis toni,* which could be sung in any of the church modes, and a complicated motet for 36 voices. In fugue he introduced the *stretto,* a now familiar device by which the answer follows the subject at a closer interval than in the original statement, and in addition to the usual form of canon in unison he added the canon at the fourth below. Much of his work was destroyed in the wars, or lost, and he lived too early to see his works in print. The masses and motets were not published till after his death. Two masses (Trent codices) have been published by the *Gesellschaft sur Herausgabe von Denkmälern der Tonkunst in Osterreich* (Vienna) and 4 Chansons are in A. W. Ambros, *Geschichte der Musik* (5 vols., Leipzig, 1862–82. The 5th vol. containing examples of music, has not been re-issued).

See also A. de Marsy, *Un musicien flamand: Jean de Ockeghem* (1895); Dragan Plauenocz, *J. Ockeghem als Motett- und Chansons-Komponist* (Vienna, 1925).

OKEN, LORENZ (1779–1851), German naturalist, whose real name was Ockenfuss, was born at Bohlsbach, Baden, on Aug. 1, 1779. He studied at Würzburg and Göttingen, where he became *Privatdozent.* In 1807 he was appointed professor extraordinarius of medical sciences at Jena. His inaugural discourse on the signification of the bones of the skull, based upon a discovery he had made in the previous year, was delivered in the presence of Goethe, as privy-councillor and rector of the university, and was published in the same year, with the title, *Ueber die Bedeutung der Schädelkrochen.* In 1816 he began to publish at Weimar the periodical *Isis, eine encyclopädische Zeitschrift, vorzüglich für Naturgeschichte, vergleichende Anatomie und Physiologie.* Comments on the politics of other German States led to a remonstrance from the court of Weimar, which demanded either the suppression of the *Isis* or resignation. Oken resigned, and continued to publish the *Isis* at Rudolstadt until 1848.

In 1821 Oken promulgated the idea of annual general meetings of German naturalists and medical practitioners, the first meeting being held in Leipzig in 1822. The British Association for the Advancement of Science was first organized after the Okenian model.

In 1828 Oken resumed his duties as privat-docent in the newly-established University of Munich, and soon afterwards was appointed professor in the same university. In 1832, on the proposal by the Bavarian Government to transfer him to a professorship in a provincial university of the State, he resigned his appointments and left the kingdom. He was appointed in 1833 to the professorship of natural history in the then recently-established University of Zurich, where he resided until his death, on Aug. 11, 1851.

All Oken's writings are eminently deductive illustrations of a foregone and assumed principle, which, with other philosophers

of the transcendental school, he deemed equal to the explanation of all the mysteries of nature. According to him, the head was a repetition of the trunk—a kind of second trunk, with its limbs and other appendages; this sum of his observations and comparisons—few of which he ever gave in detail—ought always to be borne in mind in comparing the share taken by Oken in homological anatomy with the progress made by other cultivators of that philosophical branch of the science. Oken's axiom that "all the parts of higher animals are made up of an aggregate of infusoria or animated globular nomads" is of the same order as his proposition that the head is a repetition of the trunk. This latter proposition was claimed to have been discovered by Goethe. He stated this in his *Morphologie* in 1820. A controversy followed; Oken replied with an able statement in *Isis* (Part 7, 1847).

The following is a list of Oken's principal works: *Grundriss der Naturphilosophie, der Theorie der Sinne; und der darauf gegründeten Classification der Thiere* (1802); *Die Zeugung* (1805); *Abriss der Biologie* (1805); *Beiträge zur vergleichenden-Zoologie, Anatomie und Physiologie* (along with Kieser, 1806–07); *Ueber die Bedeutung der Schädelknochen* (1807); *Ueber das Universum als Fortsetzung des Sinnensystems* (1808); *Erste Ideen zur Theorie des Lichts, der Finsterniss, der Farben und der Wärme* (1808); *Grundzeichnung des natürlichen Systems der Erze* (1809); *Ueber den Werth der Naturgeschichte* (1809); *Lehrbuch der Naturphilosophie* (1809–11; 2nd ed., 1831; 3rd ed., 1843; Eng. trans., *Elements of Physiophilosophy*, 1847); *Lehrbuch der Naturgeschichte* (1813, 1815, 1825); *Handbuch der Naturgeschichte zum Gebrauch bei Vorlesungen* (1816–20); *Naturgeschichte für Schulen* (1821); *Esquisse d'un Système d'Anatomie, de Physiologie, et d'Histoire Naturelle* (1812); *Allgemeine Naturgeschichte* (1833–42, 14 vols.).

See also A. Ecker, *L. Oken* (1880); C. Güttler, *L. Oken und sein Verhälbais zur Modernen Entwicklungslehre* (1884).

OKHOTSK, SEA OF, a part of the western Pacific Ocean, lying between the peninsula of Kamchatka, the Kurile Islands, the Japanese island of Yezo, the island of Sakhalin, and the Amur province of East Siberia. The Sakhalin Gulf and Gulf of Tartary connect it with the Japanese Sea on the west of the island of Sakhalin, and on the south of this island is the La Pérouse Strait.

OKI, a group of islands belonging to Japan, lying due north of the prefecture of Shimane, of which they form a part, 36° N. and 133° E. The group consists of one large island called Dogo, and three smaller isles—Chiburi-shima, Nishi-no-shima, and Naka-noshima—which are collectively known as Dozen. These four islands have a coast line of 182 mi., an area of 130 sq.mi., and a pop. (1940) of 31,794. The island of Dogo has two high peaks, Daimanji-mine (1,992 ft.) and Omine-yama (2,185 ft.). The chief town is Saigo in Dogo, distant about 40 mi. from the port of Sakai in Shimane. The name Oki-no-shima signifies "islands in the offing," and the place is celebrated in Japanese history not only because the possession of the islands was much disputed in feudal days, but also because a former emperor and an emperor were banished thither by the Hojo regents in the 13th century.

OKLAHOMA is a west south central state of the United States of America, lying between approximately 33° 38′ and 37° N and 94° 26′ and 103° W. It is bounded north by Colorado and Kansas; east by Missouri and Arkansas; south by Texas, from which it is separated in part by the Red river; and west by Texas and New Mexico. It has a total area of 69,919 sq.mi., of which 888 sq.mi. are water surface. Although the extreme western limit of the state is the 103rd meridian, the only portion west of the 100th meridian is a strip of land about 35 mi. wide in the present Beaver, Texas and Cimarron counties, and formerly designated as "No Man's Land." Oklahoma is called the "Sooner state" because those who entered on April 22, 1889, with the rush, found some of the best land taken up by those who had evaded the guards and entered the territory in advance of the official opening. These persons who evaded the regulations and thus secured the best land were known as "Sooners."

Physical Features.—The topographical features of the State exhibit considerable diversity, ranging from wide treeless plains in the west to rugged and heavily wooded mountains in the east. Elevations above the sea range from 4,800 ft. (Black Mesa) in the extreme north-west to 300 ft. in McCurtain county in the south-east. The State has a mean elevation of 1,300 ft., with 34,930 sq.mi. below 1,000 ft.; 25,400 sq.mi. between 1,000 and 2,000 ft.; 6,500 sq.mi. between 2,000 and 3,000 ft.; and 3,600 sq.mi. between 3,000 and 5,000 ft.

The western portion of the Ozark mountains enters Oklahoma near the centre of the eastern boundary, and extends west-southwest half way across the State in a chain of hills gradually decreasing in height. In the south central part of the State is an elevated table-land known as the Arbuckle mountains. In its western portion this table-land attains an elevation of about 1,350 ft. above the sea and lies about 400 ft. above the bordering plains. At its eastern termination, where it merges with the plains, it has an elevation of about 750 feet. Sixty miles north-west of this plateau lie the Wichita mountains, a straggling range of rugged peaks rising about 1,500 ft. above the plain, but on account of their steep and rugged slopes they are difficult to ascend. A third group of hills, the Chautauqua mountains, lie in the west in Blaine and Canadian counties, their main axis being almost parallel with the North Fork. The north-western part of Oklahoma is a lofty table-land forming part of the Great Plains region east of the Rocky mountains.

The prairies north of the Arkansas and west of the Neosho rivers are deeply carved by small streams, and in the western portion of this area, where the formation consists of alternating shales and sandstones, the easily eroded rocks have been carved into canyons, buttes and mesas. South of the Arkansas river these ledges of sandstone continue as far as Okmulgee, but the evidences of erosion are less noticeable. East of the Neosho river the prairies merge into a hilly woodland. In the north-west four salt plains form a striking physical feature. Of these, the most noted is the Big Salt plain of the Cimarron river, in Woodward county, which varies in width from ½ mi. to 2 mi. and extends along the river for 8 miles. The plain is almost perfectly level.

Following the slope of the land, the important streams flow from north-west to south-east. The Arkansas river enters the State from the north near the 97th meridian, and after following a general south-easterly course, leaves it near the centre of the eastern boundary. Its tributaries from the north and east—the Verdigris, Grand or Neosho and Illinois—are small but important; and from the south and west it receives the waters of much longer streams—the Salt Fork, Cimarron and the Canadian, with its numerous tributaries. The extreme southern portion of the State is drained by the Red river, which forms the greater part of the southern boundary, and by its tributaries, the North Fork, the Washita and the Kiamichi.

Climate and Soils.—The climate of the State is of a continental type, with light rainfall. The western and central portions of the State are in general cooler and drier than the east. Thus, at Beaver, in the extreme north-west, the mean annual temperature is 57° F. and the mean annual rainfall 18.9 in.; while at Lehigh, in the south-east, these figures are respectively 62° and 35.1 inches. At Oklahoma City, in the centre of the State, the mean annual temperature is 59.4°; the mean for the summer (June, July and August) is 78.8°, with an extreme recorded of 108°; the mean for the winter (December, January and February) is 38.4°, with an extreme recorded of −17°. At Mangum, in the south-west, the mean annual temperature is 61°; the mean for the summer is 81° and for the winter 41°, while the highest and lowest temperatures ever recorded are respectively 114° and −17°. The mean annual precipitation for the State is 31.7 in.; the variation between the east and the west being about 12 inches.

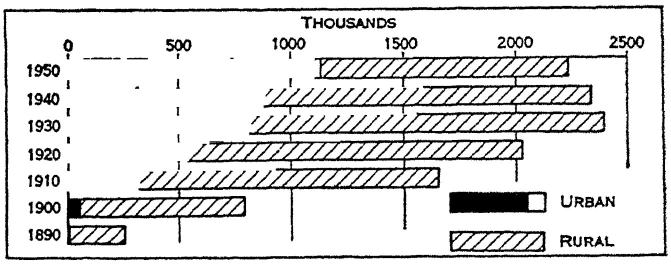
The prevailing type of soil is a deep dark red loam, sometimes (especially in the east central part of the State) made up of a decomposed sandstone, or (in the north-central part) of shales and decomposed limestone. Not infrequently there are a belt of red sandy loam on uplands north of a river, a rich deposit of black alluvium on valley bottom lands, a belt of red clay loam on uplands south of a river, and a deposit of wind-blown loess on the water parting.

History.—With the exception of the narrow strip north of the most northern section of Texas the territory comprising the present state of Oklahoma was set apart by congress in 1834, under the name of Indian territory, for the possession of the five southern tribes (Cherokees, Creeks, Seminoles, Choctaws and Chickasaws) and the Quapaw agency. Early in 1809 some Cherokees in the southeastern states made known to Pres. Thomas Jefferson their desire to remove to hunting grounds west of the Mississippi, and at first they were allowed to occupy lands in what is now Arkansas, but by a new arrangement first entered into in 1828 they received instead, in 1838, a patent for a wide strip extending along the entire northern border of Indian territory with the exception of the small section in the northeastern corner which was reserved to the Quapaw agency. By treaties negotiated in 1820, 1825, 1830 and 1842, the Choctaws received for themselves and the Chickasaws a patent for all that portion of the territory which lies south of the Canadian and Arkansas rivers, and by treaties negotiated in 1824, 1833 and 1851 the Creeks received for themselves and the Seminoles a patent for the remaining or middle portion. Many of the Indians of these tribes brought slaves with them from the southern states and during the Civil War some supported the Confederacy, but when that war was over the federal government demanded not only the liberation of the slaves but new treaties, partly on the ground that the tribal lands must be divided with the freedmen. By these treaties, negotiated in 1866, the Cherokees gave the United States permission to settle other Indians on what was approximately the western half of their domain; the Seminoles, to whom the Creeks in 1855 had granted as their portion the strip between the Canadian river and its north fork, ceded all of theirs, and the Creeks, Choctaws and Chickasaws ceded the western half of theirs back to the United States for occupancy by freedmen or other Indians. In the eastern portion of the lands thus placed at its disposal by the Cherokees and the Creeks, the federal government within the next 17 years made a number of small grants as follows: to the Seminoles in 1866, to the Sacs and Foxes in 1867, to the Osages, Kansas, Pottawatomies, absentee Shawnees and Wichitas in 1871–72, to the Pawnees in 1876, to the Poncas and Nez Percés in 1878, to the Otoes and Missouris in 1881 and to the Iowas and Kickapoos in 1883; in the southwestern quarter of the territory, also, the Kiowas, Comanches and Apaches were located in 1867 and the Cheyennes and Arapahoes in 1869. There still remained unassigned the greater part of the Cherokee outlet besides a tract embracing 1,887,800 ac. of choice land in the centre of the territory, and the agitation for the opening of this to settlement by white people increased until in 1889 a complete title to the central tract was purchased from the Creeks and Seminoles. Soon after the purchase Pres. Benjamin Harrison issued a proclamation announcing that this land would be opened to homestead settlement at 12 o'clock noon, on April 22, 1889. At that hour, no less than 20,000 people were on the border; and when the signal was given, there ensued a remarkably spectacular race for homes. In the next year that portion of Indian territory which lay south of the Cherokee outlet, and west of the lands occupied by the five tribes, together with the narrow strip north of Texas which had been denied to that state in 1850, was organized as the territory of Oklahoma.

In the meantime negotiations were begun for acquiring a clear title to the unoccupied portion of the Cherokee outlet for individual allotments to the members of the several small tribes who had received tribal allotments since 1866, and for the purchase of what remained after such individual allotments had been made. As these negotiations were successful most of the land between the tract first opened and that of the Creeks was opened to settlement in 1891, a large tract to the west of the centre was opened in 1892, a tract south of the Canadian river and west of the Chickasaws was opened in 1901 and by 1904 the entire territory had been opened to settlement with the exception of a tract in the northeast which was occupied by the Osages, Kaws, Poncas and Otoes. By the treaties with the five southern tribes they were to be permitted to make their own laws so long as they preserved their tribal relations, but since the Civil War many whites had mingled with these Indians, gained control for their own selfish ends of such government as there was and made the country a refuge for fugitives from justice. Consequently, in 1893, congress appointed the Dawes commission to induce the tribes to consent to individual allotments as well as to a government administered from Washington, and in 1898 the Curtis act was passed for making such allotments and for the establishment of a territorial government. When the allotments were nearly all made congress in 1906 authorized Oklahoma and Indian territories to qualify for admission to the union as one state. As both territories approved, a constitutional convention (composed of 100 Democrats and 12 Republicans) met at Guthrie on Nov. 20, 1906. The constitution framed by this body was approved by the electorate on Sept. 17, 1907, and the state was admitted to the union on Nov. 16.

In politics Oklahoma remained rather consistently Democratic, but with a strong Republican minority. In presidential elections through 1948 Democratic electors had been chosen nine times and Republican twice; Warren G. Harding carried the state in 1920 and Herbert Hoover in 1928. In the 16 elections for United States senators from statehood through 1950, Democrats had been successful in 13 contests, including that of 1950, and the Republican candidates in three. Democrats usually won in elections for members of the national house of representatives. The 12 men elected to the governorship through 1950 had all been elected on the Democratic ticket. The state senate had never been controlled by Republicans, and the state house of representatives had had a Republican majority only once—in 1920, the year of the Harding landslide.

Population.—The population of Oklahoma in 1890 was 258,657; in 1910 it was 1,657,155; in 1940, 2,336,434; and in 1950, 2,233,351, or 4.4% less than in 1940. The population per square mile in 1950 was 32.4 as compared with 50.7 for the U.S. as a whole.



BY COURTESY OF THE U.S BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF OKLAHOMA: 1890 TO 1950

The narrow white space at the end of the black section of the 1950 bar represents the population of the small additional areas counted as urban under the new 1950 definition.

Of the 1950 population, 1,107,252 or 49.6%, lived in incorporated places of 2,500 or more, as compared with 37.6% in 1940, when these places constituted the urban area. The entire urban population, under a new definition set up for 1950, which included also the thickly settled suburban area, or "urban fringe," adjacent to Oklahoma City and Tulsa, and one unincorporated place of 2,500 or more outside this fringe, amounted to 1,139,481, or 51.0% of the state total.

TABLE I.—*Population of Oklahoma and Its Principal Cities*

Area	Population			Per cent of increase	
	1950	1940	1930	1940–50	1930–40
The state	2,233,351	2,336,434	2,396,040	—4.4	—2.5
Urban	1,139,481*	879,663	821,681	29.5	7.1
Rural	1,003,870*	1,456,771	1,574,359	—24.9	—7.5
Per cent urban	51.0	37.6	34 3	..	..
Principal cities					
Oklahoma City	243,504	204,424	185,389	19.1	10.3
Tulsa	182,740	142,157	141,258	28.5	0.6
Muskogee	37,289	32,332	32,026	15 3	1.0
Enid	36,017	28,081	26,399	28.3	6.4
Lawton	34,757	18,055	12,121	92.5	49.0

*Final figures for 1950 based on new definition. *See* comment in text.

The number of households in 1950 was 663,262, as compared

with 610,481 in 1940. The average population per household had declined from 3.8 in 1940 to 3.4 in 1950.

The population of the state was distributed by colour and nativity in 1950 as follows: 90.2% native white; 0.8% foreign-born white; 6.5% Negro; and 2.5% of other races, mainly Indians.

There were 100.2 males per 100 females in the native white population, and 93.8 in the Negro population; 8.7% of the population was 65 years old or over; and 48.8% of the population 14 years old and over was in the labour force.

Of the total number of employed males, 25.6% was engaged in agriculture, 6.4% in mining and oil production, 10.1% in construction, 11.0% in manufacturing and 22.4% in transportation and trade.

Government.—The constitution was adopted in Sept. 1907, two months before the state was admitted into the union. Amendments may be submitted through a majority of the members elected to both houses of the legislature or through a petition signed by 15% of the electorate, and a proposed amendment becomes a part of the constitution if the majority of the votes cast at a popular election are in favour of it. The right of suffrage is conferred on all citizens of the United States, 21 years of age or over, who have resided in the state for one year, in the county six months and in the precinct for the 30 days preceding the election. General elections are held in even-numbered years; party candidates for state, district, county and municipal offices, and U.S. senators and congressmen are chosen at primary elections.

The executive authority of the state is divided among 12 elected officials, including the governor, lieutenant governor, secretary of state, treasurer, auditor, attorney general, superintendent of public instruction, examiner and inspector, commissioner of labour, commissioner of insurance, chief mine inspector and commissioner of charities and corrections. They are elected for a term of four years, and the governor, secretary of state, auditor and treasurer are ineligible for the next succeeding term. Other elected state officials are the three members of the corporation commission (one elected every two years for a six-year term), the clerk of the supreme court and four assistant mine inspectors. Administrative work is also done by more than 60 officers, commissions, departments and boards. The governor is a member of some important administrative boards, but the number of officers whom he appoints is rather limited and for most of his appointments the confirmation of the senate is required. His right of veto extends to items in appropriation bills, and to pass a bill over his veto a vote of two-thirds of the members elected to each house is required.

The legislative authority is vested in a senate of 44 members and a house of representatives (120 members in 1950), limited to 120 members. Half of the senators and all the representatives are elected every two years, senators by districts and representatives by counties. Sessions are held biennially in odd-numbered years and begin the first Tuesday after the first Monday in January. Oklahoma has put into its constitution many things which in the older states were left to legislation.

For the administration of justice there was established a supreme court, composed of nine justices elected for a term of six years; the supreme court commission of nine members appointed by the governor was discontinued after its work was completed; a criminal court of appeals composed of three justices elected one each two years, for a term of six years; 31 district courts, each with one or more justices elected for a term of four years; superior courts in certain of the more populous counties, with a judge elected for a term of four years; a county court in each county, with one judge elected for a term of two years; justice of the peace courts held by justices elected for a term of two years; and municipal courts in the cities. The supreme court has appellate jurisdiction in all civil cases, but its original jurisdiction is restricted to a general control of the lower courts. The supreme court commission, created by the legislature in 1927 to assist the supreme court in civil cases, was discontinued, as already explained. The criminal court of appeals has jurisdiction in all criminal cases appealed from the district and county courts. The district courts have exclusive jurisdiction in civil actions for sums exceeding $1,000, concurrent jurisdiction with the county courts in civil actions for sums greater than $500 and original or appellate in criminal cases. The superior courts were created to relieve the district courts and have a similar jurisdiction. The county courts have, besides the concurrent jurisdiction above stated, original jurisdiction in all probate matters, original jurisdiction in civil actions for sums greater than $200 and not exceeding $500, concurrent jurisdiction with the justices of the peace in misdemeanour cases and appellate jurisdiction in all cases brought from a justice of the peace or a police court.

Local Government.—The general management of county affairs is entrusted to three commissioners elected by districts. The other county officers are a sheriff, attorney, judge, clerk, court clerk, treasurer, assessor, surveyor, superintendent of public instruction and public weigher. They are chosen for a term of two years at the general elections in November. From 1919 only 21 counties had township government. The municipalities of Oklahoma may be classified as incorporated towns and as cities (more than 2,000 inhabitants).

Finances.—The revenues for state and for local purposes are derived almost wholly from separate sources. The greater part of the state's revenue is derived from a gross production tax on minerals, motor vehicle licences, a gasoline tax, insurance fees, an inheritance tax, an income tax, the sales tax and departmental collections. Revenue for local purposes is obtained chiefly from tax levies on personal and real property. The valuation and assessment of personal and real property and of public service corporations for 1948 was $1,648,594,702. This, however, did not include mineral property, taxed on gross production only, and allowance must be made also for an exemption of $1,000 on each homestead. There were no state levies on property in 1950, tax levies being made only by the counties, townships or cities and towns and school districts. The total revenue receipts, exclusive of federal grants, for the year ending June 30, 1948, were $182,612,145, of which $64,094,074 was returned to local governmental units. The chief state expenditures were for highways, education, debt amortization and service and penal institutions. The total bonded indebtedness of the state in 1949 was $17,757,781, but a bond issue of $36,000,000 was approved by popular vote in that year for the construction and repair of public buildings, especially those of hospitals and colleges. There were 383 banking institutions operating within the state in Sept. 1946. Their combined resources were $1,606,052,000 and their total deposits were $1,514,144,000. Of the total number of banks, 200 were national and 183 state banks.

Education.—Oklahoma has an excellent system of public education, and especially is this true for specialized and advanced instruction. The public-school system is administered by a state superintendent of public instruction, the co-ordinating board for higher institutions, several state boards of regents, the state board of agriculture, a state board of education, county superintendents and district boards. The state board of education, composed of the state superintendent and eight appointed members, apportions the state school-aid funds. The scholastic enumeration in 1948 showed 565,842 children of school age. Of this number 508,697 were enrolled in the public schools and 455,538 were in average daily attendance. The average number of days attended per enrolled pupil was 140; nearly all of the pupils were, however, enrolled in schools open 160 days or more. The number of pupils enrolled in the state high schools was 126,782, and in the private and parochial schools, 3,500 (est.). The total expenditure for schools in 1948 was $46,181,682. Of the total revenue receipts the state contributed $23,471,908; the rest came from local, county and benevolent sources. This was exclusive of aid from the federal government. Higher educational institutions supported by the state are the University of Oklahoma at Norman; Oklahoma Agricultural and Mechanical college, a land-grant college with experiment stations, at Stillwater; the Oklahoma College for Women, especially for domestic science and fine arts, at Chickasha; the Panhandle Agricultural and Mechanical college at Goodwell;

six state colleges at Durant, Edmond, Ada, Weatherford, Alva and Tahlequah; and Langston university (for Negroes) at Langston. Among the institutions of higher learning neither maintained nor controlled by the state are Phillips university at Enid; Oklahoma City university at Oklahoma City; Benedictine Heights college for women at Guthrie; the University of Tulsa at Tulsa; and Oklahoma Baptist university at Shawnee.

Charities and Corrections.—Under the constitution the supervision and inspection of charities and institutions of correction are in the hands of a state commissioner of charities and corrections, elected by the people.

The state-maintained institutions in 1950 were hospitals for the insane at Norman, Vinita and Supply; the University hospital at Oklahoma City; tubercular sanatoriums at Clinton and Talihina; orphanages for white children at Pryor and Helena; an institute for the feeble-minded at Enid; and a home for deaf, blind and orphan Negro children at Taft. The state penal institutions consisted of four training schools, for Negro girls at Taft, for Negro boys at Boley, for white girls at Tecumseh and for white boys at Stringtown; the Oklahoma state reformatory at Granite; and the state penitentiary at McAlester.

Agriculture and Stock Raising.—Prior to the first opening to settlement by white men in April 1889, the territory now comprising Oklahoma was a cattle country. Thereafter, although the opening was piecemeal, the agricultural development was remarkably rapid. By 1900, 51.1% of the total land surface was included in farms; and by 1930 the farm area was 33,791,000 ac., or approximately 76% of the total. The farm acreage in 1945 had increased to 36,161,872 or 81.6% of the total land area. The average size per farm then was 213.4 ac. The total number of farmers in 1945 was 164,790 as compared with 203,866 in 1930 and 191,988 in 1920. Of the total number of farm operators (164,790) in 1945, 153,586 were whites and 11,304 Negroes. In 1945, 18,004,630 ac. were worked by owners and 18,157,192 ac. by tenants. The total population residing on farms in 1945 was 639,948.

The value of lands and buildings in 1930 was $1,242,724,000; by 1945 the value had decreased to $1,106,154,000. The average value per farm in 1945 was $6,713. Of the 164,790 farms in 1945, 26,822 had running water, 45,387 had electricity, 39,810 had telephones and 119,252 had radios.

The total value of all crops in 1949 was $313,202,000, compared with $74,823,000 in 1940 and with $134,573,000 in 1930.

In the production of wheat in 1949, Oklahoma ranked third among states of the U.S., the state's production being exceeded by Kansas and North Dakota. The 1,300,000 ac. of cotton harvested in 1949 had a yield of 610,000 bales of lint and 246,000 tons of seed. The 6,825,000 ac. of wheat harvested in 1949 yielded 88,725,000 bu. Other important crops were Indian corn, 29,392,000 bu.; oats, 17,460,000 bu.; grain sorghums, 10,362,000 bu.; barley, 1,610,000 bu.; and rye, 297,000 bu.—in all cases the yields were below the ten-year average. The hay crop of 1,880,000 tons was harvested from 911,000 ac. of cultivated hay and 435,000 ac. of wild hay. The potato crop consisted of 814,000 bu. (ten-year average, 1,775,000 bu.) of white potatoes and 450,000 bu. (ten-year average, 639,000 bu.) of sweet potatoes. The production of peanuts in 1949 was 113,900,000 lb.

The livestock and poultry products of Oklahoma in 1948, according to the state board of agriculture, had a value of $345,259,000. Of this total $191,636,000 represented the value of the livestock slaughtered and sold for slaughter, and $45,303,000 the chickens and eggs produced. The value of turkeys produced came to $2,236,000. The livestock in the state on Jan. 1, 1950, consisted of 2,655,000 cattle of which 1,074,000 were kept for dairy purposes; 835,000 swine; 155,000 sheep; 213,000 horses; and 27,000 mules. The estimated value of livestock in the state was $300,000,000.

Minerals and Lumber Products.—The mineral production of the state in 1948 had a value of $503,654,000. The petroleum and natural gas producing regions of Oklahoma extend over about 40 counties from the north central to the southwestern parts of the state. In 1948 the greater number of Oklahoma's oil and gas fields were still producing. Tulsa, the oil centre of the state, is situated in about the centre of the north central producing area. The petroleum production in 1933 was 182,251,000 bbl. valued at $120,800,000; in 1948 it was 154,032,000 bbl. valued at $397,865,000. The 470,141,000 gal. of natural-gas gasoline produced in 1948 had a value of $36,411,000; and the 48•,573,000 cu.ft. of natural gas was valued at $23,356,000. The industry fourth in importance, ranked by value of product, was bituminous coal mining. The coal fields lie in the eastern part of the state and extend over a wide territory. The production in 1948 was 2,925,000 tons valued at $13,075,000. The industry fifth in importance was the mining of zinc ore in Ottawa county. The 1948 production was 43,821 tons valued at $11,656,386. The same region produced 16,918 tons of lead valued at $6,056,644. The balance of $15,234,000 came from miscellaneous products—asphalt, cement, clay, sand and gravel, stone, etc.

The lumber and lumber products industry, except furniture making, gave employment in 1947 to 2,324 persons. The value of production was $8,135,000. The cut of timber in 1947 was 82,793,000 bd.ft.

TABLE II.—*Manufactures*

Industry	Number of establishments	Number of wage earners	Value added
State total	1,740	55,403	$341,027,000
Petroleum and coal products	40	7,489	79,875,000
Chemical and allied products	76	1,589	12,127,000
Metal, primary and fabricated	115	6,895	35,304,000
Machinery (except electrical)	126	6,238	37,134,000
Stone, clay and glass products	86	4,373	23,411,000
Meat products	62	4,121	16,511,000
Grain-mill products	77	2,520	23,473,000
Dairy products	56	1,149	5,159,000
Bakery products	127	2,576	11,378,000
Printing and publishing	374	5,057	27,572,000

Manufactures and Transport.—Oklahoma ranks high among the states of the union in the production of raw materials; *i.e.*, products of farms, forests and mines. The total factory output (added value) came to $341,027,000 in 1947. The chief industrial centres of the state at mid-20th century were Oklahoma City, Tulsa, Muskogee, Enid and Shawnee.

The first railway in Oklahoma was the Missouri, Kansas and Texas, which completed a line across the Indian territory to Denison, Tex., in 1872. The railway mileage increased slowly until a part of the territory was opened to settlement (1889). From that time the mileage increased rapidly for several decades before declining. In 1950 the railway mileage was 7,877 and reached every part of the state. The principal lines crossing the state from north to south are the Missouri, Kansas and Texas, the St. Louis and San Francisco, the Atchison, Topeka and Santa Fe and the Chicago, Rock Island and Pacific. The Chicago, Rock Island and Pacific also crosses the middle of the state from east to west.

Oklahoma has approximately 100,000 mi. of public roads. Of this total, 10,143 mi. are included in the state-maintained highway system. By Jan. 1, 1950, 9,575 mi. of the state highways had been surfaced.

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(R. GIT.)

OKLAHOMA CITY, capital and largest city of Oklahoma, U.S., and county seat of Oklahoma county; on the North Cana-

dian river, near the centre of the state. It is on federal highways 62, 66, 77, 270 and 277.

It is served by three air lines (American, Braniff and Continental) and by six railroads (Santa Fe, Rock Island, Frisco, Missouri-Kansas-Texas, Oklahoma City-Ada-Atoka and a belt railway) and by many bus and truck lines. The population in 1950 was 242,450, and in 1940, 204,424 by the federal census.

The site covers 47.7 sq.mi. and is about 1,200 ft. above sea level. The state capitol was completed in 1917 at a cost of $4,500,000.

It is an impressive colonnaded structure of white limestone, in 100 ac. of gardens and parkland, and completely surrounded by producing oil wells.

The large modern public and business buildings ranging up to 33 stories in height are beautified with borders of turf and shrubbery.

The residential streets are tree-lined and most of the houses set in spacious lawns and gardens.

The city's parklands cover 3,006 ac. Its water is supplied by two large reservoirs, Lake Hefner, with a capacity of 75,000 ac.ft., costing $9,500,000, and Lake Overholser with a capacity of 17,000 ac.ft., constructed at a cost of $6,000,000. The west edge of the city, inside the city limits, was selected as the site of a mile-square agricultural centre and state fair grounds. The city adopted a city-manager form of government in 1927. It is the seat of Oklahoma City university and of the medical school and hospitals of the University of Oklahoma, which has its main seat at Norman, 18 mi. S. Equally accessible is the Central State college at Edmond, 15 mi. N. In Oklahoma City's medical centre is a large Medical Research institute.

Oklahoma City is the commercial and financial metropolis of the state, the seat of a branch of the federal reserve bank, the home of insurance headquarters clearing 75% of the state's policies, and of wholesale houses doing nearly 50% of the state's wholesaling, a centre of a large trade area distributing petroleum products, oil-field equipment and supplies, automobiles, trucks and tractors, farm machinery and implements, drugs, hardware, appliances, clothing and food. It is one of the nation's largest cattle markets, and is the home of the Oklahoma 4-H and F.F.A. Livestock show.

The stockyards have a capacity of 62,000 head daily, and packing plants have an annual output valued at more than $140,000,000. There are producing oil fields on two sides of the city with some wells inside the city limits; many large operating companies have their headquarters here, and there are many supply houses doing a large business in serving the rich oil-producing areas of Oklahoma and the Texas panhandle.

The Civil Aeronautics administration aeronautical centre, where their technicians are trained, is located here, as is the Tinker air force base, which is the largest repair and supply depot of the U.S. air force.

The site of Oklahoma City was opened to settlement on April 22, 1889. By night it had a population of 10,000 under tents. The city was chartered in 1890 and became the capital of the state in 1910.

OKMULGEE, a city of eastern Oklahoma, U.S.A., on federal highways 75 and 62, also the Frisco and Okmulgee Northern railways; it is the county seat of Okmulgee county. Pop. (1950) 18,298 (85% native white, 14% Negro and 1% other); (1940) 16,051 by the federal census.

It is a centre of glass manufacturing, employing approximately 1,000.

Okmulgee is the home of large refineries and the county is rated as one of the more stable oil-producing counties in the state.

There are also peanut mills and a large beef cattle and dairy industry scattered through the county. In a square in the heart of the city stands the Council house which was the capital of the Creek nation for half a century.

Okmulgee was settled about 1900. In 1910 it was still a little cattle town of 4,176 inhabitants. In the next decade the population increased more than fourfold.

It was incorporated in 1912 under a commission-manager form of government.

OKRA: *see* GUMBO.

OKU, YASUKATA, MARSHAL, COUNT (1845–1930), Japanese general, was born in Fukuoka-ken. He commanded the 2nd army in the Russo-Japanese War.

In 1906–12 he was chief of the general staff, and was made count in 1907 and marshal in 1911.

OKUBO TOSHIMITSU (1830–1878), Japanese statesman, a samurai of Satsuma, was one of the five great nobles who led the revolution in 1868 against the shogunate. He became one of the mikado's principal ministers, and in the Satsuma troubles which followed he was the chief opponent of Saigo Takamori. But the suppression of the Satsuma rebellion brought upon him the personal revenge of Saigo's sympathizers, and in the spring of 1878 he was assassinated by six clansmen. Okubo was one of the leading men of his day, and in 1872 was one of the Japanese mission which was sent round the world to get ideas for organizing the new regime.

OKUMA (SHIGENOBU), MARQUIS (1838–1922), Japanese statesman, was born in the province of Hizen in 1838. His father was an officer in the artillery. He was able to acquire in his youth a knowledge of English and Dutch, and by the help of missionaries he obtained books in those languages on scientific and political subjects. These works effected a complete revolution in his mind.

He had been designed by his parents for the military profession, but he was determined to devote his energies to the abolition of the existing feudal system and to the establishment of a constitutional government. Though he took no active part in the revolution of 1868, the weight of his opinions was felt in the struggle. Already he was recognized as a coming man and no sooner was the government reorganized, with the mikado as the sole wielder of power, than he was appointed chief assistant in the department of foreign affairs.

In 1869 he succeeded to the post of secretary of the joint departments of the interior and of finance, and for the next 14 years he devoted himself to politics. In 1870 he was made a councillor of state, and a few months later became president of the commission which represented the Japanese government at the Vienna exhibition.

In 1872 he was again minister of finance, and was president of the commission appointed to supervise the Formosa campaign of 1874. The Japanese nation had supported him up to a certain point, but opinion now turned against him.

When Okuma resigned office in the early '80s he established the Semmon Gakko, or school for special studies, and subsequently other schools.

In 1896–97 he was a member of the Matsukata cabinet. An attempted assassination by bomb necessitated the amputation of one of his legs. On Ito's retirement in 1898 he took office as premier and minister of foreign affairs. He resigned after a few months and retired into private life, cultivating his beautiful garden at Waseda near Tokyo. He emerged from his retirement in 1914 to become prime minister, in which capacity he guided the country through the opening months of World War I. In 1916, Count Okuma retired from office owing to his failing health. In the same year he was raised to a marquessate. He died at Tokyo on Jan. 10, 1922.

OLAF or **ANLAF** (d. 981), king of the Danish kingdoms of Northumbria and of Dublin, was a son of Sitric, king of Deira, and was related to the English king Aethelstan. He was of Norse descent, and he married a daughter of Constantine II, king of the Scots. When Sitric died about 927 Aethelstan annexed Deira, and Olaf took refuge in Scotland and in Ireland until 937, when he was one of the leaders of the formidable league of princes which was destroyed by Aethelstan at the famous battle of Brunanburh. Again he sought a home among his kinsfolk in Ireland, but just after Aethelstan's death in 940 he or Olaf Godfreyson was recalled to England by the Northumbrians. Both crossed over, and in 941 the new English king, Edmund, gave up Deira to the former. The peace between the English and the Danes did not, however, last long. Wulfstan, archbishop of York, sided with Olaf; but in 944 this king was driven from Northumbria by

Edmund, and crossing to Ireland he ruled over the Danish kingdom of Dublin. From 949 to 952 he was again king of Northumbria, until he was expelled once more, and he passed the remainder of his active life in warfare in Ireland. But in 980 his dominion was shattered by the defeat of the Danes at the battle of Tara. He went to Iona, where he died probably in 981, although one account says he was in Dublin in 994. This, however, is unlikely. In the sagas he is known as Olaf the Red.

This Olaf must not be confused with his kinsman and ally, OLAF (d. 941), also king of Northumbria and of Dublin, who was a son of Godfrey, king of Dublin. The latter Olaf became king of Dublin in 934; but he was in England in 937, as he took part in the fight at Brunanburh. After this event he returned to Ireland, but he appears to have acted for a very short time as joint king of Northumbria with Olaf Sitricsson. It is possible that he was the "Olaf of Ireland" who was called by the Northumbrians after Aethelstan's death, but both the Olafs appear to have accepted the invitation. He was killed in 941 at Tyningham near Dunbar.

See W. F. Skene, *Celtic Scotland* (1876); J. R. Green, *The Conquest of England* (1899).

OLAF I. TRYGGVESSÖN (969–1000), king of Norway, was born in 969, and began his career in exile. It is even said that he was bought as a slave in Estonia. After a boyhood spent in Novgorod under the protection of King Valdemar, Olaf fought for the emperor Otto III. under the Wendish king Burislav, whose daughter he had married. On her death he raided the coasts of France and the British Isles, until he was converted to Christianity by a hermit in the Scilly Islands, and his marauding expeditions ceased since he would not harry those of his new faith. He married Gyda, sister of Olaf Kvaran, king of Dublin, and administered her property in England and Ireland for some time before he sailed for Norway, then restive under its ruler Earl Haakon. He was unanimously accepted as king of Norway (995), and began the conversion of the country to Christianity. Possibly Olaf's ambition was to rule a united, as well as a Christian, Scandinavia. He made overtures of marriage to Sigrid, queen of Sweden, and increased his fleet, but she clung to her heathen faith. He made an enemy of her, and involved himself in a quarrel with King Sveyn of Denmark by marrying his sister Thyre, who had fled from her heathen husband Burislav in defiance of her brother's authority. Both his Wendish and his Irish wife had brought Olaf wealth and good fortune, but Thyre brought him ill luck; in an expedition (1000) to wrest her lands from Burislav he was waylaid off the island Svöld, near Rügen, by the combined Swedish and Danish fleets, together with the ships of Earl Haakon's sons.

The battle ended in the annihilation of the Norwegians. Olaf fought to the last on his great vessel, the "Long Snake," the mightiest ship in the North, and finally leapt overboard and was no more seen. Full of energy and daring, skilled in the use of every kind of weapon, genial and open-handed to his friends, implacable to his enemies, Olaf's personality was the ideal of the heathendom which he repudiated and oppressed. After his death he remained the hero of his people, who looked for his return. "But however that may be," says the story, "Olaf Tryggvessön never came back to his kingdom in Norway."

OLAF (II.) HARALDSSÖN (995–1030), king of Norway from 1016–1029, called during his lifetime "the Fat," and afterwards known as St. Olaf, was born in 995, the year in which Olaf Tryggvessön came to Norway. After some years' absence in England, fighting the Danes, he returned to Norway in 1015 and declared himself king, obtaining the support of the five petty kings of the Uplands. In 1016 he defeated Earl Sveyn, hitherto the virtual ruler of Norway, at the battle of Nesje, and within a few years had won more power than had been enjoyed by any of his predecessors. He had annihilated the petty kings of the South, had crushed the aristocracy, enforced the acceptance of Christianity throughout the kingdom, asserted his suzerainty in the Orkney Islands, had humbled the king of Sweden and married his daughter in his despite, and had conducted a successful raid on Denmark. But in 1029 the Norwegian nobles, seething with discontent, rallied round the invading Knut the Great, and Olaf fled to Russia. On his return a year later he fell at the battle of Stiklestad, where his own subjects were arrayed against him. After his death his cunning and cruelty which marred his character were forgotten, and his services to his church and country remembered. Miracles were worked at his tomb, and in 1164 he was canonized and was declared the patron saint of Norway, whence his fame spread throughout Scandinavia and even to England, where churches are dedicated to him. The Norwegian order of knighthood of St. Olaf was founded in 1847 by Oscar I., king of Sweden and Norway, in memory of this king.

ÖLAND, an island in the Baltic sea, next to Gotland the largest belonging to Sweden, stretching for 85 m. along the east coast of the southern extremity of that country, from which it is separated by Kalmar Sound which is from 5 to 15 m. broad. The greatest breadth of the island is 10 m., and its area 519 sq.m. The centre of the island is more densely populated than either end. The only large town is Borgholm, with 2,041 inhabitants.

For administrative purposes the island of Öland is included in the Kalmar *län*. From the raid of Ragnar Lodbrok's sons in 775 Öland is frequently mentioned in Scandinavian history, and especially as a battleground in the wars between Denmark and the northern kingdoms. In the middle ages it formed a separate legislative and administrative unity. A number of monuments of unknown age exists, including stones (*stensättningar*) arranged in groups to represent ships. Borgholm has one of the finest castle ruins in Sweden. The town was founded in 1817, but the castle, dating at least from the 13th century, was one of the strongest fortresses, and afterwards one of the most stately palaces in the country. The inhabitants were formerly styled Öningar, and show considerable diversity of origin in the matter of speech, local customs and physical appearance.

The island consists for the most part of Silurian limestone, and thus forms a striking contrast to the mainland with its granite and gneiss. Down the west side runs a limestone ridge, rising usually in terraces, but at times in steep cliffs, to a height of 200 ft.; and along the east side there is a parallel ridge of sand, resting on limestone, never exceeding 90 feet. These ridges, known as the Western and Eastern Landborgar, are connected towards the north and the south by belts of sand and heath; and the hollow between them is occupied by a desolate and almost barren tract: the southern portion, or Alfvar (forming fully half of the southern part of the island), presents a surface of bare red limestone characteristically weathered. The northern portion is covered with hazel bushes. Outside the ridges, however, Öland is well wooded, while the narrow strip of alluvial coast-land is good agricultural country. There are a few small streams in the island and one lake, Hornsjö, about 3 m. long.

OLAUS MAGNUS or MAGNI (1490–1558) (Magnus, *i.e.*, *Stora*, great, being the family name, and not a personal epithet), Swedish ecclesiastic and author, followed his brother, Johannes Magnus, archbishop of Uppsala, to Rome in 1527. Most of his life, after his brother's death, seems to have been spent in the monastery of St. Brigitta in Rome, where he subsisted on a pension assigned him by the pope. He wrote the famous *Historia de Gentibus Septentrionalibus* (Rome, 1555), a work which long remained for the rest of Europe the chief authority on Swedish matters and is still a repertory of much curious information.

The *Historia* was translated into Italian (Venice, 1565), German (Strassburg, 1567), English (London, 1658) and Dutch (Amsterdam, 1665); abridgments of the work appeared also at Antwerp (1558 and 1562), Paris (a French abridged version, 1561), Amsterdam (1586), Frankfort (1618) and Leiden (1652). Olaus also wrote a *Tabula terrarum septentrionalium* . . . (Venice, 1539).

OLBERS, HEINRICH WILHELM MATTHIAS (1758–1840), German astronomer, was born on Oct. 11, 1758, at Arbergen, a village near Bremen, where his father was minister. He studied medicine at Göttingen, 1777–80, attending at the same time Kaestner's mathematical course. In 1779 he devised a new method of calculating cometary orbits. The treatise containing this important invention was made public by Baron von Zach under the title *Ueber die leichteste und bequemste Methode die Bahn eines Cometen zu berechnen* (Weimar, 1797). A table of 87

calculated orbits was appended, enlarged by Johann Encke in the second edition (1847) to 178, and by Johann Galle in the third (1864) to 242. In 1781 Olbers settled as a physician in Bremen, where he practised till his retirement on Jan. 1, 1823. The greater part of each night was meantime devoted to astronomy, the upper portion of his house being fitted up as an observatory. He paid special attention to comets, and that of 1815 (period 74 years) bears his name in commemoration of its detection by him. He also took a leading part in the discovery of the minor planets, rediscovering Ceres on Jan. 1, 1802, and discovering Pallas on March 28 following. His hypothesis of their origin by the disruption of a primitive large planet (*Monatliche Correspondenz,* vi, 88) seemed to gain confirmation by the finding of Juno by Harding, and of Vesta by himself, in regions indicated by the hypothesis. Olbers was deputed by his fellow citizens to assist at the baptism of the king of Rome on June 9, 1811, and he was a member of the *corps législatif* in Paris (1812–13). He died on March 2, 1840. He was twice married, and one son survived him.

See *Biographische Skizzen verstorbener Bremischer Aerzte,* by G. Barkhausen (Bremen, 1844); *Allgemeine geographische Ephemeriden,* iv, 283 (1799); *Abstracts Phil. Trans.,* iv, 268 (1843); *Astronomische Nachrichten,* xxii, 265 (Bessel), also appended to A. Erman's *Briefwechsel zwischen Olbers und Bessel,* 2 vol. (Leipzig, 1852); *Allgemeine deutsche Biographie* (S. Günther). The first two volumes of C. Schilling's exhaustive work *Wilhelm Olbers, sein Leben und seine Werke* appeared at Berlin in 1894 and 1900, a third and later volume including his personal correspondence and biography. A list of Olbers' contributions to scientific periodicals is given at p. xxxv of the 3rd ed. of his *Leichteste Methode,* and his unique collection of works relating to comets now forms part of the Pulkowa library.

OLD-AGE PENSIONS: *see* Pensions; Social Security.

OLDBURY, a municipal borough (1935) in the Stourbridge parliamentary division of Worcestershire, Eng., 5 mi. W. of Birmingham. It is served by the Western Region railway. Pop. (est. 1938) 45,450. Area 5.2 sq.mi. It is in the south Staffordshire coal field, and coal, iron and limestone are worked extensively. There are also chemical, tube, tool, wagon and brick works.

OLDCASTLE, SIR JOHN (d. 1417), English Lollard leader, son of Sir Richard Oldcastle of Almeley, Herefordshire, served in the expedition to Scotland in 1400. Next year he was in charge of Builth castle in Brecon, and serving all through the Welsh campaigns won the friendship and esteem of Henry, the prince of Wales. Oldcastle represented Herefordshire in the parliament of 1404. Four years later he married Joan, the heiress of Cobham, and was thereon summoned to parliament as Lord Cobham in her right. Oldcastle held a high command in the expedition which the young Henry sent to France in 1411. Oldcastle had adopted Lollard opinions before 1410, when the churches on his wife's estates in Kent were laid under interdict for unlicensed preaching. In the convocation which met in March 1413, shortly before the death of Henry IV, Oldcastle was at once accused of heresy. But his friendship with the new king prevented any decisive action till evidence was found in a book belonging to Oldcastle, which was discovered in a shop in Paternoster row.

Oldcastle declared his readiness to submit to the king "all his fortune in this world," but was firm in his religious beliefs, and Henry at last consented to a prosecution. It was only under a royal writ that Oldcastle at last appeared before the ecclesiastical court on Sept. 23. In a confession of his faith he declared his belief in the sacraments and the necessity of penance and true confession; but to put hope, faith or trust in images was the great sin of idolatry. He would not assent to the orthodox doctrine of the sacrament as stated by the bishops, nor admit the necessity of confession to a priest. He was convicted as a heretic Sept. 25. Henry granted a respite of 40 days in the hope of saving his friend.

Before that time had expired Oldcastle escaped from the Tower by the help of one William Fisher, a parchment maker of Smithfield (Riley, *Memorials of London,* 1868). He now put himself at the head of a widespread Lollard conspiracy. The design is said to have included the seizure of the king and his brothers during a Twelfth-night mumming at Eltham. Henry, forewarned, removed to London, and when the Lollards assembled in force in St. Giles's Fields on Jan. 10 they were easily dispersed. Oldcastle himself escaped into Herefordshire, and for nearly four years avoided capture. He took part in several conspiracies. In Nov. 1417 he was captured by the Lord Charlton of Powis. On Dec. 14 he was formally condemned, on the record of his previous conviction, and was hanged that same day in St. Giles's Fields, and burned "gallows and all." Oldcastle died a martyr. At the same time his execution can be justified on political grounds. His opinions and early friendship with Henry V created a traditional scandal which long continued. In the old play *The Famous Victories of Henry V,* written before 1588, Oldcastle figures as the prince's boon companion. When Shakespeare adapted that play in *Henry IV,* Oldcastle still appeared; but when the play was printed in 1598 Falstaff's name was substituted, in deference, as it is said, to the then Lord Cobham. Though the fat knight still remains "my old lad of the Castle," the stage character has nothing to do with the Lollard leader.

Bibliography.—The record of Oldcastle's trial is printed in *Fasciculi Zizaniorum* (Rolls series) and in Wilkins' *Concilia,* iii, 351–357. The chief contemporary notices of his later career are given in *Gesta Henrici Quinti* (English Historical Society) and in Walsingham's *Historia Anglicana.* There have been many lives of Oldcastle, mainly based on *The Actes and Monuments* of John Foxe, who in his turn followed the *Briefe Chronycle* of John Bale, first published in 1544. For notes on Oldcastle's early career, consult J. H. Wylie, *History of England under Henry IV.* For literary history *see* the Introductions to Richard James's *Iter Lancastrense,* Chetham Society (1845), and to Grosart's edition of the *Poems of Richard James* (1880). *See* also W. Barske, *Oldcastle-Falstaff in der englischen Literatur bis zu Shakespeare* (Palaestra, I. Berlin, 1905); and W. T. Waugh in the *English Historical Review,* vol. xx.

OLD CATHOLICS, the sect which took its origin in a group of Roman Catholic opponents to the Vatican council's definition of the dogma of papal infallibility in 1870. Old Catholics characterized the dogma as *new* and as opposed to the rights and the traditional faith of the *old* church which they claimed to represent. Above all other countries, Germany displayed the most marked and intensive opposition. On Aug. 27, 1870, representatives from the Universities of Munich, Bonn, Breslau, Braunsberg and Prague met at Nuernberg under the presidency of Johann J. I. von Döllinger and issued a formal protest in five resolutions against the Vatican decree. On Aug. 30 the Catholic bishops of Germany, assembled in a national synod at Fulda, issued a pastoral letter promulgating the decrees of the Vatican council. In Oct. 1870 the archbishop of Munich requested the views of his theological faculty on the decrees. Johannes Friedrich refused to submit and Döllinger refused to answer. Finally in his "Declaration to the Archbishop of Munich" on March 28, 1871, Döllinger answered that "neither as a Christian, nor as a theologian, nor as an historian, nor as a citizen, could he accept the dogma of papal infallibility." He was excommunicated on April 17, and Friedrich's excommunication followed on April 19.

Opposition now turned to rebellion. Döllinger had the active and energetic support of fellow priests: Reusch, Langen, Knoodt of Bonn, Reinkens of Breslau and Michelis of Braunsberg. Two central committees were formed to organize the rebellion, one in Cologne for the north, the other in Munich for the south of Germany. Michelis toured Germany and Austria fomenting rebellion, while Johann F. von Schulte, formerly professor of canon and German law at the University of Prague and, after his apostasy, appointed by the Prussian government to a professorship at Bonn, became the legal adviser of Old Catholicism and the apologist of the state in its *Kulturkampf* with the Church of Rome.

So well had Schulte organized the rebellious groups that the first Old Catholic congress met at Munich, Sept. 22–24, 1871; 300 representatives convened from Germany, Austria and Switzerland as well as delegates from the English and Russian Churches. A central commission was set up to prepare the way for intercommunion with other Christian churches and for the organization of an independent Old Catholic sect. Döllinger warned the congress not to "raise up altar against altar" and thus to brand themselves as a new sect, but rather to remain, as they claimed to be, members of the Catholic Church. His was the sole

vote cast against the formation of a pastorate and parishes.

At the second congress, which met at Cologne, Sept. 20–22, 1872, a committee was appointed to arrange for the election of a bishop. Döllinger held aloof from Old Catholicism as a sect but accepted the chairmanship of the committee for the intercommunion of Christian churches. Resolutions were passed for the organization of parishes. Schulte obtained Bismarck's consent to the election of a bishop and on June 4, 1873, Joseph H. Reinkens was elected bishop. After the death of the Jansenistic Archbishop Loos of Utrecht, who had been invited to perform the consecration, the function was performed at Rotterdam, Aug. 11, 1873, by Bishop Heykamp of Deventer and a bishopric was established at Bonn. Bishop Reinkens then issued a pastoral in which he claimed to be the only legitimate Catholic bishop in Germany. Prussia, Baden and Hesse recognized this claim; and, through the exertions of Schulte, Prussia and Baden granted the Old Catholics many Roman Catholic churches and gave them title to a legal share of Roman Catholic church property.

Old Catholicism modelled its organization on the Protestant churches: annual synods composed of clergy and laymen were prescribed; mixed synodal commissions were appointed; a bishop was elected to ordain the clergy and to confirm. During the course of annual synods radical changes were made in discipline and dogma which completely separated Old Catholicism from Roman Catholicism. In 1874 confession, fasting and holy days were abolished; in 1875, to facilitate intercommunion with Protestant churches, tradition was abandoned and the authority of the deuterocanonical books was questioned, indulgences were rejected, the validity of Anglican orders was recognized and the *Filioque* dropped from the creed. In 1878, despite the warnings of the Jansenists and the Bavarian representatives, a resolution was carried abolishing clerical celibacy. Finally, in 1880 the Latin was supplanted by the vernacular liturgy.

In the hope that Old Catholicism would nationalize the church in Germany, the leaders of the *Kulturkampf* afforded Old Catholics wholehearted support and assistance. However, after the first 15 years the friendly governments recognized that Old Catholicism was no longer a schism but rather another Protestant sect. The number of Old Catholics had rapidly diminished, and as the bitterness of the *Kulturkampf* declined, less interest was displayed by statesmen toward the movement. In 1880 there were about 50,000 adherents in Germany; in 1910 there were 58 parishes and about 20,000 members; this number remained constant until World War II. Post-World War II figures were not available at mid-20th century.

Upon the definition of papal infallibility, the Liberal government in Austria rejected the concordat of 1855 and forbade the publication of the Vatican decrees. Refusing to recognize the jurisdiction of Bishop Reinkens, the Austrian Old Catholics erected a community in Vienna and appointed Aloysius Anton Nittel as pastor (1881–88). At first refused legal recognition by the government, they received on Nov. 8, 1878, through the energy of Schulte, a legal status under the title of Old Catholic Church. In the beginning a bishop was deemed unnecessary; later Amandus Czech (1888–1922) was elected, but not consecrated, bishop, since the government withheld its consent until an adequate episcopal fund was established.

The first bishop was Adalbert Schindelar (1925–26), who was succeeded by Robert Tüchler as overseer (1926–28) and finally as bishop (1928). Although they numbered but 10,000 in the beginning, assisted in Bohemia and Styria by the *Los von Rom* movement, in 1901 Austrian Old Catholics counted 24 parishes and about 16,000 adherents, about .1% of the total Austrian population. Before World War II there were 12 Old Catholic parishes in Austria with 31,000 members, of whom 23,635 resided in Vienna (later figures were not available). Czechoslovakia had 12 parishes and 20,000 members, with Alois Paschek (1928) as their first bishop.

Though Switzerland had previously bitterly opposed the definition of papal infallibility, in 1870 only three priests formally separated from the Roman Catholic communion; viz., Schwind, Egli and Herzog. Hoping that the Old Catholic movement would establish a national church broad enough to embrace all Christian churches, the governments of the Protestant cantons protected the dissident clergy and invoked harsh measures against Roman Catholic priests. The Old Catholic schism was legally recognized April 9, 1874. A committee was appointed on July 29 to establish an Old Catholic faculty of theology at Berne. On Nov. 23, 1874, under the dean, Friedrich, courses opened and eight students attended. Attempts were made to unite all the Old Catholic communities in Switzerland, but the titles "Old Catholic" and "Liberal Catholic" were rejected in an assembly held at Berne in 1874. On Feb. 28, 1875, however, the Old Catholic communities were organized into a "Christian Catholic National Church." In 1876 Eduard Herzog, the bishop-elect, was consecrated by Bishop Reinkens and Berne became his episcopal residence. By 1878 the Roman Catholics were strong enough to outvote the Old Catholics in the election to local church committees and thus regained possession of their former churches.

Geneva was the centre of severe persecutions of Roman Catholics. Refusing to take the prescribed oath, the Roman Catholic clergy were banished from the city and Père Hyacinthe Loyson was appointed pastor of Geneva. In 1876 the Old Catholics of Switzerland abolished confession and clerical celibacy and permitted the vernacular liturgy. Gradually they abandoned Roman Catholic dogma and discipline in the attempted intercommunion with the Protestant churches of England, Scotland and America. Old Catholicism became indistinguishable from other Swiss Protestant sects. Adolf Küry succeeded Bishop Herzog in 1924.

In Italy, Spain and France the attempts to organize Catholic national churches met with little popular sympathy and no church organization. In North America the Old Catholic movement was initiated by Joseph René Vilatte, a Parisian and Roman Catholic by birth. Vilatte apostatized while studying for the priesthood in Canada, and later became a Presbyterian minister and the pastor of a congregation in northern Wisconsin. Dissatisfied, he sought advice from Père Hyacinthe Loyson and was eventually ordained priest by the Old Catholic bishop Eduard Herzog in 1885. Returning to Wisconsin he spread Old Catholicism among the Belgian communities. Refused episcopal consecration by Bishop Herzog through the animosity of the Anglican bishop Grafton, Vilatte was consecrated by F. X. Julius Alvarez, the schismatic archbishop of Ceylon, Goa and India in 1891.

Vilatte attempted to gain the active support of the Polish schismatic priests Anthony Kozlowski of Chicago and S. Kaminski of Buffalo. Kozlowski was consecrated bishop in Nov. 1897 by Bishop Herzog at Berne and became the leader of the North American Old Roman Catholic Church. Vilatte led the Old Roman Catholic Church. Four Old Catholic bodies were registered in the United States: American Catholic Church (founded in May 1927 by James F. A. Lashley); American Old Catholic Church Incorporated (sprung from the Old Catholic Church of Utrecht in the Netherlands); North American Old Roman Catholic Church (founded June 14, 1912, by its first archbishop, De Landas Berghes, who was consecrated Oct. 4, 1916, and was succeeded by his coadjutor, Carmel Carfora, in 1919); and Old Catholic Church in America.

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(C. W. R.)

OLDENBARNEVELDT, JOHAN VAN (1547–1619), Dutch statesman, was born at Amersfoort on Sept. 14, 1547. After studying law at Louvain, Bourges and Heidelberg, and travelling in France and Italy, Oldenbarneveldt settled down to practise in the law courts at The Hague. In religion a moderate Calvinist, he became a zealous adherent of William the Silent. He served as a volunteer for the relief of Haarlem (1573) and again at Leyden (1574). In 1576 he became pensionary of Rot-

terdam. He was active in promoting the Union of Utrecht (1579) and the acceptance of the countship of Holland and Zeeland by William (1584). On the assassination of William it was at the proposal of Oldenbarneveldt that the youthful Maurice of Nassau was at once elected stadholder, captain general and admiral of Holland. During the governorship of Leicester he was the leader of the strenuous opposition offered by the states to the centralizing policy of the governor.

In 1586 he was appointed, in succession to Paul Buys, to the post of land's advocate of Holland. Nominally the servant of the states of Holland he made himself politically the personification of the province which bore more than half the entire charge of the union, and as its mouthpiece in the states-general he practically dominated that assembly.

During the two critical years which followed the withdrawal of Leicester, he prevented the disintegration of the United Provinces, which might otherwise have fallen an easy conquest to the army of Alexander of Parma. Fortunately for the Netherlands the attention of Philip of Spain was at that time riveted upon his contemplated invasion of England, and Oldenbarneveldt had time to gather into his own hands the control of administrative affairs. He was wholeheartedly supported by Maurice of Nassau, who, after 1589, held the stadholderate of five provinces, and was likewise captain general and admiral of the union. The first rift between them came in 1600, when Maurice was forced against his will by the states-general, under the advocate's influence, to undertake an expedition into Flanders, which was saved from disaster only by desperate efforts which ended in victory at Nieuwport. In 1598 Oldenbarneveldt took part in special embassies to Henry IV and Elizabeth, and again in 1605 in a special mission sent to congratulate James I on his accession.

The opening of negotiations by Albert and Isabel in 1606 for a peace or long truce led to a great division of opinion in the Netherlands. The archdukes having consented to treat with the United Provinces "as free provinces and states over which they had no pretensions," Oldenbarneveldt, who had with him the states of Holland and the majority of burgher regents throughout the country, was for peace, provided that liberty of trading was conceded. Maurice and his cousin William Louis, stadholder of Frisia, with the military and naval leaders and the Calvinist clergy, were opposed to it, on the ground that the Spanish king was merely seeking an interval of repose in which to recuperate his strength for a renewed attack on the independence of the Netherlands. For three years the negotiations went on, but at last after endless parleying, on April 9, 1609, a truce for 12 years was concluded. All that the Dutch asked was directly or indirectly granted, and Maurice gave a reluctant assent to the favourable conditions obtained by Oldenbarneveldt.

Religious Differences and the Sequel.—The now "free and independent state" was rent by internal differences between the Remonstrants (Arminians) and Contra-Remonstrants (Gomarists); the states of Holland under the influence of Oldenbarneveldt supported the former, and refused to sanction the summoning of a purely church synod (1613). They likewise (1614) forbade the preachers in the province of Holland to treat of disputed subjects from their pulpits. Obedience was difficult to enforce without military help, riots broke out in certain towns, and when Maurice was appealed to, as captain general, he declined to act. He did more, though in no sense a theologian; he declared himself on the side of the Contra-Remonstrants, and established a preacher of that persuasion in a church at The Hague (1617).

The advocate now took a bold step. He proposed that the states of Holland should, on their own authority, as a sovereign province, raise a local force of 4,000 men (*waardgelders*) to keep the peace. The states-general meanwhile by a bare majority (four provinces to three) agreed to the summoning of a national church synod. The states of Holland, also by a narrow majority, refused their assent to this, and passed (Aug. 4, 1617) a strong resolution (*Scherpe Resolutie*) by which all magistrates, officials and soldiers in the pay of the province were required to take an oath of obedience to the states on pain of dismissal, and were to be held accountable not to the ordinary tribunals, but to the states of Holland. It was a declaration of sovereign independence on the part of Holland, and the states-general took up the challenge and determined on decisive action. A commission was appointed with Maurice at its head to compel the disbanding of the *waardgelders*. On July 31, 1618, the stadholder appeared at Utrecht, which had thrown in its lot with Holland, at the head of a body of troops, and at his command the local levies at once laid down their arms. His progress through the towns of Holland met with no opposition. The states party was crushed without a blow being struck. On Aug. 23, by order of the states-general, the advocate and his chief supporters, Hugo Grotius and Hoogerbeets, were arrested.

Oldenbarneveldt was with his friends kept in the strictest confinement until November, and then brought for examination before a commission appointed by the states-general. He appeared more than 60 times before the commissioners, and was, most unjustly, allowed neither to consult papers nor to put his defense in writing. On Feb. 20, 1619, he was arraigned before a special court of 24 members, only half of whom were Hollanders, and nearly all of them his personal enemies. It was in no sense a legal court, nor had it any jurisdiction over the prisoner, but the protest of the advocate, who claimed his right to be tried by the sovereign province of Holland, whose servant he was, was disregarded. He was allowed no advocates, nor the use of documents, pen or paper. It was in fact not a trial at all, and the packed bench of judges on Sunday, May 12, pronounced sentence of death. On the following day the old statesman, at the age of 71, was beheaded in the Binnenhof at The Hague.

Not a shred of evidence has ever been produced to throw suspicion upon the patriot statesman's conduct. All his private papers fell into the hands of his foes, but not even the bitterest and ablest of his personal enemies, Francis Aarssens (*q.v.*), could extract from them anything to show that Oldenbarneveldt at any time betrayed his country's interests. His high-handed course of action in defense of what he conceived to be the sovereign rights of his own province of Holland to decide upon religious questions within its borders may be challenged on the ground of inexpediency, but not of illegality.

The harshness of the treatment meted out by Maurice to his father's old friend, the faithful counsellor and protector of his own early years, leaves a stain upon the stadholder's memory. That the prince should have felt compelled in the last resort to take up arms for the union against the attempt of the province of Holland to defy the authority of the generality may be justified by the plea *reipublicae salus suprema lex*. To eject the advocate from power was one thing, to execute him as a traitor quite another. The condemnation of Oldenbarneveldt was carried out with Maurice's consent and approval, and he cannot be acquitted of a prominent share in what posterity has pronounced to be a judicial murder.

Oldenbarneveldt was married in 1575 to Maria van Utrecht. He left two sons, the lords of Groeneveld and Stoutenburg, and two daughters. A conspiracy against the life of Maurice, in which the sons of Oldenbarneveldt took part, was discovered in 1623. Stoutenburg, who was the chief accomplice, made his escape and entered the service of Spain; Groeneveld was executed.

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OLDENBURG, a *Land* of Germany, with an area of 2,084 sq.mi. It consisted until 1937 of three widely separated provinces: (1) Oldenburg, (2) Lübeck and (3) Birkenfeld. It had one vote in the German *reichsrat.*

Oldenburg proper was bounded on the north by the North sea and on the other three sides by Hanover, with the exception of a small strip on the east, where it was conterminous with the territory of the free city of Bremen. It formed part of the northwestern German plain lying between the Weser and the Ems.

The climate is temperate and humid; the mean temperature of the coldest month at the town of Oldenburg is 26° F., of the warmest 66°. Storms are numerous and fogs and ague are prevalent in the marshlands. The chief rivers are the Hunte, flowing into the Weser, and the Hase and Leda flowing into the Ems. The Weser itself formed the eastern boundary for 42 mi., and internal navigation is facilitated by a canal connecting the Hunte and the Leda. On the north there are several small coast streams conducted through the dikes by sluices. Large tracts of moorland, however, are useful only as producing peat for fuel, or as affording pasture to the flocks of small coarse-woolled Oldenburg sheep. The rich soil of the marshlands produces good crops of wheat, oats, rye, hemp and rape, but is especially adapted for grazing. The mineral wealth of Oldenburg is very small. Woollen and cotton fabrics, stockings, jute and cigars are made at Varel, Delmenhorst and Lohne; cork cutting is extensively practised in some districts, and there are a few iron foundries. Trade is relatively of more importance, chiefly owing to the proximity of Bremen.

Lübeck.—The former principality of Lübeck had an area of 209 sq.mi. and shared in the general physical characteristics of east Holstein, within which it lies. The population was 47,494. In 1937, by an exchange of territories for the sake of administrative simplification, the Lübeck territories enclaved in Oldenburg were annexed to Oldenburg, and the rest of the Lübeck lands, including the Hanseatic city itself, were annexed to the Prussian province of Schleswig-Holstein. The Birkenfeld enclave in Prussia was annexed to the Prussian Rhine province.

Birkenfeld.—The former principality of Birkenfeld, 312 sq.mi. in extent, lies in the midst of the Prussian province of the Rhine, about 30 mi. W. of the Rhine at Worms and 150 mi. S. of the duchy of Oldenburg. The population was 55,649.

General Features.—The total population of the *Land* of Oldenburg in 1939 was 582,402. The bulk of the inhabitants are of Saxon stock, but to the north and west of the *Land* there are numerous descendants of the ancient Frisians. Low German (*Platt-deutsch*) is universally spoken, except in one limited district, where a Frisian dialect has maintained itself.

Oldenburg is mainly a Protestant country, but Roman Catholicism preponderates in the southwestern provinces, which formerly belonged to the bishopric of Münster, and Oldenburg Roman Catholics are under the sway of the bishops of Münster.

The constitution of 1919 provided for a single representative chamber (*landtag*), elected by universal suffrage and exercising rights of legislation and taxation. The chamber, which consisted of 48 members, was elected every three years.

History.—The descendants of Elimar (d. 1108), the first historical count of Oldenburg, attained the dignity of princes of the empire when the emperor Frederick I dismembered the Saxon territory in 1180. The free city of Bremen and the bishop of Münster were frequently at war with the counts of Oldenburg.

Count Christian, who in 1448 was chosen king of Denmark as Christian I, became king of Norway in 1450 and in 1457 king of Sweden. In 1460 he inherited the duchy of Schleswig and the county of Holstein, an event of high importance for the future history of Oldenburg. In 1454 he handed over Oldenburg to his brother Gerhard (*c.* 1430–99). Count Anton Günther (1583–1667), who succeeded in 1603, proved himself the wisest prince who had yet ruled Oldenburg. By his prudent neutrality during the Thirty Years' War he secured for his dominions an immunity from the terrible devastations to which nearly all the other states of Germany were exposed. He also obtained from the emperor the right to levy tolls on vessels passing along the Weser, a lucrative grant which soon formed a material addition to his resources. From 1702 to 1773 the county was ruled by the kings of Denmark, this period being on the whole one of peaceful development. In the latter year Frederick Augustus, bishop of Lübeck, a kinsman of the emperor Paul of Russia, became count, and in 1777 the county was raised to the rank of a duchy. In 1815 the title of grand duke was allowed to the reigning duke, in consideration of his services to the allies, but was not taken up till 1829. In 1871 Oldenburg became a state of the new German empire and in 1918 the grand ducal family was expelled by the German revolution.

For the history of Oldenburg *see* Runde, *Oldenburgische Chronik* (Oldenburg, 1863); E. Pleitner, *Oldenburg im 19 Jahrhundert* (Oldenburg, 1899–1900); and *Oldenburgisches Quellenbuch* (Oldenburg, 1903). *See* also the *Jahrbuch für die Geschichte des Herzogtums Oldenburg* (1892 *et seq.*).

OLDENBURG, a town of Germany, and capital of the province of Oldenburg, situated 27 mi. by rail W. of Bremen, on the navigable Hunte and the Hunte-Ems canal. Pop. (1939), including the suburbs, 78,506. According to popular tradition Oldenburg was founded by Walbert, grandson of the Saxon hero Widukind, and was named after his wife Altburga, but the first historical mention of it occurs in a document of 1108. It was fortified in 1155, and received a municipal charter in 1345. The Evangelical Lambertikirche, though dating from the 13th century, was transformed in 1874–86. The former palaces of the grand duke and the old town hall are Renaissance buildings of the 17th and 18th centuries. The picture gallery includes works by Paolo Veronese, Diego Rodriguez de Silva y Velasquez, Bartolomé Esteban Murillo and Peter Paul Rubens.

OLDESLOE: *see* BAD OLDESLOE.

OLDFIELD, ANNE (1683–1730), English actress, was born in London, the daughter of a soldier. She was apprenticed to a seamstress, but, fortunately, she attracted George Farquhar's attention by reciting some lines from a play in his hearing. She was engaged at Drury lane in 1692, and ten years later she was generally acknowledged as the best actress of her time. Mrs. Oldfield's beauty and generosity found innumerable eulogists, as well as sneering detractors. Alexander Pope, in his *Sober Advice from Horace,* wrote of her:

> "Engaging Oldfield, who, with grace and ease,
> Could join the arts to ruin and to please."

She died at 47 on Oct. 23, 1730, and was buried in Westminster abbey.

OLD FORGE, an anthracite-mining borough of Lackawanna county, Pa., U.S., on the Lackawanna river, 4 mi. S.W. of Scranton; served by the Erie, Lehigh Valley, Ontario Western and Lackawanna railways. Pop. (1950) 9,745. Old Forge was settled in 1789 and incorporated as a borough in 1899.

OLDHAM, JOHN (1653–1683), English satirist, son of a Presbyterian minister, was born at Shipton Moyne, near Tetbury, Gloucestershire, on Aug. 9, 1653. He graduated from St. Edmund hall, Oxford, in 1674, and was for three years an usher in Whitgift's school at Croydon. In 1681 he became tutor to the grandsons of Sir Edward Thurland, near Reigate. *Garnet's Ghost* was published as a broadside in 1679, but the other *Satires on the Jesuits,* although written at the same time, were not printed until 1681. His undoubted services to the Country party brought no reward from its leaders. Eventually he became chaplain to William Pierrepont, earl of Kingston. He died at Holme-Pierrepoint, near Nottingham, on Dec. 9, 1683.

Oldham took Juvenal for his model, and in breadth of treatment and power of invective surpassed his English predecessors. Thomas Garnet, who suffered for supposed implication in the Gunpowder plot, rose from the dead to encourage the Jesuits in the first satire, and in the third Ignatius Loyola is represented as dictating his wishes to his disciples from his deathbed. Oldham's verse is rugged, and his rhymes often defective, but he met with a generous appreciation from Dryden.

The best edition of his works is *The Compositions in Prose and Verse of Mr. John Oldham . . .* (1770), with memoir and explanatory notes by Edward Thompson; *see* also *Poems,* ed. with memoir by R. Bell (1891).

OLDHAM, THOMAS (1816–1878), British geologist, was born in Dublin, Ire., on May 4, 1816. He studied at Dublin and Edinburgh, and in 1839 became chief assistant in the geological department of the ordnance survey, where he helped to prepare the *Report on the Geology of Londonderry* (1843). Appointed professor of geology in Dublin university in 1845, he became director of the geological survey of Ireland in 1846, and two years later F.R.S. The fossil named *Oldhamia* was discovered by him in the Cambrian rocks of Bray head in 1849. In 1850 he was put in charge of the geological survey of India, which led him to pub-

lish, in 1864, a report on the coal resources of India. He retired in 1876, and died at Rugby on July 17, 1878.

OLDHAM, municipal, county and parliamentary borough, Lancashire, Eng., 7 mi. N.E. of Manchester, on the London Midland Region railway and the Oldham canal. Population (1951) 121,212. The principal railway station is called Mumps, but there are several others. The town lies high, near the source of the small river Medlock. Its growth as a manufacturing centre gives it a wholly modern appearance. The oldest church dates from the later 18th century. The principal buildings and institutions include the town hall, with tetrastyle portico, the reference library, art gallery and museum, the Union street baths and the county court. The Lyceum contains schools of art and science, and an observatory; the largely endowed bluecoat school was founded in 1808 by Thomas Henshaw. The Alexandra park, opened in 1865, stands on a picturesquely undulating and terraced site. Oldham is one of the most important centres of the cotton manufactures. The principal manufactures are fustians, velvets, cords, shirtings, sheetings and nankeens. There are also large foundries, mill and cotton machinery works and engineering works of various kinds. Oldham, incorporated in 1849, became a county borough in 1888. The parliamentary borough has returned two members since 1832. Area 7.4 sq.mi.

A Roman road, of which traces are still left, passes through the township. It is not mentioned in Domesday, but in the reign of Henry III Alwardus de Aldholme is referred to as holding land in Vernet (Werneth). A daughter of this Alwardus conveyed Werneth hall and its manor to the Cudworths, a branch of the Yorkshire family, with whom it remained till the 18th century. From the Oldhams was descended Hugh Oldham, who died bishop of Exeter in 1519. It appears that linens were manufactured in Oldham as early as 1630. Watermills were introduced in 1770, and with the adoption of Richard Arkwright's inventions the cotton industry grew with great rapidity.

OLDMIXON, JOHN (1673–1742), English historian, was a son of John Oldmixon of Oldmixon, near Bridgwater. He wrote a number of miscellaneous works, but his most important book is his *Critical History of England* (1724–26), which contains attacks on Clarendon and a defense of Bishop Gilbert Burnet. Its publication led to a controversy between Zachary Grey and the author, who replied to Grey in his *Clarendon and Whitlock compared* (1727). In his *History of England during the Reigns of the Royal House of Stuart* (1730) he charged Bishop Francis Atterbury and other of Clarendon's editors, unjustly, with tampering with the text of the *History*. He completed a continuous history of England by writing the *History of England during the Reigns of William and Mary, Anne and George I* (1735); and the *History of England during the Reigns of Henry VIII, Edward VI, Mary and Elizabeth* (1739). Oldmixon died on July 9, 1742.

OLD OREGON TRAIL, an American pioneer route, from Independence, Mo., to The Dalles, Columbia river, Oregon, about 2,000 mi. long, long used by the immigrants from the Mississippi valley to the northwest. Blazed in part by trappers, the Lewis and Clarke expedition and the Frémont survey, between 1805 and 1842, it followed the North Platte and its tributary the Sweetwater, went through South pass in the Rocky mountains and proceeded by way of Fort Laramie, Independence rock and Great Salt lake to the vicinity of Oregon City.

The name Oregon trail is given to a modern highway following a somewhat different route.

OLD POINT COMFORT, a summer and winter resort, in Elizabeth City county, Va., U.S., at the southern end of a narrow, sandy peninsula projecting into Hampton roads (at the mouth of the James river), about 12 mi. N. by W. of Norfolk. It is served indirectly by the Pennsylvania railroad, passengers and freight being carried by steamer from the terminus at Cape Charles; by steamboat lines connecting with the principal cities along the Atlantic coast, and with cities along the James river; and by ferry, connecting with Norfolk and Portsmouth.

There is a U.S. garrison at Fort Monroe, one of the most important permanent fortifications on the Atlantic coast of the United States. The fort was first regularly garrisoned in 1823; in 1824 the Artillery School of Practice (later called the U.S. Coast Artillery school) was established to provide commissioned officers of the coast artillery with instruction in professional work and to give technical instruction to the noncommissioned staff. During the Civil War the fort was the rendezvous for several military expeditions, notably those of Gen. B. F. Butler to Hatteras inlet, in 1861; of Gen. A. E. Burnside to North Carolina, in 1862; and of Gen. A. H. Terry, against Fort Fisher, in 1865. Jefferson Davis was a prisoner there for two years; his cell was restored and dedicated in 1951. The expedition which settled Jamestown rounded the peninsula (April 26, 1607), opened its sealed instructions there and named the peninsula "Poynt Comfort," in recognition of the sheltered harbour. The "Old" was added subsequently to distinguish it from a Point Comfort settlement at the mouth of the York river on Chesapeake bay.

OLD SLAVONIC. By the language called Old Bulgarian or Old (Church) Slavonic, and here abbreviated as O.B., is meant that first fixed in writing toward the end of the 9th century, when, at the request of the Moravian prince Rostislav, the Byzantine emperor Michael III decided to send emissaries (Constantine, afterward called Cyril—d. 869—and Methodius, his brother —d. 887) to convert the population of Moravia to Christianity. The term "Old Slavonic," frequently used by French and Czech scholars, is liable to misinterpretation as it may be confused with Common Slavonic, the postulated ancestral form of all the Slav languages, or be taken to refer to the earlier form of any particular Slavonic language. The expression "Old Church Slavonic," used by many authorities, has the disadvantage of giving no clue to the area where the language was spoken. Almost all the early manuscripts which are held to represent most accurately the language of the Slavonic apostles or that of their disciples show the phonetic features which we should expect in an earlier form of Bulgarian, more particularly in Macedonian Bulgarian.

The more important of these features are: (1) the Common Slav groups *tj* and *dj* appear as *št* and *žd* respectively, a development which exists in Bulgarian only; (2) the sound transcribed as *ě* (derived from I.E. *ē* or a diphthong ending in *i*) was a palatal *a* (probably like that in English "sand"), and it still occurs in the dialects of precisely that neighbourhood from which the brothers came; (3) the affricate *dz*, which in most Slavonic languages has become *z*, was characteristic of O.B. and is still found in Macedonian dialects.

We do not possess the actual translations made by Cyril and Methodius, but only copies, the earliest dating from the end of the 10th century, the work of those disciples who were engaged in spreading the Gospel in the Balkans. Although dialectical modifications betray the linguistic usage of the various scribes, modern research has been able to restore in great part the exact language of the brothers.

This ideal Old Bulgarian has preserved most of the archaic features of the Slavonic spoken a few hundred years earlier, before the differentiation into several languages had occurred. It offers, however, such characteristically south Slav features as: (1) the change of *or, ol* and *er, el* between consonants, to *ra, la* and *rě, lě* respectively; (2) the simplification of *tl* and *dl* to *l;* and (3) the change of *kv* and *gv* before front vowels (still preserved in the western group) to *cv* and *dzv*. The language is of the synthetic type and contains few foreign elements in its vocabulary. The Christian terminology is mainly Greek; the Latin words which occasionally occur are concessions to the Moravians and Pannonians, to whom they had become known through the proselytizing activity of the western clergy.

O.B. underwent in course of time considerable modifications, both phonetic and structural, in the various countries in which it had become the liturgical language, and the various manuscripts are consequently classified as Serbian-Slavonic, Croatian-Slavonic, Russian-Slavonic and Bulgarian-Slavonic, according to the different recensions.

The manuscripts are preserved in two alphabets. In the older (Glagolitic) alphabet we have:

1. The so-called Kiev leaves—a fragment of a missal—pub-

lished in Cyrillic transcription by Vatroslav Jagić, under the title of *Glagolitica: Würdigung neuentdeckter Fragmente* (Vienna, 1900). Linguistically and historically, this monument is of great importance and may go back to the end of the 10th century.

2. Codex Zographensis, published by Jagić under a Latin title (Berlin, 1879).

3. Codex Marianus. The edition by Jagić (Berlin, 1883) contains a full critical apparatus.

4. Codex Assemanianus, published in a Latin transcription by J. Crnčić (Rome, 1878).

5. Psalterium Sinaiticum, published by L. Geitler (Zagreb, 1883).

6. Euchologium Sinaiticum, published by Geitler (Zagreb, 1882).

7. Glagolitica Clozianus, published by V. Vondrák (Prague, 1893).

There are also a few other fragments.

The other monuments are written in the Cyrillic alphabet and are:

1. A short burial inscription, dated 993.

2. The Sava Gospel (*Savvina Kniga*), published by V. Ščepkin (St. Petersburg, 1903).

3. Codex Suprasliensis, published by Severjanov (St. Petersburg, 1904).

BIBLIOGRAPHY.—*Entstehungsgeschichte der kirchenslavischen Sprache*, by V. Jagić (Berlin, 1913), gives a mass of reliable miscellaneous information. The best grammars are: V. Vondrák, *Altkirchenslavische Grammatik* (Berlin, 1912); A. Leskien, *Grammatik der altbulgärischen (altkirchenslavischen) Sprache* (Heidelberg, 1909), which is more comparative and historical than his *Handbuch d. altb.* (*altk.*) *Sprache* (Heidelberg, 1922). There is also an excellent manual in Polish by J. Łoś (Lwów-Warszawa-Kraków, 1922) and a Czech translation (Prague, 1928), by B. Havránek, of S. Kul'bakin's manuscript grammar, which appeared in French as one of the publications of the Institut d'Études Slaves of Paris. Vondrák's *Kirchenslavische Chrestomathie* (Göttingen, 1910) is invaluable as a collection of extracts. The dictionary of F. Miklosich, *Lexicon palaeoslovenico-graeco-latinum emendatum auctum* (Vienna, 1862–65), has not been replaced, but it must be used with caution, as many words belonging to the later ecclesiastical language of the Slavs are quoted.

Bulgarian Language.—Out of Old Slavonic emerged the modern Bulgarian language. Most authorities hold that Bulgarian, together with Serbo-Croat and Slovene, belongs to the southern branch of the Slavonic languages, but its precise affinities are disputed. August Leskien, in his Serbian grammar (1914), while admitting certain special affinities with Serbo-Croat, regards it as an independent branch. Belić asserts that it belongs to the southern branch only because of its geographical position. The most noteworthy south Slav development which it shows is the change of Common Slavonic (C.S.) *or* and *ol*, either in initial position or between consonants, to *ra* and *la*, and a parallel transposition of consonant and vowel for *er* and *el;* but even this characteristic is not conclusive, as it is also partly shared by Czechoslovak, which belongs to the western branch. As to phonetics, we may note the following features of the literary language: C.S. *tj* and *dj* become *št* and *žd* respectively (a development found in no other modern Slav language); the nasal vowels *ǫ* and *ę* have become oral, the first having changed into a sound (roughly like that of the vowel in English *but*) which does not occur in any cognate language; the softening of consonants before front vowels has been, as also in Serbo-Croat, largely given up, nor have the old distinctions of quantity and intonation survived. In this last feature Bulgarian agrees with Russian, although the accented syllable often varies in the two languages, and is in marked contrast with Serbo-Croat, where length and intonation are preserved in almost all the dialects.

No less remarkable are the peculiarities in other domains of the grammar, the analytical character of which runs counter to the general trend of Slavonic and shows distinct points of resemblance to the development undergone by the languages of western Europe. Thus, whereas the cases are retained in every other Slav language and dialect, Bulgarian has discarded them almost as completely as the Romance languages and contents itself with a single case, the nominative, the others being expressed by means of prepositions. Bulgarian has a definite article and has lost the infinitive. Parallels are to be found in the other Balkan languages, both Rumanian and Greek, for example, having fewer cases than the classical languages from which they are descended: Rumanian and Albanian have a postpositive article, the uses of which largely agree with that of Bulgarian; lastly, the infinitive has entirely disappeared in Greek and has nearly gone both in Rumanian and Albanian.

This agreement with other Balkan languages has led many scholars to believe that Bulgarian has received the impress of a specifically Balkan type. This would seem incontrovertible if the modern language only were in question, but once we consider the earlier stages of the language we encounter difficulties. The language of the first translators of the Bible (*see* above), the ancestor of present-day Bulgarian, shows no trace whatever of "Balkanization." It has a complete case system, no articles and makes full use of the infinitive.

It is therefore best to regard modern Bulgarian as having undergone a development parallel with, but not dependent on, that of its neighbours. Some of the other Slav languages show in embryo the same tendencies which Bulgarian has so completely carried through. Serbian, the nearest neighbour of Bulgarian, has not only almost entirely abandoned the infinitive in the spoken language, but makes one case in the plural do duty for three (locative, dative and instrumental).

The dialects are numerous, chiefly distinguished by phonetic differences. The most usual division is into an eastern and a western group, according to how C.S. *ě* is pronounced. In the west, the sound—which in O.B. is thought to have been that of *a* in "sand," with palatalization of the preceding consonant—is *e*, as in Serbian, but in the east the old sound has been maintained before nonpalatal consonants. East Bulgarian is further divided into two zones, according to whether the articulated noun ends in *o* or *ъt*. In the main the modern literary language is based on the *ъt* dialects of east Bulgarian.

The Slav dialects spoken in Macedonia represent a transitional stage between Bulgarian and Serbo-Croat. None of them is used for literary purposes, but they have been carefully investigated in recent years, with a view to determining to what extent they have preserved characteristics of their lineal ancestor, the old ecclesiastical language (O.B.). A feature shared by many of them, but not occurring in O.B., is the development of C.S. *tj* and *dj* to fronted *k* and *g*, in place of literary Bulgarian *št* and *žd*.

In some Bulgarian dialects, notably those in the neighbourhood of Salonika and Castoria, there are distinct traces of the O.B. nasal vowels, which are not elsewhere preserved except in Polish and, also in traces, in some Slovene dialects.

In the vocabulary of modern Bulgarian there are many foreign elements, chiefly Turkish and Greek, but also some Rumanian and Albanian words. Russian supplied literary models, and its vocabulary has been very freely drawn upon, although there is now a tendency to restrict the loan words to expressions belonging to more abstract thought. The phraseology of Russian, French and German has had considerable influence on the sentence construction.

BIBLIOGRAPHY.—For the linguistic affinities of Bulgarian consult V. Vondrák, *Vergleichende Slavische Grammatik* (Göttingen, 1924), and B. Conev, *History of the Bulgarian Language* (in Bulgarian, Sofia, 1919). G. Weigand's *Balkan-Archiv* (Leipzig, 1925) also is valuable for the comparative study of the Balkan languages. *Das Ostbulgarische* by L. Miletič (Vienna, 1903) and A. Mazon's *Contes slaves de la Macédoine sud-occidentale* (Paris, 1923) are excellent introductions to the study of the dialects.

Dictionaries: N. Gerov, *Rečnik na blgarskyj jazyk* (*Dictionary of the Bulgarian Language*) 5 vol. (Philippopolis, 1895–1904); C. Stephanove, *Complete English-Bulgarian Dictionary* (Sofia, 1914), is the best work for English users. For those able to read Bulgarian the *Sbornik za narodni umotvorenija i narodopis,* published by the Bulgarian Academy, is the standard publication, and the *Bulgarska Reč*, a monthly linguistic periodical published at Sofia since 1921, will prove useful.

There are no scientific grammars, nor annotated and accented texts in English, but beginners able to read German will find G. Weigand's grammar and addition of *Baj Ganja* of great assistance. (N. B. J.)

OLD TESTAMENT: *see* BIBLE.

OLD TOWN, a city of Penobscot county, Me., U.S., on the Penobscot river, 12 mi. above Bangor. It is served by the Maine

Central railway. Pop. (1950) 8,261; (1940) 7,688 by the federal census. The city occupies Marsh Island, formed by a tributary of the Penobscot, which unites with it at two points 9 mi. apart, and considerable land on the west bank of the Penobscot. Opposite, on Indian Island, is the principal settlement of the Penobscot Indians, who are wards of the state.

The abbé Louis Pierre Thury was sent there from Quebec about 1687 and built a mission church. Permanent settlement began when John Marsh (about 1774) bought the "island" now occupied by the city. Old Town was incorporated as a town in 1840, and chartered as a city in 1891. The first railroad in Maine was built from Bangor to Old Town in 1836.

OLDYS, WILLIAM (1696–1761), English antiquary and bibliographer, natural son of William Oldys, chancellor of Lincoln, was born on July 14, 1696, probably in London.

His father had held the office of advocate of the admiralty but lost it in 1693 because he would not prosecute as traitors and pirates the sailors who had served against England under James II. William Oldys, the younger, lost part of his small patrimony in the South Sea Bubble (*q.v.*) and in 1724 went to Yorkshire, spending the greater part of the next six years as the guest of the earl of Malton.

He devoted most of his life to the collection of rare books and papers. In 1731 he sold his collections to Edward Harley, earl of Oxford, who appointed him his literary secretary in 1738. Three years later his patron died, and from that time he worked for the booksellers.

His habits were irregular, and in 1751 his debts drove him to the Fleet prison. After two years' imprisonment, he was released through the kindness of friends who paid his debts. In April 1755 he was appointed Norroy king-of-arms by the duke of Norfolk. He died on April 15, 1761.

William Oldys' chief works are: *The British Librarian,* a review of scarce and valuable books in print and in manuscript (1737–38); the *Harleian Miscellany* (1744–46), a collection of tracts and pamphlets in the earl of Oxford's library, undertaken in conjunction with Samuel Johnson; 22 articles contributed to the *Biographia Britannica* (1747–60); an edition of Raleigh's *History of the World,* with a *Life* of the author (1736); *Life of Charles Cotton* prefixed to Sir John Hawkins' edition (1760) of the *Compleat Angler.* In 1727 Oldys began to annotate another Langbaine to replace the one he had lost. This valuable book, with a manuscript collection of notes by Oldys on bibliographical subjects, is preserved in the British museum.

OLEACEAE, the olive family, dicotyledonous shrubs and trees of warm, temperate and tropical regions, especially abundant in the East Indies. *Fraxinus* includes the ash (*q.v.*) and flowering ash (*F. Ornus*). *Olea* includes the olive (*q.v.*) and the black ironwood tree (*O. laurifolia*). The family includes also numerous valuable ornamental trees and shrubs, as privet, jasmine, lilac, golden bells and fringe tree. There are 21 genera and about 500 species, approximately 40 of which occur in North America.

OLEAN, a city of Cattaraugus county, N.Y., U.S., on the Allegheny river, at the mouth of Olean creek, 70 mi. S.S.E. of Buffalo.

Olean is served by the Erie and the Pennsylvania railways. The population was 22,842 in 1950 by federal census, as compared with 21,506 in 1940 and 21,790 in 1930. The city lies in a valley 1,440 ft. above sea level, almost encircled by hills. The surrounding country is rich in oil and gas.

Six miles S.W. is "Rock City," a group of immense rocks, strangely regular in shape, covering 40 ac. At Allegany, a village 3 mi. W., is St. Bonaventure university (Roman Catholic; 1859). The city has railroad shops and an oil refinery and manufactures chrome tubular furniture, diesel engines, cutlery, floor and wall tile and various other products. Settlement in this region began in 1804.

Olean was incorporated in 1893.

OLEANDER, the common name for any shrub of the genus *Nerium.* The best known is *N. oleander,* often called rose bay, a native of the Mediterranean region, characterized by its tall shrubby habit and its thick lance-shaped opposite leaves, which exude a poisonous milky juice when punctured. The flowers are borne in terminal clusters, and are of a rose colour, rarely white. The hairy anthers adhere to the thickened stigma. The fruit or seed vessel consists of two long pods, which liberate a number of seeds, each of which has a tuft of silky hairs. The genus *Nerium* belongs to the family Apocynaceae (*q.v.*). The oleander was known to the Greeks under three names (viz., *rhododendron, nerion* and *rhododaphne*) and is well described by Pliny (xvi, 20), who mentions its roselike flowers and poisonous qualities. The oleander has long been cultivated in greenhouses, being, as John Gerard says, "a small shrub of a gallant shewe"; numerous varieties, differing in the colour of their flowers, which are often double, have been introduced. In warm countries it is widely grown outdoors.

OLEASTER (*Elaeagnus angustifolia,* family Elaeagnaceae), a handsome deciduous Eurasian tree, 15 to 20 ft. high, commonly cultivated for its edible fruit, often under the names of Trebizond date or Russian olive. The brown smooth branches are more or less spiny; the narrow leaves have a hoary look from the presence of a dense covering of star-shaped hairs; the small fragrant yellow flowers, which are borne in the axils of the leaves, are scaly on the outside.

OLEFIN, in organic chemistry, is the generic name given to an unsaturated hydrocarbon containing one or more pairs of doubly-linked carbon atoms. The unsaturation is represented by a double bond, C=C, which indicates the point of unsaturation and of reactivity in the molecule. The olefins are classified in either one, or in both, of the following ways: (1) A cyclic, or an acyclic, olefin is one in which the double bond is located between carbon atoms forming part of a cyclic, or of an open-chain, grouping respectively. (2) A mono-, di-, tri-, or polyolefin is one in which the number of double bonds per molecule is one, two, three, or an unspecified number greater than two, respectively.

The diolefins (or tri- or polyolefins) may be classified according to the relative positions of the double bonds as: (a) "cumulated" or "contiguous diolefins," or "allenes," containing the two double bonds adjacent to each other as in allene 1,2-propadiene ($CH_2=C=CH_2$); (b) "conjugated diolefins," in which the double bonds are separated by one single linkage as in 1,3-butadiene ($CH_2=CH-CH=CH_2$); (c) "isolated diolefins," in which the double bonds are separated by at least two single linkages as in 1, 4-pentadiene ($CH_2=CH-CH_2-CH=CH_2$).

The terms aliphatic, aryl, cyclic, etc., are used to indicate the form of the carbon skeleton. The terminations -ene, -diene, -triene, etc., in the systematic Geneva system of nomenclature, identify the individual hydrocarbons of mono-, di- or triolefinic structure. Sometimes the ending -ylene is given to identify a monoolefin, *e.g.,* ethylene, propylene, etc. The position of the double bonds is indicated by a numerical prefix or suffix.

Olefins containing from two to four carbon atoms per molecule are gaseous at ordinary temperatures and pressures; those containing five or more carbon atoms are usually liquid at ordinary temperatures. They are only slightly soluble in water. The physical constants of some aliphatic olefins are given in the following table. In general, the boiling points are very close to those of the saturated hydrocarbons having the same carbon skeleton; the densities are slightly higher.

Name	Formula	Melting Point °C.	Boiling Point °C.	Density d_4^{20}
Ethylene	$CH_2=CH_2$	−169.4	−103.9	
Propene	$CH_3-CH=CH_2$	−185.2	−47.6	
1-Butene	$CH_3-CH_2-CH=CH_2$	−190	−6.3	
1-Pentene	$CH_3-(CH_2)_2-CH=CH_2$	−138.0	30.1	0.6410
1-Hexene	$CH_3-(CH_2)_3-CH=CH_2$	−141.0	63.7	0.6734
1-Heptene	$CH_3-(CH_2)_4-CH=CH_2$	−120.0	92.8	0.6968
1-Octene	$CH_3-(CH_2)_5-CH=CH_2$	−102.1	121.6	0.7150
1-Nonene	$CH_3-(CH_2)_6-CH=CH_2$	−88.0	145	0.7315

Monoolefins (aliphatic) have the general formula C_nH_{2n}; they are not found in nature. They are formed in large quantities during the cracking of petroleum oils to produce gasoline. The olefins thus obtained are mixed with other types of hydro-

carbon, from which they are separated either by physical or by chemical means.

Pure olefins may be prepared by the dehydration of the corresponding alcohols. Lower olefins, C_2 to C_5 can be prepared by the catalytic dehydrogenation of the corresponding paraffins.

The principal reactions of olefins are those of the addition of various elements or groups to the two doubly-linked carbon atoms. Hydrogen reacts with olefins, under the influence of catalysts such as platinum black or finely divided nickel, to form the corresponding paraffins.

$$CH_3-C(CH_3)_2-CH_2-C(CH_3)=CH_2 + H_2 \xrightarrow{Ni} CH_3-C(CH_3)_2-CH_2-CH(CH_3)-CH_3$$

2,4,4-Trimethylpentene — 2,2,4-Trimethylpentane "isooctane"

Halogens such as chlorine, bromine and iodine add to the doubly-linked carbon atoms to yield dihaloparaffins.

$$CH_3-CH=CH-CH_3 + Cl_2 \longrightarrow CH_3-CHCl-CHCl-CH_3$$

Butene-2 — 2,3-Dichlorobutane

Hydrogen halides on reaction form monohaloparaffins (alkyl halides).

$$CH_3-C(CH_3)=CH-CH_3 + HBr \longrightarrow CH_3-CBr(CH_3)-CH_2-CH_3$$

2-Methyl-2-butene — 2-Methyl-2-bromobutane

Hypochlorous or hypobromous acids combine with olefins to produce the corresponding halohydrins.

$$CH_2=CH_2 + HOCl \longrightarrow CH_2Cl-CH_2OH$$

Ethylene — Ethylene chlorohydrin

Water reacts with olefins in the presence of catalysts such as sulphuric acid to form alcohols.

$$CH_3-CH=CH_2 + H_2O \xrightarrow[H_2SO_4]{dilute} CH_3-CH(OH)-CH_3$$

Propene — Isopropyl alcohol

Oxidation of olefins with dilute potassium permanganate results in the addition of two hydroxyl groups at the point of unsaturation to form glycols. Under the influence of stronger oxidizing agents or more drastic conditions, the double bond is ruptured and oxygen-containing compounds, such as acids or ketones, are obtained.

$$CH_3-C(CH_3)=CH-CH_3 \xrightarrow[agent]{oxidizing} CH_3COCH_3 + CH_3COOH$$

2-Methyl-2-butene — Acetone — Acetic acid

Ozone reacts with olefins in solution to form an ozonide, which, when isolated in pure form, is explosive; by treatment of the ozonide with water, the originally unsaturated carbon-carbon linkage is ruptured with the formation of aldehydes and ketones.

$$CH_3-C(CH_3)=CH-CH_3 + O_3 \longrightarrow CH_3-C(CH_3)(-O-)-O-CH(-O-)-CH_3$$

2-Methyl-2-butene — Ozonide

$$CH_3-C(CH_3)(-O-)-O-CH(-O-)-CH_3 + H_2O \longrightarrow CH_3-CO-CH_3 + CH_3-CHO + H_2O_2$$

Acetone — Acetaldehyde

This reaction is employed, in particular, for the determination of the structures of olefins.

In the presence of certain catalysts, two or more molecules of olefin combine to form polymers.

$$CH_3-C(CH_3)=CH_2 + CH_3-C(CH_3)=CH_2 \xrightarrow{H_3PO_4} CH_3-C(CH_3)_2-CH_2-C(CH_3)=CH_2$$

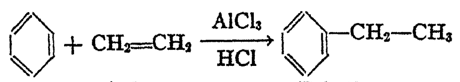
Isobutylene — Isobutylene — 2,4,4-Trimethylpentene "diisobutylene"

The proper choice of catalysts and reaction conditions makes possible the formation of valuable products with specific properties.

Olefins react in the presence of catalysts with organic compounds such as isoparaffins, aromatic hydrocarbons and phenols to form additional products of great industrial importance, which are used in the manufacture of aviation gasoline, synthetic rubber, detergents and plastics.

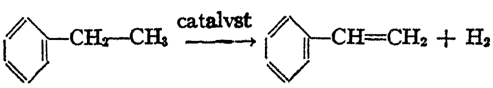
Ethylene (ethene) $CH_2=CH_2$ is the first member of the olefin series. It is one of the dominant raw materials in organic chemical industry. A large proportion is converted into industrial ethyl alcohol and derivatives thereof.

The following are some of the commercial products obtained from ethylene: ethylene glycol (CH_2OH-CH_2OH) is produced via ethylene oxide (CH_2-CH_2, bridged by O) by selective oxidation of ethylene. Polythene, a plastic obtained from ethylene at elevated pressures and temperatures in the presence of a minor amount of oxygen. On account of its high dielectric constant and chemical inactivity it is used for electric appliances. Ethylbenzene is a product of interaction of ethylene and benzene;



Benzene — Ethylene — Ethylbenzene

on dehydrogenation, it forms styrene,



Styrene

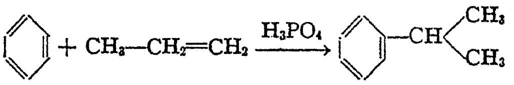
one of the important starting materials for both synthetic rubber and various plastics. Ethylene is an important starting material for the production of poisonous gases such as mustard gas.

$$CH_2=CH_2 + S_2Cl_2 \longrightarrow S(CH_2-CH_2Cl)_2 + S$$

Ethylene — Mustard gas

Ethylene is also used as a general anaesthetic and as an agent to hasten the ripening of bananas, citrous fruits, bulbs and potatoes.

Propene (propylene) $CH_3-CH=CH_2$ is used for the synthesis of isopropyl alcohol ($CH_3-CHOH-CH_3$), which on dehydrogenation, forms acetone ($CH_3-CO-CH_3$), one of the more important solvents. During World War II, a large amount of propene was made to react with benzene to form cumene,



Benzene — Propene — Cumene (Isopropylbenzene)

an important constituent of aviation gasoline.

Butene (butylene) is used for the synthesis of butyl alcohols (C_4H_9OH) and for the production of aviation gasoline. *n*-Butylenes are dehydrogenated to form butadiene.

$$CH_3-CH_2-CH=CH_2 \xrightarrow{catalyst} CH_2=CH-CH=CH_2 + H_2$$

1-Butene — 1,3-Butadiene

Olefins containing eight or more carbon atoms are useful for the synthesis of detergents and wetting agents. The sources of the normal chain olefins are animal and vegetable waxes and oils. These are converted into alcohols, from which the corre-

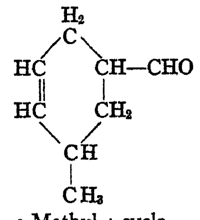
sponding olefins are obtained.

Diolefins (C_nH_{2n-2}) (dienes, alkadienes) containing conjugated double bonds are the most useful members of this series; they undergo reactions similar to those of monoolefins. When the addition reaction to conjugated diolefins is carried out stepwise, the addenda are often attached to the first and fourth carbon atoms of the conjugated system rather than to adjacent carbon atoms; such a reaction is called 1,4-addition.

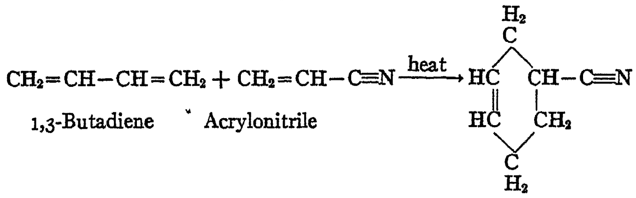
$$\underset{\text{1,3-Butadiene}}{CH_2=CH-CH=CH_2}+Br_2 \longrightarrow \underset{\text{1,4-Dibromo-2-butene}}{BrCH_2-CH=CH-CH_2Br}$$

The conjugated dienes react with compounds containing the $>C=C<$ (particularly $>C=C-C=O$, $>C=C-C\equiv N$, etc.) group with the formation of cyclic compounds.

$$\underset{\text{1,3-Pentadiene}}{CH_3-CH=CH-CH=CH_2} + \underset{\text{Acrolein}}{CH_2=CH-CHO} \xrightarrow{\text{heat}}$$



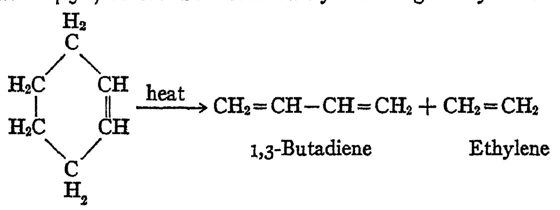
3-Methyl-4-cyclohexenylformaldehyde



1,3-Butadiene Acrylonitrile

3-Cyclohexenylcyanide

1,3-Butadiene ($CH_2 = CH - CH = CH_2$) melts at −108.7°, boils at −4.5°; it can be obtained by cracking of cyclohexene,



1,3-Butadiene Ethylene

Cyclohexene

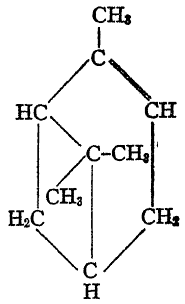
by dehydration of 1,3-butylene glycol,

$$\underset{\text{1,3-Butylene glycol}}{HOCH_2-CH_2-CHOH-CH_3} \xrightarrow{Al_2O_3} \underset{\text{1,3-Butadiene}}{CH_2=CH-CH=CH_2} + 2H_2O$$

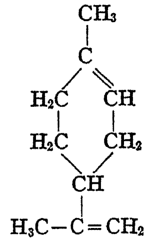
or by catalytic treatment of ethyl alcohol; it is prepared commercially by dehydrogenation of normal butylenes. Butadiene is the main starting material for the manufacture of synthetic rubber.

Isoprene (2-Methyl-1,3-butadiene) ($CH_2=\underset{\substack{|\\CH_3}}{C}-CH=CH_2$) melts at −146.8°, boils at 34.1°, d_4^{20} 0.6805. It is a building unit for naturally occurring products such as rubber and terpenes; these products, on pyrolysis, yield isoprene. Isoprene changes into rubberlike compounds when heated under pressure, or when treated with sodium or peroxides.

Cyclic Olefins.—Of the cyclic olefins, those belonging to the class of terpenes $C_{10}H_{16}$ are the most abundant in nature. They are divided into (a) bicyclic monoolefins (bicyclic terpenes) of which pinene,



the main constituent of turpentine oil, is the most important representative. Pinene is used for the synthesis of camphor, resins and plastics; (b) monocyclic diolefins (monocyclic terpenes) of which limonene



is one of the most widely distributed terpenes, is present in the oil obtained from the skin of the fruits of the citrous species. It is used as a solvent and as a raw material for the synthesis of perfumes. (H. Ps.)

OLEIC ACID: *see* OILS, FATS AND WAXES.

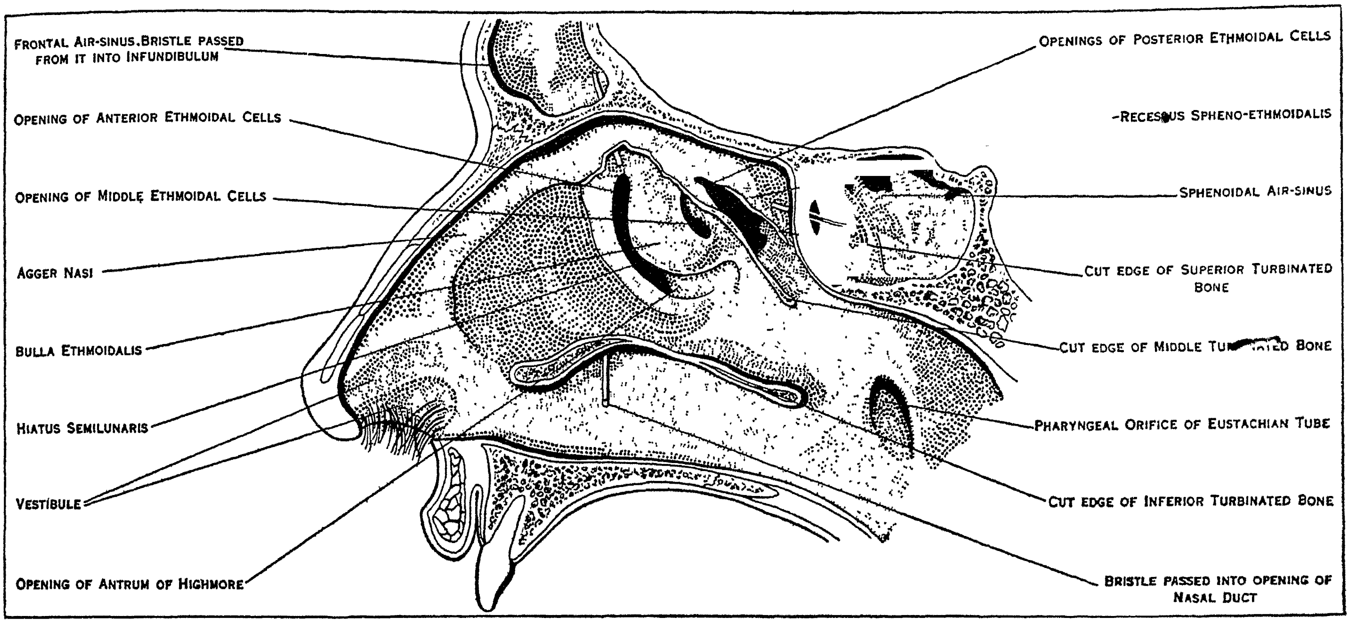
OLEN, a legendary poet and prophet, reputed author of certain hymns to Apollo, sung at Delos in historical times (Gr. Ὠλήν). Boio, a Delphic poetess, made him a Hyperborean (*see* HYPERBOREANS), founder of the oracular shrine at Delphi, first prophet there and inventor of the hexameter. Herodotus makes him a Lycian (as follower of Apollo Λύκειος). Whether any real person lies behind these stories is unknown.

OLEOMARGARINE: *see* MARGARINE.

OLÉRON, an island lying off the west coast of France, opposite the mouths of the Charente and Seudre, and included in the department of Charente-Maritime. Pop. (1946) 12,820. Oléron, the Uliarus Insula of Pliny, formed part of the duchy of Aquitaine, and came into the possession of the French crown in 1370. It is about 18 mi. in length from northwest to southeast, and 7 mi. in extreme breadth; area 66 sq.mi.; the strait (Pertuis de Maumusson) separating it from the mainland is at one point less than a mile wide. The chief places are St. Pierre (pop. 3,550 in 1946), the Château d'Oléron (1,363) and the watering place of St. Trojan-les-Bains (934).

OLFACTORY SYSTEM. In anatomy, the olfactory system consists of the nose and the nasal cavities, which support the olfactory mucous membrane for the perception of smell in their upper parts, and act as respiratory passages below.

The bony framework of the nose is part of the skull (*q.v.*), but the outer nose is supported only by bone above; lower down its shape is kept by cartilaginous plates. The expanded lower part of the side of the nose, the "ala," is formed only of skin, both externally and internally, with fibro-fatty tissue between the layers. The nasal cavities are separated by a septum covered in its lower two-thirds by thick, highly vascular mucous membrane composed of columnar ciliated epithelium with masses of acinous glands embedded in it, while in its upper part it is covered by the less vascular but more specialized olfactory membrane. Near the front of the lower part of the septum a slight opening into a short blind tube, which runs upward and backward, may sometimes be found; this is the vestigial remnant of "Jacobson's organ." The supporting framework of the septum is made up of ethmoid above, vomer below and the septal cartilage in front. The outer wall of each nasal cavity is divided into three meatuses by the overhanging turbinated bones (*see* fig. 2). Above the superior turbinated bone is a space between it and the roof known as the recessus spheno-ethmoidalis, into the back of which the



FROM R. HOWDEN, IN "CUNNINGHAM'S TEXT BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 1.—VIEW OF THE OUTER WALL OF THE NOSE, THE TURBINATED BONES HAVING BEEN REMOVED

sphenoidal air sinus opens. Between the superior and middle turbinated bones is the superior meatus, containing the openings of the posterior ethmoidal air cells, while between the middle and inferior turbinated bones is the middle meatus, which is the largest of the three and contains a rounded elevation, the bulla ethmoidalis. Above and behind this is often an opening for the middle ethmoidal cells; below and in front runs a deep sickle-shaped gutter, the hiatus semilunaris, which communicates above with the frontal air sinus and below with the opening into the antrum of Highmore or maxillary antrum. The inferior meatus is below the inferior turbinated bone, and, when that is lifted, the valvular opening of the nasal duct (*see* EYE, HUMAN) is seen. The roof of the nose is narrow, and here the olfactory nerves pass in through the cribriform plate. The floor is wider so that a coronal section through each nasal cavity has roughly the appearance of a right-angled triangle.

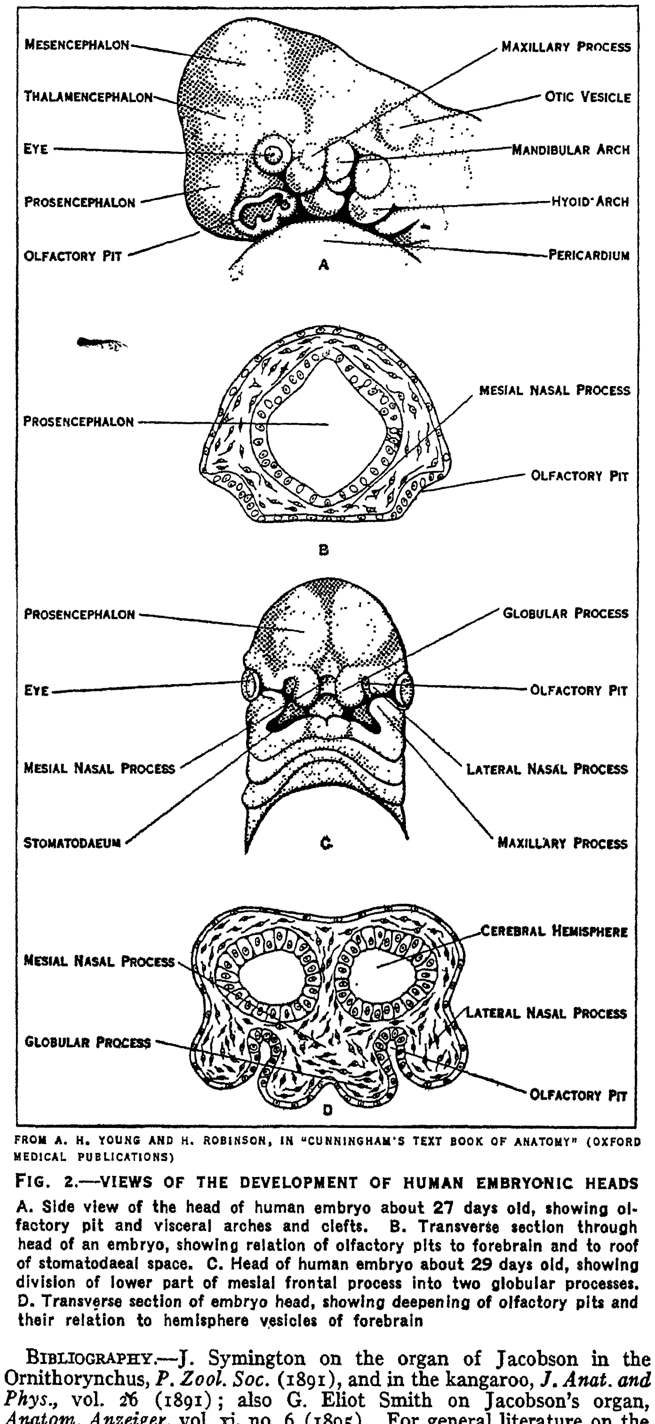
Embryology.—In the third week of intrauterine life two nasal pits appear on the under side of the front of the head; they are the first appearance of the true olfactory region of the nose, and some of their epithelial lining cells send off axons (*see* NERVOUS SYSTEM) which arborize with the dendrites of the cells of the olfactory lobe of the brain and so form the olfactory nerves. Between the olfactory pits the broad median frontonasal process grows down from the forehead region to form the dorsum of the nose (*see* fig. 2) and the anterior part of the nasal septum, while outside them the lateral nasal processes grow down and later on meet the maxillary processes from the first visceral arch. In this way the nasal cavities are formed, but are separated from the mouth by a thin bucconasal membrane which eventually is broken through; after this the mouth and nose are one cavity until the formation of the palate in the third month (*see* MOUTH AND SALIVARY GLANDS). In the third month Jacobson's organ may be seen as a well-marked tube lined with respiratory mucous membrane; no explanation of the function of Jacobson's organ in man is known, and it is probably entirely atavistic. At birth the nasal cavities are shallow from above downward, but rapidly deepen till the age of puberty.

Comparative Anatomy.—In Amphioxus among the Acrania there is a ciliated pit above the anterior end of the central nervous system, which is probably a rudiment of an unpaired olfactory organ. In the Cyclostomata (lampreys and hags) the pit is at first ventral, but later becomes dorsal and shares a common opening with the pituitary invagination. It furthermore becomes divided internally into two lateral halves. In fishes there are also two lateral pits, the nostrils of which open sometimes, as in the elasmobranchs (sharks and rays), onto the ventral surface of the snout, and sometimes, as in the higher fishes, onto the dorsal surface. Up to this stage the olfactory organs are mere pits, but in the Dipnoi (mudfish) an opening is established from them into the front of the roof of the mouth, and so they serve as respiratory passages and organs for the sense of smell. In the higher Amphibia the nasal organ becomes included in the skull and respiratory and olfactory parts are distinguished. In this class, too, turbinal ingrowths are found, and the nasolachrymal duct appears.

In the lizards, among the Reptilia, the olfactory and respiratory parts are very distinct, the latter being lined only by stratified epithelium unconnected with the olfactory nerves. There is one true turbinal bone growing from the outer wall, and close to this is a large nasal gland. In crocodiles the hard palate is formed, and there is henceforward a considerable distance between the openings of the external and internal nares. In this order, too (Crocodilia), air sinuses are first found extending from the olfactory cavities into the skull bones.

The birds' arrangement is very like that of the reptiles; olfactory and respiratory chambers are present, and into the latter projects the true turbinal, though there is a pseudoturbinal in the upper or olfactory chamber. In mammals the olfactory chamber of the nose is variously developed; most of them are "macrosmatic," and have a large area of olfactory mucous membrane; some, like the seals, whalebone whales, monkeys and man, are "microsmatic," while the toothed whales have the olfactory region practically suppressed in the adult, and are said to be "anosmatic." There are generally five turbinal bones in macrosmatic mammals, so that man has a reduced number. The lowest of the series or "maxilloturbinal" is the equivalent of the single true turbinal bone of birds and reptiles, and in most mammals is a double scroll, one leaf turning upward and the other down.

Jacobson's organ first appears in amphibians, where it is found as an anteroposterior gutter in the floor of the nasal cavity. In reptiles the roof of the gutter closes in on each side, and a tube is formed lying below and internal to the nasal cavity, opening anteriorly into the mouth and ending by a blind extremity, posteriorly to which branches of the olfactory and trigeminal nerves are distributed. In the higher reptiles (crocodiles and chelonians) the organ is suppressed in the adult, and the same applies to birds; but in the lower mammals, especially the monotremes, it is very well developed, and is enclosed in a cartilaginous sheath, from which a turbinal process projects into its interior. In other mammals, with the exception of the Primates and perhaps the Chiroptera, the organ is quite distinct, though even in man, as has been shown, its presence can be demonstrated in the embryo.



FROM A. H. YOUNG AND H. ROBINSON, IN "CUNNINGHAM'S TEXT BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 2.—VIEWS OF THE DEVELOPMENT OF HUMAN EMBRYONIC HEADS

A. Side view of the head of human embryo about 27 days old, showing olfactory pit and visceral arches and clefts. B. Transverse section through head of an embryo, showing relation of olfactory pits to forebrain and to roof of stomatodaeal space. C. Head of human embryo about 29 days old, showing division of lower part of mesial frontal process into two globular processes. D. Transverse section of embryo head, showing deepening of olfactory pits and their relation to hemisphere vesicles of forebrain

BIBLIOGRAPHY.—J. Symington on the organ of Jacobson in the Ornithorynchus, *P. Zool. Soc.* (1891), and in the kangaroo, *J. Anat. and Phys.*, vol. 26 (1891); also G. Eliot Smith on Jacobson's organ, *Anatom. Anzeiger*, vol. xi, no 6 (1895). For general literature on the comparative anatomy of the olfactory system, *see* R. Wiedersheim's *Comparative Anatomy of Vertebrates*, translated and adapted by W. N. Parker (London, 1907). (F. G. P.)

OLGA, wife of Igor, prince of Kiev, and afterward (from 945) regent for Sviatoslav her son, was baptized at Constantinople about 955 and died about 969. She was canonized in the Russian church; her feast is on July 11.

OLGIERD (d. 1377), grand duke of Lithuania, was one of the seven sons of Gedymin, grand duke of Lithuania, among whom on his death in 1341 he divided his domains, leaving the youngest, Yavnuty, in possession of the capital, Vilnius, with a nominal priority. With the aid of his brother Kiejstut, Olgierd in 1345 drove out the incapable Yavnuty and declared himself grand duke. His reign (1345–77) saw the development and extension of Lithuania to one of the greatest states in Europe of that time. The Teutonic knights in the north and the Tatar hordes in the south were equally bent on the subjection of Lithuania, while Olgierd's eastern and western neighbours, Muscovy and Poland, were far more frequently hostile competitors than serviceable allies. Olgierd not only held his own, but acquired influence and territory at the expense of both Muscovy and the Tatars, and extended the borders of Lithuania to the shores of the Black sea. He desired to establish the Lithuanian power in those Russian lands which had formed part of the ancient grand duchy of Kiev. He procured the election of his son Andrew as prince of Pskov, and a powerful minority of the citizens of the republic of Novgorod held the balance in his favour against the Muscovite influence, but his ascendancy in both these commercial centres was precarious. However, he acquired the principalities of Smolensk and Bryansk in central Russia. His relations with the grand dukes of Muscovy were friendly, and twice he married orthodox Russian princesses; nevertheless, he besieged Moscow in 1368 and again in 1372, both times unsuccessfully.

Olgierd won a great victory over the Tatars at Siniya Vodui on the Bug in 1362, which practically broke up the great Kipchak horde and compelled the khan to migrate farther south and make his headquarters for the future in the Crimea. Indeed, but for the unceasing simultaneous struggle with the Teutonic knights, the burden of which was heroically borne by Kiejstut, Russian historians frankly admit that Lithuania, not Muscovy, must have become the dominant power of eastern Europe. Olgierd died in 1377, accepting both Christianity and the tonsure shortly before his death. His son Jagiello ultimately ascended the Polish throne, and founded the dynasty which ruled Poland nearly 200 years.

BIBLIOGRAPHY.—Kazimierz Stadnicki, *The Sons of Gedymin* (in Polish) (Lemberg, 1849–53); Vladimir Bonifatevich Antonovich, *Monograph on the History of Western Russia* (in Russian), vol. i (Kiev, 1885). (R. N. B.; X.)

OLIGARCHY is the traditional term used to denote the rule of the few when that rule is looked upon with disfavour. Aristotle used it to designate the rule of the few when it was exercised not by the best, but by bad men unjustly. In this sense, it overlaps with the later concept of plutocracy.

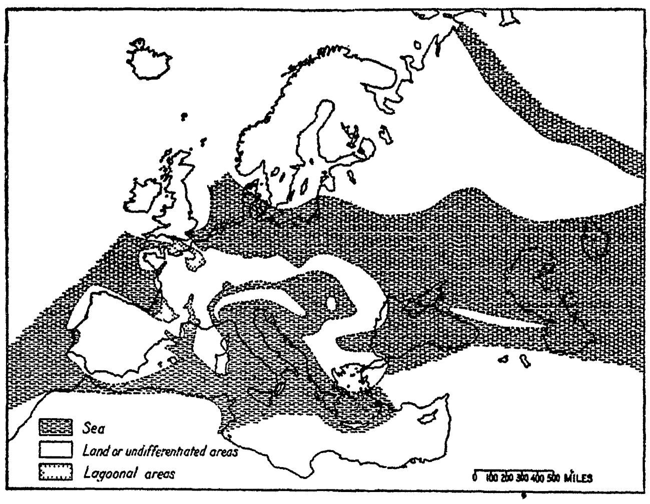
It is a recurrent idea that all forms of government are in the final analysis reducible to the rule of a few. Oligarchs will secure effective control whether the formal authority is vested in the people, a monarch, the proletariat or a dictator. Thus, Karl Marx and Friedrich Engels insisted that throughout capitalism, the key capitalists had controlled the government; they coined the famous phrase that "the state is the executive committee of the exploiting class." The Italian political scientist Gaetano Mosca likewise insisted that a "ruling class" always constituted the effective oligarchical control. Vilfredo Pareto elaborated the idea in his doctrine of the "elite." The modern tendency to analyze social patterns in terms of an "elite," although greatly reinforced by Pareto's theory, goes further back than Marx and Engels, who employed the term "elite" to describe the class-conscious communists, the leading group within the proletariat.

To say that all governments are in essence oligarchical may be an exaggeration. Yet a tendency persists in all organizations to evolve a limited group at the centre who, as insiders, "run the show." Political science and sociology are beginning to differentiate more carefully between various types of control and power. The type of power held by a democratic party boss, while overwhelming in relation to any single member of the party, is very different from that wielded by the boss of the single party in a totalitarian and authoritarian pattern. Likewise, the control group within an organization does not occupy the same position under democratic conditions (which provide for the group's being effectively challenged by outsiders at any time) as it does under an authoritarian plan. If effective control changes hands as rapidly as it does in a city of the U.S. or a British trade union, it is doubtful that those exercising it should be spoken of as a "class" or an "elite." The expression "the few" is too abstract to tell us much. Like the other purely numerical concepts of government inherited from Greek philosophy, oligarchy is an outmoded term, because it fails to direct attention to what we really wish to know about a government. (C. J. FR.)

OLIGOCENE (Gr. ὀλίγος, few, and καινός, recent), in geology the name given to the third series of the Tertiary system.

The Oligocene series thus includes those strata which occur above the Eocene and below the Miocene. These rocks were originally classed by Sir Charles Lyell as Older Miocene, the term Oligocene being proposed by H. E. Beyrich in 1854 and again in 1858. The Oligocene is thus the upper division of the older Tertiary system or Palaeogene. (*See* EOCENE; TERTIARY.)

Conditions during the Oligocene.—The Oligocene deposits are of fresh-water, brackish, marine and terrestrial origin; they include sands, sandstones, grits, marls, shales, limestones, conglomerates, lignites and volcanic materials. Here and there in Europe the sea gained ground that had been unoccupied by Eocene waters, but important changes were in progress, and a general relative uplifting took place which caused much of the Eocene sea floor to be occupied at this time by lake basins and lagoons. Thus, there is a general tendency for marine Oligocene deposits to occupy a more restricted area than the marine Eocene. Among the earliest of the Tertiary mountain chains to arise were the Pyrenees and the mountains of Provence (the Alpine chain, properly speaking), which were already in existence at the end of the Eocene. Thus, relatively unfolded Oligocene sediments are found on the flanks of belts of folded Eocene strata. In some areas the folding of the margins of Eocene gulfs resulted in the deepening of the centre of the trough and permitted huge thicknesses of Oligocene to be deposited. This, for example, is the case in the Burmese gulf and on the Pacific coast of North America and northern border of South America where Oligocene sediments reach a thickness of more than 10,000 ft. As in the Eocene epoch, minor oscillations of level gave rise to cycles of sedimentation Perhaps the most striking change from



MAP OF EUROPE DURING THE OLIGOCENE EPOCH

Eocene topography in Europe, shown on the accompanying map, is the extension of the Oligocene sea over north Germany, whence it extended eastward through Poland and Russia to the Aral-Caspian region, communicating thence with arctic waters by way of a Ural depression. It was later in the epoch when the widespread emersion set in.

Life of the Epoch.—In its general features the life of the epoch resembled that of the Eocene (*q.v.*); foraminifera were abundant; nummulites were still numerous but of smaller size and are characteristically associated with lepidocyclines. Corals and bryozoa were abundant in the clear waters of southern seas but echnoids were rather less numerous. Cephalopods were still fewer but gastropods and pelecypods assumed more and more their present importance, and the genera were those already noted in the Eocene. Among vertebrates, rays and dogfish were the dominant marine fish; tortoises were abundant and the genus *Rana* made its appearance. The most interesting feature of the land fauna is the great variety of mammals, especially from the interior of North America and the continental Oligocene of Europe, Asia and South America. The mammals are important fossils for distinguishing subdivisions of the epoch. While many of the mammals were of mixed types, others are clearly representatives of modern groups and forerunners of existing genera. Thus, it is possible to distinguish carnivores (Canidae and Felidae), insectivores, rodents, ruminants and camels. Forerunners of the rhinoceros, elephant and horse are all clearly separable. For an account of the flora *see* PALAEOBOTANY OR PLANT PALAEONTOLOGY. The abundance of *Chara* associated with such molluscan genera as *Limnaea* and *Planorbis* in fresh-water deposits is especially noteworthy.

Oligocene Stratigraphy.—Neither the lower nor the upper limit of the Oligocene is well defined. As mentioned in the article on the Eocene (*q.v.*), the lower limit is usually taken as the top of the Bartonian stage (including the Ludian). The Aquitanian stage is classed sometimes with the Oligocene, sometimes with the Miocene. The first opinion is adopted by those who pay first attention to the mammalian faunas; the Aquitanian fauna is an impoverished representative of preceding faunas and is not marked by the appearance of new forms. On the other hand, the Aquitanian deposits seem to mark the feeble beginning of the Miocene transgression.

The type areas for Oligocene stratigraphy lie mainly in France, Belgium and Germany, among the lagoons left by the retreat of the Eocene seas. The following is the classification of the Oligocene which has been generally adopted (reading downward):

Marine stages Europe	Western North America	Eastern North America
Chattian (Casselian)	Lower Blakeley	Flint River
Rupelian	Lincoln	Byram limestone Marianna limestone
Tongrian (Lattorfian)	Upper Keasey	Forest Hill sand and Red Bluff clay

Tongrian Stage (Tongern, Belgium) is represented by marine and fresh water clays and sands in Belgium, marine sandy glauconitic beds in northern Germany at Latdorf between Magdeburg and Leipzig, and the famous series of supragypsiferous marls of the Paris basin. These sediments change in character from place to place and in the Paris basin were called the Sannoisian stage. Here at the base are blue marls, laid down in salt lagoons, then white marls with fresh-water horizons and finally green marine marls having a wide geographic distribution. Marine sands and clays deposited contemporaneously in northern Germany were called Lattorfian. In Britain, classic exposures of Lower Oligocene sediments of fresh, brackish and marine origin occur in the cliffs of the Isle of Wight and have been described from base upward as Middle Headon beds (brackish and marine), Upper Headon beds (fresh-water clays, marls and limestones) and Osborne and Bembridge beds (brackish and fresh-water sands, clays and limestones).

The exact correlation of the different members of the Tongrian stage in western Europe is still uncertain. Many geologists have considered the molluscan and echinoid faunas in these beds as closely allied biologically to those of the uppermost Eocene of the Paris basin.

Rupelian Stage (Rupel, a tributary of the Scheldt, in Belgium) is the most widely distributed and easily recognized geologic unit of the Oligocene in western Europe. It is represented in Belgium by a thick series of clays—the Argiles de Boom, in the Paris basin by the Sables de Fontainebleau and the underlying Brie limestone which formerly were referred to by the stage term Stampian. Marine sandstones of equivalent age, called the Septarien-ton, occur in the Mainz basin and in northern Germany, where they were deposited in a rapidly transgressing sea. The Hampstead beds in the Isle of Wight, which consist of marine brackish-water clays and marls, were deposited during early Rupelian time.

Chattian Stage (Chattes, an ancient tribe which lived near Cassel, Germany) is best represented in the Mainz basin and northern Germany by basal glauconitic marine sands and overlying brackish and fresh-water marls and limestones. Equiva-

lent beds are unknown in Britain and Belgium. After the deposition of the Fontainebleau sands, the sea left the Paris basin and its area was occupied by a huge lake within which accumulated the Étampes limestone of which the Meulière de Montmorency is a lateral equivalent. Above these beds lie the fresh-water Beauce limestones, which in part belong to the Aquitanian stage. Continental Oligocene beds are found in several basins of the central European continent.

Marine and continental Oligocene deposits occur in the Alpine geosyncline in southern and eastern Europe, in North Africa, southern Russia, the Aral-Caspian region, Iran and India and in places on the eastern border of Asia.

An exact correlation of the marine Oligocene deposits of North America and the Caribbean region with those of western Europe is difficult because of the provincial nature of the faunas in the western hemisphere. Marine sediments occur in the Gulf and Atlantic coastal plains of the United States, in eastern Mexico, Central America, West Indies, the northern third of Venezuela and Colombia and in western Ecuador and northwestern Peru. Thick deposits occur in the Coast ranges of California, Oregon and Washington and in southern Alaska and northeastern Asia.

Lower Oligocene sediments in the eastern United States occur only in Mississippi and Alabama and are represented by less than 100 ft. of the Forest Hill sand and the Red Bluff clay which accumulated as delta deposits. Resting on these are light-coloured shaly marls and clays of the Vicksburg group. These are known locally as the Marianna limestone, the Byram limestone and in Texas as the Frio clay. They were deposited during the Middle Oligocene in a more widely transgressing sea which extended at times from South Carolina westward into the Gulf coastal plain of Mexico. A slight subsidence of the coastal sea floor during Late Oligocene time was followed by the deposition of nearly 100 ft. of the Flint River and Suwanee limestones from South Carolina to northern Florida and by marls and shales of the Chickasaw from Alabama to the Mississippi river. No sediments of uppermost Oligocene (Upper Chattian) are exposed unless the sandstones of the lower part of the Catahoula formation extend down into the Oligocene. This formation is thought to have been deposited during the Aquitanian stage of the Lower Miocene. Marine limestones and shales of Oligocene age are widely distributed in the West Indies, Costa Rica and Panamá.

Marine Oligocene sediments which vary greatly in lithology and thickness are exposed in the northern part of Venezuela and Colombia. They are composed mainly of blue, brown and gray shales, interbedded sandy shales and sandstones and thick deposits of massive sandstone which were deposited in a slowly subsiding trough. These deposits range from 5,000 ft. to 10,000 ft. thick and have been described as the Mugrosa series, Colorado series and Poso series in Colombia and the El Fausto, Icotea, Churuguara, San Luis, Agua Clara, Agua Salada and Carapita formations in Venezuela. The Agua Clara formation is best known and consists of more than 800 m. of lagoonal gypsiferous shales with marine intercalations.

Several thousand feet of marine sandstones and shales occur in the coastal part of northwest Peru and extend northward through western Ecuador to Colombia. They accumulated in a north and south trough which at times had connections with the Pacific ocean. The marine faunas are related to those of the Caribbean region. Marine Oligocene deposits are almost entirely absent from the interior of South America.

During the Oligocene an area more than 100 mi. wide in western North America, extending from Vancouver Island to Lower California, was occupied from time to time by embayments of the Pacific ocean. These downfolds in the crust were formed at an earlier time by folding and faulting. In Oregon and Washington more than 10,000 ft. of marine shale, sandstone and conglomerate which accumulated in these basins have been classified from top downward as the Blakeley, Lincoln and Keasey formations. Faunal zones based on molluscs and foraminifera have been recognized within these deposits but it is uncertain how much of the Keasey formation extends down into the Eocene and how much of the upper part of the Blakeley formation ranges into the Miocene. In central California the Oligocene is represented by marine sandstones, sandy shales and deposits of volcanic tuff. Farther south in the Coast ranges occur thick deposits of massive and stratified light-gray shale called the Kreyenhagen formation. Zones based on foraminifera were established in these sediments indicating a time range from Upper Eocene, through Oligocene, into Lower Miocene. Stratigraphic sections of this formation vary greatly in age from place to place. Other basins in southern California were above sea level during the Oligocene and received thick accumulations of conglomerate, sandstone and shale which were named the Sespe formation. In certain places this formation ranges in age from Upper Eocene to Lower Miocene.

Sandstones and shales containing marine fossils similar to those of the Blakeley formation occur in southern Alaska, Sakhalin Island and the Kamchatka peninsula of Siberia. Several genera with eastern Asiatic ancestry were introduced into western North America during the Oligocene.

Land-laid deposits of Oligocene age occur in eastern Colorado, Nebraska, eastern Wyoming, North and South Dakota, Montana, Oregon, Nevada and California. In the eastern Rocky mountain area they are represented by the Wind River series, in Montana by the Pipestone Springs and Cook Ranch formations and in Oregon by the Lower John Day formation. The Sespe formation already referred to is best known in California. (C. E. We.)

OLIGOCHAETA, a class of the Annelida (*q.v.*), comprising the earthworms (*q.v.*), the enchytraeids and several families of small mud-living or aquatic, rarely marine or parasitic, species.

OLIGOCLASE, a rock-forming mineral of the group of felspars (*q.v.*).

OLIPHANT, LAURENCE (1829–1888), British author, son of Anthony Oliphant (1793–1859), was born at Capetown, U. of S. Af. His father was then attorney general in Cape Colony, but was soon transferred as chief justice to Ceylon. The boy's education was of the most desultory kind. In the years 1848 and 1849 he accompanied his parents on a tour on the continent of Europe. In 1851 he accompanied Jung Bahadur from Colombo to Nepal and found material for his first book, *A Journey to Khatmandu* (1852). From Nepal he returned to Ceylon, then to England and then to Russia, after which he wrote *The Russian Shores of the Black Sea in the Autumn of 1852, and a Tour through the Country of the Don Cossacks* (1853). Between 1853 and 1861 he was successively secretary to Lord Elgin during the negotiation of the Canada Reciprocity treaty at Washington, D.C., the companion of the duke of Newcastle on a visit to the Circassian coast during the Crimean War, and Lord Elgin's private secretary on his expedition to China. Each of these experiences produced a pleasant book of travel. In 1861 he was appointed first secretary in Japan and might have made a successful diplomatic career if it had not been interrupted, almost at the outset, by a night attack on the legation, in which he nearly lost his life. It seems probable that he never properly recovered from this affair. He returned to England and resigned the service and was elected to parliament in 1865 for the Stirling burghs.

Oliphant did not show any conspicuous parliamentary ability, but made a great success by his vivacious and witty novel *Piccadilly: a Fragment of Contemporary Biography* (1870). He fell, however, under the influence of the spiritualist prophet Thomas Lake Harris, who about 1861 had organized a small community, the Brotherhood of the New Life, which at this time was settled at Brocton on Lake Erie where Oliphant spent many years living as a farm labourer. As late as Dec. 1878 he continued to believe that Harris was an incarnation of the Deity.

In 1879 he visited Palestine and in 1881 he crossed again to the United States. On this visit he finally broke with Harris. He and his wife (the former Alice Le Strange) settled at Haifa in Palestine.

There they wrote together the strange book called *Sympneumata: Evolutionary Forces Now Active in Man* (1884), and in the next year Oliphant produced there his novel *Masollam,* which may be taken to contain its author's latest views with regard to the personage whom he long considered as "a new Avatar." One of his cleverest works, *Altiora peto,* had been published in 1883.

In 1886 his wife died of fever. He was persuaded that after death he was in much closer relation with her than when she was still alive and conceived that it was under her influence that he wrote his *Scientific Religion.* In Nov. 1887 he went to England to publish that book. By the Whitsuntide of 1888 he had completed it and started for the U.S. Oliphant married, as his second wife, a granddaughter of Robert Owen. They were starting for Haifa when he died, at Twickenham, on Dec. 23, 1888.

See Margaret Oliphant, *Memoir of the Life of Laurence Oliphant and of Alice Oliphant His Wife* (1892). (M. G. D.; X.)

OLIPHANT, MARGARET OLIPHANT (1828–1897), British novelist and historical writer, daughter of Francis Wilson, was born at Wallyford, near Musselburgh, Midlothian, in 1828. Her childhood was spent at Lasswade (near Dalkeith), Glasgow and Liverpool. She had long been a regular contributor to *Blackwood's* and had written some novels when she married in 1852 her cousin Frank Wilson Oliphant. They settled at Harrington square in London. Her husband was an artist, principally in stained glass. She died at Wimbledon on June 25, 1897. Her *Autobiography* gives a touching picture of her domestic life. Mrs. Oliphant was one of the most popular writers of her time. She wrote more than 120 books. Among the best known are the novels *Adam Graeme* (1852), *Miss Marjoribanks* (1866) and the short stories collected in the *Chronicles of Earlingford.*

OLIPHANT or **OLIFANT,** the large signal horn of the middle ages, made, as its name indicates, from the tusk of an elephant. The oliphant was the instrument of knights and men of high degree.

OLIVARES, GASPAR DE GUZMAN, Count of Olivares and Duke of San Lúcar (1587–1645), Spanish royal favourite and minister, born in Rome, Jan. 6, 1587. Combining his inherited title of count with that of duke granted him by Philip IV, he became commonly known as *el conde-duque.* Philip III had appointed him to the household of the heir apparent, over whom he obtained such influence that from the beginning of the new reign all papers requiring the royal signature were sent first to the count-duke.

For 22 years, from 1621, Olivares directed the policy of Spain. It was a period of disaster abroad and of rebellion at home, for which the minister was inevitably held responsible, until he became the accepted model of a grasping and incapable favourite. History has modified the harshness of this judgment. A man of great energy and resolve, ambitious less for wealth than for power, he was also a Maecenas of letters and the arts and was much painted by Velazquez.

Most of the errors of Olivares' foreign policy—the renewal of war with the Netherlands in 1621, intervention in the Thirty Years' War, lesser wars in Sicily—were supported by king, church and the country at large. Where his initiative was most personal, and most disastrous, was in his internal policy of consolidating peninsular unity by force, in defiance of regional interests. The resulting revolts which took place in Catalonia and Portugal in 1640 were the immediate cause of his fall, though only in Jan. 1643, and reluctantly, did Philip part with him, under pressure of a strong court intrigue headed by the queen.

Olivares retired to Toro in the province of Zamora, where he composed, or inspired, an able apology which was confiscated by the Inquisition. He died there on July 22, 1645, driven mad by fear that Philip would accede to the persisting demands, chiefly of the Aragonese, for his head.

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OLIVE (*Olea europaea*), the plant that yields the olive oil of commerce, belonging to a section of the family Oleaceae, of which it has been taken as the type. The genus *Olea* includes about 35 species, very widely scattered, chiefly over the old world, from the Mediterranean basin to South Africa and New Zealand. The wild olive is a small tree or bush of rather straggling growth, with thorny branches and opposite oblong pointed leaves, dark grayish-green above and, in the young state, hoary beneath with whitish scales; the small white flowers, with four-cleft calyx and corolla, two stamens and bifid stigma, are borne on the last year's wood, in racemes springing from the axils of the leaves. In the cultivated forms (*O. europaea,* var. *sativa*) the tree acquires a more compact habit, the branches lose their spinous character, while the young shoots become more or less angular; the leaves are always hoary on the underside and are generally lanceolate in shape. The fruit may be globular, oblong or even crescent shaped and when ripe is usually purplish black in colour. The wild olive is found in most countries around the Mediterranean but is probably a native of Syria and the maritime parts of Asia Minor. It was cultivated on the island of Crete as early as 3500 B.C.

The olive tree is of rather slow growth, but after long years of natural development the trunk often attains a considerable diameter. Augustin Pyrame de Candolle records one exceeding 23 ft. in girth, its age being estimated at 700 years. The tree in cultivation seldom exceeds 30 ft. in height and is generally kept much smaller by frequent pruning. The wood, of a yellow or light greenish-brown hue, is often finely veined with a darker tint and, being very hard and close grained, is valued by the cabinet-maker and turner.

Distribution.—At what remote period of human progress the wild olive became the fruitful garden olive it is impossible to conjecture. Some trees yielded with little labour a valuable oil, and this product became a symbol of peace and good will among the warlike barbarians. At a later period the oil was conveyed, as an article of trade, to neighbouring nations, and the plant doubtless soon followed.

In the Homeric world, as depicted in the *Iliad,* olive oil is known only as a luxury of the wealthy, an exotic product prized chiefly for its value in the heroic toilet, but there is no mention of the cultivation of the tree. Whenever it may have been introduced, tradition points to the limestone hills of Attica as the seat of its first cultivation on the Greek peninsula. By the time of Solon the olive had so spread that he found it necessary to enact laws to regulate the cultivation of the tree in Attica, from which country it was probably distributed gradually to all the Athenian allies and tributary states.

In Latin Italy the cultivation seems to have spread slowly, for it was not until the consulship of Pompey that the production of oil became sufficient to permit of its exportation. In Pliny's time it was already grown abundantly in the two Gallic provinces and in Spain; indeed, in the earlier days of Strabo the Ligurians supplied the Alpine barbarians with oil, in exchange for the wild produce of their mountains. Along the southern shore of the Mediterranean the tree was carried by the Phoenicians, at a remote period, to their numerous colonies in Africa and then into Spain.

Yielding a substitute for the butter and animal fats consumed by the races of the north, the olive, among the southern nations of antiquity, became an emblem not only of peace but of national wealth and domestic plenty; the branches borne in the Panathenaea, the wild olive spray of the Olympic victor and the olive crown of the Roman conqueror at ovation alike typified gifts of peace that, in a barbarous age, could be secured by victory alone. Among the Greeks the oil was valued as an important article of diet as well as for its external use. The Roman people employed it largely in food and cookery and the wealthy considered it an indispensable adjunct to the toilet; and in the luxurious days of the later empire it became a favourite axiom that long and pleasant life depended on two fluids, "wine within and oil without." The gourmet of the empire valued the unripe fruit, steeped in brine, no less than his modern representative, and pickled olives have been found among the buried stores of Pompeii.

In modern times the olive has been spread widely over the world. The tree was introduced into Chinese agriculture and became an important addition to the resources of the Australian planter. It was likewise successfully introduced into parts of Cape of Good Hope, Union of South Africa.

The olive is grown mainly for oil, the average annual world output usually averaging in the neighbourhood of 1,000,000 tons. Olive oil weighs approximately 7.6 lb. per gallon. Spain leads with 38% of the total production, followed in order of importance by

Italy, Greece, Portugal, Tunisia and Turkey. Olives and olive products form about 6% of the total agricultural production of Spain, three-fourths of the total area in olives being in the southern provinces, such as Jaén, Córdoba and Sevilla. Only 1.5% of Spanish olives are used for green pickles, the rest being pressed for oil. Of the 20 or more varieties grown in southern Spain, the Sevillano and Manzanillo are preferred for pickling, while the Zorzalena is principally used for oil.

OLIVE (OLEA EUROPAEA)

In Italy the olive is second only to the grape as a horticultural crop. Specialized olive culture, where olive trees occupy the major portion of the land, constitutes 2.6% of the area of Italy; associated olive culture, with olives only a secondary crop, covers another 4.4% of the area. The province of Puglia is credited with 721,000 ac. of specialized olive orchards —more than twice that of Calabria, the next in importance. Sicily leads in the total area devoted to mixed olive culture. More than 85% of Italian olive trees are grown on hills and mountainsides rather than on the plains. Almost the entire production of olives in Italy is used for oil, a very small percentage being used for table olives as dried, salted and pickled fruit. The number of olive varieties grown is from 150 to 300, depending upon the authority consulted, each zone or region having its favourites, such as Corregiolo, Leccino and Morinello in the central provinces.

Specialized olive culture is an important industry on hillsides throughout Greece.

While olives in Greece are grown mostly for oil, this country is also one of the principal exporters of table olives, consisting of black fruit dried, processed in oil or salted, the last being well known in world trade as Greek olives.

In Portugal olive trees are of first importance, the chestnut, fig and carob following in order. Olive culture is mainly concentrated in the central provinces, which possess about two-thirds of the total area planted to this fruit tree. Ninety per cent of Portuguese olive oil is usually consumed in the country.

In Tunisia, olive culture reached its highest development during the Roman occupation of North Africa. It is estimated that the olive orchards covered 2,500,000 ac. when the Arabs conquered the country about A.D. 700. Ancient Rome taxed this province 300,000 gal. of olive oil yearly, and one of the cities near the eastern coast is reputed to have built a conduit solely for the purpose of transporting oil to its seaport. Remains of more than 1,000 oil mills are said to exist in the 100 sq.mi. around Suffetula alone. In the region of Sfax are found optimum conditions for development of olive trees and fruit, so that 30% of all Tunisian olives are grown in that vicinity. More than 90% of the olive production of Tunisia is pressed for oil. The Chemlali is the most common variety and has a high oil content. Tunisia ordinarily supplies many markets with oil for direct consumption, including France, Great Britain and the United States. Algeria is also an important producer of olives for oil.

Olives form the most important tree crop of Anatolia in Turkey, especially on the seaward slopes. The government took steps to promote the industry and to encourage the grafting of fruitful varieties on wild olive trees.

Olives are grown to some extent in the arid regions of South America, and interest in olive culture has been stimulated in various ways. In the United States commercial olive culture is confined almost entirely to California, where the industry is based mostly upon the production of large-sized olives for processing rather than for oil. Thus, California olive oil output is normally less than 1% that of Spain.

Of the average annual production of approximately 50,000 tons, 38% is pressed for oil and 18% is for green pickles, fresh fruit shipments and for other uses. The varieties, all from old world countries, are, in order of importance, Mission, Manzanillo, Sevillano and Ascolano.

The canned ripe olive pack of California averages about 1,500,000 cases of 24 no. 2½ cans, with sizes of fruit in the cans ranging from small to large, mammoth, giant, colossal and even to super-colossal. A ton of ripe olives produces approximately 70 cases of canned fruit.

Ripe olive prices to the grower are based upon the size of fruit and increase rapidly with increase in size. Crops of five tons to the acre are not uncommon, but it is the aim of the grower to get moderate production of large-sized fruit annually rather than alternate heavy and light crops.

Propagation and Culture.—In some Mediterranean countries the desired varieties are grafted on wild olive trees which grow naturally on the hillsides. Seedling stocks are sometimes grown in nurseries, then grafted, but olive trees so propagated may not be any more fruitful than trees of the same variety growing on their own roots. Cuttings are therefore almost universally used for olive tree propagation. These may be of branches several inches in diameter and five to six feet long, planted in the ground where the tree is to remain, or of shorter and smaller pieces planted in nursery rows. The large knots or ovoli which naturally grow at the base of olive trees are sometimes chiselled off and planted, their sprouts being treated as cuttings. In California the trees are grown either from hardwood or softwood cuttings. Cuttings of mature wood placed in sand with bottom heat in February form roots and make a short growth by fall. Softwood olive cuttings are made in October of mature terminal twigs about five inches long, and placed close together in sand for rooting. The following May the rooted cuttings are set in nursery rows where they grow for two years, after which they can be transplanted to the orchard.

In unirrigated orchards of the old world the trees are widely spaced, as much as 75 ft. apart in Tunisia. In California, where irrigation is the rule, the trees are spaced 30–40 ft. apart, depending upon the variety. Trees come into bearing at 5 years of age but are not in full production until 15 or 20 years old. In Spain and Italy olive trees are pruned rather heavily each year or every other year in order to promote new growth. Experiments in California, however, show that Mission olive trees unpruned during the first four or five years develop much more rapidly and have a larger trunk than trees pruned each year. Furthermore, pruning of bearing trees has neither increased the yield nor substantially improved the size of fruit. The advantage of pruning appears to be the greater convenience in harvesting and the more effective control of pests and diseases. Olives intended for oil are sometimes beaten from the trees with poles, but this method of harvesting is injurious to both tree and fruit. Olives for canning are carefully harvested by hand and transported in boxes to the processing plants. Both animal manures and commercial fertilizers are commonly used in European olive orchards. Fertilizer experiments in California show that nitrogen is the only element which has appreciably increased the yield of olives.

The extraction of oil from olives is largely a mechanical process. As soon after harvesting as possible the fruit is first crushed beneath stone or steel rollers, then placed in press cloths which are stacked one above the other somewhat like broad flat cheeses. Hydraulic presses are commonly used, the first oil secured being known as virgin oil. Olives vary considerably in oil content, which ranges from 50% to 60% of the dry weight of pit-free pulp. Ripe olives contain a bitter principle which, in order to make the fruit palatable, is commonly neutralized by submersion in a lye solution. The natural black colour of the fruit is retained by aeration during the pickling process. Pickled olives are packed in cans in a salt solution and sterilized with steam under pres-

sure for one hour at 116° C. Green olives are pickled in barrels, going through a process of lactic acid fermentation.

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(I. J. CT.)

OLIVEIRA MARTINS, JOAQUIM PEDRO DE (1845–1894), Portuguese writer, was born in Lisbon, and in 1870 was appointed manager of the mine of St. Eufemia near Cordova. In Spain he wrote *O Socialismo,* and developed that sympathy for the industrial classes of which he gave proof throughout his life. Returning to Portugal in 1874, he became administrator of the railway from Oporto to Povoa, residing in Oporto. He entered parliament in 1886, became minister of finance on Jan. 17, 1892, and later vice-president of the Junta do Credito Publico. He died on Aug. 24, 1894. A psychologist, a profound sociologist, a stern moralist and an ardent patriot, Oliveira Martins deserved his European reputation. His *Bibliotheca das sciencias sociaes,* a veritable encyclopaedia, comprises literary criticism, socialism, economics, anthropology, histories of Iberian civilization, of the Roman republic, Portugal and Brazil. Toward the end of his life he specialized in the 15th century and produced two volumes, *Os fithos de D. João I* (1891) and *A vida de Nun' Alvares* (1893), leaving unfinished *O principe perfeito* (1896), a study on King John II, edited by Henrique de Barros Gomes. The chief characteristics of the man—psychological imagination combined with realism and a gentle irony—make his strength as a historian and his charm as a writer. He drew admirable portraits; in his *Historia de Portugal* and *Portugal Contemporaneo* (1881) those of King Pedro I and Herculano are among the best known.

See Moniz Barreto, *Oliveira Martins, estudo de psychologia* (Paris, 1887), a remarkable study; F. Diniz D'Ayalla, *Os Ideaes de Oliveira Martins* (1897), which contains an admirable statement of his ideas, philosophical and otherwise; Anthero de Quental, *Oliveira Martins* (1894); *Diccionario bibliographico portuguez,* xii, 125; P. Leal, *Sociologia de Oliveira Martins* (Pôrto, 1945).

OLIVENITE, a mineral consisting of basic copper arsenate with the formula $Cu_2(OH)AsO_4$. It crystallizes in the orthorhombic system, and is sometimes found in small brilliant crystals of simple prismatic habit terminated by domal faces. More usually it occurs as globular aggregates of acicular crystals, these fibrous forms often having a velvety lustre. A characteristic feature, and one to which the name alludes, is the olive-green colour, which varies in shade from blackish-green in the crystals to almost white in the variety known as wood copper.

OLIVE OIL is the oil expressed from the fleshy part of the ripened fruit (pericarp) of the olive tree, which is chiefly cultivated in the countries of the Mediterranean basin, also in California, South America and Australia. The ripe fruit contains from 20% to 50% oil, depending on climatic conditions and care in cultivation. Some varieties contain more oil than others.

The fruit intended for oil production is gathered when fully ripe. Virgin oil, so termed because it is carefully prepared from selected sound fruits in the first pressing, is seldom exported in its natural state but forms the basis of edible export types of the finest qualities. The apparatus used in expressing the oil (crushing) varies from the most primitive Roman presses, consisting of conical stones, hand or mule propelled, to the most modern types of hydraulic presses. To obtain the best quality edible oil it is essential that the oil be removed from contact with the residual and putrescible pulp as soon as possible; otherwise the consequent formation of free fatty acids may induce rancidity. In practice the residual pulp is subjected to a second pressing with hot water yielding an oil of higher free fatty acid content, called *lampante* after its primitive use as a fluid for lamps. This oil of second pressing is then subjected to a refining process of decolorization, deacidification and deodorization and is commercially known as refined olive oil. It is largely used to blend with virgin oils for edible export types.

A third type of oil, lowest in quality, is obtained from the residue by a process of extraction with a volatile solvent, usually carbon disulphide. This oil is commercially known as sulphur olive oil or olive oil foots, and is largely used in the production of soap, especially green and mottled laundry soaps.

Edible olive oil should be practically devoid of free fatty acids. The U.S. Pharmacopoeia requires olive oil not to exceed 1.41%; however, most export types do not exceed 1%. It varies in colour from water white (refined) to golden yellow. Certain types, pressed from unripe fruit, will have a greenish tint. Almost every producing country produces oils of varying characteristics and qualities, depending on the districts in which the olive is grown and the degree of the ripeness of the fruit.

Oil Production of Principal Olive-Growing Countries
(In short tons)

Countries	1951	1935–39 Average
France	13,000	8,000
Greece	15,200	131,500
Italy	389,700	265,000
Portugal	117,000	64,000
Spain	770,000	357,100*
Yugoslavia	3,200	5,900*
Israel (Palestine)	200	[illegible]
Syria }	5,500	12,500
Lebanon }	6,500	
Turkey	28,000	20,000
French Morocco	27,000	13,000*
Tunisia	50,000	49,300
Libya	4,000	2,600
All countries	1,609,300	971,200
World production	1,620,000	975,000

*Average figures based on less than five years.
Source: U S. Department of Agriculture, Foreign Agriculture Service, Washington, D.C.

Each oil has definite characteristics which generally consist of glycerides made up of saturated or unsaturated fatty acids. The majority of the glycerides are not made up of one fatty acid, but of combinations. The average composition of olive oil is approximately as follows: oleic acid, 70%–85%; linoleic acid, 4%–12%; palmitic acid, 7%–14%; and stearic acid 1%–2%.

Olive oil is sometimes adulterated with other vegetable and seed oils. However, any adulteration that may be used can be detected by chemical tests that are specific for each adulterant.

Pure olive oil is largely used for comestible purposes (cooking, salads, etc.) and in the preservation of foods (sardine canning, etc.); it is also used in the textile industry (wool combing), in the manufacture of high-class toilet preparations and cosmetics, in the pharmaceutical industry for medicinal purposes and in the manufacture of high-class Castile soap. (J. M. CN.)

OLIVER, ISAAC PETER (d. 1617), miniature painter, was born at Rouen of Huguenot parents who brought him to London *c.* 1568. He died, aged between 50 and 60, in London, and was buried at St. Anne's, Blackfriars. He studied under N. Hilliard, and was in Venice in 1596. Apparently he married Sarah, daughter of Marc Gheeraerts, the portrait painter, in 1602. Besides miniature portraits he painted small religious and classical pictures. His patrons included Queen Elizabeth I, Henry, prince of Wales, Sir Philip Sidney and Anne of Denmark. His earlier miniatures carry on the fine tradition of Hilliard; his later are influenced by the oil painters of that time. Oliver's work is in the first rank of British miniatures.

His son PETER OLIVER (*c.* 1594–1647) was his pupil and capably carried on his later style. Peter copied Italian pictures in miniature, and his signed and dated portraits range from 1619 to 1646. He is said to have painted landscapes in miniature.

See Basil Long, *British Miniaturists* (London, 1929); R. W. Goulding, *Walpole Society Annual, IV.* (C. H. C. B.)

OLIVES, MOUNT OF, the ridge, 2,680 ft. above sea level, facing the Temple mount at Jerusalem on the east and separated from it by the Vale of Kidron: Arabic, *Jebel et-Tōr.* Of the four distinct elevations on the ridge the southernmost is the scene of Solomon's idolatrous worship. The mount is referred to only four times in the Old Testament. Jesus crossed it on his entry into Jerusalem. The Ascension took place "over against Bethany" (Luke xxiv, 50), probably in one of the secluded ravines of the eastern slope. The tradition that the Ascension was from the central eminence of the hill dates from Eusebius Caesarea, and over a sacred cave in that place there was built a succession of sanctuaries. The latest chapel on the site was built by the crusaders and modified by the Moslems, who erected beside the entrance to the *haram* a minaret.

Close by is the grotto of St. Pelagia (d. 457) and a short way down the hill the rock-cut cave called the "Tomb of the Prophets." A tradition of the middle ages identified Olivet with

the Mount of Transfiguration. At its foot was the Garden of Gethsemane (*q.v.*).

At the present day there stands on Mt. Scopus, a continuation of the Mt. of Olives, the new Hebrew university opened by Lord Balfour in 1925. The German hospice was opened in 1910. The earthquake of July 11, 1927, was particularly severe in the area of the mount. (E. Ro.)

OLIVETANS, one of the lesser monastic orders following the Benedictine rule, founded by St. Bernard Tolomei, a Sienese nobleman. At the age of 40, when the leading man in Siena, he retired along with two companions to live a hermit's life at Accona, a desert place 15 mi. to the south of Siena, 1313. Soon others joined them, and in 1324 John XXII approved of the formation of an order, the Benedictine rule being taken as the basis of the life. Partly from the olive trees that abound there, and partly out of devotion to the Passion, Accona was christened Monte Oliveto, whence the order received its name. By the end of the 14th century, there were more than 100 monasteries, chiefly in Italy; and in the 18th there still were 80, one of the most famous being San Miniato at Florence. The Olivetans have a house in Rome and in a few other cities.

OLIVIER OF RAMSDEN, SYDNEY OLIVIER, 1ST BARON, cr. 1924 (1859–1943), English statesman and writer, was educated at Tonbridge and Corpus Christi college, Oxford. He entered the colonial office in 1882 and was governor of Jamaica from 1907 to 1913. After his return from Jamaica he was permanent secretary of the board of agriculture (1913–17) and assistant comptroller of the exchequer (1917–20). In 1924 Olivier received a barony, and took office in the Labour government as secretary for India.

Olivier wrote books on colonial questions. He was created K.C.M.G., 1907. He died Feb. 15, 1943.

OLIVINE, a rock-forming mineral composed of magnesium and ferrous orthosilicate, the formula being $(Mg,Fe)_2SiO_4$. The name alludes to its olive-green colour and is often applied incorrectly by jewellers to various green stones. The transparent varieties, or "precious olivine," used in jewellery, are known as chrysolite (*q.v.*) and peridot.

Olivine crystallizes in the orthorhombic system, but distinctly developed crystals are comparatively rare, the mineral more often occurring as compact or granular masses or as grains and blebs embedded in the igneous rocks of which it forms a constituent part. The hardness is $6\frac{3}{4}$; the specific gravity 3.27–3.37, but reaching 3.57 in the highly ferruginous variety known as hyalosiderite. The amount of ferrous oxide varies from 5% (about 9% in the gem varieties) to 30% in hyalosiderite. The depth of the green, or yellowish-brown, colour also varies with the amount of iron. The lustre is vitreous. The indices of refraction (1.66 and 1.70) and the double refraction are higher than in many other rock-forming minerals; and these characteristics, together with the indistinct cleavage, enable it to be readily distinguished in thin rock sections under the microscope. The mineral is decomposed by hot hydrochloric acid with separation of gelatinous silica; it often contains small amounts of nickel and titanium dioxide; the latter replaces silica, and in the variety known as titan olivine reaches 5%.

Olivine is a common constituent of many basic and ultrabasic rocks, such as basalt, dolerite, gabbro and peridotite; and the dunite, of Dun mountain near Nelson in New Zealand, is an almost pure olivine rock. It also occurs as an accessory constituent of some granular dolomitic limestones and crystalline schists. With enstatite it forms the bulk of the material of meteoric stones; and in another type of meteorites large blebs of glassy olivine fill spaces in a cellular mass of metallic iron.

Olivine is especially liable to alteration into serpentine (hydrated magnesium silicate); the alteration proceeds from the outside of the crystals and grains or along irregular cracks in their interior, and gives rise to the separation of iron oxides and an irregular network of fibrous serpentine, which in rock sections presents a very characteristic appearance. Large greenish-yellow crystals from Snarum in Buskerud, Nor., at one time thought to be crystals of serpentine, really consist of serpentine pseudomorphous after olivine. Many of the large rock masses of serpentine have been derived by the serpentinization of olivine rocks. Olivine also sometimes alters, especially in crystalline schists, to a fibrous, colourless amphibole, to which the name pilite has been given. By weathering processes it alters to limonite and silica.

Closely related to olivine are several other species, which are included together in the olivine group: they have the orthosilicate formula R''_2SiO_4, where R'' represents calcium, magnesium, iron, manganese and rarely zinc; they all crystallize in the orthorhombic system, and are isomorphous with olivine. These include: monticellite, $CaMgSiO_4$, a rare mineral occurring as yellowish-gray crystals and grains in granular limestone at Monte Somma, Vesuvius; forsterite, Mg_2SiO_4, as colourless or yellowish grains embedded in many crystalline limestones; fayalite, Fe_2SiO_4, or iron olivine, a dark brown or black variety occurring as nodules in volcanic rock; tephroite, Mn_2SiO_4, a gray (τεφρός, ash-coloured), mineral occurring in Sweden and New Jersey. (L. J. S.)

OLLIVIER, OLIVIER ÉMILE (1825–1913), French statesman, was born at Marseilles on July 2, 1825. On the establishment of the second republic his father, DEMOSTHENES OLLIVIER (1799–1844), secured for him the position of commissary-general of the department of Bouches-du-Rhône. His repression of a Socialist outbreak at Marseilles commended him to Gen. Louis Cavaignac, who made him prefect of the department. His removal to the prefecture of Chaumont (Haute-Marne) he ascribed to his father's enemies. He therefore resigned from the civil service to take up practice at the bar.

He re-entered political life in 1857 as deputy for the 3rd circumscription of the Seine. His candidature had been supported by the *Siècle,* and he joined the constitutional opposition. With Alfred Darimon, Jules Favre, J. L. Hénon and Ernest Picard he formed the group known as Les Cinq, which wrung from Napoleon III some concessions in the direction of constitutional government. The imperial decree of Nov. 24, permitting the insertion of parliamentary reports in the *Moniteur,* and an address from the Corps Législatif in reply to the speech from the throne, were welcomed by him as a first instalment of reform. This acquiescence marked a considerable change of attitude, for only a year previously a violent attack on the imperial government, in the course of a defense of Étienne Vacherot, brought to trial for the publication of *La Démocratie,* had resulted in his suspension from the bar for three months. He gradually separated from his old associates, who grouped themselves around Jules Favre, and during the session of 1866–67 Ollivier helped to form a third party, which definitely supported the principle of a liberal empire. This led to a struggle of personal rivalry between Ollivier and Eugène Rouher, the minister of state, who attempted, by the issue of his *Senatus-consulte* (July 1866), to uphold the constitution of 1852. On Jan. 19, 1867, an imperial decree was issued, restoring the right of interpellation to the deputies. A promise was also inserted in the *Moniteur* of a relaxation of the stringency of the press laws and of concessions in respect of the right of public meeting. On June 28, 1869, the third party, which consisted of 116 members, with the support of the left, obtained a majority in the chamber for their demand for a responsible ministry "and the right of the Legislative Body to regulate the essential conditions of its own activity." The emperor prorogued the legislative body on July 13, and on the same day appointed Rouher president of the senate. The *sénatus-consulte* of Sept. 8, 1869, gave the two chambers the ordinary parliamentary rights. On Nov. 29 the chambers again met and on Dec. 28 the emperor was obliged to give in to the third party's demands. He dismissed Rouher and entrusted Ollivier with the formation of a responsible ministry of which Ollivier was really premier, although that office was not nominally recognized by the constitution. The new cabinet, known as the ministry of the Jan. 2, had a hard task before it, complicated a week after its formation by the hostile manifestation following the shooting of Victor Noir by Prince Pierre Bonaparte. Ollivier immediately summoned the high court of justice for the judgment of Prince Bonaparte and Prince Joachim Murat. His ministry included four members of the right centre and four of the left centre. In March his position obliged him to propose a revision of the constitution, and on April 20, a *sénatus-consulte*

was issued which accomplished the transformation of the Empire into a constitutional monarchy. Ollivier, however, still had to face violent opposition from the Republicans and Socialists. He had arrested Rochefort on Feb. 9 for his presence at the funeral of Victor Noir, and he arrested also the editors of the *Marseilléien.* Neither concessions nor firmness sufficed to appease the "Irreconcilables" of the opposition, who since the relaxation of the press laws were able to influence the electorate. On May 8, however, the amended constitution was submitted to a plebiscite, which resulted in a vote of nearly seven to one in favour of the government. The most distinguished members of the Left in his cabinet—L. J. Buffet, Napoléon Daru and Talhouët Roy—resigned in April on the question of the plebiscite. Ollivier himself held the ministry of foreign affairs for a few weeks, until Daru was replaced by the duc de Gramont.

The revival of the candidature of Prince Leopold of Hohenzollern-Sigmaringen for the throne of Spain early in 1870 disconcerted Ollivier's plans. The French government, following Gramont's advice, instructed Benedetti to demand from the king of Prussia a formal disavowal of the Hohenzollern candidature. Ollivier allowed himself to be gained by the war party. The story of Benedetti's reception at Ems and of Bismarck's manipulation of the Ems telegram is told elsewhere. (*See* BISMARCK.) It is unlikely that Ollivier could have prevented the eventual outbreak of war, but he might perhaps have postponed it at that time, if he had taken time to hear Benedetti's account of the incident. He was outmanoeuvred by Bismarck, and on July 15 he made a hasty declaration in the Chamber that the Prussian government had issued to the powers a note announcing the rebuff received by Benedetti. He obtained a war vote of 500,000,000 francs, and used the fatal words that he accepted the responsibility of the war "with a light heart," saying that the war had been forced on France. On Aug. 9, with the news of the first disaster, the Ollivier cabinet was driven from office, and its chief sought refuge in Italy. He returned to France in 1873, and occupied himself with writing the apology for his government, *L'Empire libéral* (1895 *seq.*). His first wife, Blandine Liszt, was the daughter of the Abbé Liszt by Mme. d'Agoult (Daniel Stern). She died in 1862, and Ollivier married in 1869 Mlle. Gravier. He died at St. Gervais-les-Bains on Aug. 30, 1913.

His other works include *Démocratie et liberté* (1867), *Le Ministère du 2 janvier, mes discours* (1875), *Principes et conduite* (1875), *L'Église et l'État au concile du Vatican* (2 vols., 1879), *Solutions politiques et sociales* (1893), *Nouveau Manuel du droit ecclésiastique français* (1885).

See M. T. Ollivier, *Emile Ollivier; sa jeunesse d'apres son journal et sa correspondance* (1918).

OLMEDO, JOSÉ JOAQUÍN DE (1780–1847), Ecuadorian poet and politician, was born in Guayaquil on March 20, 1780. Sent to Europe in 1825 as Peruvian diplomatic representative, he returned in 1828 and in 1830 was elected vice president of the recently created (1830) independent republic of Ecuador, but declined the honour. In 1845 he headed a successful revolt and, having been chosen first member of the provisional government, was a candidate for the presidency, but was not elected. He died in Guayaquil on Feb. 19, 1847. A neo-classicist, Olmedo has been called by a distinguished Spanish critic "one of the three or four great Spanish-American poets, if not the first." He is best known for his ode *La Victoria de Junín, Canto a Bolívar* (1825), commemorating the final overthrow of Spain in America, and the ode *Al General Flores, Vencedor en Miñarica* (1835), written after the defeat of a revolt against the government.

See M. L. Amunátegui, *Juicio crítico de algunos poetas hispano-americanos* (Santiago de Chile, 1861); P. Herrera, *Apuntes biográficos de Don José Joaquín Olmedo* (Quito, 1887); J. L. Mera, *Ojeada histórico-crítico sobre la poesía ecuatoriana* (2nd ed. Barcelona, 1893); J. J. Olmedo, *Poesías* (ed. by C. Ballén, Paris, 1896); V. M. Rendón, *Olmedo* (Paris, 1904); E. Piñeyro, *Biografías americanas* (Paris, 1907); A. Coester, *The Literary History of Spanish-America* (New York, 1916); E. C. Hills, ed., *The Odes of Bello, Olmedo and Heredia* (New York, 1920). The *Enciclopedia Universal Ilustrada* (Barcelona, 1919), has a full bibliography. (W. B. P.)

OLMSTED, FREDERICK LAW (1822–1903), American landscape architect, was born in Hartford (Conn.), on April 27, 1822. He already had an adventurous career when he published his *Journeys and Explorations in the Cotton Kingdom* (1861), which gave a picture of the conditions surrounding American slavery that had great influence on British opinion, and was much quoted in the controversies at the time of the Civil War. During the war he was the untiring secretary of the U.S. sanitary commission.

When Central Park, New York city, was projected, he, in conjunction with Vaux, proposed the plan which, in competition with more than 30 others, won first prize. Olmsted was made superintendent to carry out the plan. This was practically the first attempt in the United States to apply art to the improvement or embellishment of nature in a public park; it attracted great attention, and the work was so satisfactorily done that he was engaged thereafter in most of the important works of a similar nature in America—Prospect park, Brooklyn; Fairmount park, Philadelphia; South park, Chicago; Riverside and Morningside parks, New York; Mount Royal park, Montreal; the grounds surrounding the Capitol at Washington, and at Leland Stanford University at Palo Alto (Calif.), and many others. He developed the bare stretch of lake front at Chicago into the World's Fair grounds, contributing much to the architectural beauty and the success of the exposition. He was greatly interested in the Niagara reservation, made the plans for the park there, and also did much to influence the State of New York to provide the Niagara park.

He was the first commissioner of the national park of the Yosemite and the Mariposa grove, directing the survey and taking charge of the property for the State of California. He also held directing appointments under the cities of New York, Boston, Philadelphia, Baltimore, Wilmington and San Francisco, the joint committee on buildings and grounds of Congress, the Niagara Falls Reservation commission, the trustees of Harvard, Yale, Amherst and other colleges and public institutions. After 1886 he was largely occupied in laying out an extensive system of parks and parkways for the city of Boston and the town of Brookline, and on a scheme of landscape improvement of Boston harbour. He died on August 28, 1903.

OLMÜTZ: *see* OLOMOUC.

OLNEY, RICHARD (1835–1917), American statesman, was born at Oxford, Mass., on Sept. 15, 1835. He graduated at Brown university in 1856, and at the law school of Harvard university in 1858. In 1859 he began the practice of law at Boston, Mass., and attained a high position at the bar. He served in the State House of Representatives in 1874, and in March 1893 became attorney-general of the United States in the cabinet of President Cleveland. In this position, during the strike of the railway employees in Chicago in 1894, he instructed the district attorneys to secure from the Federal courts writs of injunction restraining the strikers from acts of violence, and thus set a precedent for "government by injunction." He also advised the use of Federal troops to quell the disturbances in the city, on the ground that the Government must prevent interference with its mails and with the general railway transportation between the States. Upon the death of Secretary W. Q. Gresham (1832–95), Olney succeeded him as secretary of State on June 10, 1895. He became specially prominent in the controversy with Great Britain concerning the boundary dispute between the British and Venezuelan Governments (*see* VENEZUELA), and in his correspondence with Lord Salisbury gave an extended interpretation to the Monroe Doctrine which went considerably beyond previous statements on the subject. In 1897, at the expiration of President Cleveland's term, he returned to the practice of the law. He died in Boston, Mass., on April 8, 1917.

OLNEY, a market town of Buckinghamshire, England, on the Ouse, 59 mi. N.N.W. of London on the London Midland Region railway. Pop. (1931) 2,438. The church of St. Peter and St. Paul is Decorated. William Cowper lived there from 1767 until 1786. John Newton, curate of Olney, had the assistance of Cowper in the production of the Olney hymns. The trade of Olney is principally agricultural, but boots and shoes are manufactured.

OLNEY, a city of Young county, Tex., U.S., 90 mi. N.W. of Fort Worth, on the Wichita Falls and Southern railroad.

By the federal census the population of Olney was 3,753 in

1950; 3,497 in 1940; 4,138 in 1930. It is in a rich agricultural, stock-raising and oil-producing section. More than 2,000 producing wells are within a ten-mile radius.

OLOMOUC, a town in Morava Slezsko, Czechoslovakia, at the confluence of the Bystrice and the Morava. Pop. (1930) 66,442, of which 15,017 were Germans. Near the head of a fertile gulf, floored with sandy loam and loess, and having a sheltered climate, it is a market for cereals and cattle and such prepared materials as malt, meal, beer, spirits, starch and sugar.

Until 1640 Olomouc was the recognized capital of Moravia. Originally fortified by Maria Theresa it was, until 1886, one of the strongest fortresses in central Europe and withstood a seven-weeks' attack of Frederick the Great in 1758, but the site of the fortification is now occupied by park, gardens and promenade. Notable buildings are the 14th-century cathedral in Gothic style, with a 328-ft. tower, the 15th-century Mauritius church, also Gothic, and the 15th-century town hall and museum. Olomouc was made the see of a bishop in 1073 and in 1777 was raised to the rank of an archbishopric. It was occupied by Germany in 1939.

OLONA (*Touchardia latifolia*), a shrub of the nettle family (Urticaceae), native to the Hawaiian Islands, where it has long been cultivated as a fibre plant. The bast fibre obtained from the young shoots possesses remarkable tensile strength, being three times as strong as that of the finest grades of abacá fibre (*q.v.*). Because of its great pliability olona fibre is readily woven into cloth or made into cordage. Another valuable quality is its unusual durability in water, making it especially suitable for fish nets.

OLONETS, a former government of northwestern Russia (*see* KARELIA).

OLORON-SAINTE-MARIE, a town of southwestern France, capital of an arrondissement in the department of Basses-Pyrénées, 21 mi. S.W. of Pau on a branch of the Southern railway. Pop. (1946) 10,567. It lies at the confluence of the mountain torrents (locally known as *gaves*) Aspe and Ossau, which, after dividing it into three parts, unite to form the Oloron, a tributary of the Pau. A Celtiberian and then a Gallo-Roman town, known as *Iluro,* occupied the hill on which the old feudal town of Sainte-Croix now stands, still surrounded by remnants of its 14th-century ramparts, between the two rivers; Sainte-Marie lies on the left bank of the Aspe, and the new town on the right bank of the Ossau. Oloron is the seat of a subprefect. The town carries on a thriving trade with Spain by way of the passes of Somport and Anso, chiefly in wool and skins, salt pork and hams, cattle and horses.

OLTEN (1,312 ft.), a town in the canton of Solothurn, Switzerland, at the south foot of the Jura. An important railway centre at the junction of the railways Basle-Luzern (Lucerne), Berne-Zürich and Solothurn-Zürich. Pop. (1941) 15,282.

OLUSTEE, a village of Baker county, Fla., U.S., in the precinct of Olustee, about 46 mi. W. by S. of Jacksonville. Population of the precinct (1950) 350. The village is served by the Seaboard railway. The battle of Olustee, or Ocean Pond (the name of a small body of water in the vicinity), one of the most sanguinary engagements of the Civil War in proportion to the numbers engaged, was fought on Feb. 20, 1864, about 2 mi. east of Olustee, between about 5,500 Federal troops, under Gen. Truman Seymour (1824–91), and about 5,400 Confederates, under Gen. Joseph Finegan, the Federal forces being decisively defeated, with a loss, in killed and wounded, of about one-third of their number, including several officers. The Confederate losses, in killed and wounded, were about 940.

OLYBRIUS, Roman emperor of the west from July 11, to Oct. 23, 472, was a member of a noble family and a native of Rome. After the sack of the city by Gaiseric in 455, he fled to Constantinople, where, about 464, he married Placidia, daughter of Valentinian III. This afforded Gaiseric the opportunity of claiming the empire of the west for Olybrius. In 472 Olybrius was sent to Italy by the emperor Leo to assist the emperor Anthemius against his son-in-law Ricimer, but, having entered into negotiations with the latter, was himself proclaimed emperor and on the murder of his rival ascended the throne unopposed.

See Gibbon, *Decline and Fall,* ch. xxxvi; J. B. Bury, *Later Roman Empire.*

OLYMPIA, the scene of the Olympic games, is in western Peloponnesos on the north bank of the Alpheus (mod. Ruphia), about 11 mi. E. of modern Pýrgos, where the ancient Cladeus tributary flows in from the north. Olympia is bounded on the west by the Cladeus, on the south by the Alpheus, on the east by the ancient racecourses and on the north by low heights. There a conical hill, about 400 ft. high, cut off by a cleft, descends abruptly on Olympia. This is the *Cronion* hill sacred to Cronus.

HISTORY

The importance of Olympia in the history of Greece is religious and political. Religious associations date from the prehistoric age, when a centre of worship is attested by house-remains and early votive offerings found beneath the Heraeum. The earliest extant building is the temple of Hera, which may date in its original form from about 1000 B.C. and retained till Pausanias' time one original column of wood. There were various traditions as to the origin of the games. According to one the first race was between Pelops and Oenomaus, who used to challenge the suitors of his daughter Hippodameia and then slay them. Another attributed the festival to Heracles, either the well-known hero or the Idaean Dactyl of that name. In early times the control of the festival belonged to Pisa, but Elis seems to have claimed some share in it. Sixteen women, representing eight towns of Elis and eight of Pisatis, wove the festal robe for the Olympian Hera. Olympia thus became the centre of an amphictyony (*q.v.*), or federal league under religious sanction, for the west coast of Peloponnesos. It suited the interests of Sparta to join this amphictyony; and, before the list of Olympic victors begins in 776 B.C., Sparta had formed an alliance with Elis. Aristotle saw in the temple of Hera a bronze disk, recording the traditional laws of the festival, on which the name of Lycurgus of Sparta stood next to that of Iphitus, king of Elis. Whatever may have been the age of this disk, the relation which it indicates is well attested. Elis and Sparta, making common cause, had no difficulty in excluding the Pisatans from their proper share in the management of the Olympian sanctuary. Pisa had, indeed, a brief success, when Pheidon of Argos celebrated the 28th Olympiad under its presidency. But this festival, from which Eleans and Spartans were excluded, was afterward struck out of the official register. The destruction of Pisa (before 572 B.C.) by Sparta and Elis put an end to the rivalry: Pisatis, and also Triphylia to the south of it, becoming dependent on Elis. On the religious side of the festival the Eleans had unquestioned supremacy. All candidates were tested at Elis, in the gymnasium, before they were admitted to the athletic competitions at Olympia, and training (usually of ten months) at Elis was regarded as the most valuable preparation. Elean officials, who not only adjudged the prizes, but decided who should be admitted to compete, assumed the title of *Hellanodicae.*

Long before the overthrow of Pisa the list of contests had been so enlarged as to give the celebration a Panhellenic character. Exercises of Spartan type—testing endurance and strength with a special view to war—had almost exclusively formed the earlier program. But as early as the 25th Olympiad the four-horse chariot race was added, an invitation to wealthy competitors from every part of the Hellenic world, and the recognition of a popular spectacular element, as distinct from athletic or military. Horse races were added later. For such contests the hippodrome was set apart. Meanwhile the list of contests on the old racecourse, the stadium, had been enlarged. Besides the original foot race in which the course was traversed once only, there were the double course (*diaulos*) and the "long" foot race (*dolichos*). Wrestling and boxing were combined in the *pancration;* leaping, quoit throwing, javelin throwing, running and wrestling in the *pentathlon.* Under the protection of the Spartans, the festival acquired new importance for, having failed in their plans of actual conquest in the Peloponnesos, they sought at least acknowledged predominance. While therefore the Eleans were the religious supervisors of Olympia the Spartans constituted

themselves its political protectors, enforcing the sanction which the Olympian Zeus gave to the amphictyones, whose federal bond was symbolized by common worship, and punishing violation of that "sacred truce" which was indispensable if Hellenes from all cities were to have peaceable access to the Olympian festival.

Olympia thus became a recognized Panhellenic institution after the establishment of Elean supremacy in 572 B.C.; and to the last remained a central expression of the Greek ideas that the body of man has a glory as well as his intellect and spirit, that body and mind should alike be disciplined, and that it is by the harmonious discipline of both that men best honour Zeus. The significance of Olympia was larger and higher than the political fortunes of the Greeks who met there, and it survived the overthrow of Greek independence. In the Macedonian and Roman ages the temples and contests of Olympia still interpreted the ideal at which free Greece had aimed. Philip of Macedon and Nero are among those who have record in the Altis. According to Cedrenus, a Greek writer of the 11th century (*Synopsis*, i. 326), the Olympian festival ceased to be held after A.D. 393, the first year of the 293rd Olympiad. The list of Olympian victors, which begins in 776 B.C. with Coroebus of Elis, closes with the name of an Armenian, Varastad, who is said to have belonged to the race of the Arsacidae. In the 5th century desolation had set in. The chryselephantine statue of the Olympian Zeus, by Pheidias, was carried to Constantinople, and perished in a great fire, A.D. 476. The Temple of Zeus was dismantled; either by Goths or by Christian zeal, in the reign of Theodosius II. (A.D. 402–450). The temple of Zeus, probably thrown down by earthquakes in the 6th century A.D., and the region south of it became a fortress, constructed from materials found among the ancient buildings.

Excavations.—The German excavations were begun in 1875, and completed in 1881. The deposit of earth over the Altis from the overflowing of the Cladeus had an average depth of 16 ft.; it was also necessary to excavate, especially on the west, the south and the east, several ancient buildings not included within the sacred precinct. Moreover in many places early Greek work had later Greek on top of it, or late Greek work had been overlaid with Roman.

The form of the Altis is not regularly rectangular. The west side is about 215 yd.; the south side is about equally long; the east side, about 200 yd.; the north side, behind the treasure-houses, about 275 yd.

REMAINS WITHIN THE ALTIS

Within the Altis are three main groups of buildings:—(A) chief centres of religious worship; (B) votive buildings; (C) buildings connected with the administration or with the reception of visitors.

A. **Chief Centres of Religious Worship.**—1. There are traces of an altar near the Heraeum older than the great altar of Zeus, and probably the original centre of worship. The great altar of Zeus was of elliptic form; imposed on this basis, in two tiers, and also, lozenge-shaped, was the famous "ash-altar" at which the Iamidae, the hereditary family of seers, practised rites of divination by fire in virtue of which Olympia is saluted by Pindar as "mistress of truth."

2. The *Pelopium,* to the west of the Altar of Zeus, was a small walled precinct in which sacrifices were offered to the hero Pelops. In the middle was a low tumulus of elliptic form. A Doric gateway with three doors gave access on the south-west side.

The three temples of the Altis were those of Zeus, Hera and the Mother of the gods. All were Doric and completely surrounded by a colonnade.

3. *The Temple of Zeus,* south of the Pelopium, stood on a high substructure with three steps. It was probably built about 470 B.C. The colonnades at the east and west ends were of six columns, the north and south sides of thirteen. The cella had a prodomos on the east and an opisthodomos on the west. It was itself divided longitudinally by a double row of columns. The central, and widest, partition was in three sections; the western containing the throne and image of the Olympian Zeus; the middle section, a table and stelae, where, probably, the wreaths were presented to the victors; the eastern was open to the public. On the east pediment was represented in twenty-one colossal figures the moment before the contest between Oenomaus and Pelops; on the western the fight of the Lapithae and Centaurs. The statement of Pausanias that the two pediments were made by Paeonius and Alcamenes is now generally supposed to be an error. On the metopes of the prodomos and opisthodomos were depicted the Twelve Labours of Heracles.

Near this temple was found the statue of a flying goddess of victory—the Nike of Paeonius. (*See* GREEK ART.)

4. *The Temple of Hera* (Heraeum), north of the Pelopium, was on two steps. It is the oldest of extant Greek temples, and may date from about 1000 B.C. It was smaller than the temple of Zeus, and of unusual length relatively to its breadth. It has colonnades of six columns at east and west, and of sixteen at north and south. When Pausanias saw it, one of the two columns of the opisthodomos was of wood; and for long, probably, all the columns of this temple had been wooden, gradually replaced as they decayed in progressively later styles. Only the lower part of the cella wall was of stone, the rest of unbaked brick; the entablature was of wood covered with terra-cotta. The cella—divided, like that of Zeus, by a double row of columns—had four small screens, projecting at right angles from its north and south walls. In the third niche thus formed, from the east, on the north side, was found the Hermes of Praxiteles still preserved in the local museum. (*See* GREEK ARCHAEOLOGY.)

5. *The Temple of the Great Mother of the Gods* (Metroum) was smaller than the Heraeum. It stood to the east of it and had a different orientation. It was on three steps, and had six columns east and west by eleven north and south. The cella had prodomos and opisthodomos. It was probably built in the 4th century, and underwent a Roman restoration.

B. **Votive Edifices.**—These were erected, either by states or by individuals.

1. Twelve *Treasure-houses* on the north side of the Altis, immediately under the Cronion, have the same general character of a Doric temple *in antis,* facing south. Of several the fragments are sufficient for reconstruction. The 2nd and 3rd from the west had been dismantled early for a roadway winding upward towards the Cronion, which is itself older than A.D. 157. This explains the fact that, though we can trace twelve, Pausanias names only ten. Each treasure-house was erected by a Greek state, either as a thank-offering for Olympian victories gained by its citizens, or as a general mark of homage to Olympian Zeus, and to contain the dedicated gifts in which the wealth of the sanctuary consisted. Temple inventories discovered at Delos and at Lindus in Rhodes illustrate how such possessions accumulated at a shrine of Panhellenic celebrity. The treasure-houses were founded by the following states, in order from the west: 1. Sicyon; 2, 3, unknown; 4, Syracuse (referred by Pausanias to Carthage); 5, Epidamnus; 6, Byzantium; 7, Sybaris; 8, Cyrene; 9, Selinus; 10, Metapontum; 11, Megara; 12, Gela. While the majority are the Greek colonies, from Libya to Sicily, from the Euxine to the Adriatic, Greece proper is represented only by Megara and Sicyon. The dates of the foundations cannot be fixed. The Megarian treasury had pedimental figures of gods fighting with giants; others supplemented stonework with painted terra-cotta.

2. The *Philippeum* near the north-west corner of the Altis was dedicated by Philip of Macedon, after his victory at Chaeronea (338 B.C.), illustrating how his position and power enabled him without risking any revolt of Hellenic feeling to erect a monument of the overthrow of Greek freedom in the very heart of the Panhellenic sanctuary. The building had a circular Ionic colonnade about 15 metres in diameter, raised on three steps enclosing a circular cella, with fourteen Corinthian half-columns. It contained portraits by Leochares of Philip, Alexander and other members of their family, in gold and ivory.

3. The *Exedra of Herodes Atticus* at the north limit of the Altis by the N.E. angle of the Heraeum consisted of a half-dome of brick (54 ft. diam.), containing twenty-one marble statues, representing the family of Antoninus Pius, of Marcus Aurelius and of the founder. In front was a drinking trough, its ends adorned by very small temples with circular colonnade.

C. Official Buildings for the management of the sanctuary or the accommodation of guests.

1. Olympia, besides its religious character, originally was the centre of a political amphictyony. So, like a Greek city, it should have a public hearth, where fire should always burn, and where Olympia should exercise hospitality. The *Prytaneum* was at the northwest corner of the Altis, close to the Heraeum. It was a square building containing a chapel of Hestia at the front.

2. The *Porch of Echo,* also called the "Painted Porch," extended 100 yd. along the east Altis wall. A single Doric colonnade, on three steps, open toward the Altis, afforded a place from which to view processions and the sacrifices at the great altar. Built in the Macedonian period, it replaced an earlier portico. In front were pedestals for votive offerings.

3. The *Agora* was that part of the Altis which had the Porch of Echo on the east, the altar of Zeus on the west, the Metroum on the north, and the precinct of the temple of Zeus on the southwest. There stood altars of Zeus Agoraios and Artemis Agoraia.

4. The *Zanes* were bronze images of Zeus, erected out of the fines exacted for breaches of the rules of the contests. They stood at the north side of the Agora, in a row, from the Metroum to the gate of the private entrance into the stadium. Sixteen pedestals were there discovered *in situ.*

REMAINS OUTSIDE THE ALTIS

A. *West Side.*—The wall bounding the Altis of the time of Nero has two gates, at its north and south ends. Each had on the west a portico of four columns. A smaller gate is nearly opposite the Pelopium.

West of this wall, between the Altis and the Cladeus, the following buildings succeed each other from north to south.

1. *The Gymnasium,* a large open space, enclosed on two sides at least by Doric colonnades, on the east by a double portico, more than a stadium in length (220 yd.), served as a racecourse for practice in bad weather. At the southeast corner was a Corinthian doorway, leading to the northwest gate of the Altis. The gymnasium was used by competitors during the last month's training.

2. *The Palaestra,* for wrestlers and boxers, about 70 yd. square, containing rooms of different sizes, and enclosing a building surrounded by a Doric colonnade.

3. *A Byzantine Church* occupies the site of an older brick building, perhaps the "workshop of Pheidias" seen by Pausanias. Among adjacent structures an inscribed altar marks the *Heroum,* where worship of heroes was practised. The *Theocoleon,* a large building of Roman age, was probably the house of the priests. A long narrow building south of the church may have been occupied by those alleged "descendants of Pheidias" (Pausanias v, 14) whose privilege it was to keep the statue of Zeus clean. The so-called "workshop of Pheidias" evidently continued to be used for actual work, and a lodging was required for the artists.

4. *The Leonidaeum,* dedicated by an Elean in the 4th century B.C., for the reception of distinguished visitors. Its orientation is from W.S.W. to E.N.E. An outer Ionic colonnade encloses suites of rooms, around a small interior Doric peristyle. In Roman times it was altered to distribute the rooms into four suites. The porticos show traces of much carriage traffic.

B. *South Side.*—The limits of the Altis toward the Alpheus can only be traced approximately, since architectural changes were numerous down to the latest times.

1. *The Council Hall* (*Bouleuterium*), nearly at the middle of the south wall, comprised two Doric buildings of different date but identical oblong form, divided by a single row of columns, terminating to the west in an apse. In the space between stood a small square building. In front, on the east, a portico covered the front of all three with a large forehall, enclosed by a colonnade.

2. *The South Colonnade,* a late but handsome structure, closed on the north side, with Doric colonnade to southeast and west, and Corinthian columns within, served as a promenade and to view the processions.

3. *A Triumphal Gateway* of Roman age, with triple entrance, opens on the Altis, a little east of the *Bouleuterium.*

C. *East Side.*—The line of the east wall can be followed from the northeast corner of the Altis until it breaks off at the remains known as Nero's house.

1. *Nero's House* is a building of 4th-century date and uncertain purpose, afterward absorbed into a Roman house, to make room for which the south part of the east Altis wall was destroyed. A leaden water pipe bears NER. AVG., and since only a Roman master could have dealt thus with a building within the sacred precinct, it cannot be doubted that the Roman house—from which three doors gave access to the Altis—was that occupied by Nero when he visited Olympia. Later the building, further enlarged, may have been occupied by Roman officials.

2. *The Stadium* extends east of the Altis from W.S.W. to E.N.E., and is entered from the northeast angle. This position was due simply to the curve of the slopes which bound the valley. The stadium is only cleared so far as was necessary for ascertainment of essential points. Low embankments had been built on west, east and south, the north boundary being formed by the natural slope. The space thus defined was about 234 yd. long by 35 broad. There were no artificial seats. From 40,000 to 45,000 spectators could have found sitting room. The exact length of the stadium itself—which was primarily the course for the foot race—was 192.27 m. (about 210 yd.), and consequently the Olympian foot was 0.3204 m. or 1.05 English foot. In the Heraeum, however, the unit adopted was not this Olympian foot, but an older one of 0.297 m., and in the temple of Zeus an Attic foot of 1.08 English foot. The starting point and the goal in the stadium were marked by limestone thresholds. Drainage was by a marginal channel. The stadium was used not only for foot races, but for boxing, wrestling, leaping, quoit throwing and javelin throwing. The entrance from the northeast corner of the Altis was reserved for the judges, competitors and heralds. It was a vaulted tunnel, 100 Olympian feet in length, probably constructed in Roman times. To the west the Altis was entered by a gateway and vestibule.

3. *The Hippodrome,* in which chariot races and horse races were held, can no longer be accurately traced, owing to the overflowings of the Alpheus. But it is clear that it lay south and southeast of the stadium, parallel with it, though stretching beyond it to the east. Its length was probably 770 m. or 4 Olympic stadia.

D. *North Side.*—A wall running east-west immediately north of the treasuries protects them from landslides off the *Hill of Cronus,* and carries the water channel of Herodes Atticus. Further west it is doubtful whether the Altis was ever marked off from the "Hill of Cronus," which is associated with the oldest worship there.

BIBLIOGRAPHY.—The official *Die Ausgrabungen zu Olympia,* 5 vol. (1875–81); Laloux and Monceaux, *Restauration de l'Olympie* (1889); Curtius and Adler, "Topographie und Geschichte," "Baudenkmäler," "Bildwerke in Stein und Thon," "Bronzen," "Inschriften," *Olympia die Ergebnisse der Ausgrabungen* (1890–97); K. Boetticher, *Olympia* (1890); Daremberg-Saglio iv, *s.v.* (1904–05); E. N. Gardiner, *Olympia, its History and Remains* (1925).

OLYMPIA, the capital city of Washington, U.S.A., and the county seat of Thurston county, at the extreme southern end of Puget sound, 60 mi. S.S W. from Seattle, at the junction of federal highways 99, 101 and 410.

Olympia has a large airport; other transportation is by the Northern Pacific and the Union Pacific railways, motor-coach lines and steamboats.

Pop. (1950) 15,711; (1940) 13,254.

The city occupies 7.9 sq.mi. and is surrounded on the landward sides by low green hills. On the south the DesChutes river flows through a rocky canyon into DesChutes basin, a fresh-water lake that is part of the capitol grounds, with an outlet to Puget sound. The snow-capped Olympics form the northern horizon, and to the east rises Mt. Rainier. On a promontory jutting into the sound stands the group of state buildings, built of white sandstone in classic design at a cost of $17,000,000. The trade of the port of Olympia averages 500,000 tons per year and consists of logs, lumber, plywood, forest products of all types, ores, petroleum products, aluminum and steel products, beverages, military supplies and products from various industries, including canned goods and miscellaneous articles. Olympia is headquarters of the Olympia Na-

tional Forest service.

The first settlement on Puget sound was made in 1845 at the falls of the DesChutes river, on the site of Tumwater, 1 mi. S. of Olympia, under the leadership of Michael T. Simmons from Kentucky, but in 1849 it was practically deserted when the men left for the California gold fields.

In 1850 a town (at first called Smithfield) was laid out where Olympia now stands. In 1852 the first newspaper north of the Columbia river was established there (the *Columbian*) and in 1853 the town became the capital of the newly created territory of Washington.

It was chartered as a city in 1859. A monument in Capitol park marks the terminus of the old Oregon trail.

OLYMPIAD, in Greek chronology, a period of four years, used as a method of dating for literary purposes. The four years were reckoned from one celebration of the Olympic games to another, the first Olympiad beginning with 776 B.C., the last with A.D. 394, when they were abolished during the reign of Theodosius the Great.

The system was first regularly used by the Sicilian historian Timaeus (352–256 B.C.). (*See* CHRONOLOGY.)

OLYMPIAS, daughter of Neoptolemus, king of Epirus, wife of Philip II of Macedon and mother of Alexander the Great. The marriage took place in 359 B.C., shortly after Philip's accession, and Alexander was born in 356. Philip married a new wife, Cleopatra, in 337, and Olympias and Alexander withdrew into Epirus, from which they both returned in the following year, after the assassination of Philip, which Olympias is said to have countenanced. During the absence of Alexander, with whom she regularly corresponded on public as well as domestic affairs, she had great influence, and on Alexander's death in 323 withdrew to Epirus, because of her hostility to Antipater the regent. In 319 she allied herself with Polyperchon, Antipater's successor, and became ruler of Macedonia. Cassander, Antipater's son, hastened from Peloponnesus, and, after an obstinate siege, compelled the surrender of Pydna, where she had taken refuge. One of the terms of the capitulation had been that her life should be spared; but she was brought to trial for the numerous executions which she had ordered during her reign. Condemned without a hearing, she was put to death in 316 by the friends of those she had slain, the promise to spare her life being disregarded.

BIBLIOGRAPHY.—Plutarch, *Alexander,* 9, 39, 68; Justin, vii, 6, ix, 7, xiv, 5, 6; Arrian, *Anab.*, vii, 12; Diod. Sic., xviii, 49–65, xix, 11–51. *See* also the articles ALEXANDER III THE GREAT; MACEDONIAN EMPIRE.

OLYMPIC GAMES. While the origin of the Olympic games is not known exactly, there is a historical record of the ancient games beginning in 776 B.C. Thereafter they were held at four-year intervals until A.D. 394, when they were abolished by the Roman emperor Theodosius after Greece had lost its independence. Few enterprises created by man have lasted so long. At first the program was confined to one day and consisted only of a single event, a race the length of the stadium. Afterward additional races, the discus throw, the javelin throw, the broad jump, boxing, wrestling, the pentathlon, chariot racing and other events were added, and the duration, including the religious ceremonies, was extended to seven days. The games were restricted to Greeks, but competitors came from all the Greek colonies around the Mediterranean. A sacred truce was declared and enforced to permit participants to travel unmolested to the games. Women were not allowed as competitors or spectators. Before the contests opened all the competitors and their families, the trainers and the judges swore a solemn oath to keep the competition clean and fair and to give just decisions.

The games occupied such an important position in the life of Greece that time was measured by the four-year interval between them—an "Olympiad." The greatest honour then to be attained by any Greek was the winning of the simple branch of wild olive given to a victor in the games. Kings competed alongside commoners; even the Roman emperor Nero sought Olympic honours. Winners became national heroes, musicians sang their praise and sculptors preserved their strength and beauty in marble. Their feats of skill and courage were recorded by the poets and writers of the time. The gracefulness and sportsmanship of the contestant and the method of winning were esteemed equally with the victory itself.

It was through the efforts of the Baron Pierre de Coubertin (1863–1937) of France, a brilliant educator and scholar but not an athlete, that the Olympic games were revived. Having decided that at least one of the reasons for the glory of the Golden Age of Greece was the emphasis placed on physical culture and frequent athletic festivals, he concluded that nothing but good could result if the athletes of all countries of the world were brought together once every four years on the friendly fields of amateur sport, unmindful of national rivalries, jealousies and differences of all kinds and with all considerations of politics, race, religion, wealth and social status eliminated. He summoned an international conference at the Sorbonne, Paris, in 1894, which was attended by the representatives of nine different nations.

The games of the I Olympiad of the modern cycle were held under the royal patronage of the king of Greece in 1896 in a new marble stadium constructed in Athens for the purpose. Subsequent games were held in Paris (1900), St. Louis (1904), London (1908), Stockholm (1912), Antwerp (1920), Paris (1924), Amsterdam (1928), Los Angeles (1932), Berlin (1936), London (1948) and Helsinki (1952). The games of the XVI Olympiad were scheduled for Melbourne, Austr., in 1956. The games of the VI, XII and XIII Olympiads, scheduled, respectively, for Berlin (1916), Tokyo then Helsinki (1940) and London (1944), were not held because of war. In 1906 a set of games was held in Athens, but these were not part of the official series.

A separate cycle of winter games was initiated in 1924 at Chamonix, Fr.; subsequent games were held at St. Moritz (1928), Lake Placid (1932), Garmisch-Partenkirchen (1936), St. Moritz (1948) and Oslo (1952). The VII winter Olympic games were scheduled for Cortina d'Ampezzo, It., in 1956.

The direction of the Olympic movement and the regulation of the games is vested in the Comité International Olympique, with headquarters at Mon Repos, Lausanne, Switz. The committee elects its members for life after a thorough investigation. The C.I.O. is a unique organization in that its members do not represent their countries but are delegates from the committee to their countries. No country may have more than three members. The members must not accept from other organizations or from their governments any instructions that may bind them or interfere with the independence of their votes. In 1952 the committee numbered 72 from 47 different countries. Baron Pierre de Coubertin headed the committee until he retired in 1925. He was followed by Count Henry de Baillet Latour of Belgium, who served until his death in 1942. The next president was J. Sigfrid Edstrom of Sweden, who was succeeded in 1952 by Avery Brundage of the United States.

Contestants in the Olympic games must be amateurs. The Olympic definition is as follows:

> An amateur is one who participates and always has participated in sport solely for pleasure and for the physical, mental or social benefits he derives therefrom, and to whom participation in sport is nothing more than recreation without material gain direct or indirect and in accordance with the rules of the International Federation concerned.

One of the features of the Olympic games introduced successfully for the first time at the Los Angeles games is the Olympic Village. This is special housing provided so that all the competitors from the different countries can live in the same compound.

At the Berlin games in 1936 the sacred Olympic flame, which burns in the stadium throughout the games, was ignited by a torch carried from Olympia, Gr., the site of the ancient games, through the intervening countries by relays of runners. This procedure was repeated at the following games.

The Comité International Olympique awards the following various cups and diplomas annually:

The *Olympic cup* is awarded to an institution or organization for outstanding service to amateur sport or the Olympic movement.

The *Olympic diploma* is awarded for the same reasons to an individual.

The *Taher Pacha cup* is awarded to an athlete who merits special recognition.

The *Fearnley cup* is awarded to an amateur sport club or local association for merit.

The C.I.O. has granted its patronage to certain regional games which contribute to the development of amateur sports in the areas where they are organized. These are the Far Eastern games-Mediterranean games; Asiatic games; Juegos Deportivos Pan Americanos; Juegos Deportivos Bolivarianos; and Juegos Deportivos Centroamericanos y del Caribe.

Participation in the Olympic games is organized by the national Olympic committees, of which 79 were recognized by the C.I.O. in the early 1950s. National Olympic committees must include representatives of all the national governing bodies whose sports are included in the Olympic program. They must be independent and autonomous and must avoid any political, commercial or religious interference. Only national Olympic committees can enter competitors in the games, and they must certify to their amateur standing.

National Olympic committees exist in the following countries: Afghanistan, Argentina, Australia, Austria, Bahamas, Belgium, Bermuda, Bolivia, Brazil, British Guiana, Bulgaria, Burma, Canada, Ceylon, Chile, China, Colombia, Cuba, Czechoslovakia, Denmark, Egypt, El Salvador, Finland, France, Germany, Gold Coast, Great Britain, Greece, Guatemala, Haiti, Hong Kong, Hungary, Iceland, India, Indonesia, Iraq, Iran, Ireland, Israel, Italy, Jamaica, Japan, Korea, Lebanon, Liechtenstein, Luxembourg, Malta, Mexico, Monaco, Netherlands, Netherlands Antilles, New Zealand, Nigeria, Norway, Pakistan, Panamá, Paraguay, Peru, Philippines, Poland, Portugal, Puerto Rico, Rumania, Saar, Singapore, Spain, Sweden, Switzerland, Syria, Thailand, Trinidad, Turkey, Union of South Africa, Union of Soviet Socialist Republics, United States, Uruguay, Venezuela, Vietnam, Yugoslavia.

Each Olympic sport is governed by international federations composed of national federations in each participating country. Competitors must belong to these national federations. The international federations write the rules governing their sports, and the events in the Olympic games are under their direction subject only to the Olympic regulations.

Ceremonies.—The opening ceremony of the games, staged in the principal stadium, is impressive. The king or president of the country where the games are held is received at the entrance of the stadium by the president of the Comité International Olympique and the president of the organizing committee, who escort him to a box where he is greeted with the national anthem of his country. The parade of the competitors then takes place. Each national contingent, dressed in its official uniform, preceded by a shield bearing the name of its country and its national flag, enters the stadium in alphabetical order, except that Greece heads the parade and the organizing country appears last. Each contingent after completing its march around the stadium lines up on the centre of the grounds in a column, behind its shield and flag, facing the tribune of honour. The president of the organizing committee delivers a brief speech of welcome and asks the king or president to proclaim the games open. Immediately a fanfare of trumpets is sounded and the Olympic flag is slowly hoisted; pigeons are released, followed by an artillery salute. At this moment the Olympic flame arrives in the stadium and the sacred fire is lit. A benediction is pronounced and the Olympic hymn is sung. Immediately afterward a contestant from the country where the games are taking place mounts the tribune and pronounces the following oath on behalf of all the assembled athletes:

> We swear that we will take part in the Olympic Games in fair competition, respecting the regulations which govern them and with the desire to participate in the true spirit of sportsmanship for the honour of our country and for the glory of sport.

The choir sings the national anthem and the competitors leave the stadium. The ceremony thus comes to an end and the competitions may begin.

The closing ceremony, equally impressive, is concluded by the president of the C.I.O., who calls the youth of the world to assemble in four years to celebrate the games of the next Olympiad. "May they display cheerfulness and concord so that the Olympic torch may be carried on with ever greater eagerness, courage and honour for the good of humanity throughout the ages." The trumpet sounds, the Olympic fire is extinguished, the Olympic flag is lowered, there is a salute of five guns and the choir sings the final anthem.

National Participation.—In 1896 when the games were revived, interest in competitive sport was largely confined to Great Britain, the United States and the British empire. There was practically no international competition. In the games of the I Olympiad of the modern cycle only a handful of participants from a dozen countries took part. In the games of the XV Olympiad almost 6,000 contestants from 69 different countries participated. Hundreds of journalists, photographers and radio commentators from all over the world travelled to Helsinki to report on the games; public interest in the Olympic movement had spread throughout the entire world. Contestants who placed sixth or better at Helsinki came from 49 different nations, and countries such as Luxembourg, Jamaica, Switzerland, Brazil, Turkey and India produced Olympic champions. Norwegian athletes had made by far the best record in the winter games. Table I shows the growth of participation in the games.

Records.—Because of the increase in the number of competitors, the improved facilities and more scientific coaching, records of performance showed vast improvement. In the 1952 games, in track-and-field athletics alone, 8 new world and 26 new Olympic records were established. Table II lists the Olympic records in track-and-field.

Miscellaneous Facts.—Following are some specific data regarding the Olympic games:

Only nationals can represent a country in the games.

No discrimination is allowed against any country or person on grounds of colour, religion or politics.

There is no age limit for competitors.

No more than three competitors from any country (four in the winter games) may participate in each event.

The games are confined to a period of 16 days.

There is no scoring of points in the games, which are contests between individuals and teams and not between nations.

The honour of holding the games is entrusted to a city and not to a country, and they must be held in the first year of the Olympiad.

Once the Olympic games have been awarded to a city, an organizing committee is formed to provide the facilities and handle

TABLE I.—*Participation in the Olympic Games*

(Official, demonstration and optional sports included)						Winter games (Demonstration events included)					
Location	Date	Sports	Events	Participants (women included)	Participating nations	Location	Date	Sports	Events	Participants (women included)	Participating nations
Athens	1896	10	42	285 —	13	Chamonix	1924	7	16	293 (13 women)	16
Paris	1900	13	60	1,066 (6 women)	20	St. Moritz	1928	7	15	491 (27 women)	25
St. Louis	1904	12	67	496 —	11	Lake Placid	1932	7	19	307 (30 women)	17
London	1908	20	104	2,059 (36 women)	22	Garmisch-Partenkirchen	1936	7	21	756 (76 women)	28
Stockholm	1912	14	106	2,541 (57 women)	28	St. Moritz	1948	7	24	878 (90 women)	28
Antwerp	1920	19	154	2,606 (63 women)	29	Oslo	1952	6	23	1,178 (111 women)	30
Paris	1924	19	137	3,092 (136 women)	44						
Amsterdam	1928	16	120	3,015 (290 women)	46						
Los Angeles	1932	16	124	1,408 (127 women)	37						
Berlin	1936	21	142	4,069 (328 women)	49						
London	1948	20	138	4,468 (438 women)	59						
Helsinki	1952	20	151	5,871 (573 women)	69						

TABLE II.—*Olympic Men's Track-and-Field Records*

Event	Location	Year	Holder	Country	Time or distance
100 m.	Los Angeles	1932	E. Tolan	United States	10.3 sec.
	Berlin	1936	J. Owens	United States	10.3 sec.
	London	1948	H. Dillard	United States	10.3 sec.
200 m.	Berlin	1936	J. Owens	United States	20.7 sec.
	Helsinki	1952	A. Stanfield	United States	20.7 sec.
400 m.	Helsinki	1952	V. G. Rhoden	Jamaica	45.9 sec.
400-m. relay	Berlin	1936	United States		39.3 sec.
800 m.	London	1948	M. G. Whitfield	United States	1 min. 49.2 sec.
	Helsinki	1952	M. G. Whitfield	United States	1 min. 49.2 sec.
1,500 m.	Helsinki	1952	J. Barthel	Luxembourg	3 min. 45.2 sec.
1,600-m. relay	Helsinki	1952	Jamaica		3 min. 3.9 sec.
3,000-m. steeplechase	Helsinki	1952	H. Ashenfelter	United States	8 min. 45.4 sec.
5,000 m.	Helsinki	1952	E. Zatopek	Czechoslovakia	14 min. 6.6 sec.
10,000 m.	Helsinki	1952	E. Zatopek	Czechoslovakia	29 min. 17 sec.
110-m. hurdles	Helsinki	1952	H. Dillard	United States	13.7 sec.
400-m hurdles	Helsinki	1952	C. Moore	United States	50.8 sec.
Marathon (26 mi. 385 yd.)	Helsinki	1952	E. Zatopek	Czechoslovakia	2 hr. 23 min. 3.2 sec.
10-km. walk	Helsinki	1952	J. Mikaelsson	Sweden	45 min. 2.8 sec.
50-km. walk	Helsinki	1952	G. Dordoni	Italy	4 hr. 28 min. 7.8 sec.
High jump	Helsinki	1952	W. Davis	United States	(2.04 m.) 6 ft. $8\frac{1}{4}$ in.
Broad jump	Berlin	1936	J. Owens	United States	(8.06 m.) 26 ft. $5\frac{5}{16}$ in.
Hop, step and jump	Helsinki	1952	A. F. da Silva	Brazil	(16.22 m.) 53 ft. $2\frac{1}{2}$ in.
Pole vault	Helsinki	1952	R. Richards	United States	(4.55 m.) 14 ft $11\frac{1}{4}$ in.
Shot put	Helsinki	1952	W. P. O'Brien	United States	(17.41 m.) 57 ft $1\frac{1}{2}$ in.
Hammer throw	Helsinki	1952	J. Csermak	Hungary	(60.34 m.) 197 ft. $11\frac{3}{4}$ in.
Javelin throw	Helsinki	1952	C Young	United States	(73.78 m.) 242 ft. $\frac{3}{4}$ in.
Discus throw	Helsinki	1952	S. Iness	United States	(55.03 m.) 180 ft. $6\frac{1}{2}$ in.
Decathlon	Helsinki	1952	R. Mathias	United States	7,887 points (new scoring table)

all the business arrangements for these festivals.

Any profits derived from the games must be applied for the promotion of the Olympic movement or for the development of amateur sport.

The following events must be included in the program: athletics, gymnastics, boxing, fencing, shooting, wrestling, rowing, swimming, equestrian, modern pentathlon, cycling, weight lifting, yachting, fine arts (architecture, literature, music, painting, sculpture).

The following sports are optional: soccer football, rugby, polo, water polo, grass hockey, handball, basketball, canoeing, gliding.

Only sports practised in at least ten countries (six of which must enter) may be included.

The program for the winter games may include skiing, skating, ice hockey, bobsled, skeleton and curling.

Women are allowed to compete in athletics, fencing, gymnastics, swimming, canoeing, figure skating, skiing, yachting and fine arts.

The Olympic flag has a white background with no border. In the centre are five interlaced rings—blue, yellow, black, green and red, colours which appear on the flags of all countries.

The Olympic motto is "Citius-Altius-Fortius."

The flag and the motto are the exclusive property of the Comité International Olympique and together with the words "Olympic" and "Olympiad" insofar as they refer to sport are protected by law in many countries.

BIBLIOGRAPHY.—A voluminous official report is published by the organizing committee for each set of games. Nearly all national Olympic committees also issue reports. *See* also J. Kieran, *The Story of the Olympic Games, 776 B.C.–1936 A.D.* (1936); F. A. M. Webster, *Olympic Cavalcade* (London, 1948); Ernest A. Bland (ed.), *Olympic Story* (London, 1948); Bill Henry, *Approved History of the Olympic Games* (1948). (Av. BE.)

OLYMPIODORUS, the name of several Greek authors, of whom the chief are:

1. A historical writer (5th century A.D.), born at Thebes in Egypt, who was sent on a mission to Attila by the emperor Honorius in 412 and later lived at the court of Theodosius. He was the author of a history (Ἱστορικοὶ Λόγοι) in 22 books of the western empire from 407 to 425. The original is lost, but an abstract is given by Photius. A manuscript on alchemy ascribed to him and preserved in the National library in Paris was printed with a translation by P. E. M. Berthelot in his *Collection des alchimistes grecs* (1887–88).

2. A Peripatetic philosopher (5th century A.D.), an elder contemporary of Proclus. He lived at Alexandria and lectured on Aristotle with considerable success. His best-known student was Proclus.

3. A Neoplatonist philosopher, also of Alexandria, who flourished in the 6th century A.D., during the reign of Justinian. He was, therefore, a younger contemporary of Damascius and seems to have carried on the Platonic tradition after the closing of the Athenian school in 529, at a time when the old pagan philosophy was at its last ebb.

His philosophy is in close conformity with that of Damascius, and, apart from great lucidity of expression, shows no striking features. He is, however, important as a critic and a commentator, and preserved much that was valuable in the writings of Iamblichus, Damascius and Syrianus.

He made a close and intelligent study of the dialogues of Plato, and his notes, formulated and collected by his pupils (ἀπὸ φωνῆς Ὀλυμπιοδώρου τοῦ μεγάλου φιλοσόφου), are extremely valuable. In one of his commentaries he makes the interesting statement that the Platonic succession had not been interrupted by the numerous confiscations it had suffered. Zeller points out that this refers to the Alexandrian, not to the Athenian, succession; but internal evidence makes it clear that he does not draw a hard line of demarcation between the two schools. The works which have been preserved are a life of Plato, an attack on Strato and Scholia on the *Phaedo, Alcibiades I, Philebus* and *Gorgias*.

See Überweg, *Grundriss der Gesch. der Philosophie,* Bd. I (1926).

OLYMPUS, the name of many mountains in Greece and Asia Minor, and of the fabled home of the gods; also a city name and a personal name.

Of the mountains (1) the most famous is the lofty ridge (mod. Gk. *Elympo*) on the borders of Thessaly and Macedonia; it is nearly 10,000 ft. high and covered with snow for a great part of the year. The great gorge of Tempe close below the southeastern end separates it from Mt. Ossa. Olympus is of massive appearance, rising in precipices broken by ravines, above which is the summit of naked rock concave toward the northwest. The lower parts are densely wooded. (2) The peak of Mt. Lycaeus in the southwest of Arcadia. (3) East of Olympia, on the north bank of the Alpheus. (4) Beside Sellasia in Laconia. The name was even commoner in Asia Minor; it referred to a lofty chain in Mysia (Keshish Dagh) and to a ridge east of Smyrna (Nif Dagh); other mountains in Lycia, in Galatia, in Cilicia and in Cyprus were also all called Olympus.

In the *Iliad* the gods are described as dwelling on a lofty peak, rising high above the clouds of the lower atmosphere into the clear ether; in the *Odyssey* Olympus is more remote and less definite; the notions of later poets vary from a definite mountain to a vague conception of heaven. In literary mythology, though each deity had special haunts, all had residence at the court of Zeus on Olympus; there were their assemblies and feasts.

There was a city in Lycia named Olympus; it was a bishopric in Byzantine times.

OLYNTHUS, an ancient city at the head of the Gulf of Torone, in Chalcidice, near the neck of the peninsula of Pallene, about 60 stadia (7 or 8 mi.) from Potidaea. It may have been a colony of Chalcis, and struck coins early, but the district belonged to a Thracian tribe, the Bottiaeans, who held the town

till 479 B.C., when the Persian general Artabazus, on his return from escorting Xerxes to the Hellespont, suspecting that a revolt from the great king was meditated, slew the inhabitants and handed the town over to Greeks from Chalcidice. Olynthus thus became a Greek *polis*, but it remained insignificant in the lists of the Delian league until 432. King Perdiccas of Macedon added to its population the inhabitants of Chalcidian towns in the neighbourhood (Thucyd. i, 58). Henceforward the chief Hellenic city west of the Strymon, it revolted from Athens, formed a base for Brasidas' expedition (424) and was never again reduced. In the 4th century it was the head of the Chalcidic league which may be traced back to the peace of Nicias (421), when the Chalcidians acted in common and were enrolled as allies of Argos. The motive for its formation is almost certainly to be found in fear of Athens. Coins of the league can be dated as early as 405; one specimen may go back to 415–420. After the Peloponnesian war the league concluded an important treaty, about 390, with Amyntas, king of Macedon (the father of Philip), and by 382 it had absorbed most of the Greek cities west of the Strymon, and even held Pella, the chief city in Macedonia. But in this year Sparta was induced by an embassy from Acanthus and Apollonia, not yet included by the league, to attack; and Olynthus, after three years of indecisive warfare, formally dissolved the confederacy (379). Chalcidians, however, appear among the Athenian naval confederacy of 378–377. Twenty years later, in the reign of Philip, the power of Olynthus is asserted by Demosthenes to have been much greater than before the Spartan expedition, and the league included 32 cities. When war broke out between Philip and Athens (357), Olynthus was at first in alliance with Philip. Subsequently, it concluded an alliance with Athens; but in spite of all the efforts of the Athenians and their orator, Demosthenes, Philip razed it in 348.

BIBLIOGRAPHY.—Herodotus viii, 127; Thucydides i, 58; Xenophon, *Hell.* v, 2; Demosthenes *Olynthiacs* and *De fals. leg.*, 263–6; Diodorus xvi, 53, 2; Hicks *Manual of Greek Inscriptions* Nos. 74, 81; Head, *Historia Numorum, s.v.;* British Museum *Catalogue of Greek Coins, s.v.*

OLYPHANT, an anthracite-mining borough of Lackawanna county, Pa., U.S., on the Lackawanna river, 6 mi. N.N.E. of Scranton; served by the Delaware and Hudson railway, and for freight by the New York, Ontario and Western and the Erie railways. Pop. (1950) 7,047; (1940) 9,252 by the federal census.

OMAGH (ō'mah), a market town, urban district and county town of Co. Tyrone, Northern Ireland, on the Strule, 72 mi. W. of Belfast by road. Pop. (1951) 6,762. Area 1.6 sq.mi. The town, picturesquely situated above the river, is a military training centre. Shirts and milk products are the chief manufactures. Local antiquities include the scanty remains of a castle which played a part in the Tudor and Confederation wars.

OMAHA. This Siouan tribe of Nebraska, closely associated with the Ponca, combined agriculture with seasonal buffalo hunting. Since 1829 they have numbered between 1,105 and 1,900. They were organized into moieties and ten patrilineal clans. *See* J. O. Dorsey, *Bur. Am. Ethn. Rep.* xv, (1897); A. C. Fletcher and F. La Flesche, *ibid.* xxvii (1911).

OMAHA, the largest city of Nebraska, U.S.A., a port of entry, and the seat of Douglas county; on the west bank of the Missouri river, 500 mi. W. by S. of Chicago. It is on federal highways 6, 30A, 73, 75 and 275; is served by Mid-Continent and United air lines and by numerous motor bus and truck lines. It has a large municipal airport. Omaha is the nation's fourth largest rail centre, and is served by the Burlington, the Chicago and North Western, the Chicago Great Western, the Chicago Milwaukee, St. Paul and Pacific, the Chicago, St. Paul, Minneapolis and Omaha, the Illinois Central, the Missouri Pacific, the Rock Island, the Union Pacific and the Wabash railways.

The population of Omaha was 251,117 in 1950 and was 223,844 in 1940 and 214,006 in 1930 by the federal census.

Omaha has an altitude ranging from 940 to 1,270 ft. The original town site of 270 blocks, an elongated terrace above the river, is now entirely a business quarter, and gradually the city extended over the hills and bluffs beyond until it covered 41 sq.mi.

The stockyards and packing plants are on the south side (formerly an independent municipality, with a population in 1910 of 26,259), which was annexed in 1915. There are 56 parks, with an aggregate area of 2,500 ac., connected by 125 mi. of boulevard; 31 supervised playgrounds for children; 5 municipal golf courses; and 4 country clubs.

Fontenelle Forest reserve covers 1,800 ac. and is the largest unbroken tract of native forest in the state. Fort Crook (10 mi. S.) and Fort Omaha in the northern part of the city are important military posts. At Fort Crook was constructed a large Martin bomber assembly plant built by the government and operated by the Glenn L. Martin company of Baltimore, Md. Offutt Air Force base is the home of the strategic air command of the U.S. air force.

Among the educational institutions are Nebraska School for the Deaf (1867); the University of Nebraska college of medicine; Creighton university (1878; conducted by the Jesuits), comprising seven colleges and a high school; the University of Omaha (originally a Presbyterian institution, later municipal, founded 1908); and the Presbyterian Theological seminary (1891). Principal newspaper is the *Omaha World-Herald,* formed in 1889. Among the 60 other periodical publications is the *Daily Journal Stockman,* devoted to the livestock industry. Omaha has a community playhouse, a drama club and ten musical organizations. Ak-Sar-Ben (Nebraska spelled backward) is a civic organization, (formed in 1895 to promote interest in the history and progress of the city and the state) which is nationally famous for its livestock shows, horse shows, racing meets, coronation balls, ice hockey and ice revues.

Omaha is the see of Roman Catholic and Protestant Episcopal bishoprics, a district headquarters of the Methodist Church and the Presbyterian Church, and is Baptist state headquarters. There are more than 200 churches and missions in the city, and 11 hospitals. Thirty of the charitable organizations are financed jointly through a Community Chest. The proportion of homes owned by their occupants is high; the percentage of illiteracy is low. Boys Town, site of the internationally famous Father Flanagan's boys' home, is located 11 mi. W. of Omaha. Hundreds of thousands visit the modern farm and plant each year. The home has facilities for 500 boys. Joslyn memorial, a $4,000,000 art museum, is per capita the nation's second most popular art centre.

The city operates under a home-rule charter of 1923, providing for a commission form of government, with elections every three years.

Omaha is the largest retail centre between Chicago and Denver; an important insurance centre, being the location of the home offices of numerous companies and of branches of many others, and one of the leading manufacturing and wholesale distributing centres of the country. It ranks first in the production of butter, and is a primary grain market and milling market and one of the largest general livestock markets and meat-packing centres.

History.—In 1804 Meriwether Lewis and William Clark camped on the Omaha plateau, and in 1825 a licensed Indian trading post was established there. Fur traders and trappers frequented the region through the first half of the 19th century. In 1846 the Mormons settled at "Winter Quarters" (called Florence after 1854, and annexed to Omaha in 1917), but in 1848 they were obliged to move, as it was within the Indian reservation. About 12,000 of them built camps in this vicinity, on both sides of the Missouri, in 1846 and 1847, from which gradually they emigrated to Utah, but their local influence was strong for nearly a decade. Speculative "squatters" intruded on the Indian lands in 1853, and a rush of settlers followed the opening of Nebraska territory in 1854. Omaha (named from the Omaha Indians) was laid out in 1854 and chartered as a city in 1867. Prairie freighting and river traffic were important before the construction of the Union Pacific railroad, which was begun in Dec. 1863. The city was an important outfitting point during the rush to the Colorado gold fields. Connection by telegraph was established with San Francisco in 1861, with Chicago and St. Louis in 1863. The Union Pacific railroad bridge across the Missouri was completed in 1869. The Rock Island, the Burlington and the North Western railways entered the city in 1867 and 1868. Meat packing began as early as 1871, and grew rapidly after 1884, when the

Union Stock Yards company was formed and yards established in South Omaha. In 1860 the population was 1,883; 16,083 in 1870; and 30,518 in 1880. In the next 20 years it increased 236%, and between 1900 and 1920, 87%.

OMAHA BEACHHEAD, the World War II military code name given by the U.S. 5th army corps to a five-mile cliffless section of the Normandy coast at St. Laurent, Fr. It was one of five assault beaches invaded by Allied forces on June 6, 1944.

The U.S. assault troops at Omaha encountered more initial difficulties than the invading U.S. troops on the right flank or the British and Canadian troops on the left flank. Heavy seas and unfavourable surf conditions made navigation of the landing craft difficult, and many men were drowned or reached the beach in a state of near exhaustion. The Allied air attacks had proved ineffective as a result of cloudy weather which obscured visibility, and the configuration of the ground hampered observation for the naval guns. Moreover, it was not possible to manoeuvre the amphibious tanks to provide fire support for the infantry.

The 116th infantry of the 29th division and the 16th infantry of the 1st division encountered the well-prepared German 352nd division and suffered heavy casualties. However, the 5th corps overcame initial difficulties and reached the line of the Bayeux-Carentan road by June 7, and on June 8 contacted the British 50th division on the left flank. Reinforced on June 9 by the U.S. 2nd division, it advanced rapidly to the south and west, reaching the Caumont-Cerisy Forêt-Isigny line by June 11.

On June 12 Carentan fell to U.S. troops. All beachheads were consolidated, and the coast of Normandy was secured by the Allied forces from Quinéville to the east bank of the Orne.

OMAN, SIR CHARLES WILLIAM CHADWICK (1860–1946), British historian, was born at Mozufferpore, India, on Jan. 12, 1860. Educated at Winchester and at New college, Oxford, he was made a fellow of All Souls in 1883. In 1905 he became Chichele professor of modern history at Oxford and he was chosen a fellow of the British academy in the same year. He was president of the Royal Historical society, 1917–21. In 1919 he was elected M.P. for Oxford university and in 1920 he was knighted. His most important work was done in military history. He died June 23, 1946. His works include: *History of the Art of War in the Middle Ages* (1898; new ed., 1924); *History of Greece* (1890); *A Short History of England* (1895; new ed., 1920); *A History of the Peninsular War 1807–13* (7 vol., 1902–30); and *Napoleonic Studies* (1929).

OMAN ('UMĀN), a nominally independent state in southeastern Arabia, extending from Ras Musandam, on the Gulf of Oman, to the eastern limits of Hadhramaut at Ras Sajar (lat. 16° 8″ N.) on the Indian ocean. Inland the state is bounded by the Empty Quarter. The population (1947 est.) 830,000, chiefly Arabs, with a strong Negro element in the coastal regions; the area is about 82,000 sq.mi. The prevailing religion is Ibadi Islam.

Oman is a mountainous district forming part of the ancient land mass of Arabia, granite and limestone rocks being most in evidence. The high ground culminates in Jabal Akhdar (9,900 ft.), which is flanked by steps of the old mountain block down to the coast. The lateral valleys between the steps are often fertile and cultivated, expecially where a good supply of water is available. The wadis, which cut across the mountainous area to the coast, are merely torrential channels, dry for most of the year and often flowing in narrow precipitous gorges, but provide the only ways to the interior. Of these ways, always difficult, the best known are those by the Wadi Qahza, from the port of Matrah; by the Wadi Hail from the port of Quryat; and by the Sama'il valley, leading into the Wadi Munsab from a point 50 mi. N.W. of Muscat. Northwest of Muscat lies the coastal plain known as Al Batinah; it is fertile, prosperous and well populated.

The climate is tropical, with a mean annual rainfall of less than ten inches and a mean annual temperature of 80° F. or more. The vegetation is, however, abundant: tamarisks, oleanders, euphorbias, the milkbush, rhamus and acacias predominate.

Muscat, the capital and the only important harbour, was in Portuguese hands from 1508 to 1648. In 1741 it was taken by Ahmed ibn Sa'id, a descendant of those Yemenite imams who consolidated Arab power in Zanzibar and on the east African coast. His family has ruled Oman ever since. It was the most powerful state in Arabia during the first half of the 19th century, but subsequent raids by the nomadic tribes of the interior, as in 1913–14, and the opportunities for foreign intervention reduced the country for a time to a dependency of India. A treaty of friendship and commerce between Britain and Sultan Sir Sa'id ibn Taimur (succeeded 1932), signed Feb. 5, 1939, reaffirmed the close ties which had existed for nearly 150 years. (*See* ARABIA.)

Date cultivation has reached a high level in the interior. Cereals and vegetables, as well as vines, peaches, apricots, oranges, mangoes and melons, are grown with the dates.

Trade is mainly with India. Dates, promegranates and dried fish are exported, while rice, coffee and cotton goods are the chief imports. Oman's riding camels are considered the best in the world. The little port of Gwadar, on the coast of Baluchistan, the outlet for most of the trade of Makran, is a dependency of Oman.

There are airfields at Salala and on Masira Island, which are staging posts on the routes crossing Africa and the Arabian coast to Karachi. Ships between Karachi and the gulf call weekly at Muscat. Cable communication from Muscat to Jask links Oman with Iran, Iraq and Pakistan.

See Bertram Thomas, *Arab Rule under the Al Bu Sa'id Dynasty of Oman, 1741–1937* (London, 1938).

OMAR (*c.* 581–644), in full 'OMAR IBN AL-KHAṬṬAB, the second of the Mohammedan caliphs (*see* CALIPHATE). Belonging to the clan of 'Adi of the Meccan tribe of Koraish (Quraish), Omar at first opposed Mohammed but later became one of his ablest advisers and on his death secured the election of Abu Bekr as his successor. His own reign (634–644) saw the emergence of Islam as an imperial power. The chief events were the defeat of the forces of the Greek emperor Heraclius on the Yarmuk river (636) and that of the Persians at Kadisiya (637); the settlement of Arab garrisons in Syria and Iraq; the conquest of Egypt by 'Amr ibn el-'As (*q.v.*); and the final rout of the Persians at Nehavend (Nihawand, 641), which opened Iran to Arab rule. Omar also laid down principles for the administration of the conquered lands and helped stabilize the legal practice of Islam. He was a man of strong and ascetic character; his justice and authority were held in universal respect. He was assassinated by a Persian slave in 644. Though he lingered several days after the attack he left the selection of his successor to a council of six of the leading Meccan "Companions of the Prophet." (H. A. R. G.)

OMAR KHAYYAM (GHIYATHUDDIN ABULFATH 'OMAR IBN IBRĀHĪM AL-KHAYYĀMĪ), the great Persian mathematician, astronomer, free thinker and epigrammatist, who derived the epithet Khayyam (the tentmaker) most likely from his father's trade, was born in or near Nishapur, where he is said to have died in A.H. 517 (A.D. 1123). His standard work on algebra, written in Arabic, and other treatises of a similar character raised him at once to the foremost rank among the mathematicians of that age, and induced Sultan Malik-Shah to summon him in A.H. 467 (A.D. 1074) to institute astronomical observations on a larger scale, and to aid him in his great enterprise of a thorough reform of the calendar. The results of Omar's research were a revised edition of the *Zīj* or astronomical tables, and the introduction of the Ta'rikh-i-Malikshahi, or Jalali; that is, the so-called Jalalian or Seljuk era, which commences in A.H. 471 (March 15, A.D. 1079).

Omar's scientific fame, however, is eclipsed in the west by his still greater poetical renown, which he owes to his *rubā'is* (made famous in the west by E. FitzGerald's translation, *The Rubáiyát*) or quatrains, a collection of about 500 epigrams. Although some of his quatrains are purely mystic and pantheistic, most of them bear quite another stamp; they are the breviary of a radical freethinker, who protests in the most forcible manner both against the narrowness, bigotry and uncompromising austerity of the orthodox ulemā and the eccentricity, hypocrisy and ravings of advanced Sūfīs.

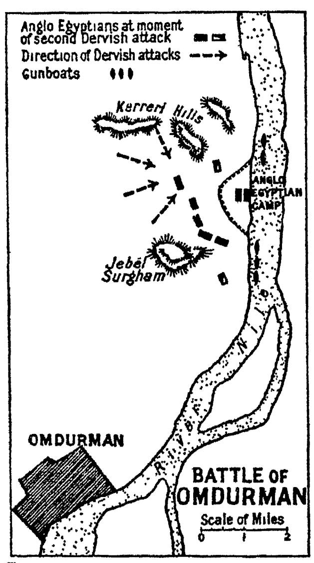
BIBLIOGRAPHY.—The Leyden copy of Omar Khayyām's work on algebra was noticed as far back as 1742 by Gerald Meerman in the preface to his *Specimen calculi fluxionalis;* further notices of the same work by Sédillot appeared in the *Nouv. Jour. As.* (1834) and in vol. xiii of the *Notices et extraits des MSS. de la Bibl. roy.* The complete

text, together with a French translation (on the basis of the Leyden and Paris copies, the latter first discovered by M. Libri, *see* his *Histoire des sciences mathématiques en Italie,* vol. i, p. 300), was edited by F. Woepcke, *L'Algebrè d'Omar Alkhayyāmi* (Paris, 1851). Articles on Omar's life and works are found in Reinaud's *Géographie d'Aboulféda,* pref., p. 101; *Notices et extraits,* vol. ix, p. 143 *et seq.;* Garcin de Tassy, *Note sur les Rubā'iyāt de 'Omar Hhaïyām* (Paris, 1857); Rieu, *Cat. Pers. MSS. in the Br. Mus.,* vol. ii, p. 546; A. Christensen, *Recherches sur les Rubā'iyāt de 'Omar Hayyām* (Heidelberg, 1905); V. Zhukovski, *'Umar Khayyām and the "Wandering" Quatrains,* translated from the Russian by E. D. Ross in the *Journal of the Royal Asiatic Society,* vol. xxx (1898); E. G. Browne, *Literary History of Persia,* vol. ii, p. 246. The quatrains have been edited at Calcutta (1836) and Tehran (1857 and 1862); in English verse, by Edward FitzGerald (London, 1859, 1872 and 1879). FitzGerald's translation has been edited with commentary by H. M. Batson (1900), and the 2nd ed. of the same (1868) by E. Heron Allen (1908). A new English version was published in Trübner's "Oriental" series (1882) by E. H. Whinfield, and the first critical edition of the text, with translations, by the same (1883). Important later works are N. H. Dole's variorum edition (1896), J. Payne's translation (1898), E. Heron Allen's edition (1898) and the *Life* by J. K. M. Shirazi (1905); but the literature in new translations and imitations has recently multiplied exceedingly. *See* A. G. Potter, *A Bibliography of Printed Editions of the Quatrains of Omar Khayyām in Foreign Languages* (1923).

OMBRE, a game of cards, the most fashionable in Europe for many years but now practically obsolete. It has been traced as far back as the 14th century. As late as 1884 Friedrich Anton in a standard manual stated, "Of all games, undoubtedly the most interesting, diversified, and widely known is Ombre." Originally played with the Spanish packs of 40 or 48 cards, it was adapted to the French pack of 52. In the course of time it accreted terms from Spanish, French, Italian and English, as well as a great complexity of rules. Played for the most part by three players, it generated a variant for four, so-called quadrille, which gained great popularity and was one of the five games treated by Edmond Hoyle (1743). A simplification of quadrille, usually called solo, is still played.

BIBLIOGRAPHY.—Henry G. Bohn, "Quadrille," *Handbook of Games* (1850); Friedrich Anton, "L'Hombre," *Encyclopädie der Spiele* (1884).

OMDURMAN. The largest town in the Anglo-Egyptian Sudan, on the west bank of the Nile, opposite Khartoum and immediately north of the junction of the White and Blue Niles. Pop. (1949 est.) 117,650 (87 Europeans). The town covers about 8 sq.mi. Most of the houses are built of mud, but the number of brick houses is increasing. Few buildings survive from the time of the Mahdi. Among these are the Mahdi's tomb, ruined in 1947, the khalifa's house (now a museum), the Beit el Amana, or arsenal (now a football stadium), and part of the old slave market. In the market trade most of the big Sudanese merchants, the chief articles of commerce being hides and gum arabic for export, and imported cotton piece goods. There is also an important camel, sheep and cattle market. Many dwellers in Omdurman are employed in government service in the administrative capital, Khartoum, about 5 mi. distant, to which Omdurman is connected by a bridge over the White Nile. There are many schools, government and private, for both boys and girls. The government maintains a large hospital, and medical and educational work is undertaken by various missionary societies. Local services are controlled by a municipal council composed entirely of Sudanese.



PLAN OF THE BATTLE OF OMDURMAN, SEPT. 2, 1898

Omdurman, then an insignificant village, was chosen in 1884 by the Mahdi Mahommed Ahmed as his capital and so continued after the fall of Khartoum in Jan. 1885. Its growth was rapid, the khalifa (who succeeded the Mahdi) compelling large numbers of disaffected tribesmen to live in the town under the eye of his soldiery. The European captives of the Mahdists—notably Slatin Pasha and Father Ohrwalder—were also imprisoned there. On Sept. 2, 1898, the Anglo-Egyptian army under Lord Kitchener totally defeated the forces of the khalifa at Kerreri, 7 mi. N. of the town. A marble obelisk marks the spot where the 21st Lancers made a charge, in which Winston Churchill took part.

See EGYPT: *Egypt and Sudan Campaigns (1882–1900.)*

(E. H. MH.)

OMEN, a sign in divination, favourable or unfavourable as the case may be (*see* AUGURS; DIVINATION; and ORACLE).

OMICHUND (d. 1767), an Indian whose name is indelibly associated with the treaty negotiated by Robert Clive before the battle of Plassey in 1757. His real name was Amir Chand; and he was not a Bengali, as stated by Thomas Macaulay, but a Sikh from the Punjab. It is impossible now to unravel the intrigues in which he may have been engaged, but some facts about his career can be stated. He had long been a resident of Calcutta, where he had acquired a large fortune by providing the "investment" for the East India company, and also by acting as intermediary between the English and the native court at Murshidabad. Several houses owned by him in Calcutta are mentioned in connection with the fighting that preceded the tragedy of the Black Hole in 1756, and it is on record that he suffered heavy losses at that time. He had been arrested by the English on suspicion of treachery, but afterward he gave help to the fugitives and also valuable advice. On the recapture of Calcutta he was sent by Clive to accompany Watts as agent at Murshidabad. It seems to have been through his influence that the nawab gave reluctant consent to Clive's attack on Chandernagore. Later, when the treaty with Mir Jafar was being negotiated, he put in a claim for 5% of all the treasure to be recovered, under threat of disclosing the plot. To defeat him, two copies of the treaty were drawn up: the one, the true treaty, omitting his claim; the other containing it, to be shown to him, which Adm. Charles Watson refused to sign, but Clive directed the admiral's signature to be appended. When the truth was revealed to Omichund after Plassey, Macaulay states (following Robert Orme) that he sank gradually into idiocy, languished a few months and then died. As a matter of fact, he survived for ten years, till 1767; and by his will he bequeathed £2,000 to the Foundling hospital (where his name may be seen in the list of benefactors as "a black merchant of Calcutta") and also to the Magdalen hospital in London. (J. S. Co.)

OMNIBUS. A term often shortened to "bus," signifying a public passenger-carrying vehicle of large seating capacity. It has become synonymous in popular use with the word "motorbus." Horse-drawn and steam-driven omnibuses have been superseded by motor-propelled omnibuses.

In several particulars an omnibus must conform with regulations laid down by public authorities, especially in connection with dimensions and weights. The carried load, consisting of the passengers and the omnibus body, will at most be less than the regulation weight by a figure termed the chassis weight. The proportion borne by the carried load to the total weight is largely determined by the speed, hill climbing and other performances characteristic of the omnibus and such proportion is always made as large as possible to obtain the maximum earning power. For any specified purpose, designers have in recent years been able to increase this proportion without prejudicing either the reliability of the vehicles or the lowness of their running costs.

Body design aims at making the proportion borne by the passenger load to the carried load as great as possible, and is influenced very greatly by public requirements in the matter of comfort and safety. This proportion tends to become less as more exacting conditions have to be met in the provision of seating, shelter, ventilation and lighting. Passengers may be taken to weigh on an average one-sixteenth of a ton each, but as soon as an omnibus body is provided to carry them, the weight that must be credited to each passenger becomes much greater.

The almost universal practice in omnibus design in 1928 was to employ two axles, the rear wheels being used for driving and braking, and the front wheels being used for steering. The weight

distribution, as indicated by the front and rear axle weights, must be such as to give the adhesion necessary for rapid acceleration and good braking on normal road surfaces. Skidding and inferior performance are the natural consequences of bad weight distribution. The limit is set to front axle weight by the consideration that the driver must be able to turn the front wheels easily in order to steer the vehicle. This limit is reached before the other, which otherwise would affect both axles alike (but which, in consequence of the earlier limit on the front axle, affects the rear axle alone), viz. the limiting axle weight tolerated by local authorities.

Low Centre of Gravity.—In the complete omnibus, under all conditions of loading, the centre of gravity must be so low in relation to the width of the vehicle as to render exceedingly remote the possibilities of over-turning. Where conditions permit, the centre of gravity should occupy a position even lower than that which gives the desired stability. All deviations of a 'bus from uniform motion in a straight line will bring about changes in the loading of every wheel, and these changes become smaller as the centre of gravity approaches the plane of the road. With a low centre of gravity, it will be usual to work very close to the adhesion figures calculated for the stationary omnibus, since the greatest acceleration and braking effects that these figures allow, can be actually approached in practice under all conditions. Where the centre of gravity is high, braking is liable to promote skidding at corners, and on cambered surfaces; rapid acceleration will give rise to the same tendency. Since the carried load in a modern omnibus forms the large proportion of the total weight, and since the carried load comprises very nearly everything which is above floor level, it follows that the problem of making further reductions in the height of the centre of gravity, resolves itself simply into the problem of reducing the floor height.

To obtain the lowest possible floor height, omnibus designers have developed the double reduction driving axle. In this axle, the driving shafts do not transmit the torque direct to the road wheels, but communicate their motion to them through gearing. Each wheel bears a drum coaxial with the brake drum, but of smaller diameter, on which teeth are cut internally. Pinions on the ends of the driving shafts engage with these drums at their lowest points. This arrangement permits the use of full size driving wheels with an axle whose height is considerably less than that of the wheel centres. It permits, moreover, the use of a smaller housing for the right angled drive in the centre of the axle. This drive no longer effects the whole torque multiplication, but only a part of it; whereas the whole multiplication may be nearly 10 to 1, the right angled drive may be called upon to give a multiplication of only 2 to 1, and may therefore be much more compact than one giving the full multiplication.

The centre of gravity is lower in the "N.S." omnibus than in other types. Under the worst conditions, when the upper deck is laden and the lower deck is unladen, the ground may tilt to the extent of 28° beneath the car before over-turning can occur. The best figure obtained with the more usual construction, and without a top cover, was 25°. With the advent of cross seating, omnibus axle weights became so great as to approach the limit tolerated by road authorities. Rear axle weights, reaching that limit, could no longer be increased, and the need arose, as bigger omnibus weights were required, for throwing the weight forward. To this end the forward drive omnibus was introduced in London, and subsequently in all parts of the world.

The modern 'bus body is continued forward to a point only an inch or two behind the rear cylinder block. The driver sits forward alongside the engine, and is actually in a much more favourable position to steer his vehicle round blind corners than formerly. The drawbacks to the forward drive omnibus, are, firstly, the heaviness of steering consequent upon the increased front axle loading, and secondly, the difficulty of access to the engine on the off-side. Neither of these drawbacks has, however, proved serious. There is a tendency among vehicle builders of six wheelers to return to the conventional driving position of many years ago, but the day cannot long be postponed when forward drive will be forced upon designers of six wheelers, as it has been forced upon designers of four wheelers.

Transmission Problem.—Common to all road vehicles employing the internal combustion engine, is the problem of transmitting the power developed by a relatively inflexible prime mover to the road wheels. In the omnibus, above all other vehicles, this problem is one of great difficulty to which no entirely satisfactory solution has yet been found. The high power weight ratio of an ordinary car makes possible the employment of a lightly constructed clutch and gearbox, since the car will normally run in top or direct gear. Only motoring enthusiasts care for driving on the gears and obtaining thereby a splendid performance out of a small capacity engine. Nevertheless, the omnibus driver is called upon to do this, and in consequence, the transmission must be of great robustness and be simple to manipulate. In addition to the need for gear changing, ever present on undulating roads, with the relatively low powered omnibus there is the constant stopping to let down and take up passengers which also calls for gear manipulation. With the very heavy omnibus used in services necessitating a great many stops, it has become impossible to achieve, without high maintenance costs, the propulsion of the load through the agency of the clutch and gearbox. It is probably only a matter of a year or two before other forms of transmission—electric transmission in particular—will live down their many drawbacks, and show on the whole a saving in costs.

For the right angled drive in an omnibus rear axle, bevel, and other forms of gearing have yet to be proved superior to worm gearing. Within recent years, the old fashioned motion communicating screw and wheel has been developed to meet modern automobile and industrial requirements, and in its original form it can scarcely claim a relationship with the highly efficient reversible worm gearing of the present day. The difficulties inherent in the many forms of bevel drive are to make them compact and also silent.

Suspension.—The suspension of an omnibus is effected through longitudinally disposed semi-elliptic leaf springs mounted on the axles, supplemented by rubber buffers, steel volute springs, or other energy absorbing devices over the axles. The latter augment the stiffness of the suspension to meet exceptional load or road conditions.

Rear springs are often allowed to take the driving and braking torque reactions of the rear axle. Where this is not permissible, a torque arm is provided, and the rear springs are shackled at both ends. Tractive effects are often communicated to the vehicle through the rear springs also, though, where a torque arm is provided, the springs must, in view of their being shackled at both ends be relieved of this duty. Where it is provided, the torque arm usually swings from a well braced frame cross-member that has sufficient strength to withstand the pushing and tugging in a horizontal plane to which it will be subjected by the driving and braking exertions of the rear axle. Some vehicles are made with a torque tube surrounding the propeller shaft.

No effort is made by designers to produce completely rigid chassis frames for omnibuses. All things carried on the frame are mounted so as to flex with it or be able to take up a new position without strain. Such rigid structures as engine, gearbox and radiator, are mounted on frame attachments or bearers with rubber or other resilient pads interposing and permitting small relative movements. Where severe conditions must be met, the engine and gearbox are mounted on three such bearers only. Three points of support, however, situated, remain always in a plane, and there can be no distortion from twisting with three point suspension. The drive between units, disposed none too rigidly in relation to one another, is effected by means of shafts bearing flexible couplings or universal joints at their extremities.

The enormous mileages accomplished by the omnibus as compared with the light car, prohibit the adoption by omnibus engineers of light car greasing methods. There is no part of an omnibus which can be packed with grease and left to itself from one year's end to another. Grease nipples and filler caps are provided everywhere in accessible positions, and positive action grease feeding guns which can be relied upon to urge lubricant where

lubrication is necessary, are used under service conditions at frequent intervals.

Tiremakers, anticipating the call for higher omnibus speeds which had been heard for some considerable time, developed the pneumatic tire that would carry heavy loads. With higher running speed, better braking must be provided on all vehicles. Rear wheel adhesion becomes insufficient and all four wheels must be fitted with drums and brake shoes. Four-wheel braking is, in any event, often forced upon designers by the difficulty of accommodating two sets of brake drums on the very small wheel centres that accompany these deep-section tires.

OMRI, an Israelite general, chosen by the army as ruler when, during a campaign against the Philistines, reports came that Zimri, a captain of the chariots, had murdered the king, Elah, in the royal city of Tirzah and proclaimed himself king. Omri promptly marched against Zimri, and captured Tirzah; Zimri, recognizing the hopelessness of his position, set fire to the palace and perished in the flames. A rival party set up Tibni, with whom the Greek versions associate his brother Joram, as king, but Omri defeated this faction and became undisputed king of Israel *c.* 884 B.C. The one deed of his reign recorded in I Kings xvi, 24, is his purchase of the hill of Samaria, upon which he founded a new royal city. But Mesha of Moab mentions him as "having afflicted Moab many days." In spite of the fact that he suffered some reverses at the hand of Syria (I Kings xx, 34), he must have been an accomplished statesman who consolidated his kingdom and made it respected, because for generations after his death Israel is known to the cuneiform writers as "House (or Land) of Omri," and the Israelite Jehu as a "son of Omri." He reigned 12 years and was succeeded by his son Ahab (*q.v.*).

OMSK, a town in the Omsk region of the Russian S.F.S.R., in lat. 55° N., long. 73° 38′ E., on the right bank of the Irtysh, where the Om joins it. It is in the midst of a treeless steppe; violent winds bring snow, often to a depth of six feet, in winter, and sandstorms in summer. Average January temperature 5° F., July 68° F.; annual rainfall 12.4 in.; altitude 285 ft. It is on the trans-Siberian railway, and has a branch linking with Sverdlovsk through Ishim and Tyumen. Steamer routes connect it with the Ob northward along the Irtysh, and southward with the Altai towns and Lake Zaisan, and caravan routes from the Central Asiatic republics and Kazakstan converge upon it. Its population grew from 37,376 in 1897 to 280,716 in 1939, but its appearance is still that of a frontier town, with one-storied wooden huts and unpaved streets, through which Kirghiz ponies and camel caravans thread their way. Stone buildings have been constructed and the cathedral is built of stone; there is a municipal electricity, water and bus service. Its industries include the making of agricultural and other machinery, distilling, brewing, cloth manufacture and foodstuffs, especially sausage. It is a centre for the collection and export of meat, butter, hides and skins. The Russian Geographical society has a museum there and there is much educational and dramatic activity.

A fort was established there in 1716 to protect the Russian settlers from Kirghiz raids. Later, with the increasing colonization of the area and the coming of the railway, the town developed rapidly and became a military centre, with large barracks. After the 1917 revolution, it was the nucleus of Siberian political activity and various governments rapidly succeeded one another; Adm. Alexander Kolchak declared himself dictator of Siberia at Omsk. With the advance of the Bolshevik army, refugees from the west crowded into the town and the insanitary conditions resulted in a plague of spotted fever and typhus. On the capture of the town the refugees fled farther eastward carrying infection with them, though many died of cold, hunger and disease.

ONA, an Indian tribe which once occupied the interior of Tierra del Fuego except the southwestern corner, which was uninhabited, and the southeastern corner, where dwelt a related tribe known as the Haush. The Ona in speech, physique and culture were similar to the giant Tehuelche of Patagonia. They subsisted by hunting and were expert archers. Their chief food was the flesh of the guanaco, a wild camel related to the llama. In addition they ate birds, fish, shellfish, berries and fungi. Ona culture was very primitive. Their dress was a large robe of guanaco fur, moccasins, a petticoat for the women and a fur diadem for the men. In spite of their cold environment they rarely used houses, and habitually slept behind a windbreak of hides. Their manufactures included bows and arrows, short fishing spears, slings, baskets, braided necklaces, wristlets and anklets and a few simple tools. Ona society was organized into hunting groups of relatives. Each group controlled a well-defined territory which it vigorously defended from poachers. As a result blood feuds were common. At times each hunting group assembled to perform initiation ceremonies. Candidates were taught tribal lore, were terrified by masked apparitions and were forced to live in solitude for two years that they might become strong and self-reliant. Ona religion consisted in a fear of certain malevolent spirits and belief in a supreme deity. Ona mythology is rich. The tribe has almost died out.

See S. K. Lothrop, "The Indians of Tierra del Fuego," Museum of the American Indian, Heye Foundation, *Contributions,* vol. x (1928); J. M. Cooper, *Analytical and Critical Bibliography—of Tierra del Fuego,* Bureau of American Ethnology, Bulletin 63 (1917).

(S. K. L.)

ONAGRACEAE or OENOTHERACEAE, a family of dicotyledons belonging to the order Myrtiflorae, to which belongs also the myrtle family, Myrtaceae. It contains about 40 genera and 500 species, and occurs chiefly in the temperate zone of the new world, especially on the Pacific side. It is represented in Britain by several species of *Epilobium* (willow herb), *Circaea* (enchanter's nightshade), and *Ludwigia* (false loosestrife), a small perennial herb very rare in boggy pools in Sussex and Hampshire. In the United States, especially in the Pacific states, the family is well represented, the principal genera being *Oenothera* (containing as a native the evening primrose, now naturalized in certain parts of Europe), *Epilobium* and *Ludwigia.* The plants are generally herbaceous, sometimes annual, as species of *Epilobium, Clarkia, Godetia,* or biennial, as *Oenothera biennis*—evening primrose—or sometimes become shrubby or arborescent, as *Fuchsia* (*q.v.*). The simple leaves are generally entire or inconspicuously toothed, and are alternate, opposite or whorled in arrangement; they are generally exstipulate. The flowers are often solitary in the leaf axils, as in many species of *Fuchsia, Clarkia,* etc., or associated, as in *Epilobium* and *Oenothera,* in large showy terminal spikes or racemes; in *Circaea* the small white or red flowers are borne in terminal and lateral racemes. The regular flowers have the parts in fours, the typical arrangement as illustrated by *Epilobium, Oenothera* and *Fuchsia* being as follows: four sepals, four petals, two alternating whorls of four stamens, and four inferior carpels. The floral receptacle is produced above the ovary into the so-called calyx tube, which is often petaloid, as in *Fuchsia,* and is sharply distinguished from the ovary, from which it separates after flowering.

GREAT HAIRY WILLOW HERB (EPILOBIUM HIRSUTUM)

In *Clarkia* the inner whorl of stamens is often barren, and in *Eucharidium* it is absent. In *Circaea* the flower has its parts in twos. Both sepals and petals are free; the former are valvate in bud, and reflexed in the flower; in *Fuchsia* they are petaloid. The petals are generally convolute in bud; they are entire (*Fuchsia*) or bilobed (*Epilobium*); in some species of *Fuchsia* they are small and scalelike, or absent (*F. apetala*). The stamens are free, and those of the inner whorl are generally shorter than those of the outer whorl. The flowers of *Lopezia* (Central

America) have only one fertile stamen. The large spherical pollen grains are connected by viscid threads. The typically quadrilocular ovary contains numerous ovules on axile placentas; the one- to two-celled ovary of *Circaea* has a single ovule in each loculus. The long slender style has a capitate (*Fuchsia*), four-rayed (*Oenothera, Epilobium*) or four-notched (*Circaea*) stigma. The flowers, which have generally an attractive corolla and honey secreted by a swollen disk at the base of the style or on the lower part of the calyx tube, are adapted for pollination by insects, chiefly bees and lepidoptera; sometimes by night-flying insects when the flowers are pale and open toward evening, as in evening primrose. The fruit is generally a capsule splitting into four valves and leaving a central column on which the seeds are borne as in *Epilobium* and *Oenothera*—in the former the seeds are scattered by aid of a long tuft of silky hairs on the broader end. In *Fuchsia* the fruit is a berry, which is sometimes edible, and in *Circaea* a nutlet bearing recurved bristles. The seeds are exalbuminous. Several of the genera are well-known as garden plants; *e.g., Fuchsia, Oenothera, Clarkia* and *Godetia.* Evening primrose (*Oenothera biennis*), a native of North America, occurs apparently wild as a garden escape in Britain. *Jussieua,* a tropical genus of 50 species of water and marsh herbs, shows a development of well-developed aerating tissue in certain species.

ONATAS, a Greek sculptor of the time of the Persian wars, a member of the flourishing school of Aegina. Many of his works are mentioned by Pausanias; they included a Hermes carrying the ram, and a strange image of the Black Demeter made for the people of Phigaleia; also some groups in bronze at Olympia and Delphi, including a bronze chariot for Hieron I of Syracuse. From Pausanias' descriptions we may assume that the figures on the pediments of Aegina represent his style. They are manly, vigorous, athletic, showing great knowledge of the human form, but somewhat stiff and automatonlike.

ONCOSTS: *see* OVERHEAD CHARGES.

ONEGA (ŏn′e-gah), the largest lake in Europe next to Ladoga, area, 3,764 sq.mi. and coast line 870 mi. in length. It lies mostly in the Karelian A.S.S.R., though its southern portion is in the province of Leningrad. The lake basin extends northwest and southeast, the direction characteristic of the lakes of Finland and the line of glacier-scoring observed in that region. The southern coast is comparatively regular and has few islands, but the north is broken into inlets, the largest being Povyenets bay, and is crowded with islands (*e.g.,* Klimetsk) and submerged rocks. The northwestern shore between Petrozavodsk and the mouth of the river Lumbosha consists of dark clay slates, generally arranged in horizontal strata and broken by protruding, parallel ridges of diorite, which extend far into the lake. The eastern shore, as far as the mouth of the Andoma, is for the most part alluvial, with outcroppings of red granite and in one place (the mouth of the Pyalma) diorite and dolomite. To the southeast are sedimentary Devonian rocks, and the general level of the coast is broken by Mt. Andoma and Cape Petropavlovskiy (160 ft. above the lake); to the southwest a quartz sandstone (used as a building and monumental stone in Leningrad) forms a fairly bold rim. Lake Onega lies 125 ft. above the sea. The greatest depths, 318 to 408 ft., occur at the entrance to the double bay of Lizhemsk and Unitsk. On the continuation of this line the depth exceeds 240 ft. in several places. In the middle of the lake the depth is 120 to 282 ft., and less than 120 ft. in the south. The lake is 145 mi. long, with a maximum breadth of 45 mi. The most important affluents, the Vodka, the Andoma and the Vytegra, come from the east. The Kumsa, a northern tributary, is sometimes represented as if it connected the lake with Lake Seg, but at the present time the latter drains to the White sea. The Onega canal (45 mi. long) was constructed in 1818–51 along the southern shore in order to connect the Svir (and hence Lake Ladoga and the Baltic) with the Vytegra, which connects with the Volga. In 1928 an electric station was constructed on the Svir river. Lake Onega remains free from ice for 209 days in the year (middle of May to second week of December). The water is at its lowest level in the beginning of March; by June it has risen two ft. A considerable population is scattered along the shores of the lake, mainly occupied in the timber trade, fisheries and mining industries. The opening of the Murmansk railway along the western shore in 1917 developed settlement. Salmon, *palya* (a kind of trout), burbot, pike, pike perch and perch are among the fish caught in the lake.

The Onega river rises in Lake Vozhe, and is navigable for boats and rafts from Kargopol to the Gulf of Onega, an inlet of the White sea. It flows through the provinces of Vologda and Archangel and has no connection with Lake Onega. At the mouth of this river (on the right bank) in 63° 55′ N., 38° 55′ E., in the province of Archangel, stands the town and port of Onega. Pop. (1926) 5,254. It dates from settlements made by the people of Novgorod in the 15th century, known in history as Ustenskaya or Ustyanskaya. It has a sawmilling industry, and has summer steamer routes to Soroka, Kem and Archangel, but the season is short because of the persistence of land floes and loose pack. Telegraphic communication is by the Archangel railway.

ONEIDA, the only city of Madison county, New York, U.S., on Oneida creek, 6 mi. S.E. of Oneida lake, midway between Utica and Syracuse. It is served by the New York Central and the New York, Ontario and Western railways. Pop. (1950) 11,367; 10,291 in 1940. Adjoining Oneida on the west is the village of Wampsville, the county seat. Across the creek, to the southeast, is the village of Oneida Castle, formerly the gathering place of the Oneida Indians. Oneida is the headquarters of the Oneida community (*q.v.*), which controls important industries (notably the manufacture of silver-plated ware) there and elsewhere. The city also manufactures caskets and furniture, chucks and bottle caps, silverware cases, milking machines, pole line hardware, electric transmission equipment, gray iron castings, bandages, paper boxes and memorials. Oneida was founded by Sands Higginbotham, who bought the site in 1829–30. It was incorporated as a village in 1848 and as a city in 1901.

ONEIDA (a corruption of their proper name *Oneyotka-ono,* "people of the stone," in allusion to the Oneida stone, a granite boulder near their former village, which was held sacred by them), a tribe of North American Indians of Iroquoian stock, forming one of the Six Nations. They lived around Oneida lake in New York state, in the region southward to the Susquehanna. They were not loyal to the league's policy of friendliness to the English, but inclined toward the French, and were practically the only Iroquois who fought for the Americans in the War of Independence. As a consequence they were attacked by others of the Iroquois under Joseph Brant and took refuge within the American settlements till the war ended, when the majority returned to their former home, while some migrated to the Thames river district, Ontario. Early in the 19th century they sold their lands, and most of them settled on a reservation at Green Bay, Wis., a few remaining in New York state. In 1926 the Oneidas in the United States numbered 3,238 persons, of whom 2,976 were in Wisconsin and 262 in New York state. They are civilized and prosperous. *See* NORTH AMERICA: *Ethnology.*

ONEIDA COMMUNITY, a U.S. communistic society at Oneida, N.Y. It was founded at Putney, Vt., in 1842, by John Humphrey Noyes (1811–86), a graduate of Dartmouth college. "Converted" at a revival, he entered Yale Theological seminary. Bible studies convinced him that Christ came a second time in 70 A.D. and absolved Christians from necessity of sin. Called a perfectionist, he barely escaped expulsion from the seminary before graduation, and later was deprived of his licence as a Congregational minister. He and his followers established a commune, eventually pooling all property, renouncing all religious observances and instituting "complex marriage." Monogamy was antagonistic to their ideals. In 1847, dissension having brought them before the courts and their theories and practices before the public, they were forced to leave Putney. They purchased, near Oneida, N.Y., 600 ac. of forestland which proved extremely productive. They planted orchards, lumbered, blacksmithed, farmed and made steel traps—their most profitable industry. In Jan. 1847 their first annual inventory revealed them to be worth about $67,000.

They were mostly New England farmers and mechanics. They had the reputation of being excellent citizens only remarkable for

their earnest interest in eugenics. They sought to make practical application of what scientific information they possessed endeavouring by change and experiment to produce the best possible offspring.

Owing to increasing pressure of public sentiment, which had been anticipated though for 25 years it was unexpressed, Noyes, with a few adherents, removed to Canada in 1880 and the community at Oneida voluntarily dissolved as a communistic experiment and formed a stock company known as the Oneida Community, Limited. At that time it manufactured sewing and embroidery silk, steel traps and silverware, and canned large quantities of fruits and vegetables, but has gradually confined itself to the manufacturing of silverware. The present company has "no connection with the old beyond the personnel and traditions which it inherited from its 40 years' experience as a community."

Among the chief writings of J. H. Noyes dealing with the origin, principles and history of the Oneida Community are *The Berean* (1847), a manual for the use of members; *Salvation from Sin the End of Christian Faith* (1869); *History of American Socialisms* (1870); *Home-Talks* (1875); *Essay on Scientific Propagation* (c. 1875). *See* also *Bible Communism* (1853), a compilation of the community's theories; George Noyes, comp. and ed., *Religious Experiences of John Humphrey Noyes* (1923); Robert A. Parker, *A Yankee Saint* (1935); Pierrepont B. Noyes, *My Father's House* (1937). (P. B. N.)

O'NEILL, the name of an Irish family descended from Niall, king of Ireland in the 5th century, and known as Niall of the Nine Hostages. He is said to have made war against rulers in Ireland, Britain and Gaul, stories of his exploits being related in the *Book of Leinster* and the *Book of Ballymote.* This king had 14 sons, one of whom was Eoghan (Owen), from whom the O'Neills were descended. The descendants of Niall were divided into two main branches, the northern and the southern Hy Neill, to one or other of which nearly all the high-kings (ard-ri) of Ireland from the 5th to the 12th century belonged; the descendants of Eoghan being the chief of the northern Hy Niell[1]. Eoghan was grandfather of Murkertagh (Muircheartach) (d. 533), said to have been the first Christian king of Ireland, whose mother, Eirc or Erca, became by a subsequent marriage the grandmother of St. Columba. Of this monarch, known as Murkertagh MacNeill (Niall), and sometimes by reference to his mother as Murkertagh Mac Erca, the story is told, illustrating an ancient Celtic custom, that he emphasized the inviolability of a treaty with a tribe in Meath by having it written with the blood of both clans mixed in one vessel. Murkertagh was chief of the great north Irish clan, the Cinel Eoghain, and after becoming king of Ireland in 517, he seized a tract in the modern Co. Derry, which remained till the 17th century in the possession of the Cinel Eoghain. The inauguration stone of the Irish kings, the Lia Fail, or Stone of Destiny, fabled to have been the pillow of the patriarch Jacob when he dreamed of the heavenly ladder, was said to have been presented by Murkertagh to the king of Dalriada, by whom it was conveyed to Dunstaffnage castle in Scotland. (*See* SCONE.) A lineal descendant of Murkertagh was Niall Frassach (*i.e.*, of the showers), who became king of Ireland in 763. His grandson, Niall (791–845), drove back the Vikings who began to infest the coast of Donegal. Niall's son, Aedh (Hugh) Finnlaith, was father of Niall Glundubh (*i.e.*, Niall of the black knee), one of the most famous of the early Irish kings, from whom the family surname of the O'Neills was derived. His brother Domhnall (Donnell) was king of Ailech, a district in Donegal and Derry; the ruined masonry of the royal palace is still to be seen on a hill overlooking loughs Foyle and Swilly. On the death of Domhnall in 911 Niall Glundubh became king of Ailech, and, after defeating the kings of Dalriada and Ulidia he became king of Ireland in 915. To him is attributed the revival of the ancient meeting of Irish clans known as the Fair of Telltown. He fought many battles against the Norsemen, in one of which he was killed in 919 at Kilmashoge, where his place of burial is still to be seen.

His son Murkertagh, who gained a victory over the Norse in 926, is celebrated for his triumphant march round Ireland, the *Moirthimchell Eiream,* when he captured many kings and chieftains. From the dress of his followers in this expedition he was called "Murkertagh of the Leather Cloaks." The exploit was celebrated by Cormacan, the king's bard, and a number of Murkertagh's other exploits are related in the *Book of Leinster.* He was killed in battle against the Norse in 943, and was succeeded as king of Ailech by his son, Donnell Ua Niall (*i.e.,* O'Neill, grandson of Neill, or Niall, the name O'Neill becoming about this time an hereditary family surname), whose grandson, Flaherty, made a pilgrimage to Rome in 1030.

Aedh (Hugh) O'Neill, chief of the Cinel Eoghain, or lord of Tir-Eoghain (Tir-Owen, Tyrone) at the end of the 12th century, came into conflict with the Anglo-Norman monarchy, whose pretensions he disputed in Ulster. His son (or nephew), Hugh O'Neill, lord of Tyrone, was styled "Head of the liberality and valour of the Irish." Hugh's son, Brian, was inaugurated prince, or lord, of Tyrone in 1291; and his son Henry became lord of the *Clann Aodha Buidhe* (Clanaboy or Clandeboye) early in the 14th century. Henry's son Murkertagh the Strongminded, and his great-grandson Hugh, greatly consolidated the power of the O'Neills. Niall Og O'Neill, one of the four kings of Ireland, accepted knighthood from Richard II.; and his son Eoghan formally acknowledged the supremacy of the English crown, though he afterwards ravaged the Pale, and was inaugurated "the O'Neill" (*i.e.,* chief of the clan) on the death of his kinsman Domhnall Boy O'Neill. He was deposed (1455) by his son Henry, who in 1463 was acknowledged as chief of the Irish kings by Henry VII. Contemporary with him was Neill Mor O'Neill, lord of Clanaboy. From Neill Mor O'Neill's son Brian was descended the branch of the O'Neills who, settling in Portugal in the 18th century, became Portuguese nobles. This branch represents the male line of the ancient Irish kings of the house of O'Neill.

CONN O'NEILL (*c.* 1480–1559), 1st earl of Tyrone, surnamed Bacach (the Lame), grandson of Henry O'Neill mentioned above, was the first of the O'Neills to come to the front as a leader of the Irish against the English in the 16th century. Conn became chief of the Tyrone branch of the O'Neills (Cinel Eoghain) about 1520. Tyrone having been invaded in 1541 by Sir Anthony St. Leger, the lord deputy, Conn delivered up his son as a hostage, attended a parliament held at Trim, and, crossing to England, made his submission at Greenwich to Henry VIII., who created him earl of Tyrone for life. He was also made a privy councillor in Ireland, and received a grant of lands within the Pale. O'Neill's submission to the English king, and his acceptance of an English title were resented by his clansmen and dependents. The earl maintained a feud with his son Shane (John), arising out of his transaction with Henry VIII. The nomination of O'Neill's reputed son Matthew as his heir with the title of baron of Dungannon by the English king conflicted with the Irish custom of tanistry (*q.v.*), which regulated the chieftainship of the Irish clans; moreover, Matthew, if indeed he was O'Neill's son at all, was illegitimate, and Shane, Conn's eldest legitimate son, would not permit any invasion of his rights. The fierce family feud ended in the murder of Matthew by agents of Shane in 1558; Conn dying about a year later. Conn was twice married, Shane being the son of his first wife, a daughter of Hugh Boy O'Neill of Clanaboy. An illegitimate daughter of Conn married the celebrated Sorley Boy MacDonnell (*q.v.*).

SHANE O'NEILL (*c.* 1530–1567), rejected overtures from the earl of Sussex, the lord deputy, and refused to help the English against the Scottish settlers on the coast of Antrim, allying himself instead with the MacDonnells, the most powerful of these immigrants. Nevertheless Queen Elizabeth was disposed to come to terms with Shane, who after his father's death was *de facto* chief of the O'Neill clan. She recognized his claims to the chieftainship, thus throwing over Brian O'Neill, son of the murdered Matthew, baron of Dungannon, on terms. O'Neill, however, refused to put himself in the power of Sussex without a guarantee for his safety; and his claims were so exacting that Elizabeth determined to restore Brian. An attempt to incite the O'Donnells against him was frustrated by Shane's capture of Calvagh O'Donnell, whom he

[1]A list of these kings will be found in P. W. Joyce's *A Social History of Ancient Ireland* (London, 1903), vol. i., pp. 70, 71.

kept a prisoner for nearly three years.

Elizabeth, who was not prepared to undertake the subjugation of the Irish chieftain, urgently desired peace with him, especially when the devastation of his territory by Sussex brought him no nearer to submission. Sussex was not supported by the queen, who sent the earl of Kildare to arrange terms with O'Neill. The latter agreed to present himself before Elizabeth. Accompanied by Ormonde and Kildare he reached London on Jan. 4, 1562. Elizabeth temporized; but finding that O'Neill was in danger of becoming a tool in the hands of Spanish intriguers, she permitted him to return to Ireland, recognizing him as "the O'Neill," and chieftain of Tyrone; though a reservation was made of the rights of Hugh O'Neill, who had succeeded his brother Brian as baron of Dungannon, Brian having been murdered in April 1562 by his kinsman Turlough Luineach O'Neill.

There were at this time three powerful contemporary members of the O'Neill family in Ireland—Shane, Turlough and Hugh, 2nd earl of Tyrone. Turlough had been elected tanist (*see* Tanistry) when his cousin Shane was inaugurated the O'Neill, and he schemed to supplant him during Shane's absence in London. The feud did not long survive Shane's return to Ireland, where he reestablished his authority and renewed his turbulent tribal warfare. Elizabeth at last authorized Sussex to take the field against Shane, but two expeditions failed. Shane then laid the whole blame for his lawless conduct on the lord deputy's repeated alleged attempts on his life. Elizabeth consented to treat, and practically all O'Neill's demands were conceded. O'Neill then turned his hand against the MacDonnells, claiming that he was serving the queen of England in harrying the Scots. He fought an indecisive battle with Sorley Boy MacDonnell near Coleraine in 1564, and in 1565 routed the MacDonnells and took Sorley Boy prisoner near Ballycastle. This victory strengthened Shane O'Neill's position, and preparations were made for his subjugation. O'Neill ravaged the Pale, failed in an attempt on Dundalk, made a truce with the MacDonnells and sought help from the earl of Desmond. The English, on the other hand, invaded Donegal and restored O'Donnell. O'Neill was routed by the O'Donnells at Letterkenny; and seeking safety in flight, he threw himself on the mercy of his enemies, the MacDonnells. Attended by a small body of galloglasses, and taking his prisoner Sorley Boy with him, he presented himself among the MacDonnells near Cushendun, on the Antrim coast. There, on June 2, 1567, he was slain by the MacDonnells.

Turlough Luineach O'Neill (*c.* 1530–95), earl of Clanconnell, was inaugurated chief of Tyrone on Shane's death. He sought to strengthen his position by alliance with the O'Donnells, MacDonnells and MacQuillans. An expedition under the earl of Essex was sent against him, which effected little, and by treaty in 1575 O'Neill received extensive grants of land and permission to employ 300 Scottish mercenaries. In 1578 he was created baron of Clogher and earl of Clanconnell for life; but for the next few years he continued to intrigue against the English authorities. The latter, as a counterpoise to Turlough, supported his cousin Hugh, brother of Brian, whom Turlough had murdered. Eventually Turlough resigned the headship of the clan in favour of Hugh, who was inaugurated the O'Neill in 1593. Turlough died in 1595.

Hugh O'Neill (*c.* 1540–1616), 2nd earl (known as the great earl) of Tyrone, was the second son of Matthew, reputed illegitimate son of Conn, 1st earl of Tyrone. He succeeded his brother Brian when the latter was murdered by Turlough in 1562, as baron of Dungannon. He was brought up in London, but returned to Ireland in 1567 after the death of Shane, under the protection of Sir Henry Sidney. He served with the English against the 15th earl of Desmond in Munster in 1580, and assisted Sir John Perrot against the Scots of Ulster in 1584. In the following year he attended parliament as earl of Tyrone, though Conn's title had been for life only, and had not been assumed by Brian. Hugh's constant disputes with Turlough were fomented by the English, but after Hugh's inauguration as the O'Neill on Turlough's resignation in 1593, he was supreme in the north. Having roused the ire of Sir Henry Bagnal (or Bagenal) by eloping with his sister in 1591, he afterward assisted him in defeating Hugh Maguire at Belleek in 1593; and then again went into opposition and sought aid from Spain and Scotland. Sir John Norris was ordered to Ireland to subdue him in 1595, but Tyrone took the Blackwater fort and Sligo castle before Norris was prepared; he was thereupon proclaimed a traitor of Dundalk. In spite of the traditional enmity between the O'Neills and the O'Donnells, Tyrone allied himself with Hugh Roe O'Donnell, nephew of Shane's former enemy Calvagh O'Donnell, and the two chieftains opened communications with Philip II of Spain, their letters to whom were intercepted by the viceroy, Sir William Russell. They presented themselves as champions of the Catholic religion, claiming religious and political liberty for the Irish. In April 1596 Tyrone received promises of help from Spain. He temporized successfully for more than two years, making professions of loyalty which deceived Sir John Norris and the earl of Ormonde. In 1598 a formal pardon was granted to Tyrone by Elizabeth. Within two months he was again in the field, and on Aug. 14 he destroyed an English force under Bagnal at the Yellow ford on the Blackwater. If the earl had known how to profit by this victory, he might then have successfully withstood the English power in Ireland; for in every part of Ireland—and especially in the south, where James Fitzthomas Fitzgerald, with O'Neill's support, was asserting his claim to the earldom of Desmond at the head of the Geraldine clansmen—discontent broke into flame. But Tyrone procrastinated. Eight months after the battle of the Yellow ford, the earl of Essex landed in Ireland. He met Tyrone at a ford on the Lagan on Sept. 7, 1599, when a truce was arranged; but Elizabeth objected to the conditions allowed to the O'Neill and to Essex's treatment of him as an equal. Tyrone then issued a manifesto to the Catholics of Ireland summoning them to join his standard. After an inconclusive campaign in Munster in Jan. 1600, he returned to Donegal where he received supplies from Spain and a token of encouragement from Pope Clement VIII. In May of the same year armies under Sir Henry Docwra and Lord Mountjoy (later earl of Devonshire) compelled O'Neill to retire to Armagh, a large reward having been offered for his capture alive or dead.

The appearance of a Spanish force at Kinsale drew Mountjoy to Munster in 1601; Tyrone followed him, and at Bandon joined forces with O'Donnell and with the Spaniards under Don John d'Aquila. The attack failed. O'Donnell went to Spain, where he died, and Tyrone with a shattered force went to the north, where he renewed his temporizing policy. Early in 1603 Elizabeth instructed Mountjoy to open negotiations; and in March Tyrone, in ignorance of Elizabeth's death, made his submission. In Dublin he heard of the accession of King James, at whose court he presented himself in June accompanied by Rory O'Donnell, who had become chief of the O'Donnells after the departure of his brother Hugh Roe. James confirmed Tyrone in his title and estates, but new disputes arose on his rights over certain of his feudatories, of whom Donnal O'Cahan was the most important. This dispute dragged on until 1607, when Tyrone arranged to go to London to submit the matter to the king. Warned, however, that his arrest was imminent, and possibly persuaded by Rory O'Donnell (created earl of Tyrconnel in 1603), Tyrone resolved to fly from the country.

"The flight of the earls," one of the most celebrated episodes in Irish history, occurred on Sept. 14, 1607, when Tyrone and Tyrconnel embarked at midnight at Rathmullen on Lough Swilly, with their wives, families and retainers numbering 99, and sailed for Spain. Driven by contrary winds to take shelter in the Seine, the refugees passed the winter in the Netherlands, and in 1608 went to Rome, where they were entertained by Pope Paul V, and where Tyrconnel died the same year. In 1613 Tyrone was outlawed and attainted by the Irish parliament, and he died in Rome on July 20, 1616. He was four times married, and had a large number both of legitimate and illegitimate children.

Sir Phelim O'Neill (*c.* 1603–53), a kinsman and younger contemporary of the earl of Tyrone, took a prominent part in the rebellion of 1641. In that year he was elected member of the Irish parliament for Dungannon, and joined the earl of Antrim and other lords in supporting Charles I against the parliament. On Oct. 22, 1641, he surprised and captured Charlemont castle; and having been chosen commander in chief of the Irish in the north,

he forged and issued a pretended commission from Charles I sanctioning his proceedings. Phelim and his followers ravaged Ulster on the pretext of reducing the Scots, but failed to take Drogheda, being compelled by the duke of Ormonde to raise the siege in April 1642. During the summer his fortunes ebbed, and he was superseded by his kinsman Owen Roe O'Neill.

Owen Roe O'Neill (*c.* 1590–1649), one of the most celebrated of the O'Neills, the subject of the well-known ballad "The Lament for Owen Roe," was the son of Art O'Neill, a younger brother of Hugh, 2nd earl of Tyrone. Having served with distinction in the Spanish army, he was immediately recognized on his return to Ireland as the leading representative of the O'Neills. Phelim resigned the northern command in his favour, and escorted him from Lough Swilly to Charlemont. But jealousy between the kinsmen was complicated by differences between Owen Roe and the Catholic council which met at Kilkenny in 1642. Owen Roe's real aim was the complete independence of Ireland, while the Anglo-Norman Catholics represented by the council desired to secure religious liberty and an Irish constitution under the English crown. In 1646 a cessation of hostilities was arranged between Ormonde and the Catholics; and O'Neill, furnished with supplies by the papal nuncio Giovanni Rinuccini, turned against the Scottish parliamentary army under General Monro. On June 5, 1646, O'Neill routed Monro at Benburb, on the Blackwater; but, being summoned to the south by Rinuccini, he had to leave Monro unmolested at Carrickfergus. For the next two years confusion reigned, O'Neill supporting the party led by Rinuccini, though continuing to profess loyalty to Ormonde as the king of England's representative. Isolated by the departure of the papal nuncio from Ireland in 1649, he made overtures to Ormonde, and to George Monk (later duke of Albemarle), who had superseded Monro in command of the parliamentarians in the north. O'Neill's chief need was supplies, and failing to obtain them from Monk he turned once more to Ormonde and the Catholic confederates, with whom he prepared to co-operate more earnestly when Oliver Cromwell's arrival in Ireland in Aug. 1649 brought the Catholic party face to face with serious danger. Before anything was accomplished by this combination, however, Owen Roe died on Nov. 6, 1649.

The alliance between Owen Roe and Ormonde had been opposed by Phelim O'Neill, who after his kinsman's death expected to be restored to his former command. In this he was disappointed; but he continued to fight against the parliamentarians until 1652, when a reward was offered for his apprehension. Betrayed by a kinsman while hiding in Tyrone, he was tried for high treason, and executed on March 10, 1653. Phelim married a daughter of the marquis of Huntly, by whom he had a son, Gordon O'Neill, who was member of parliament for Tyrone in 1689; fought for the king at the siege of Derry and at the battles of Aughrim and the Boyne; and afterward commanded an Irish regiment in the French service, and died in 1704.

Daniel O'Neill (*c.* 1612–64), a member of the Clanaboy branch of the family, spent much of his early life at the court of Charles I, and became a Protestant. He commanded a troop of horse in Scotland in 1639; was involved in army plots in 1641, for which he was committed to the Tower, but escaped; and on the outbreak of the Civil War returned to England and served with Prince Rupert, being present at Marston moor, the second battle of Newbury and Naseby. He then went to Ireland to negotiate between Ormonde and his uncle, Owen Roe O'Neill. He was made a major general in 1649, and but for his Protestantism would have succeeded Owen Roe as chief of the O'Neills. He joined Charles II at The Hague, and took part in the expedition to Scotland and the Scottish invasion of England in 1652.

Hugh O'Neill (d. *c.* 1660), son of Owen Roe's brother, Art Oge, and therefore known as Hugh Mac Art, had served with distinction in Spain before he accompanied his uncle, Owen Roe, to Ireland in 1642. After the death of Owen he defended Clonmel in 1650 against Cromwell, on whom he inflicted the latter's most severe defeat in Ireland. In 1647 he so stubbornly resisted Henry Ireton's attack on Limerick that he was excepted from the benefit of the capitulation, and, after being condemned to death and reprieved, was sent as a prisoner to the Tower. He was released in 1652, and died, some time after 1660, probably in Spain.

The Clanaboy (or Clandeboye) branch of the O'Neills descended from the ancient kings through Neill Mor O'Neill, lord of Clanaboy in the time of Henry VIII, ancestor (as mentioned above) of the Portuguese O'Neills. Neill Mor's great-great-grandson, Henry O'Neill, was created baronet of Killeleagh in 1666. His son, Sir Neill O'Neill, fought for James II in Ireland, and died of wounds received at the battle of the Boyne. Through an elder line from Neill Mor was descended Brian Mac Phelim O'Neill, who was treacherously seized in 1573 by the earl of Essex, whom he was entertaining, and executed together with his wife and brother, about 200 of his clan being at the same time massacred by the orders of Essex. (*See* Essex, Walter Devereux, 1st Earl of.) Brian Mac Phelim's son, Shane Mac Brian O'Neill, was the last lord of Clanaboy, and from him the family castle of Edenduffcarrick, on the shore of Lough Neagh in Co. Antrim, was named Shane's castle. He joined the rebellion of his kinsman Hugh, earl of Tyrone, but submitted in 1586.

In the 18th century the commanding importance of the O'Neills in Irish history had come to an end. But John O'Neill (1740–98) took an active part in debate in the Irish parliament, being a strong supporter of Catholic emancipation. He was one of the delegates in 1789 from the Irish parliament to George, prince of Wales, requesting him to assume the regency. In 1793 he was raised to the peerage of Ireland as Baron O'Neill of Shane's Castle, and in 1795 was created a viscount. In defending the town of Antrim against the rebels in 1798 O'Neill received wounds from which he died on June 18, being succeeded as Viscount O'Neill by his son Charles Henry St. John (1779–1841), who in 1800 was created Earl O'Neill. Dying unmarried, when the earldom therefore became extinct, Charles was succeeded as Viscount O'Neill by his brother John Bruce Richard (1780–1855), a general in the British army; on whose death without issue in 1855 the male line in the United Kingdom became extinct. The estates then devolved on William Chichester, great-grandson of Arthur Chichester and his wife Mary, only child and heiress of Henry (d. 1721), eldest son of John O'Neill of Shane's Castle.

William Chichester (1813–83), 1st Baron O'Neill, a clergyman, on succeeding to the estates as heir general, assumed by royal licence the surname and arms of O'Neill; and in 1868 was created Baron O'Neill of Shane's Castle. On his death in 1883 he was succeeded by his son Edward, 2nd Baron O'Neill, who was member of parliament for Co. Antrim, 1863–80, and who married in 1873 Louisa, daughter of the 11th earl of Dundonald.

Bibliography.—For the history of the ancient Irish kings of the Hy Neill *see* R. Atkinson (ed.), *The Book of Leinster,* with introduction (Dublin, 1880); W. M. Hennessy and B. MacCarthy (eds.), *The Annals of Ulster,* 4 vol. (Dublin, 1887–1901); W. M. Hennessy (ed.), *The Annals of Loch Cé,* in "Rolls" series (London, 1871). For the later period *see* P. W. Joyce, *A Short History of Gaelic Ireland* (London, 1924), *A Social History of Ancient Ireland,* 2 vol. (London, 1913); J. O'Donovan (ed.), *The Annals of Ireland by the Four Masters,* 7 vol. (Dublin, 1851); Sir J. T. Gilbert, *History of the Viceroys of Ireland* (Dublin, 1865), and, especially for Owen Roe O'Neill, Irish Archaeological Society, *Contemporary History of Affairs in Ireland, 1641–1652,* 3 vol. (Dublin, 1879); *History of the Irish Confederation and the War in Ireland* (Dublin, 1882); John O'Hart, *Irish Pedigrees,* 2 vol. (1923); George Hill (ed.), "The Flight of the Earls, 1607," p. 767 in *The Montgomery MSS.* (Belfast, 1878); Thomas Carte, *History of the Life of James, Duke of Ormonde,* 3 vol. (London, 1735); C. P. Meehan, *Fate and Fortunes of Hugh O'Neill, Earl of Tyrone, and Rory O'Donel, Earl of Tyrconnel* (Dublin, 1886); Richard Bagwell, *Ireland under the Tudors,* 3 vol. (London, 1885–90); J. F. Taylor, *Owen Roe O'Neill* (London, 1896); John Mitchell, *Life and Times of Hugh, Earl of Tyrone, with an Account of His Predecessors, Con, Shane, Turlough* (Dublin, 1846); L. O'Clery, *Life of Hugh Roe O'Donnell* (Dublin, 1893). For the O'Neills of the 18th century, and especially the 1st viscount O'Neill, see *The Charlemont Papers;* and F. Hardy, *Memoirs of J. Caulfield, Earl of Charlemont,* 2 vol. (London, 1812). *The O'Neills of Ulster: Their History and Genealogy,* by Thomas Mathews, 3 vol. (Dublin, 1907), an ill-arranged and uncritical work, has little historical value, but contains a mass of traditional and legendary lore, and a number of translations of ancient poems, and genealogical tables of doubtful authority.

O'NEILL, EUGENE GLADSTONE (1888–1953), U.S. dramatist, was born in New York city on Oct. 16, 1888. He was, by common consent, America's greatest playwright, and an artist

of international renown. His career divided U.S. theatrical history in two. Before O'Neill, U.S. stages were awash with genteel, sentimentally spurious plays; he pioneered the drama of serious realism and uncompromising honesty.

When Eugene O'Neill took his place on the U.S. literary scene in the 1920s, it was to join a band of iconoclasts. H. L. Mencken was tilting with the "booboisie." Sinclair Lewis was baiting Babbitt. Sherwood Anderson was gingerly lifting the lid off sex. O'Neill ranged over the same themes but he sprayed them with a melancholy that clung like poison gas. Cries a leading character in *The Great God Brown:* "Why am I afraid to dance, I who love music and rhythm and grace and laughter? Why am I afraid to live, I who love life and the beauty of the flesh and the living colors of earth and sky and sea? Why am I afraid of love, I who love love? . . . Why was I born without a skin, O God . . . Or rather Old Greybeard, why the devil was I ever born at all?" (*The Plays of Eugene O'Neill,* 3 vol., New York, Random House, 1946.) O'Neill took this language of failure and flavoured it with the accent of tragedy. It was a convincing performance, in part, because failure is often regarded as tragic in America, and in part, because O'Neill had a rare mastery of his craft.

He came by a mastery of his craft early. His father James O'Neill was a matinee idol of the 1880s, playing for 16 years the count in *The Count of Monte Cristo*. Barnstorming with his father, young O'Neill soaked up theatrical know-how. In the fall of 1906 he entered Princeton university, Princeton, N.J., and flunked out the following spring. In the next few years he married and divorced, prospected for gold, went to sea and sailed the Atlantic from Southampton to South Africa. For O'Neill, the sea was a mystic experience, and some of the best of his 47 plays (e.g., *The Moon of the Caribbees, The Long Voyage Home*) are salty with the tang of the sea and the tongue of lonely, hard-bitten sailormen.

It was not until a mild case of tuberculosis bedded him in a sanitarium in 1913 that Eugene O'Neill thought of becoming a playwright. When the Provincetown (Mass.) Players produced his one-actor *Bound East for Cardiff* in 1916, modern American drama unofficially began. By 1920, O'Neill fashioned a Broadway success and won a Pulitzer prize with his first full-length play, *Beyond the Horizon,* a bitter domestic tragedy. O'Neill was already felt to be a man of morose views who could be counted on to find the worm in the apple of life. Actually his plays were cardiograms of the outraged heart, poignantly charting the cancelled dream, the twisted love, the thwarted hope.

O'Neill won two more Pulitzer prizes with *Anna Christie* (1922) and *Strange Interlude* (1928), and in 1936 became the second American (after Sinclair Lewis) to win the Nobel prize for literature. A restless technician, he thrilled theatregoers with tom-toms (*Emperor Jones*), masks (*The Great God Brown*), old-fashioned asides (*Strange Interlude*) and choral chants (*Lazarus Laughed*). A troubled thinker, he tried to pour modern experience into tragic moulds.

It has been said that tragedy is the story of man's fate. Greek tragedy is the tragedy of destiny. Man's fate is in his stars. Shakespearean tragedy is the tragedy of character. Man's fate is in his will. Through suffering and death, Greek and Shakespearean tragic heroes appeased the gods and found redemption. O'Neill had to cope with an audience that was almost as suspicious of God, will and destiny as of a flat earth. Bowing to his time, O'Neill wrote the tragedy of personal psychology. Man's fate is in his genes and hormones. But if man is his own fate, there can be no release, only an endless cycle of sin and guilt. Says Lavinia Mannon at the end of *Mourning Becomes Electra:* "There's no one left to punish me . . . I've got to punish myself!" (*The Plays of Eugene O'Neill,* 3 vol., New York, Random House, 1946.) O'Neill blended the determinism of John Calvin and Sigmund Freud to produce the only kind of tragic hero the 20th century could understand—the victim of circumstance.

The "sickness of today," O'Neill once said, was that the "old God was dead" and a new one was not in sight. To "belong" to the machine age, as O'Neill saw it, man had to be subhuman, an automaton. The instinct to love had been debased by possessiveness. The instinct to believe had atrophied. The best O'Neill could offer was chilly, stoic resignation. As the old barge captain puts it in *Anna Christie:* "You can't see where you vas going, no. Only dat ole devil, sea—she knows." (*The Plays of Eugene O'Neill,* 3 vol., New York, Random House, 1946.)

O'Neill sometimes handled these themes crudely. He wrote a kind of waterlogged English that never floated memorably across the mind. What he intended for encounters with the inexpressible were simply collisions with the badly expressed. When the juice of life ran low in his characters, he pumped them full of grease paint. His mind was an open manhole; ideas (J. A. Strindberg's, Freud's, C. G. Jung's) tumbled in but were never really absorbed. Yet there is something granitic in O'Neill that refuses to be chipped away—the sweep of his passion and compassion, the hypnotic moods he projects over the footlights and, above all, his probity. He never cheated with his evidence, and his evidence came from the heart. He never consciously wrote a shoddy line.

The coming of World War II sapped O'Neill's will to write; then a muscular disorder made it physically impossible. When he died he left at least three plays in manuscript, including the reportedly autobiographical *Long Day's Journey into Night,* which by the terms of his will could not be produced until 1978.

On the world's stages, only G. B. Shaw and Sean O'Casey clearly outrank him among 20th-century dramatists. Yet O'Neill never achieves the Aristotelian catharsis of pity and terror, or climbs to tragedy's classic realm where man's suffering and death stand bare, awesome and ennobling; his heroes wander instead, like eternally lost children through a haunted wood of pathos, futility, self-pity and frustration. But in his dedication to the best in his art form, Eugene O'Neill was a cultural hero, and as such, he left the U.S. theatre the memory of something finer than his best plays.

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ONEONTA, the only city of Otsego county, N.Y., U.S., on state highways 7, 23 and 28 and the Susquehanna river, 76 mi. S.W. of Albany. It is served by the Delaware and Hudson and the New York Central railways. Pop. (1950) 13,564; (1940) 11,731. Oneonta is beautifully situated among the western foothills of the Catskills, at an altitude of 1,150 ft., in a fertile farming and dairying region. It is the seat of a state teachers' college, a state armoury and Hartwick college (United Lutheran; founded 1928). The manufacturing industries include extensive railroad shops and dress and glove factories.

Oneonta was founded about 1780 and until 1830 was known as Milfordville. It was incorporated as a village in 1848 and as a city in 1908. The name is derived from the Indian name for the creek flowing through the city.

ONESICRITUS or Onesicrates, of Aegina or Astypaleia (probably simply the "old city" of Aegina), one of the writers on Alexander the Great. At an advanced age he became a pupil of Diogenes the Cynic, and gained such repute as a student of philosophy that he was selected by Alexander to hold a conference with the Indian Gymnosophists.

When the fleet was constructed on the Hydaspes, Onesicritus was appointed chief pilot (in his vanity he calls himself commander), and in this capacity accompanied Nearchus on the voyage from the mouth of the Indus to the Persian gulf. He wrote a diffuse biography of Alexander, which in addition to historical details contained descriptions of the countries visited, especially India. After the king's death, Onesicritus appears to have completed his work at the court of Lysimachus, king of Thrace. Its historical value was considered small, it being avowedly a panegyric, and contemporaries (including even Alexander himself) regarded it as untrustworthy.

Strabo especially takes Onesicritus to task for his exaggeration and love of the marvellous. His *Paraplus* (or description of the coasts of India) probably formed part of the work, and incorpo-

rated by Juba II of Mauretania with the accounts of coasting voyages by Nearchus and other geographers, and circulated by him under the name of Onesicritus, was largely used by Pliny.

ONION, *Allium cepa* (family Liliaceae), a hardy bulbous biennial which has been cultivated from time immemorial. It is one of the earliest of cultivated plants; it is represented on Egyptian monuments, and one variety cultivated in Egypt was accorded divine honours. It is commonly cultivated throughout the temperate zones. A. de Candolle regards it as a native of western Asia. The edible part of the onion is the thickened bases of the leaves that arise from an extremely shortened or telescoped stem, the small hard structure at the base of the bulb, called the stem plate. The upper portion of the leaves is cylindrical and hollow. The seed stalk formed in the second season may be 2 to 5 ft. tall, topped by a globose umbel of small whitish flowers. In some types of onions this umbel is replaced by a cluster of bulblets, or bulblets and flowers. The seeds are small, black and shaped roughly like halves of a sphere. Most varieties of onion are sensitive to the length of day and night. Varieties adapted to summer culture in northern latitudes when the days are long will not form normal bulbs and ripen when grown during the short winter days of lower latitudes although soil and temperature may be favourable. Conversely, certain varieties that make large bulbs during the short winter days of low latitudes ripen and stop growth when very small if grown during long days in higher latitudes. There are three main classes of onions: (1) those forming well-developed bulbs the first season and seeds the second season; (2) forms in which bulbs form at the top of the stalk; (3) the nonbulbing multiplier onion that is propagated by division of the cluster of vegetatively produced plants. The mild Spanish type of onion must be used soon after harvest while the hot, firm, northern varieties can be stored all winter.

Most varieties, particularly those grown extensively in Great Britain and the northern parts of Europe and the United States, require a cool or mild mean temperature. The Spanish and Egyptian types will tolerate hot days of spring or early summer but are not adapted to midsummer heat of the lower latitudes. Seed must thus be sown as far ahead of summer heat as possible, and still escape sharp freezing weather: late February to mid-March in England, or late March and early April in the northern United States. In the southwestern United States and in England seed of adapted varieties is sown in the fall. A large portion of the crop in the United States is grown from seedlings transplanted from plant beds to the field 3 in. apart, and from small dry bulbs or sets grown from seed the previous year. Small bulbs or sets are grown by planting seed very thickly (50 to 100 lb. per acre) in a wide band, on soil of moderate fertility, thus crowding and stunting the plants. Onions require rich soil, especially well prepared. Onions grown from seed sown in the field require careful thinning to 2 to 4 in. apart in the rows, depending on variety and conditions of culture. Rows are usually 1 to 1½ ft. apart. The average annual production of onions in the United States, for market, was (1942–51) about 14,316,000 sacks of 100 lb. each. Production in 1952 was 39,414,000 sacks. (V. R. B.; X.)

ONION MAGGOT, the common name of *Hylemya antiqua* of the family Muscidae of the order Diptera (*q.v.*), which attacks the roots of onions and related plants. The eggs are laid on the soil close to the plants; the young larvae feed on the roots or attack the bulbs and bases of the leaves. Many other insects are attracted to and feed upon the damaged onions. Species commonly found associated with *H. antiqua* are the lesser bulb fly, *Citabaena tuberculatus,* and species of *Fannia.* Modern treatment consists of watering the plants with a solution of corrosive sublimate. (*See* ENTOMOLOGY: *Economic Entomology.*)

(C. H. CN.)

ONOMACRITUS (*c.* 530–480 B.C.), seer, priest and poet of Attica. He had great influence on the development of the Orphic religion and mysteries, and was said to have composed a poem on initiatory rites. The works of Musaeus, the legendary founder of Orphism in Attica, are said to have been reduced to order (if not actually written) by him (Clem. Alex. *Stromata,* i, p. 143 [397]; Pausanias i, 22, 7). He was in high favour at the court of the Peisistratidae until he was banished by Hipparchus for making additions of his own in an oracle of Musaeus. When the Peisistratidae were themselves expelled and were living in Persia, he furnished them with oracles encouraging Xerxes to invade Greece and restore the tyrants in Athens (Herod. vii, 6).

See F. W. Ritschl, "Onomakritos von Athen," in his *Opuscula,* vol. i, and p. 35 of the same volume (1866); Smith, *Dict. of Gk. and Roman Biography,* s.v. (bibl.).

ONOMATOPOEIA, a term used in philology to denote the formation of words by imitation of natural sounds, *e.g.,* "hiss," "click" and "hush."

Some philologists held that the term "echoism" for this process was preferable, since it suggested the imitative repetition of the sounds heard.

At one time there was an exaggerated tendency to find in echoism a principal source in the origin and growth of language, ridiculed as the "bow-wow" theory of language; it was recognized, however, that it played only a limited part.

Onomatopoeia means literally the making or formation of words. It was derived from the Greek ὀνοματοποιία, from ὄνομα, name, word, ποιεῖν, to make.

ONONDAGA, a tribe of North American Indians of Iroquoian stock, forming one of the Six Nations. The tribal headquarters was about the lake and creek of the same name in New York state. Its territory extended northward to Lake Ontario and southward to the Susquehanna river. It was the official guardian of the council fire of the Iroquois. Its chief town, near the site of the present Onondaga, consisted of about 140 houses in the middle of the 17th century, when the tribe was estimated as numbering between 1,500 and 1,700. During the 18th century the tribe divided, part loyally supporting the Iroquois league, while part, having come under the influence of French missionaries, migrated to the Catholic Iroquois settlements in Canada. Of those who supported the league, the majority, after the War of Independence, settled on a reservation on Grand river, Ont., where their descendants remained.

In 1926 there were 568 upon the Onondaga reservation in New York state. (*See* also NORTH AMERICA: *Ethnology.*)

See F. W. Hodge (ed.), *Handbook of American Indians North of Mexico,* pt. ii (Washington, D.C., 1910).

ONTARIO, a province of Canada, bounded by Quebec to the east, by the states of New York, Ohio, Michigan and Minnesota to the south, by Manitoba to the west and by part of Hudson bay with James bay to the north. In most cases the actual boundary consists of rivers and lakes: the Ottawa to the northeast; the St. Lawrence and its chain of lakes and rivers to the south as far as Pigeon river, which separates Ontario from Minnesota. From this point it follows small rivers and lakes to the Lake of the Woods between Ontario, Minnesota and Manitoba. From Lake of the Woods northward the western boundary follows approximately the meridian of 95° almost to the 53rd parallel, and then swings northeastward to Hudson bay. From Lake Timiskaming northward the eastern boundary is the meridian of 79° 30′.

Physical Geography.—Ontario extends 1,000 mi. from east to west and 1,050 mi. from north to south, between latitudes 57° and 42°, including the most southerly point in Canada. Its area is 412,582 sq.mi. (49,300 water), and it is the most populous of the provinces, but the bulk of its inhabitants live in one-tenth of its area, between the Great Lakes, the Ottawa and the St. Lawrence, a country of relatively fertile soils.

The control of settlement by geology is readily observed in southern Ontario. Reference to the mantle map (fig. 1) shows that the good farming country is all south of the Pre-Cambrian shield, the edge of which extends from the Muskoka lakes to the St. Lawrence near Kingston. There is also a corner of southern Ontario (in the southeast) where the surface rocks are younger than the shield. Separating these two is the notable feature called the Frontenac axis, where an upfold has brought the granites of the shield to the surface. It is this bar of hard granite which determines the presence of the Thousand Islands in the St. Lawrence, and which causes the many rapids (and canals) between Kingston and Montreal, Que.

To the southwest of the shield the map shows that southern Ontario consists of a series of Palaeozoic beds dipping gently to the southwest. Over the granites come the Ordovician rocks, between Toronto and Kingston. These are often shales which produce good materials for bricks. Then, quite suddenly, rises the pronounced Cuesta of Silurian rocks, north and south of Hamilton. This consists of a hard dolomitic limestone which extends as a fairly continuous scarp from Albany, N.Y., around Lake Michigan to Chicago. In the Silurian rocks are considerable beds of gypsum, which are worked to the south of Guelph. Still farther west is an overlying layer of Devonian rocks which form the surface deposits between Kitchener and Detroit, Mich. Bores through these deposits have tapped gas, oil and brine springs, all of considerable commercial value. Unfortunately, Carboniferous rocks do not occur in Ontario, but are widespread in Michigan, where valuable coal seams are worked in these youngest rocks of the region. (Fig. 1.)

The higher areas of southern Ontario consist of rolling hills of boulder clay or moraines; the lower levels are plains sloping toward the Great Lakes and containing the silt deposited in ancient lakes at the end of the glacial period. The old shore cliffs and gravel bars of those glacial lakes frequently provide sites for roads, towns and cities. The Niagara escarpment is the cause of waterfalls on all the streams which plunge over it, Niagara falls being, of course, the most important.

While all the larger cities and most of the manufacturing and farming districts are in southern Ontario, there is developing a "new Ontario," stretching for hundreds of miles to the north and northwest of the region just described and covering a much larger area, chiefly made up, except for an extensive clay belt, of ancient rocks forming the Pre-Cambrian shield. The rocky character of that area long repelled settlement until its abundant minerals, water powers and northern forests invited exploitation. Later, industries dependent upon these natural resources drew population.

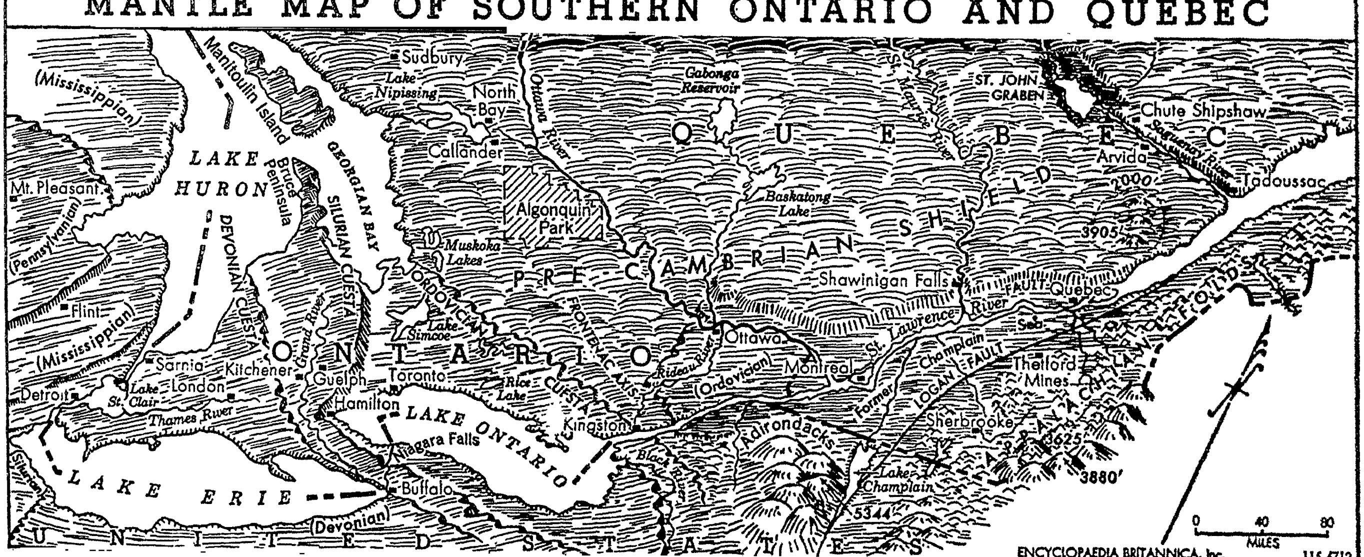
Lakes and Rivers.—Numerous lakes and rivers are scattered throughout Ontario, the most important chain being that of the St. Lawrence and the Great Lakes with their tributaries, which drain the more populous southern districts. Lake Nipigon, a beautiful body of water 852 ft. above the sea, 70 mi. long and 50 mi. wide, may be regarded as the headwaters of the St. Lawrence, since Nipigon river is the largest tributary of Lake Superior. All the rivers entering Lake Superior have high falls which provide power for the industries of the region. At the southeastern end of Lake Superior the St. Mary's river carries its waters to Lake Huron with a fall from 602 to 581 ft., most of which takes place at Sault Ste. Marie where locks permit vessels of 10,000 tons to pass from one lake to the other and where water power is generated. The northeast shores of Lake Huron and its large expansion, Georgian bay, are fringed with numerous islands, mostly small, but Manitoulin Island, 80 mi. long and 30 mi. broad, is a notable exception. This island and the Bruce (Saugeen) peninsula shut away the greater part of Georgian bay from the main lake. The eastern shore of Georgian bay is bordered with "Thirty Thousand Islands," and is so named.

Lakes Superior and Huron both reach depths hundreds of feet below sea level, but Lake St. Clair, toward which Lake Huron drains southward through the St. Clair river, is shallow and marshy. Detroit river connects Lake St. Clair with Lake Erie at an elevation of 572 ft., and this comparatively shallow lake, running for 241 mi. east and west, empties northward by Niagara river into Lake Ontario, which is only 245 ft. above the sea. Niagara falls, with rapids above and below, hurry the waters of the upper lakes over the Niagara escarpment, and provide hydroelectric power for the industries of southern Ontario. The Welland canal, between Port Colborne on Lake Erie and Port Weller on Lake Ontario, has a limiting depth between locks of 25 ft. and of 30 ft. in the locks. From Lake Ontario the St. Lawrence passes through the meshes of the Thousand Islands and follows several rapids, separated by stretches of quiet water, to Montreal at the head of ocean navigation. Some steamers can run the rapids going down, but must ascend through the canals. All other rivers in southern Ontario are tributaries of the lakes or of the St. Lawrence. The Ottawa, navigable by the use of locks to the city of Ottawa, is the largest. The 240-mi. Trent waterway (rivers and lakes joined by locks and canals) connects Trenton on the Bay of Quinte (Lake Ontario) and Port Severn on Georgian bay; and the 124-mi. Rideau waterway connects the cities of Ottawa and Kingston. Numerous lakes in northern Ontario constitute a picturesque region for summer resorts, especially Lake Timagami, the Muskoka lakes and Lake of the Woods, the last mentioned forming part of the Hudson bay system of waters flowing through Manitoba.

In northern Ontario the Albany, Moose, Winisk, Severn and their many tributaries flow into Hudson bay, but none of those rivers is navigable except for canoes.

Climate.—The climate of Ontario varies greatly, as might be expected from its wide range of latitude and the relations of the Great Lakes to the southern peninsula of the province. The northern parts, as far south as the north shore of Lake Superior, have long and cold but bright winters, with temperatures reaching sometimes −50° F.; while the summers are delightful, with much sunshine and some hot days but pleasantly cool nights. Between Georgian bay and Ottawa the winters are less cold, but usually

MANTLE MAP OF SOUTHERN ONTARIO AND QUEBEC



ADAPTED FROM GRIFFITH TAYLOR'S "CANADA" (METHUEN & CO., LTD.)

FIG. 1.—A MANTLE MAP IS A DIAGRAMMATIC REPRESENTATION GENERALIZED TO SHOW THE STRUCTURE AND GEOLOGY OF THE REGION

have a plentiful snowfall; while the summers are warm. At Cochrane in the northern clay belt the range of temperature is from 0° F. in January to 63° F. in July. At Toronto the similar range is from 22° F. to 68° F. The southwest peninsula of Ontario has a climate greatly modified by the lakes which almost enclose it. Since the lakes never freeze, the prevalent cold northwest winds of North America are warmed in their passage over them, and often much of the winter precipitation is in rain, resulting in weather more uncertain than that in the north. The rainfall increases fairly regularly from 20 in. in the far northwest to 38 in. in the southeast. The summers are often sultry, although the presence of the lakes prevents the intense heat experienced in the states to the south and west. Because of its mild winters, the southwest peninsula is a famous fruit country, and also grows such field crops as Indian corn (maize) and tobacco. Small fruits and the common garden vegetables are widely cultivated for the city markets and the canning industry.

History.—Samuel de Champlain was the first European to record anything about the present Ontario. In 1613 he went up the Ottawa in a vain search for the northern ocean; and in 1615 he pushed westward and reached the eastern shores of Lake Huron, the first to tell of the Great Lakes with their vast stretches of fresh water.

Missions to the natives were a chief interest of the French pioneers in Canada and within Ontario is found their earliest important effort. Huronia, on the borders of Lake Simcoe and the Georgian bay, the scene of a promising Jesuit mission, was devastated by the Iroquois in 1649 with the martyrdom of Fathers Brébeuf, Lalemant and others, making one of the most tragic stories in Jesuit annals. Meanwhile, the fur trade expanded, and before the British conquest the French had trading posts at strategic points; Fort Frontenac, where modern Kingston is—a defiance of the Iroquois—at the northeast end of Lake Ontario; Toronto, on its north shore, near the west end; Niagara; Detroit; Michilimackinac at the entrance to Lake Michigan; Sault Ste. Marie; and on the greatest and farthest lake, Superior, a fort near where the modern city of Fort Williams stands.

The French, however, did little settlement, and apart from such posts, Ontario was still virgin wilderness in 1763 when it became British. In 1774, by the Quebec act, it became a part of the province of Quebec ruled from Quebec city by an appointed Roman Catholic-Protestant council. The American Revolution began the next year and for the first time came serious settlement by exiled loyalists from the United States, bitterly hostile to that country. The Quebec act entrenched the civil law of France; but the loyalists wished English law and a representative assembly, and in 1792 two Canadas were created: Lower Canada, east of the Ottawa river; Upper Canada, west; each with its own legislature. At once Upper Canada adopted English law. The first governor, John Graves Simcoe, considered the seat of government at Niagara too near the American frontier; and it was quickly changed to York, the modern Toronto.

Simcoe, a soldier who was later appointed commander in chief in India, was alert to the problems of defense. When war with the United States broke out in 1812, the Americans captured and burned York, for which the British retaliated in 1814 by burning the capitol at Washington, D.C. Only after peace in 1814 and the fall of Napoleon in 1815 was there adequate opening for development. English, Scots and Irish arrived in considerable numbers, until, by 1837, there were 350,000 people in Upper Canada. Political differences became acute; one extreme wing, composed chiefly of the loyalist elements, was reactionary; the other, led in the end by a Scot, William Lyon Mackenzie, was radical. In Lower Canada there was a similar issue with Louis Joseph Papineau as the radical leader. Holding the middle ground, on clear-cut principles of constitutional right, was Robert Baldwin. He claimed that in Upper Canada as in England the head of the state must govern through advisers who had the confidence of the people. After abortive rebellion in both provinces in 1837–38 a striking political evolution took place. Upper and Lower Canada were united in 1842 under a parliament in which they had equal representation. Sectionalism as between French and English endured and the solution was found in 1867 in a federal system. (*See* CANADA: *History*.)

The long Liberal ministry of Sir Oliver Mowat (1871–96) was followed by a decline of the party's prestige, and in 1905 the Conservatives, led by Sir James Whitney, came into power. In 1916, during World War I, Whitney's successor, Sir William Hearst, passed a drastic prohibition law relating to the sale of intoxicating liquors. An election in 1919 gave the new Farmers' party a larger number of members than had either the Conservatives or the Liberals and they took office under C. A. Drury. They showed a lack of experience, and in 1923, while the Liberal party made a poor showing, the Conservatives, under G. Howard Ferguson, came into power with a large majority. There was discontent with the rigour of the Prohibition law, and in 1926 Ferguson carried his second election by securing a large majority for the system of state control of the hard liquor traffic under individual licences and strict supervision and rigid state inspection of beverage rooms (also called beer parlors), where beer and ale could be bought. In 1947 the Ontario Liquor Control act was expanded to permit operation of licensed cocktail bars and lounges.

The Conservatives were sustained in power in the general election of 1929, but Ferguson, who in 1930 accepted the office of Canadian high commissioner in London, was succeeded by G. S. Henry in the provincial premiership. The party was defeated in 1934 and the Liberals assumed office under Mitchell Hepburn, who was succeeded in 1942, in a cabinet reconstruction, by his colleague Gordon Conant, but remained in office as provincial treasurer. The leadership of the Conservatives in opposition passed to Col. George Drew. During Hepburn's regime Ontario politics centred largely on power policy, on the cancellation by the Ontario government of the contracts with extraprovincial power companies, by virtue of jurisdiction over property and civil rights (British North America act [§ 92]). With this went a general alienation of the policy of Hepburn's Liberal government from that of the Liberal government at Ottawa. In 1943 Drew led the Conservatives to power and became premier, but in 1948, while the Conservatives again won the election, Drew was personally defeated and entered federal politics. The Ontario Conservatives were led in turn by T. L. Kennedy and Leslie Frost, who in turn became premier.

Population.—The population growth of the province after 1911 is reflected in the decennial censuses:

	1911[1]	1921	1931	1941	1951
Population of province . .	2,527,292	2,933,662	3,431,683	3,787,655	4,597,542
Percentage of the total Canadian population . .	35.07	33.38	33.07	32.89	32.82

The percentage increase of the population in 70 years (1871–1941) was 131.77. In 1951 the density of population was 12.55 per square mile of land area compared with the 1941 average of 5.74 for the nine provinces. An increasing percentage of the people lived in cities, towns or incorporated villages, as is illustrated in two such census years as 1911 and 1941:

	1911	1941
Percentage of population rural	47.43	38.3
Percentage of population urban	52.57	61.7

The smallest urban unit, the village, when asking for incorporation must by provincial law have a population of at least 750 in an area not exceeding 500 ac. The villages are numerous, and in 1951 Ontario had 70 cities and towns with more than 5,000 inhabitants. In 1951 Toronto, the largest city and capital of the province, had a population of 670,945, and Greater Toronto, which included the satellite communities in close relationship to the city, had 1,108,532. Four other important cities, each having more than 100,000 people, were Hamilton, Ottawa, London and Windsor. Ontario ranked third among the nine provinces in the proportion of the British in its population. In 1941, 72.6% of the people were of British origin, 9.9% French, 16.5% European other than British and French and the rest of Asiatic and indigenous origin. The French settlements are mainly near the St. Lawrence and in the

newer areas of northeastern Ontario. The strongest sectarian group numerically in 1941 was the United Church, which as in other provinces resulted from union of the Methodists, Congregationalists and Presbyterians. Its strength and influence gave a puritan tone to social life and legislation. Next in strength of membership was the Roman Catholic Church followed closely by the Anglican.

Government.—The structure of government in Ontario differs little from that in other Canadian provinces. Nominally executive power is vested in a lieutenant governor appointed for five years by the federal administration, but actually it dwells in an executive council (or cabinet) the members of which sit in and are responsible to an elected legislature in unison with the traditional British principles of cabinet government. The legislature consists of one house, of 90 members, elected on a wide franchise including women; its maximum life is five years unless extended by a special act. The revenue of the provincial government has been derived from a variety of direct taxes, licences, federal subsidies, royalties from use of resources, and returns on the sale and control of liquor. An extensive system of municipal administration came into existence in the middle of the 19th century, and by 1949 slightly more than one-tenth of the area of Ontario was municipally organized and embraced 43 counties, 29 cities, 147 towns, 157 villages, 571 townships and 13 improvement districts, all possessing in some form elected councils and officials with some taxing power on property. The municipal regime of Ontario influenced notably the municipal development in other provinces, especially the provinces of the west.

Education.—Ontario has been distinguished for its ready support of education. In the early years the legislature made considerable grants of land for this purpose, and by mid-20th century no other service of government absorbed so large a proportion of the provincial expenditure. A minister in the executive council is responsible to the legislature for policy, but his permanent deputy may exercise a more important influence. School inspectors, appointed by the provincial department, endeavour to secure uniform standards throughout the province, while in every school section elected trustees levy taxes, appoint the teachers and in general provide for the needs of the local school. Attendance is compulsory between the ages of 8 and 16 although in rural areas permission is readily obtained for children to work on farms from the age of 14, and under special conditions the law may be relaxed also in the cities. The public schools are free and undenominational, but not secular, since prayer and Bible reading may hold a place in the daily program. From 1863 the Roman Catholics exercised the right to separate schools, set up in any district upon request of not less than five heads of families. Taxes levied upon the supporters of these institutions are devoted wholly to their maintenance. Protestants and Negroes may also claim, but rarely do, the right to separate schools.

Secondary education, with increased emphasis on social studies, is provided in high schools and collegiate institutes, which may require fees or give free education at the option of the local trustees. There are also many incorporated private schools, exempt from municipal taxation. They are grouped principally in Toronto and its neighbourhood, the most distinguished being Upper Canada college, founded in 1829. Higher education is provided by the provincial university in Toronto, Queen's university in Kingston, the University of Western Ontario in London, McMaster university (Baptist) in Hamilton and the University of Ottawa (Roman Catholic) in the federal capital. In 1942 Carleton college (nondenominational) was founded in Ottawa. The provincial institution, known as the University of Toronto, had in 1951–52 a student body of more than 11,000 in all faculties. It is a federation of colleges, with a distinguished place among the universities of North America. All the universities are coeducational, and women generally form about two-fifths of the whole student body. In addition to the universities, model and normal schools exist to train teachers, while scientific agriculture is promoted by the Ontario Agricultural college at Guelph, founded and endowed by the government.

Agriculture.—Ontario is Canada's richest agricultural province. The value of its farm capital (including land, buildings, implements and stock) at mid-20th century exceeded one-fourth of the total value of farm capital in Canada; the same remark may be made of the gross values of its agricultural production; and the average value per acre of its occupied farm land ranked next to that of British Columbia. The wide variety of production is notable. Field crops take the lead in gross value, followed by dairying, production of farm animals, poultry products, fruits and vegetables (much production for canning), sugar beets and tobacco. Wheat growing has long ceased to hold the premier place held by it in the prairie provinces, and farmers, not depending upon the foreign wheat market, are saved from the rapid changes of income suffered by their compatriots farther west. The average Ontario farmer has won relative security through diversification made possible by the presence of urban markets and a suitable climate and fertility. A mixed and pioneer farming is found in the clay belt of the north, the products being sold in the mining centres.

Environment and Settlement.—A glance at the generalized population map appearing as a part of fig. 2 shows that with few exceptions the moderate and dense populations are to be found south of the Pre-Cambrian shield. The empty loop, which is due to the southern extension of the shield known as the Frontenac axis, is well brought out in the map. However, the great importance of the tourist traffic in the lake region of Muskoka—on the shield to the north of Toronto—led to the development of a host of small farms, which raise some hay and cows, but depend largely on summer visitors. Well to the north are two areas of moderate settlement, which are entirely due to the presence of the unrivalled nickel resources of Sudbury, or to the gold of the region between Timmins and Cobalt. The considerable extension of sparse settlement (even in the northern shield) along the northern railway is due to the presence of the clay belt, the residue of a huge former glacial lake.

South of the shield the main distributions of the croplands are shown in separate maps in fig. 2. One map shows the number of acres cleared in each square mile (*i.e.*, in each 640 ac.). In the west of the peninsula almost the whole is cleared (500 of each 640 ac.). The edge of the shield agrees fairly well with the 300 line on the map; so that there, as in the population map, the "Frontenac axis" shows up well. Croplands are denser again in the small area of Palaeozoic rocks to the south of Ottawa. By far the main crops of southern Ontario consist of oats and hay, so that the distribution of cleared land indicates fairly closely the distribution of oats and hay. The other map in fig. 2 shows the distribution of minor crops. Vines shelter under the scarp of the Niagara peninsula, and tobacco grows on the sandy soils of the hottest part of Canada. There also silo maize (corn) grows thickest, while the milch cows are densest in the London region to the north. Orchards are found along the shore of Lake Ontario, and potatoes are grown close to the great city of Toronto since their transport is difficult. The great industrial belt, including the "quadrilateral" of the big cities of Toronto, Hamilton, Kitchener and London, is indicated in the population map of fig. 2.

Manufactures.—Ontario long led the other provinces individually in the gross and net value of manufactures; indeed, until 1940 the gross value of its manufactures equalled that of the remainder of Canada, and even the net value at mid-century still exceeded greatly that of agriculture within the province. This premier place of manufacturing in the economy is due finally to the geographic assets of Ontario, the fertile soils maintaining many farmers with a high level of living, the presence of rich forest and mineral resources, the relative proximity to the coal and iron ore of the United States, the cheap transport afforded by the St. Lawrence and the Great Lakes and the abundance of water power which made up for the absence of domestic coal and stimulated the rise of electrometallurgical industry. In manufactures, as in agriculture, the variety of production is notable; it includes nonferrous metal smelting and refining, automobiles, agricultural implements, meat-packing products, electrical apparatus, machinery, pulp and paper, flour and livestock feed, rubber goods, leather, butter, cheese, primary iron and steel, furniture, hosiery, knit

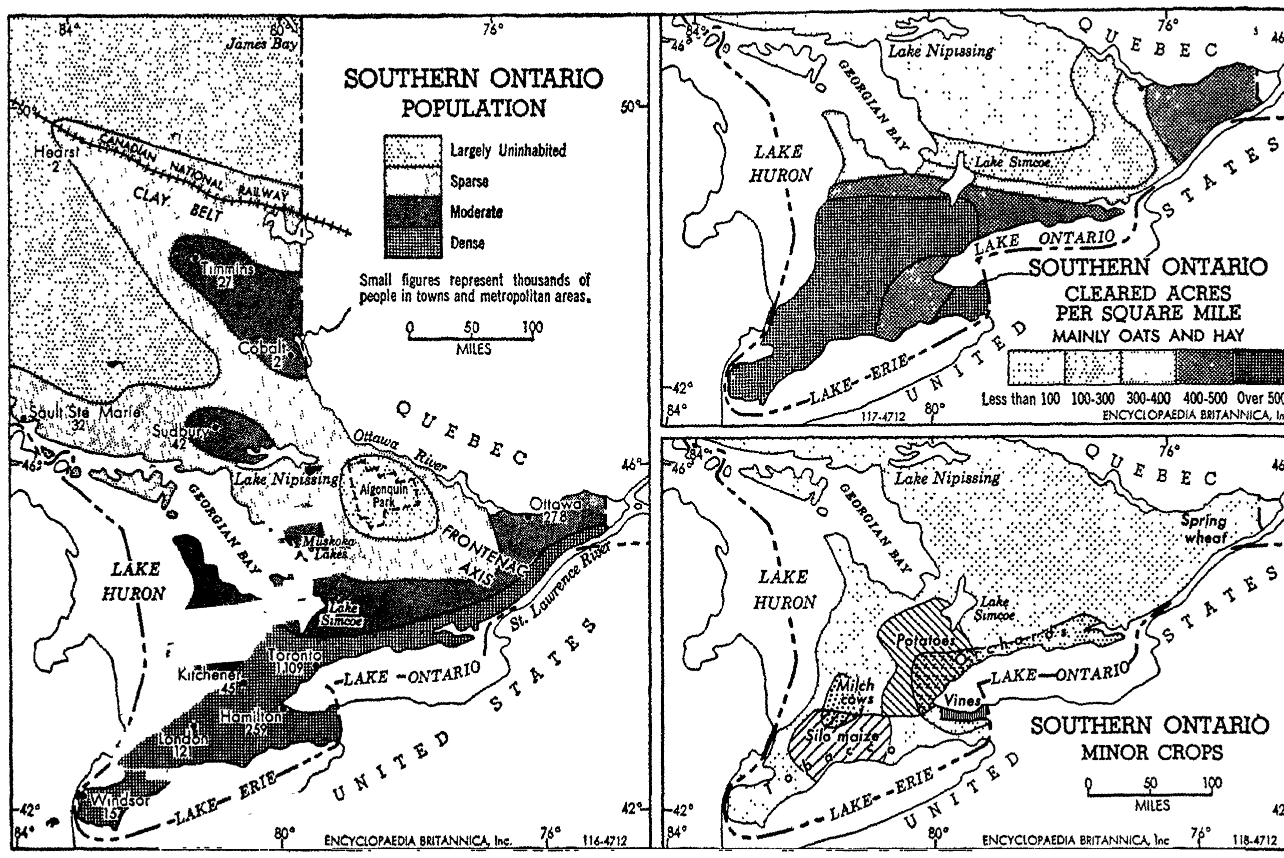


FIG. 2.—POPULATION: DENSEST SETTLEMENT IS IN THE EXTREME SOUTH ALONG LAKE ERIE, LAKE ONTARIO AND THE ST. LAWRENCE RIVER. CLEARED ACRES: THE MARKED EASTWARD LOOP OF THE 100–300 CLEARED ACRES PER SQUARE MILE AREA INDICATES THE POOR SOILS OF THE FRONTENAC AXIS. MINOR CROPS: NEARLY ALL THE MINOR CROPS ARE GROWN IN THE SOUTHWEST WHERE THE MODERATING EFFECT OF THE LAKES ON TEMPERATURE IS GREATEST

goods, gloves, canned fruit and vegetables, petroleum products, biscuits and miscellaneous foods, clothing, printing and bookbinding, railway rolling stock, breweries and tobacco processing. At mid-20th century Ontario manufactured three-fourths or more of the "Made-in-Canada" products from iron, nonferrous metals, leather, rubber, cordage, wool and abrasives; one-half or more of the products from chemicals, aluminum, wheat and coal; and about one-third of the products made from paper, glass and wood. Significant in the development of manufacturing was the extension of U.S. branch plants, which concentrated in Ontario more than in any other province.

Water Power.—Among Canadian provinces in 1949 Ontario ranked second only to Quebec in the horsepower developed and in potential power resources. In Dec. 1949 the figure of turbine installation was 2,896,540 h.p. and the available 24-hr. power at ordinary six-month flow was estimated at 7,621,000 h.p. Most of the power is developed in central electric stations, but much is produced by pulp and paper mills and other industries. Ontario was the pioneer province in the public ownership of hydro power. In 1906 it constituted the Hydro-Electric Power commission, which at first merely bought power generated at Niagara by private companies and transmitted it at cost to the municipalities, the initial capital being provided by the government. Later the commission purchased the private companies at Niagara and elsewhere, and thus achieved for public ownership the most vital force in the industry of the province. Public opinion and all the political parties consistently supported this policy of public ownership, although some details of the policy gave rise to sharp controversy. In 1949 the commission served 1,017 municipalities and 1,078,221 customers with a total of 2,150,231 kw. In Sept. 1950 demand on the commission reached a new all-time high of 40,933,035 kw.hr. Modern significant developments were the purchase and import of power from private Quebec companies (some power is transmitted 225 mi. from the Gatineau river to Toronto) to meet the expanded needs of manufactures in southern Ontario; the utilization of many power sites in the north, notably on the Abitibi, to aid mining and the pulp industry; the extension of rural electrification through subsidies from the government to about 270,000 customers by Jan. 1950; and the diversion of water from parts of the Kenogami and Ogoki rivers, which are tributaries of the Albany flowing to James bay, into the Lake Superior system, thus ultimately increasing the hydro power of the Niagara. During 1949–50 the commission undertook intensified hydroelectric construction on the Ottawa, Madawaska, Nipigon and Mississagi rivers, putting about 1,098,000 h.p. more into transmission lines by the end of 1951. In addition, steam plants at Toronto and Windsor, with a total capacity of 386,000 h.p., were brought into operation in 1951. On June 14, 1950, Canada ratified with the United States a treaty which allocated Canada enough extra water from the Niagara river for an additional 900,000 h.p. of hydroelectricity, construction for which began late in 1950.

Mining.—From 1907 to 1940 Ontario was the chief mineral-producing province of Canada, but by 1949 its annual contribution fell to 35% of the total mineral production. The minerals are varied, including gold, silver, cobalt, radium, copper, nickel, lead, zinc and practically all the commercial nonmetallic minerals except coal. The richest mining areas are in the extensive Pre-Cambrian region of northern Ontario, although petroleum, natural gas and salt have been developed in the southwestern peninsula of the province. For many years, because of the nickel-copper deposits at Sudbury, Ontario has been the principal producer of the world's supply of nickel, turning out in the 1938–48 period about 90% of the world total exclusive of the U.S.S.R. The International Nickel company at Sudbury became noted for finding varied industrial uses for its metal. But in the economic life of Ontario for many years the crucial mineral factor was gold, of which that province produces between 50% and 60% of the total Canadian output. There as elsewhere the special stimulus to mining came with the revaluation of gold in the depression of the 1930s, when old properties were enlarged and new mines were dis-

covered and speedily developed. In 1948 the federal government's emergency gold mining assistance law kept a number of marginal mines in operation despite higher working costs. The consequence of these influences on Ontario gold mining was reflected in production figures: 1925, 1,461,039 fine oz.; 1941, 3,194,308; 1948, 2,068,-978; 1950, 2,448,764. Most of the Ontario gold comes from auriferous quartz mines in the districts of Porcupine and Kirkland lake. In contrast with the gold of Quebec and Manitoba, only a negligible quantity is derived from mines producing ores of copper, nickel and zinc. Ontario also has much iron ore, generally of low grade, but the development of an extensive subaqueous mine of high grade ore at Steep Rock lake west of Port Arthur was stimulated by World War II.

Forest Industry.—More than 60% of the land area of Ontario, or about 241,000 sq.mi., is classified as forested. The area of merchantable timber is of course much smaller than this figure, being about 66,000 sq.mi. Among the provinces, Ontario ranks second only to Quebec in total stand of conifer and broad-leaved timber, estimated in 1949 at 58,000,000,000 cu.ft. out of a total for Canada of accessible timber of 191,000,000,000 cu.ft. Undue importance, however, need not be attached to the precise figures, since in detail they are subject to error and are constantly revised. It is sufficient to emphasize that Ontario has highly valuable forests which continued to influence profoundly its economic development, as they helped to shape its history, feeding with raw material many secondary manufactures. Its commercial woods are varied. White pine, durable and easily worked, has the largest market, while red pine, spruce, jack pine, birch, hemlock, balsam and maple are also significant. The pulp and paper industry, providing much employment and facilitating Canadian foreign exchange, is central in the forest economy of northern Ontario, where it exists as the dominant secondary industry not merely because of abundant spruce and balsam but also because of hydro power in the numerous rivers of the Pre-Cambrian shield. Secondary to pulp and paper but important is the sawn lumber industry, which found a wider market in manufactures when World War II checked the displacement of lumber materials by metals. Because of the shortage of light metals, for example, wood was reintroduced into the manufacture of aeroplanes. Progress was made in forest conservation, notably in fire control with the effective aid of lookout towers, aviation, the world's largest forestry radio network and more rigorous regulations. The Ontario forests had been recklessly exploited, and in the southern part of the province many counties at mid-20th century had less than 10% wood coverage, not always sufficient even to protect watersheds. In 1949 a target of 18%–25% forest cover was set for the depleted southern counties; a year later capacity of the provincial nurseries was increased to 60,000,000 seedlings annually for free distribution (20,000,000 shipped in 1949), and timber management was started over 165,000 sq.mi. of northern forest. Of the eight proclaimed provincial forests, the largest is Timagami, wherein settlement is prohibited, and no timber may be sold except by order in council. It is the aim to bring those forests on a sustaining yield basis. Two provincial forest parks are Algonquin, in the highlands of Ontario, and Quetico, in the Rainy river country, which are maintained chiefly to ensure a primaeval forest, to protect wildlife and to offer a recreation resort for the public.

Communications.—The waterways of Ontario, previously described, provide natural avenues of communication which have greatly aided the development of the province. But in addition to the waterways, the southern and closely peopled part of Ontario is gridironed with railways and roads, some U.S. lines also running through the southwestern portion of the province. The province has one-fourth of the total single-track mileage of Canada, about 10,463 in 1949. A portion of the mileage in the past had been constructed under the spur of municipal and provincial subsidies, and gradually many small lines were consolidated into great railway systems. Important in opening up the mining areas of northern Ontario was the provincially owned line known as the Ontario Northland railway.

In 1949 the province had surfaced roads totalling 58,645 mi., which then constituted more than one-third the total for the whole of Canada and partly explained why Ontario attracted more U.S. tourists than any other province. About 84% of this road mileage was surfaced with gravel and stone. Registered motor vehicles numbered 970,137.

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ONTARIO, a city of San Bernardino county, Calif., U.S., 38 mi. E. of Los Angeles, at an altitude of 1,000 ft. It is served by the Santa Fe, the Southern Pacific and the Union Pacific railways. The population was 22,872 in 1950. It lies on a sloping plateau at the foot of Mt. San Antonio ("Old Baldy," 10,080 ft. high). Through the heart of the city and on up to the foothills runs famous Euclid avenue, a straight avenue 7 mi. in length and 200 ft. wide, with 4 mi. of grassed parkway. The Ontario International airport has ample runways to provide for the landing and take-off of the largest aircraft. Ontario has many diversified activities, which include packing plants and nurseries, manufacture of electric irons, citrus by-products, venetian blinds, clothing, plastic tile wallboard, handcraft commodities, etc. Ontario is in the heart of the citrus belt. The city was founded in 1882 by George and William Chaffey, and was incorporated in 1891. It is governed by a modified council-manager form.

ONTARIO, LAKE, the smallest and most easterly of the Great Lakes of North America, is bounded on the north by the province of Ontario and on the south by the state of New York. It is roughly elliptical, its major axis, 193 mi. long, lies nearly east and west, and its greatest breadth is 53 mi. The area of its water surface is 7,540 sq.mi.; and the total area of its basin, 34,640 sq.mi. Its greatest depth is 778 ft.; its average depth, much in excess of that of Lake Erie; and it is, as a general rule, free from outlying shoals or dangers.

Physiography.—On the north side of the lake the land rises gradually from the shore, and spreads out into broad plains, which are thickly settled by farmers. A marked feature of the topography of the south shore is what is known as the Lake ridge, or, as it approaches the Niagara river, the Mountain ridge. This ridge extends, with breaks, from Sodus to the Niagara river, and is distant from the lake 3 to 8 mi. The low ground between it and the shore is a celebrated fruit-growing district, covered with vineyards, peach, apple and pear orchards and fruit farms. The Niagara river is the main feeder of the lake; the other largest rivers emptying into the lake are the Genesee, Oswego and Black from the south side, and the Trent, which discharges into the upper end of the bay of Quinte, a picturesque inlet 70 mi. long, on the north shore, between the peninsula of Prince Edward, near the eastern extremity of the lake, and the mainland. The east end of the lake, where it is 30 mi. wide, is crossed by a chain of five islands, and the lake has its outlet near Kingston, where it discharges into the head of the St. Lawrence river between a group of islands. Elsewhere the lake is practically free from islands. There is a general surface current, down the lake toward the eastward, of about 8 mi. a day, strongest along the south shore, but no noticeable return current. As a result of its relatively great depth there are seldom any great fluctuations of level in this lake due to wind disturbance, but the lake follows the general rule of the Great Lakes of seasonal and annual variation. Its mean surface elevation above mean sea level, for a period of 68 years, is 246.09 ft., which is about 326.33 ft. below the level of Lake Erie. The lake never freezes over except near land, but the harbours are closed by ice from about mid-December to mid-April.

Ports.—The principal Canadian ports are Kingston, at the head of the St. Lawrence river; Toronto, where the harbour is formed by an island with improved entrance channels constructed both east and west of it; and Hamilton, at the head of the lake, situated on a land-locked lagoon, connected with the main lake by Burlington channel, an artificial cut. The principal U.S. port is Oswego, N.Y., where a breakwater has been built, making an outer harbour.

Commerce.—The commerce of Lake Ontario is limited in comparison with that of the lakes above Niagara falls, and is in general confined to vessels which can pass the Welland canal and the St. Lawrence canals; the harbours on the lake are planned to accommodate vessels limited to the size determined by the dimensions of the smallest locks, which are: length 270 ft., width 45 ft. and depth 14 ft. on sills. The commerce on the lake is generally confined to coal shipped from Rochester, Sodus bay, Little Sodus bay and Oswego to Canadian ports on the lake and U.S. and Canadian ports on the St. Lawrence river; to coal from Oswego to upper lake ports; to grain and other products shipped from upper lake ports through the Welland canal to the St. Lawrence; to lumber from Canadian ports; and to pleasure traffic.

Canals.—The Welland ship canal, between Port Weller, Lake Ontario, and Port Colborne, Lake Erie, was opened to navigation in 1931. It permitted the large lake vessels operating on the upper Great Lakes to enter Lake Ontario. (*See* NIAGARA RIVER.)

The Erie and Oswego canals, built and operated by the state of New York, became important water outlets from Lake Erie and Lake Ontario to the Hudson river and to New York city. The canal is 12 ft. deep and is designed for use by boats drawing 10½ ft. The canal distance from Oswego to New York city is 338 mi. The Murray canal extends from Presqu'ile bay, on the north of the lake, to the head of the bay of Quinte, and enables vessels to avoid 70 mi. of open navigation. It is 11 ft. deep below the lowest lake level and has no locks.

Trent canal is the term applied to a series of rivers and lakes connected by short canals, designed to form a continuous system of light-draught navigation between Lake Ontario and Georgian bay, Lake Huron. The system in 1948 ran from Trenton to Peterborough lock, Peterborough, 88.74 mi.; Peterborough lock to Swift Rapids, 135.71 mi.; Swift Rapids to Big Chute, 8 mi.; Big Chute to Port Severn, 8.11 mi.; Sturgeon lake to Lindsay (Scugog branch), 10 mi.; and Lindsay to Port Perry (Scugog branch), 25 mi. There were 44 locks in the system.

At Kingston the Rideau canal, extending 123.53 mi. to Ottawa, enters the St. Lawrence river at the foot of the lake. This canal has 47 locks, with minimum dimensions of 134 ft. by 33 ft., and a depth of 5 ft.

Proposals for the construction of a St. Lawrence seaway power and navigation project were being considered at mid-20th century by the United States and Canadian governments.

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ONTENIENTE, a town of eastern Spain, in the province of Valencia; on the right bank of the Clariano or Onteniente, a subtributary of the Júcar, and on the Játiva-Villena railway. Pop. (1940) 11,712 (mun., 13,564). Onteniente has a parish church remarkable for its lofty square tower, and a palace of the dukes of Almodovar. Linen and woollen cloth, paper, brandy, furniture and earthenware are manufactured.

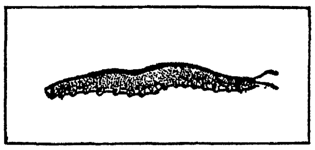
ONTOLOGY, the name given to that branch of philosophy which deals specially with the nature of being, *i.e.,* reality in the abstract. The idea, denoted in modern philosophy by the term "ontology" in contrast to the broader "metaphysics" and the correlative "epistemology," goes back to such phrases as ὄντως ὄντα, which Plato uses to describe the absolute reality of ideas; Plato, however, uses the term "dialectic" for this particular branch of metaphysics. Aristotle, likewise, holding that the separate sciences have each their own subject matter, postulates a prior science of existence in general which he describes as "first philosophy." So far, therefore, the science of being is distinguished not from that of knowing but from that of the special forms of being: as to the possibility of objective reality there is no question. A new distinction arises in the philosophy of Christian Wolff who first made "ontology" a technical term. Theoretical philosophy (metaphysics) is by him divided into that which deals with being in general whether objective or subjective, as contrasted with the particular entities, the soul, the world and God. The former is ontology. This intermediate stage in the evolution of the science of being gave place to the modern view that the first duty of the philosopher is to consider knowledge itself (*see* EPISTEMOLOGY), and that only in the light of conclusion as to this primary problem is it possible to consider the nature of being. The evolution of metaphysics has thus relegated ontology to a secondary place. On the other hand it remains true that the science of knowing is inseparable from, and in a sense identical with that of being. Epistemological conclusions cannot be expressed ultimately without the aid of ontological terms *See* KNOWLEDGE, THEORY OF; METAPHYSICS; PHILOSOPHY AND PHILOSOPHICAL STUDIES.

ONYCHOPHORA, a small but unusually interesting group of animals of the phylum Arthropoda (*q.v.*), differing in so many important respects from all other Arthropoda that a special class has been created for them. The class Prototracheata or Onychophora, containing only about 110 species, is equivalent in rank to the classes Crustacea, Insecta, Diplopoda, Chilopoda and Arachnida, although these groups contain thousands of genera and species.

A small group of genera which necessitates the creation of a separate class is usually the recipient of particular interest, for it will present highly important indications of the evolutionary relations between other groups of the animal kingdom. It is often to be regarded as the survivor of a group more extensive in range and more numerous in species and individuals in past times.

The Onychophora is such a case. It presents features which are typically arthropod. At the same time it possesses nephridia which recall the segmented worms (Annelida, *q.v.*), the group to which the Arthropoda are structurally most closely related. It may be relict of the evolutionary transition between these groups, as a fossil genus, *Asheaia,* has been discovered in deposits of Cambrian age.

The Onychophora contains only seven genera but these are so much alike that it is still common to use the term *Peripatus* as the generic name for all. The different species resemble each other externally so closely that, but for the differences in the number of legs, a picture in black and white like fig. 1 would stand for any of them. Notwithstanding this resemblance it appears necessary to restrict the use of the old generic name *Peripatus* to a few species.



AFTER SEDGWICK

FIG. 1.—PERIPATOPSIS CAPENSIS, DRAWN FROM LIFE, LIFE SIZE

The geographical distribution of the group is very wide but discontinuous and very local. Species occur in the West Indies, western Mexico, Central America, northern South America and Chile, South Africa, Malaya, India, Melanesia and Australasia.

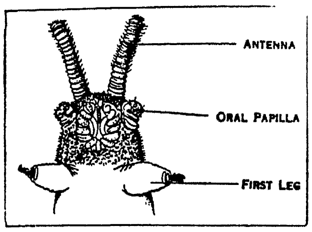
Specimens are only met with here and there, even where favourable conditions exist over a wider area. This discontinuity of occurrence coupled with the obviously poor powers of distribution of these creatures is strong evidence to indicate a group on the way to extinction. The distribution of the genera, which form two families, Peripatidae and Peripatopsidae, is as follows: *Peripatus*—America; *Eoperipatus*—Indo-Malaya; *Peripatoides* and *Oöperipatus*—Australia; *Opisthopatus*—Chile and South Africa; *Paraperipatus*—Malaya; *Peripatopsis*—central Africa.

Since the present account is a short general summary we shall continue to use the term "Peripatus" to include all species of the group. It will be understood, however, that this is for convenience only.

The animal is always found in moist situations (although the district itself may not be moist during the whole year). It is generally found under rotting branches lying on the ground, under stones, under bark and in the crevices of tree stumps. It is extremely sensitive to a dry atmosphere (specimens frequently will not withstand 24 hr. in a dry cardboard box, whereas they will be happy for many days in a small glass tube containing moist soil although the tube may be tightly corked). It never comes out into daylight and in captivity is much more active at night. It is probably carnivorous, feeding on small insects and other small animals in slime which it secretes.

Peripatus is a segmented animal, and at a first glance looks

somewhat like a caterpillar; but the long antennae, the peculiar body-surface and the legs soon dispel that view. The actual segmentation is shown externally only by the occurrence oı paired legs, one pair to each segment. The surface of the body is marked by ring-like ridges, 12 or 24 to each segment. Some of these are almost continuous round the circumference of the animal (they are all broken by a fine groove down the middle of the dorsal surface), others are less complete and arise between the former. The skin and body wall is highly characteristic, the superficial cuticle being very thin (as in the worms, in contrast to the usual arthropod condition) and raised everywhere on the ridges into delicate microscopic papillae. These close papillae give the skin a velvety appearance and their presence makes it difficult to wet the creature. The colours of these animals are dark gray, olive green, or brown to brick red above, and light, often almost white, on the under surface. Some species are uniformly coloured; others present distinct colour patterns, usually of lozenge-shaped spots Those of the western hemisphere are usually slightly patterned and the old world species show more contrasting colours.



FROM SEDGWICK IN "TEXTBOOK OF ZOOLOGY" (G. ALLEN & UNWIN)

FIG. 2.—VENTRAL VIEW OF HEAD OF P. CAPENSIS

Both head- and tail-ends taper and there is no distinct head. The anterior end bears two characteristic antennae, very mobile and extensible. In fact the whole animal is remarkably extensible and there is a great difference in length between a living specimen in motion (especially if this is rapid) and one in spirit.

Slightly posterior and ventral to the antennae are two small blunt oral papillae, and between these the buccal cavity is situated (fig. 2). An anal aperture is found at the extreme posterior end of the animal and further forward on the ventral surface between the last pair of legs is the reproductive aperture in both sexes. The males may sometimes be distinguished from the females by slight differences in the appearance of the genital opening. In many cases, however, the only difference, not always distinct, is the presence of little apertures of crural glands on the legs of the male (fig. 3).

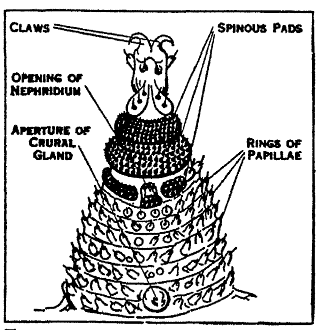


FIG. 3.—FOURTH LEG OF PERIPATOIDES (MALE)

The other apertures on the surface of the body are those of the tracheae (respiratory organs—*see* below) and the excretory organs. None of the former can be seen with the naked eye and only four of the latter, on the 4th and 5th pairs of legs (fig. 3).

The limbs of Peripatus are characteristic. Each consists of a cone-like stumpy leg bearing distally a narrower foot which carries two sickle-shaped claws. The skin of the legs bears rings of tiny papillae like those of the body and near the apex there are spinous pads. The structure of the appendages is thus quite unlike the jointed arthropod leg.

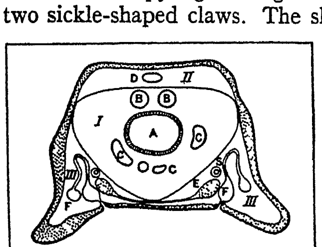
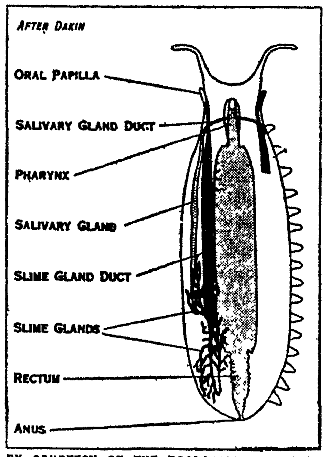


FIG. 4.—DIAGRAM OF TRANSVERSE SECTION THROUGH MIDDLE OF BODY OF PERIPATUS

Internal Structure.—A transverse section through an adult shows clearly how the body cavity, which is a haemocoele, is subdivided by delicate sheets of tissue (fig. 4) into (I.) a large central space extending the whole length and containing the gut (A), slime glands (B) and reproductive organs (C); (II.) a shallow dorsal space above the central cavity, containing the heart (D); (III.) two lateral spaces each with a nerve cord (E), nephridia (F), and salivary glands (S). The excretory organs are also found in these compartments, especially in the extensions which exist in the legs.

The *Alimentary Canal.* The buccal cavity contains a pair of horny jaws (fig. 5) which may just be seen from the exterior. Each consists of two cutting plates lying in contact. These jaws are the only mouth appendages present. The mouth at the posterior end of the buccal cavity leads into a short, muscular pharynx and from this a short oesophagus opens into the stomach (fig. 5). This forms the greater part of the alimentary canal. It is a straight and wide tube leading almost to the posterior end where a short, narrow rectum opens at the terminal anus.



BY COURTESY OF THE ZOOLOGICAL SOCIETY

FIG. 5.—PERIPATOIDES OCCIDENTALIS, SHOWING PARTS

The only glands connected with the alimentary canal are two salivary glands (fig. 5) which open by a common duct into the buccal cavity. Each gland is a long tubular structure lying in a lateral cavity close to the nerve cord.

The *Slime Glands* (fig. 5) are another peculiar feature. There are two of these, each opening on an oral papilla. Each consists of a long dilated tube which acts as a reservoir and lies over the stomach in the central cavity of the body. This reservoir extends back a considerable distance and then gives off numerous diverticula in which the slime is secreted. These diverticula lie around the posterior part of the stomach, often entangled in the coils of the reproductive organs. When a living specimen is touched the slime is shot out from the oral papillae to a distance of several inches. Contact with the air causes it to congeal into white, sticky threads. It is supposed that the substance is used for offence or defence.

The *tracheae* are among the most noteworthy features of the Onychophora because they are characteristic of certain other Arthropoda. They arise in bunches from the bottom of little epidermal pockets, tracheal pits. It is impossible, however, to see these pits externally. From each pit a large or small bunch of parallel tracheae start off, without branching; then they separate and finally branch, when they reach the organs they supply. Since the small single tubes require a high magnification to see them, one can only see readily the little rosettes of tubes where they are bunched at the tracheal pits and then only by examining the internal surface of the body-wall in fresh specimens.

The tracheal pits are numerous and arranged in definite positions. In the West Australian species there are two main rows, one on each side, between the mid-dorsal line and the level of the legs. There are also four longitudinal series on the ventral surface. E. Gaffron stated that there were about 75 openings to a segment in *P. edwardsi.* The present author has counted 32 without difficulty in *Peripatoides occidentalis.* The tracheal tubes have a spiral thickening in the walls similar to that in other Arthropoda.

The *excretory organs* are probably the most surprising of all the structures found in this animal and at once call to mind the annelid worms, being not at all like the excretory organs of the arthropod groups. They are paired structures, one pair to each pair of legs. With the exception of those of the 4th and 5th pairs, each excretory tube opens on the ventral surface at about the point where its corresponding leg joins the body. The 4th and 5th pairs open on papillae near the distal end of the corresponding legs (fig. 3). It is a striking fact that this distinction should be found constantly in the different genera.

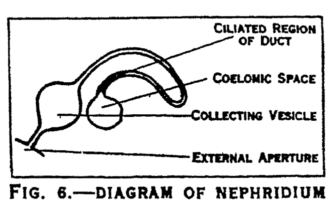


FIG. 6.—DIAGRAM OF NEPHRIDIUM OF PERIPATOIDES OCCIDENTALIS

The excretory organs have been termed *nephridia* and there is some evidence from embryology in support of this. Anatomical study, however, is insufficient to indicate the exact homologies of

these organs and the embryological evidence requires confirmation. Each "nephridium" (fig. 6) consists of a tube with an enlargement, the collecting vesicle, near its aperture and another, corresponding to a coelomic cavity, at its internal blind end. In the West Australian *Peripatoides* W. J. Dakin discovered that cilia were present in that part of the tube leading out from the coelomic vesicle. This is the second part of the body where cilia have been found in these animals and since cilia are characteristically absent in the Arthropoda, it is a point of importance. Their other site is the reproductive organs of the female.

The *blood system* appears to consist only of a feebly developed dorsal tubular heart.

The *nervous system* consists of a pair of large supraoesophageal ganglia completely united in the middle line and occupying most of the head space, and a pair of cords which run backward. These latter, instead of being close together in the mid-ventral line, are situated at the sides in the lateral cavities of the haemocoele. Numerous commissures, 8–10 between successive pairs of legs, connect the lateral cords. There are indications of ganglia, corresponding to the legs in number, where the lateral cords are slightly thickened. Nerves pass out from the supraoesophageal ganglia to the tentacles, eyes and skin sense organs and also leave the lateral nerve cords.

The only sense organs are the eyes and numerous skin sense organs all of which look alike in structure.

The eyes are moderately well-developed, situated on the head near the base of the antennae. They are simple eyes, not compound like those so characteristic of the Arthropoda. They differ also fundamentally from the arthropod type of simple eye, the ocellus. It is sufficient here to point out that on the whole the visual organ presents features of a simple type met with in both annelid worms and arthropods, but it has followed its own line of evolution.

The skin sense organs consist of little packets of cells associated with a projecting spine. They look like and are usually regarded as tactile organs. Peripatus is, however, extremely sensitive to chemical stimuli as well as to vibrations and the presence of a very little chloroform vapour or acetic acid in the air produces a quick reaction.

Reproduction.—The sexes are separate. The reproductive organs consist of a pair of tubular testes in the male and a pair of ovaries in the female. In both sexes the reproductive organs are continuous with the tubes which lead their products to the exterior, opening at the single aperture already described. In the female, part of each duct is differentiated to form a uterus in which the young develop. Slight differences in the arrangement occur in the different species. Almost all produce living young.

One feature of special note is the varying amount of yolk in the eggs and its result. The Australian species have large yolk-laden eggs, and all species come near to laying eggs. At least one species of eastern Australia is actually oviparous and eggs are laid in sculptured shells. In all others the eggs are retained within the female and after a period of several months the young are born.

The South African and Australian species give birth to the young in April–June. Fertilization in one of the latter species takes place in the preceding August or September and the period of gestation would thus be 8–9 months. It has been given as 13 months for the Cape species.

The eggs are fertilized internally and it has been stated that the male of the Cape species deposits its spermatozoa on the surface of the female. Since the uterus is said never to contain spermatozoa, the mode of entrance into the body would be a complete mystery. There can be no doubt that in the Australian species copulation of the two sexes takes place and the spermatozoa pass up the vagina of the female.

The embryology of the Cape species has been worked out and reference should be made to A. Sedgwick (*see* below) for details. Further work is required in this direction and would be of undoubted interest and importance.

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ONYX, a striped agate in which white layers alternate with black. When brown or red bands occur instead of black the stone is termed sardonyx (*see* SARD AND SARDONYX). The Romans applied this name originally to a species of marble, now called onyx marble, because of a resemblance between its well-defined white and yellow veins and the shades in the fingernail (ὄνυξ). When this marble became less important the name was transferred to the striped agate. Onyx has always been largely employed in cameo work because the design and background could be cut so as to occur in differently coloured layers. The best cameos are those produced by the ancients, though a revival of the art was occasioned by the discovery in the middle of the 19th century of the South American sources of onyx. Many inferior agates are now made suitable for the cutting of cameos by artificially dyeing the layers (*see* AGATE) and glass imitations are also extensively produced. Beads, brooches, ring stones and other small ornaments are frequently made of onyx and larger pieces are fashioned into cups and vases. Onyx marble is much softer and less precious than true onyx and includes the following ornamental stones; Mexican onyx or Tecali marble, which is often of a delicate green shade, Algerian onyx and Gibraltar stone.

The chief localities for onyx are South America and India.

See C. W. King, *Precious Stones, Gems and Precious Metals* (London, 1865); A. Eppler, *Die Schmuck und Edelsteine* (Stuttgart, 1912). For onyx marbles *see* G. P. Merrill, *Rep. U.S. Nat. Mus. for* 1893 (1895). (W. A. W.)

OOLITE, a geological term used in two senses; the commonest use refers to a particular type of structure common in limestones and ironstones, where the rock is composed of small rounded grains, resembling the roe of a fish (Gr. ὤον, an egg, λίθος, a stone). This structure is apparently produced in more than one way, most commonly perhaps by accretion of $CaCO_3$ from solution in water around tiny sand grains or shell fragments in moving water, where the grains are kept in constant motion. Grains formed in this way show radial or concentric crystalline structure when cut open. In some instances the grains are merely minute rounded pebbles of an older limestone, and such may show no particular structure. Many fine examples of oolitic deposits are formed by calcareous algae in hot springs, as at Carlsbad and Vichy. Such grains consist of aragonite, not calcite. Oolitic ironstones are apparently formed in a way similar to that first described, but the exact manner of precipitation of the iron is still somewhat doubtful. Bacteria may play a part.

The second use of the term is stratigraphical, to indicate the British rocks forming the middle and upper divisions of the Jurassic system (*q.v.*) where oolitic rocks are common. This usage is now out of date. (R. H. RA.)

OOLOGY: *see* EGG.

OOTACAMUND, town, British India, headquarters of the Nilgiris district in Madras, approached by a rack railway from Mettupalaiyam station on the Madras railway. Pop. (1941) 29,850.

Ootacamund is the principal sanatorium of southern India and summer residence of the governor of Madras and is noted for hunting, fishing and shooting. It is placed on a plateau 7,220 ft. above the sea, with a fine artificial lake, and mountains rising above 8,000 ft. The mean annual temperature is 58° F., with a minimum of 38° in January and a maximum of 76° in May; mean annual rainfall, 49 in. The houses are scattered on the hillsides amid luxuriant gardens. In the neighbourhood are plantations of coffee, tea and cinchona. The Lawrence Memorial school for the children of European soldiers was founded in 1858.

OPAH (*Lampris luna*), a pelagic fish of the order Allotriognathi. The body is compressed and deep, with minute scales. A dorsal fin, high anteriorly, runs along nearly the whole length of the back; the caudal is strong and deeply cleft, for rapid swim-

ming. The pelvic fins contain numerous (15–17) rays. In its gorgeous colours the opah surpasses even the dolphin. The fins are bright scarlet, and the sides bluish-green above, violet in the middle, red beneath, variegated with oval spots of brilliant silver. Its home is the Atlantic, especially near Madeira and the Azores. It occurs also in the Pacific, and is rare in the Mediterranean. It grows to a length of 4 to 5 ft. and a weight exceeding 100 lb.

OPAL, a mineral, in chemical composition an amorphous hydrated silica, some forms of which are highly prized as gems. Many varieties of opal (Lat. *opallus*, Gr. ὀπάλλιον) are recognized but of these few have any value as gem stones. The most beautiful is precious opal which displays a wonderful scintillating coloured brilliance, known as opalescence. In early times it excited the keenest admiration, witnessed by Pliny's enthusiastic description, "For in them you shall see the living fire of the ruby, the glorious purple of the amethyst, the green sea of the emerald, all glittering together in an incredible mixture of light." Orange or yellow stones which exhibit opalescence are called fire opals. Black opals are stones in which the background is extremely dark. Really black stones are extremely valuable and rather rare. Common opal is a term applied to the varieties which do not exhibit opalescence. Most of the names applied are self-explanatory; *e.g.,* milk opal, resin opal, liver opal, agate opal, etc. Prase and jasper opals are green and red respectively. A curious, very porous variety, which can absorb surprising quantities of water, is called hydrophane. It will adhere to the tongue. It is almost opaque when dry, but becomes practically transparent when saturated with water. Another porous variety is cachelong, which has a lustre like mother of pearl.

Opal is the silicious material of the tests of radiolaria and the frustules of diatoms. These may accumulate as deposits of tripoli or kieselguhr, used for polishing. Opal is often found as pseudomorphs after gypsum, glauberite, calcite and other minerals. Pseudomorphic aggregates are sometimes known as pineapple opal. Opal has been discovered in a fibrous form much like asbestos, from which it may be distinguished by its harsh touch.

Occurrence.—Opal is widely distributed as nodules and stalactitic masses in the cavities of volcanic rocks, deposits from hot springs, etc. It is deposited as a gel or sol. Precious opal is found only in a few places. Cserwenitsa in Hungary was for long the only source; probably all the ancient stones were found there. Since the discovery of the rich fields in Australia, the Hungarian mines have lost most of their importance. The discovery of opals at White Cliff, New South Wales, was followed in a few years by the field on the boundary between New South Wales and Queensland. Many "black opals" are found there, but truly black stones are found at Lightning Ridge. The black opal has been thus described: "It combines the iridescence of the dewdrop with the colour of the rainbow, set in the blackness of night. It is a smothered mass of hidden fire." Precious opals have been found in Hōsako, Japan, which are nearly colourless and transparent with a bluish tint, and show a change rather than a play of colours, from emerald green to apple red. Esperanza, Queretana and Timapan in Mexico are noted particularly for fire opals (girasol). A fine mass of precious opal was found in Nevada.

Coloration.—Pure opal, which is colourless, is rarely found. It is usually stained dull colours by ferric oxide, alumina, lime or magnesia. That the coloration is not ordinary absorption is shown by the fact that the transmitted light is complementary to the reflected. If for example a blue stone is held up to the light, it appears yellow. The opalescence is not due to any pigmentation, but to the fact that as the original gel dried and cooled it became riddled with cracks, which were subsequently filled up by another gel containing a different amount of water. The resulting heterogeneity of the opal gives it a varying refractive index, which affects the light in the same way as a soap bubble. The thinner and more uniform the cracks the greater the splendour of the colours, the shade depending on the direction in which it is viewed. In the variety known as harlequin opal the rainbow colours are flashed from little angular surfaces forming a mosaic.

Opals are usually cut *en cabochon.* If they are too thin for this, they are used for inlay work, and if scattered in small pieces throughout the matrix, they are sold as such, under the name "root of opal." Fire opal shows to best advantage if facetted. Opal is not placed among the most precious of stones because of its softness, but Pliny placed it after the emerald. He relates that Mark Antony exiled a rich senator, Nonius, for the sake of an opal the size of a hazel nut. Many superstitions have centred around opal, and even in modern times it has been regarded as unlucky.

Properties.—Opal contains from 3%–13% of water, precious opal between 6% and 10%. It is soluble in caustic alkalies, and when mixed with soda easily fusible. It is soft, 5.5–6 on Mohs' scale, and is therefore easily scratched. It is brittle and has a conchoidal fracture. Opals are porous, and it is dangerous to immerse them in liquids. Normally opal is isotropic, but owing to internal strains it is sometimes doubly refracting. The refractive index ranges from 1.444 to 1.464. They are said to be more brilliant on warm days, but a high temperature, by withdrawing water, destroys their value. Milk opal has been coloured by oils and pigments to imitate the rare blue and dark red stones. The colour is fixed with Canada balsam.

See A. Eppler, *Die Schmuck- und Edelsteine* (Stuttgart, 1912); G. F. Herbert Smith, *Gemstones* (London, 1926). (W. A. W.)

OPAVA (German, *Troppau*), Czechoslovakia, lies on the Opava, a tributary of the Oder, in the middle of a wide fertile plain. The old town, founded in the 13th century, is girdled by parkland beyond which stretch extensive suburbs of the new town, in which are centred the industries (brewing, sugar refining, cloth and industrial machinery). Pop. (1930) 36,030, mostly German. In 1938 the town was ceded to Germany by the pact of Munich; it was returned to Czechoslovakia in 1945.

OPELIKA, a trading and industrial centre of eastern Alabama, U.S., county seat of Lee county; on federal highways 29 and 241, served by the Central of Georgia railway and the Western Railway of Alabama. Pop. 12,264 in 1950 and 8,487 in 1940. Founded in 1773; incorporated 1858.

OPELOUSAS, a city of southern Louisiana, U.S., capital of St. Landry parish; 130 mi. W.N.W. of New Orleans, on the Missouri Pacific, the Southern Pacific and the Texas and Pacific railways and truck and bus lines. Pop. (1950) 11,600. It has a meat packing plant, cottonseed mill and refinery, large outdoor-advertising factory, cracking plant for oil products, moss and cotton gins, saw mills, a broom and mop factory, ice factories, bottling works and a brick factory.

OPEN BILL. A curious stork (*q.v.*) of the genus *Anastomus,* so called from the formation of the lower mandible, which is hollowed out so as to meet the maxilla at the base and tip. There is an African and an Indian species.

OPEN-FIELD SYSTEM. The "open" or "common" field was a characteristic feature of manorial agriculture (*see* LAND TENURE: ECONOMIC AND AGRARIAN ASPECTS). It had its origin, however, in primitive conditions long antecedent to the development of feudalism. Three or four centuries before the Roman occupation the Celtic inhabitants of Britain had evolved a system of co-operative tribal husbandry on the open-field system. The cultivated, or arable, land occupied by the kindred, or tribe, was divided into narrow strips separated by balks of turf. The strips were about a furlong in length and of varying widths. The length of the strips became more or less standardized at an early date, as the disadvantage of irregular lengths for adjoining strips became obvious. The furlong—clearly "furrow-long"—is generally agreed to have represented the distance which oxen would conveniently plow at a stretch, and the plowman could keep a fairly straight line. Persistent trial and error resulted in the general acceptance of the most suitable length which when once adopted became the standard enforced by tradition. The width of the ordinary strip was, in like manner, gradually fixed at four times the length of an oxgoad, which was $5\frac{1}{2}$ yd. Land measurements were no doubt not very exact in those days but the result was eventually to establish the standard size of the strip at approximately 220×22 yd., or in other words an acre.

In the Celtic open-field each free tribesman was allotted five strips. The allocation of the strips was made in accordance with strict tribal regulations, and the cultivation of the land was carried out co-operatively.

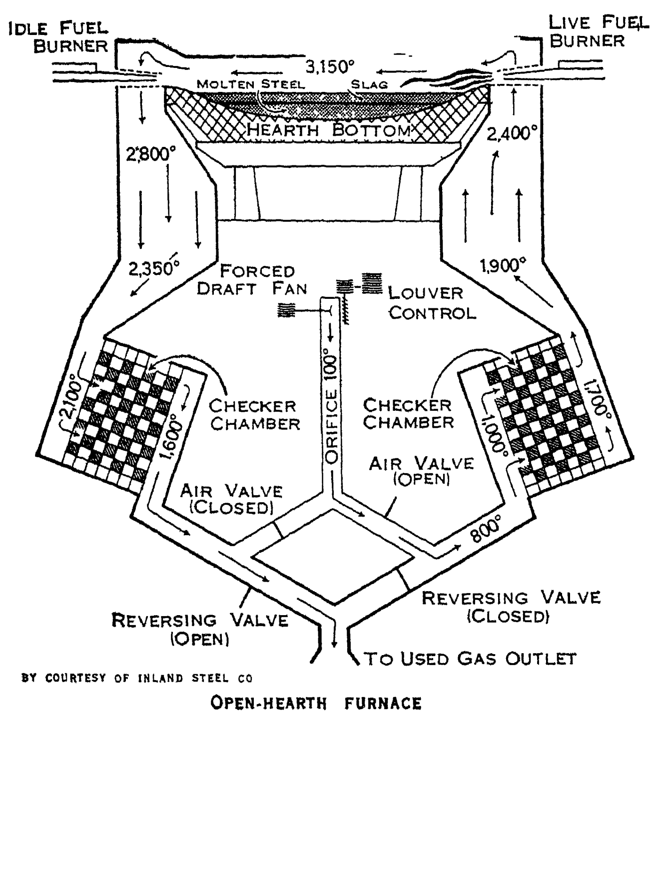
The plow was common property but the oxen appear to have been individually owned.

This system fitted very readily into the manorial organization introduced by the Normans. The status of the cultivators was changed, but the open-field with its separate acre or half-acre strips and its co-operative methods of husbandry continued. The administration of the manor became in form autocratic and the land was held in servile tenure, but in practice the rules governing the allocation of the strips and the cultivation of the land were settled by the tenants. Gradually the rigidity of the manorial organization broke down, the relations of lord and tenants were changed and only the forms of feudalism lingered. But the open-field system survived in thousands of parishes until the wholesale enclosures of the end of the 18th and early part of the 19th centuries abolished it generally, although it lingered in isolated cases until the beginning of the 20th century. Indeed at least two open-fields—at Laxton in Nottinghamshire and Braunton in Devon—continued to exist after that time. (R. H. R.; X.)

OPEN-HEARTH STEEL PROCESS. The idea that steel could be made from pig iron by oxidizing carbon with iron ore, using the regenerative principle for preheating gaseous fuels, was proved in 1868 by Karl Wilhelm Siemens, a naturalized British citizen of German birth. The Martin brothers of France substituted scrap for ore in the Siemens process, which reduced the extent of oxidation required. Open-hearth furnaces in Europe today are called Siemens-Martin or Martin furnaces. Of the additional modifications made since the Martin brothers, the Talbot (duplex) process proved the most important. This furnace is a tilting open-hearth, which refines molten metal which has had carbon removed in an acid converter. Although only a small percentage of open-hearth steel is made by this process today, it is useful during scrap shortages and for removing phosphorus from molten metal, which cannot be removed in the converter.

The modern open-hearth plant is usually made up of 9 to 12 furnaces arranged side by side. The trend is toward larger furnaces ranging from 200 to 275 tons, with a cost of more than $4,000,000 per furnace, including auxiliary equipment. An open-hearth furnace with a capacity of 550 tons per heat was built at Weirton, W.Va.

Modern open-hearth furnaces are of the reverberatory type and have a hearth in the shape of a large, oval dish, as the accompanying diagram shows. At each end of the furnace are ports where the fuel and air meet; these are connected to the refractory checkers—regenerators—by flues. Through a system of valves and flues,



BY COURTESY OF INLAND STEEL CO

OPEN-HEARTH FURNACE

the checkers are connected either to the incoming air supply or the stack for waste gases. Utilization of heat from waste gases is made possible by these valves, which change the direction of the flow of air and gases automatically about every 15 min. to maintain a checker temperature of from 1,800° to 2,200° F., which is required for efficient operations.

Oil, tar, natural gas and coke-oven gas are the most common fuels used in the U.S. in open-hearth furnaces. To obtain high enough flame temperature and economic fuel consumption, the air supplied for combustion is always preheated, and when gases of low British thermal unit (B.T.U.) values, such as producer gas, or blast-furnace gas enriched with coke-oven gas, are used as fuel, these are also preheated. Since a large number of furnaces were designed originally for producer gas, they were built with two regenerators at each end of the furnace, a small one for gas and a large one for air. The majority of these furnaces were converted for high-B.T.U.-value fuels and use all chambers for heating air. Modern furnaces which are not designed for use of a gas requiring preheating are built with only one chamber for air at each end.

Fuel consumption, using hot metal (molten pig iron) and scrap, varies from 2,850,000 to 4,800,000 B.T.U. per ton of steel produced. Oxygen, used by some open-hearth plants for flame enrichment, increases the flame temperature and reduces the quantity of combustion gases produced, which in turn reduces the heat loss in flue gases.

Except for the hearth, the refractory material used in building an open-hearth is about the same for acid or basic types. Both use silica-brick roofs, which will withstand temperatures up to 3,100° F. A typical basic hearth is made up of insulating brick and magnesite or chrome brick covered with magnesite and dolomite. Chrome brick is also frequently used to separate the bottom and roof because of its neutral chemical properties. In the acid hearth, silica brick and silica sand are used.

The basic open-hearth charge usually consists of limestone, steel scrap and pig iron (molten or cold). Charges vary from nearly 100% scrap with very little pig iron to 100% hot metal. The most widely used charge in the United States is one consisting of 40% to 65% hot metal and 35% to 65% scrap. When the hot-metal portion exceeds about 55%, enough iron ore is charged to oxidize part of the carbon and other impurities from the hot metal. A violent reaction (ore boil) takes place when the hot metal is added to this type of charge, which produces a flush slag containing about 30% iron, 22% silica, 3% aluminum oxide, 20% calcium oxide (lime) plus magnesium oxide, 1% phosphorus, 8% manganese and 0.1% sulphur. This slag, which accounts for about 5% metallics lost, is run off into slag ladles. The next step in the process is the lime boil, which is caused by calcination of the limestone. The lime (CaO), which comes to the surface, makes the second slag for the above operation and the first slag for heats that make use of less than 55% hot metal. During the lime boil and refining period, lumpy iron ore is added to furnish available oxygen to oxidize the carbon, silicon and phosphorus from the molten bath. Carbon is liberated as carbon dioxide, and the latter two are held in the slag in the form of calcium compounds. Oxygen, supplied through a lance injected into the molten bath, was used in some open-hearth plants to supplement iron ore. Fluorspar is added to thin the slag (break up lumps of lime) to make it more adaptable to hold silicon, phosphorus, and other impurities.

Removal of sulphur is one of the most serious problems in the open-hearth as well as the entire steel industry. It enters the bath as a constituent in most raw materials, as well as from the flame. Large slag volumes, high slag basicity, and fluid slags with good bath action tend to aid desulphurization. High temperatures aid in promoting fluidity and motion.

When all the above impurities have been removed, the desired carbon content is reached, and the temperature is correct (2,850°–3,000° F.), the melt is tapped and cast into ingots or castings. Adjustments to meet specification are made by adding ferroalloys to the furnace before tapping and to the ladle during tapping. In the acid process the elimination of sulphur and phosphorus is not possible. The basic slag, essential to the removal of these impurities, cannot be used in the acid-lined furnace without injury to the

OPEN-HEARTH STEEL PROCESS

BY COURTESY OF THE U S STEEL CORPORATION, PHOTOGRAPHS, (1, 2, 3) ROBERT YARNALL RICHIE, (4) AIKINS

MELTING AND CASTING OF STEEL

1. Charging an open hearth with scrap iron
2. Charging an open-hearth furnace with molten pig iron
3. Tapping molten steel from an open-hearth furnace
4. Pouring molten steel from ladle into ingots

acid (silica) lining. Oxidation of the carbon is accomplished in the same manner as in the basic process. To produce good steel, therefore, it is necessary to use raw materials low in impurities in the acid process.

In the early 1950s approximately 90% of the steel made in the United States was produced in open-hearth furnaces. The annual ingot capacity of the United States steel industry, as reported by the American Iron and Steel institute, was 117,500,000 net tons as of Jan. 1, 1953, of which open-hearth furnaces supplied 102,700,000 tons. (*See* also IRON AND STEEL.)

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OPEN SHOP: *see* CLOSED SHOP.

OPERA, a dramatic work in which the words, instead of being spoken in verse or prose, are wholly or partly sung to an instrumental accompaniment almost invariably assigned to an orchestra of variable size. The music of an opera may be divided into separate, formal pieces for single or combined voices (arias, concerted numbers), and sometimes for instruments only (interludes, dances), connected either by spoken dialogue or by sung recitative; or it may be composed continuously in a more or less symphonic manner, with structural sections still discernible or entirely submerged in an organization spread over whole acts. Whatever the composer's procedure, which depends partly on his individual disposition and partly on his place in operatic history, there must be musical structure of some kind in opera.

The question of the relative importance of the various elements found in opera cannot be better expounded than by quoting from Sir Donald Tovey's article on this subject in an earlier edition of the *Encyclopaedia Britannica:*

"... here we may profitably consider what are the qualities necessary for success in opera. It is notorious that the absolute value of the music comes last, if it is a factor of success at all. Unquestionably it is a factor in immortality; and the music of *Idomeneo* is immortal, though that opera is revived only in Mozart festivals. But operas cannot wait for immortality, and can manage on quite flimsy music to achieve as much immortality as musical history has given time for. It might be thought that success depends on dramatic power; and this is nearer the truth. But dramatic power comes only third in the conditions, and coherence is not necessary at all.

Two qualities take precedence of dramatic power as conditions for success in opera; one is the theatrical sense, and the other the histrionic sense. They are inseparable but not identical. The theatrical sense can thrill the listener before the curtain rises, as in the modulation to F major at the end of the overture to *Don Giovanni;* the histrionic sense can save the stage-manager the trouble of telling the actors what to do with their hands. . . ."

Beginnings.—The opening date of the history of opera can be conveniently placed in the year 1600, when J. Peri's *Euridice* was produced at Florence, though he had already brought out his setting of O. Rinuccini's *Dafne* in 1597. But opera has a long prehistory, which it is not too far-fetched to trace back to Greek tragedy of the Periclean age, portions of which were undoubtedly sung. The share music may have had in the Roman theatre and in quasi-dramatic performance up to the middle ages is so uncertain as to be unprofitable to speculate upon, but we do know that the mediaeval church, from the 10th century onward, had an elaborate form of sacred music drama, performed on particular feast days by clergy in costume, with the chancel for a stage, and intoned in plainsong. Allowing for the conditions of the time, we may say that these performances had every feature of opera except that of instrumental accompaniment.

Italy.—Outside the church, and nearer the time of opera proper, performances of mystery and miracle plays made enough of music, now instrumental as well as vocal, to show distinctly operatic ingredients, and out of them grew in Italy a special type of acted oratorio or allegorical drama with music, the 16th century *rappresentazione.* The most famous and one of the last before opera came into its own was Emilio de' Cavalieri's *La Rappresentazione di anima e di corpo,* performed in Rome in Feb. 1600. The "soul" and the "body" of the title are impersonated by human characters, and so are various abstractions, such as virtues and vices.

The madrigal opera, of which O. Vecchi's *L'Amfiparnasso* of 1594 is the best-known example, anticipated by A. Striggio and others and imitated by A. Banchieri and others, cannot really be regarded as a direct forerunner of true opera, except in so far as it was in a kind of dramatic form; for modern scholarship no longer regards it as having been performed on the stage in dumb show, with the voice parts sung behind the scenes. Nevertheless, it must be taken into account, if only because it may have done something to discourage dramatic stage presentation with music of a highly wrought character. Composers who cultivated polyphony (the mass and motet in church, the madrigal and its forerunners in the polite world) left the stage alone, because their music could not be accommodated to dramatic action; and this gave a chance to musicians who were performers rather than creative artists to try their hands at dramatic pieces with words turned into song. Simplicity of treatment, which to the fully trained composers would have been an embarrassment, if not an impossibility, was an advantage to the dilettanti who gathered at Florence in the house of Count Bardi, an aristocratic patron of the arts. The most gifted of the musicians among them were V. Galilei, the father of Galileo, who however did not dabble in dramatic music, Peri and G. Caccini. It was not the art of composition in the first place that was felt by the Bardi *camerata* to be required for what they had in mind, which was nothing less than a revival of Greek drama as they imagined it; and in setting about to give shape to their imagination they did what the great composers failed to do—they produced opera for the first time in a form recognizably like that we still know today.

Three days after the production of Peri's *Euridice* came Caccini's *Il Rapimento di Cefalo,* and this composer made his new setting of *Euridice* for 1602. These pieces were feeble enough musically; the vocal line was little more than continual recitative and the accompaniments were played on whatever was available, from the sketchiest of scores; but as essays in the treatment of the voice for the purpose of eloquent and often truly dramatic declamation they were remarkable enough to exercise a decisive influence on the first great master of opera, Claudio Monteverdi, who was soon at hand. His *La Favola d'Orfeo* (Mantua, 1607), is in the declamatory style of the Florentines, with the difference that an artist is in charge for whom musical invention is important and who seizes every chance to insert organized musical pieces. An even greater work by Monteverdi is his last, *L'Incoronazione di Poppea* (Venice, 1642), interesting also for its treatment of a subject from history instead of mythology. We now see the two chief sources opened up from which serious opera during the 17th century was to draw its librettos exclusively.

Monteverdi's orchestra was still an *ad hoc* affair: the score remained incomplete, with the harmony indicated in the continuo part, and the general principle was that such instruments should be used as happened to be available. But we have a specification of what he suggested for *Orfeo,* extravagantly enough. At Venice, where Monteverdi moved from Mantua in 1613, he took his share in the establishment of opera for the first time as a public entertainment, as distinct from a court function. In his last years there were four public theatres in the city devoted to music. The chief Venetian composers succeeding him before 1660 were F. Cavalli, M. Cesti, P. Sacrati and the elder Ziani. Their works were elaborately spectacular, and there is small doubt that the stage machinery was regarded as more exciting than either the plot or the music, both of which were apt to stiffen into conventions which only in the best composers' best moments escaped being tedious. There was also public opera in Rome, with S. Landi, L. Rossi and D. Mazzocchi as the main musical figures. Nowhere else did it as yet flourish outside the courts.

Germany.—Meanwhile there had been an abortive beginning in Germany. An adaptation of Rinuccini's *Dafne* libretto by Martin Opitz was set as an opera by Heinrich Schütz and produced at Torgau in 1627. But Schütz was diverted into other activities and never again wrote an opera. No other German composer did for half a century, and even then there was only one public opera house in all Germany, at the free Hansa city of Hamburg, which had no court. The courts themselves cultivated Italian opera and some of them French a little later. Had it not been for the German princes, who vied with each other in keeping up luxurious

establishments, opera might easily have suffered the same neglect in Germany as in England, for it was from the courts that during the 19th century the municipalities of the larger towns gradually inherited the tradition that opera must be subsidized.

England.—The English neglect had various causes. The most potent cause was not a lack of composers to whom opera was congenial, but an overwhelmingly great school of spoken drama that flourished at the very time opera arose in Italy and produced verse drama in which the words often reached a splendour apt to make a perfectly satisfactory substitute for music. The commonwealth also had something to do with the stagnation of opera before Henry Purcell's maturity. All the same, the suppression was not complete. The masque, which in England had much the same influence on the musical stage as the ballet had in France, was well established, and what is called the first English opera, Sir William D'Avenant's *The Siege of Rhodes,* with music by M. Locke, H. Lawes, H. Cooke, E. Coleman and G. Hudson, was staged four years before the Restoration.

France.—In France tournaments and masquerades led to the immediate predecessor of opera, the court ballet, the most famous specimen of which, *Le Ballet comique de la reine* of 1581, already shows operatic elements. But the composer, Balthasar de Beaujoyeulx (Baldassare de Belgioioso) was Italian-born. It was long before the first real French opera appeared. It is sometimes claimed that this was the *Andromède* of 1650; but this was a play by Corneille in which the words immeasurably overtowered what was little more than incidental music, by C d'Assoucy. A better claim to priority is disputed by M. de La Guerre's *Le Triomphe de l'amour* (1655) and R. Cambert's *Pastorale* (1659). The latter is rather more important musically, but both pieces are pastorals, lyrical and spectacular, and both give as much scope to dancing as to drama. The earliest French operas had some influence in London, particularly those of Cambert, who went to live there.

In Paris the next great figure, indeed the first truly great one in French opera, was Jean-Baptiste Lully, again originally an Italian, Giovanni Battista Lulli of Florence, but belonging at least as much to French music as Handel later did to English. Nevertheless, it is significant that before him Italian opera was cultivated in Paris to some extent. Lully's musical technique is limited, and he avoided counterpoint except in the fugal allegro section of his overtures, where he created a type of instrumental piece that remained in force, by no means only in France, until well into the 18th century, even being used by Bach and Handel. On the other hand Lully had a great fund of graceful and sometimes pathetic melody, and he laid much stress, especially in his recitatives, on correct declamation of the French language, a difficult problem where so little syllabic stress occurs, and yet one to which so literary a nation as the French attached great importance.

It was in French opera that recitative first became sharply detached from set musical numbers, which had to be formally self-sufficient because they were not only rounded-off airs, but quite often dances. But French recitative was accompanied by the orchestral strings, whereas in Italian opera, which soon began to use it in even more strict separation from the formal numbers, it became relegated to the harpsichord that played the continuo throughout the opera, but in the recitatives was supported by bass strings alone.

The Later 17th Century.—During the last third of the 17th century, while France and Italy continued to build at opera in their several ways, with M. A. Charpentier, P. Colasse, A. Campra, H. Desmarets and A. C. Destouches as new figures in France and A. Draghi, B. Pasquini, A. Stradella and A. Steffani in Italy, there were some isolated events in Spain and Germany. J. Hidalgo in Madrid, J. Theile at Hamburg and Nicholas Adam Strungk (the younger Strungk) there and at Leipzig. H. J. F. von Biber at Salzburg brought out the first work by an Austrian (strictly speaking Bohemian) in 1687. But this still had an Italian libretto, and the court in Vienna had already patronized Italian opera on a lavish scale, with Cesti's *Il Pomo d'oro* (1666–67) as the most extravagantly spectacular work.

Two major figures now arose, the first opera composers whose work is capable of maintaining itself in the regular modern repertory. They were Alessandro Scarlatti in Italy and Henry Purcell in England. Born within less than a year of each other, they dominate this period, both by superior musical genius and Purcell, in addition, by a realistic foresight that penetrated far into the next century. He was hampered by texts which were in every case but one sadly nonoperatic, in the sense that they were merely plays containing an unusually large number of opportunities for musical settings. The exception was the small-scale *Dido and Aeneas,* the libretto of which, in spite of Nahum Tate's doggerel, enabled Purcell to anticipate by more than 70 years C. W. von Gluck's *Orfeo.* For if Gluck swept away the artificialities that had been grafted on Italian opera ever since Purcell's youth and earlier, Purcell simply ignored them and allowed his own common sense and imagination to guide him toward the shaping in *Dido and Aeneas* of what *Orfeo* is usually called—the first "reform opera." (Indeed, one might call it the first music drama, as distinct from opera in the conventional sense.) But this was his only chance, and his isolated, insular position conspired with his early death, the absence of any sufficiently strong successor and any system of patronage in damming up what might have grown into an operatic main stream in Britain. For Purcell, while as independently enterprising as Gluck, was technically a far more accomplished master.

Scarlatti, too, was a master of the first order. However, he did nothing to alter the Italian operatic conventions which by his time had become too rigid to be easily upset; he simply did first-rate work within their limitations. Among these was an exclusively Italian phenomenon, which however found its way until well into the middle of the 18th century into opera elsewhere—that of the male soprano and contralto. The barbarism of turning boys into eunuchs before their voices broke began in the church, where women singers were not allowed. Artificial treble voices were thus available which it became the fashion to admire in opera, the more so because these freak singers were capable of performing incredibly difficult florid passages, not only written for them by the composers, but also improvised by them in long cadenzas as elaborate as those inserted later into instrumental concertos. The absurdity of seeing eunuchs with soprano voices interpreting Greek gods and heroes, and sometimes taking women's parts, was accepted as one of the ordinances of opera.

Scarlatti's numerous and splendid operas are among the chief exemplars of this phase of excessive artifice, which causes them to survive all too precariously as historical curiosities. It has also robbed other composers of this period of any but the slenderest chance of survival, however fine the music of such men as A. Caldara, L. Vinci, L. Leo, J. A. Hasse, N. A. Porpora and G. B. Bononcini may have been. R. Keiser is also an offshoot of this school; he brought the Hamburg opera to its culmination with works of the Scarlatti type in a mixture of German and Italian words set to wholly Italianate music. J. Mattheson was associated with him; and so was the youthful Handel, who thus knew the Italian style of the day before his visit to Italy and his settling in England. Handel's first operas were like Keiser's and appeared at Hamburg. Those produced by him in London (35 works between 1711 and 1741) are all full of glorious music, but music almost entirely confined to arias, cruelly difficult to sing and such a dead weight on the plots that the whole of his operatic output is now an all but complete loss to the stage. Handel's operas are far less dramatic than his oratorios.

18th-Century Developments.—The greatest 18th-century librettist was Metastasio. It was chiefly he who influenced composers for a long time to come to persist in this overformalized kind of opera, which he handled with consummate skill. Between 1724 and 1771 most of the important opera composers, and many unimportant ones, in Italy and abroad, set Metastasio's texts, many of which were used over and over again. He caused much fine music to be written and opera as an art form to become stuck in a rut. But this happened only to the so-called *opera seria,* and another species—the *opera buffa*—now began to emerge in Italy and to revitalize the musical stage with characters more directly in touch with the audiences than the gods and heroes of antiquity, though even they at first appeared in the conventional guise of the harlequinade figures of the *commedia dell'arte.* The first Italian

comic operas were not independent works, but interludes inserted, scene by scene, between the acts of the serious operas to enliven the evening. These *intermezzi* were very slight, and only one has survived—*La serva padrona* by G. B. Pergolesi, produced in 1733.

It was this work which in 1752 brought the *opera buffa* to Paris as a model for the coming French comic opera; it was this, too, which unleashed the quarrel known as the *guerre des bouffons.* This lasted until 1754 and was nothing more than an argument, for argument's sake, between the partisans for Italian and for French opera, a dispute between men of letters rather than musicians.

The next great figure in French serious opera after Lully was J. P. Rameau. He did not follow the Metastasian conventions, but had rigid theories of his own and was musically somewhat cold and dry. But his works are as nobly classical in their way as the tragedies of Corneille and Racine, and bigger, though of lower vitality, than the French type of comic opera which developed in the hands of small-scale but delightful composers like A. Dauvergne, F. A. Philidor, P. A. Monsigny and, a little later, A. E. M. Grétry and N. Dalayrac. Their pieces were often tearfully sentimental but also freshly and charmingly human. Out of them developed the quite peculiar type of *opéra-comique,* which is not necessarily comic, but has to contain spoken dialogue. As late a work as G. Bizet's *Carmen,* with its original dialogue, is still an *opéra-comique,* for all its tragic ending, and so were the "rescue operas" of the Revolution period, one of which, P. Gaveaux's *Léonore,* led by way of a close translation of its libretto straight to Beethoven's *Fidelio,* which is thus also in a sense an *opéra-comique.* In Italy the *opera buffa* continued well, and one of its major composers, B. Galuppi, had the advantage of finding a playwright of genius, C. Goldoni, for his librettist.

In Germany opera in the vernacular at last began to emerge in the middle of the 18th century. It did so as modestly as English so-called opera, which had started with the most famous of the ballad operas, *The Beggar's Opera* of 1728, and was to continue for a long time with slight pieces by T. Arne, S. Arnold, C. Dibdin, W. Shield and others. Indeed, the first impulse came to Germany from England: a translation of C. Coffey's ballad opera *The Devil to Pay,* with music by J. C. Standfuss, given at Leipzig in 1752, began the vogue of the *Singspiel,* a simply sentimental and even more naïvely humorous play with music restricted mainly to songs and choruses of an easy, popular kind. The first full-scale German opera, Mozart's *Die Entführung,* was still 30 years off, and even this retained some elements of the "song-play."

With Gluck began the period which still supplies the regular repertory of today, although in recent times a few isolated works of earlier date have been added. But Gluck himself was slow to produce anything capable of surviving a first production, as indeed operas up to nearly the end of the 18th century were never intended to do. His numerous Italian operas, not all of them written before *Orfeo,* are in fact technically weaker than those by the best of his contemporaries, such as D. Terradellas, N. Jommelli and T. Traetta. There is more vitality in his French comic operas, written for the Viennese court, but they are little more than plays with songs. For German opera he did nothing; indeed, like Handel, he set next to no German words to music.

Gluck's first "reform opera," *Orfeo ed Euridice,* appeared in Vienna in 1762 and *Alceste* followed in 1767. French versions of both (1774 and 1776), together with his four original French serious operas (1774–79), spread his influence to Paris, though he was himself influenced by Rameau to some extent, and they provoked another literary dispute there among his partisans and those of N. Piccinni, an Italian who wrote as nobly as Jommelli, but remained conservative. He and Gluck respected each other and took no part in the quarrel. Gluck's reforms—which did away with vocal virtuosity shown off for its own sake, suited the character of the music to the situation and turned stock figures into human beings—were really due in the first place as much to R. Calzabigi, the librettist of *Orfeo;* but that the composer knew very well what he was doing is evident from his preface to *Alceste.* Gluck still had to concede artificially happy endings, however, and in the works specially written for Paris he was obliged to retain the traditional ballet, which remained a feature of French *grand opéra.*

The 19th Century.—When we reach what may be called the modern repertory, it is possible to survey the rest of operatic history much more briefly, both because its major works are still familiar, or at least accessible, and because discussions of the principles underlying them (*e.g.,* Wagner's) may be found in many of the articles on individual composers.

The entry of Mozart into German opera with *Die Entführung aus dem Serail* has already been mentioned, and in his last year he was to climb to the topmost peak of the *Singspiel* with *Die Zauberflöte* (1791), which still belongs to that category, exalted and for the most part solemn and uplifting though it be. But he had already written several Italian works and produced his first masterpiece in that class, *Idomeneo,* in 1781. The three greatest, which indeed place him with Wagner and Verdi in the triumvirate of opera composers who have so far remained unmatched are *Le Nozze di Figaro* (1786), *Don Giovanni* (1787) and *Così fan tutte* (1790). In some ways Mozart stands alone in supreme mastery. Never has opera achieved such ideal balance between the conflicting elements that go to the making of it. In him alone music in itself of the purest shape and quality, the most flawless workmanship, is reconciled with all the dramatic claims made by a libretto: perfect delineation of characters, faultless timing of every situation, simultaneous handling of conflicting emotions in unified concerted pieces.

Some minor Germans continued to set Italian words; others tried their own language. But the first great opera in German was Beethoven's *Fidelio* (1805, revised 1806, 1814), though, as we have seen, its model was French and the musical influences behind it were Franco-Italian (M. L. Cherubini, F. Paer, E. Méhul). As an opera it is not perfect, and the spoken dialogue lowers its temperature; but its high moral tone is divested of smugness or ingenuousness by the incomparable elevation of the composer's musical thinking and feeling. *Fidelio* had no influence on later German works: its form was unsatisfactory and its music unapproachable.

The progress of German opera was threatened at the outset by the enormous success of G. A. Rossini, whose career began as early as 1810. His new type of *opera buffa,* with its enticing, peppery music, was made as welcome in Vienna and Germany as anywhere and interfered with the operatic careers of Germanic composers, making Schubert's impossible and C. M. Weber's difficult, and driving G. Meyerbeer first to Italy and then to Paris. Still, in 1821 Weber managed to bring out *Der Freischütz* in Berlin, and here for the first time was a musically important work thoroughly German in every respect, so much so indeed that it has never taken a firm footing anywhere else. It was also the first romantic opera of any consequence.

Romanticism, by this time established in literature, poured into opera after Weber's lurid story of the magic bullet. He also dealt with a French subject in *Euryanthe* (1823) and actually set an English libretto in *Oberon* (London, 1826). In Germany, though, a strongly romantic vein had already been apparent by 1816 in E. T. A. Hoffmann's *Undine,* a musically rather feeble work by a man whose major gift was literary, and to a lesser extent in Ludwig Spohr's *Faust.* In France romanticism took a rather different, semihistorical form in D. F. E. Auber's *La Muette de Portici,* a revolutionary opera (1828), and in Meyerbeer's works, especially *Robert le diable* (1831). Even in Italy, which was far less open to it, a streak of it is perceptible in works based on Sir Walter Scott: Rossini's *La Donna del lago* (1819) and G. Donizetti's *Lucia di Lammermoor* (1835). But both Rossini and Donizetti were at their best in *opera buffa,* which indeed, with the exception of the suavely lyrical works by the short-lived V. Bellini, remained the most vital operatic phenomenon in Italy until the advent of Verdi, who furnished only two examples of it, a failure in 1840 and *Falstaff* (1893), which, written when the composer was 80, is his most perfect work, flawless in every particular and even, unlike the operas of his earlier years, incomparably refined. It improves immeasureably on conventional *opera buffa* by removing its heartlessness and by adding poetry.

Verdi up to *Otello* (1887), and even there once or twice, could be crude; but from the first he never failed to be strikingly effective, and at his best he had not only an unfailing sense of the stage, but also a discriminating and resourceful musicianship far exceeding that of any of his Italian, and most of his other, contemporaries, and much more mastery in technical matters than is generally acknowledged. He was matched in skill only by Wagner, his exact contemporary, who, however, matured later. Wagner's *Rienzi* (1842) still shows the influence of G. L. P. Spontini, H. A. Marschner and Meyerbeer, whose works he knew well as a conductor. Wagner also knew what to his mind was feeble, artificial and illogical in conventional opera and by much theorizing arrived gradually at a thoroughgoing reform. Though this reform has not proved as vital in the hands of his imitators as he doubtless hoped, much less found general acceptance among later composers, it was more than suited to his own needs. What ultimately saved his work for future generations was not his feat of turning opera into music drama so much as his surpassing eminence as a composer. His resources are endless and perfectly serve his special requirements; his use of the leitmotiv (*q.v.*) is wonderfully eloquent and flexible,

not only because it does so much to allow the orchestra to express what the characters on the stage are doing and even thinking, but also because his handling of these themes developed into the very highest art of symphonic composition.

Romanticism in German opera verged on hysterical extravagance in Marschner's *Der Vampyr* (1828) and *Hans Heiling* (1833). Marschner also wrote an opera based on Scott's *Ivanhoe, Der Templer und die Judin* (1829). Another *Undine,* by G. A. Lortzing (1845), still enjoys some favour in Germany; but Lortzing's talent was particularly suited to comic opera, pieces deriving from the *Singspiel* and influenced by French works of the lighter kind, which flowered charmingly in Paris during the first half of the century under D. F. E. Auber, F. A. Boieldieu, A. C. Adam and L. J F Hérold.

In Russia, which now came on the operatic scene with M. I. Glinka, opera took a rather different turn, its subjects being as a rule either historical or fairy tale material. Glinka's two operas represent both tendencies: *A Life for the Tsar* (1836) the historical, *Russlan and Ludmilla* (1842) the fairy tale. Subsequent historical works were M. Mussorgsky's *Boris Godunov* (1874), A. Borodin's *Prince Igor* (posthumously, 1890) and N. Rimsky-Korsakov's *Ivan the Terrible* (1873). Most of Rimsky-Korsakov's works were fairy tales. Glinka is the great originator of many devices used by later Russians, Mussorgsky the undisciplined but powerful realist. All these were nationalist composers, but Tchaikovsky was more cosmopolitan. Except for *Eugen Onegin* (1879), however, he was never quite happy in his choice of subjects, his inspiration was unequal and his dramatic sense weak; but his technical competence and lyrical charm are considerable.

England for long had nothing of lasting value to contribute in the 19th century but M. Balfe scored successes in Italy, France and Russia as well as at home. During the last decades C. Stanford wrote fine, if not very stageworthy, works and Sir Arthur Sullivan's light pieces have remained unique of their kind, with a musical craftsmanship far surpassing that shown in the operettas of Jacques Offenbach and Johann Strauss. There were beginnings of national opera in Bohemia with F. Smetana, in Hungary with F. Erkel, in Poland with S. Moniuszko and in Spain with F. A. Barbieri.

Perhaps the most characteristic product of the 19th century, though by no means the most valuable, was the French *grand opéra,* in which C. F. Gounod, J. E. F. Massenet, among others, followed Meyerbeer and to which Rossini's last opera, *Guillaume Tell* (Paris, 1829), also belongs. It suffered from a heavy load of absurd traditions, such as the obligatory five acts and ballet. Bizet's work, culminating in the daringly inventive, realistic and splendidly orchestrated *Carmen* (Paris, 1875), blew refreshing air into this conventional stuffiness, as did, in another way, the profoundly original operas by H. Berlioz, which unfortunately had no success. A. Bruneau at the end of the century followed Bizet in a sense and V. d'Indy followed Berlioz, with a difference, but with much the same lack of success. In Italy the school of *verismo* began at that time. A. Ponchielli, R. Leoncavallo, P. Mascagni and U. Giordano turned out crudely effective works which appealed to the masses. G. Puccini followed the same lines, with better musicianship and a rather more refined artistic conscience. His *Tosca,* and G. Charpentier's *Louise,* a French work following some of the tendencies of *verismo,* both produced in 1900, brought the century to a close with both a threat and a promise.

The 20th Century.—In the next two years appeared two new composers who seemed to sweep all this away. Richard Strauss's *Feuersnot* (1901) was still Wagnerian in its music, but attempted to scandalize the public by a modern and "immoral" libretto. Claude Debussy's *Pelléas et Mélisande* (1902) first of all made a new departure by using a spoken play by Maeterlinck instead of a specially written libretto, and it shocked its hearers as much as Strauss's work had done, though in quite a different way, by disappointing every expectation of accustomed procedures. It was uneventful, unemphatic, undervitalized and almost devoid of action. But those who looked for musical quality of the finest kind and were not to be put off by understatement and drastic harmonic innovations learned to cherish this ultra-refined work, which remained unique, for Debussy never wrote another opera. Strauss did, and continued until long into old age, retaining his mastery to the last, but falling back too often on what had served him well before. Even at his best he is uncertain in style and taste, but astonishingly inventive and vibrant. *Der Rosenkavalier* (1911) is his most glamorous success, *Ariadne auf Naxos* (1912) his most enchanting work, but just beginning to show the first cracks of decay.

E. F. C. d'Albert's *Tiefland* (1903), F. Schreker's various works, which approach decadence, R. Zandonai, I. Montemezzi and E. Wolf-Ferrari (in *I Gioielli della Madonna*) continued along the line of *verismo*. Wolf-Ferrari also revived the Goldonian comedy of the 18th century, with a charm that seemed faded and a humour more Germanic than Italian. High comedy of the most sophisticated kind is represented by M. Ravel's brilliant *L'Heure espagnole* (1911). F. B. Busoni's operas ran along a remote sideline in the 20th century much as Berlioz's had done in the 19th.

One of the most interesting figures of the 20th century is the Czech L. Janáček, as thorough a nationalist as Mussorgsky and one of the most original minds in all opera, untouched by any fashion and free from preconceived theories except those connected with the natural declamation of words which unfortunately make his work almost untranslatable. The notion that theory must come first and practice conform to it, on the other hand, makes A. Schönberg's short essays in opera inaccessible to those who wish to see what an opera looks like on the stage rather than in the score. It must be said, though, that Schönberg did not apply his 12-note system rigidly to his dramatic works. A. Berg in his remarkable *Wozzeck* (1925) and his unfinished *Lulu* (posthumously, 1937) used it only as far as it would bend to his intentions. What is more remarkable about his works is that they are cast in various traditional musical forms scene by scene without allowing the least constraint to appear in the dramatic events, if also, it has to be admitted, without making these forms perceptible to the listener. An *a priori* theorist of another sort is I. Stravinsky, who always makes up his mind precisely beforehand as to what he is to do and then does it in cold blood, with extraordinary precision and skill. His Hogarthian opera, *The Rake's Progress* (Venice, 1951), which has actually very little to do with Hogarth, is deliberate 18th-century pastiche, refined, witty, often charming, but dry and appealing to intellect and taste alone.

In Germany H. Pfitzner, after several neoromantic works, produced a masterpiece of a kind in *Palestrina* (1917), long and heavy-handed, old-fashioned in some ways, but impressive. P. Hindemith's *Mathis der Maler* (Zürich, 1938) is something of the same sort, masterly, noble and inclined to dullness, but more up-to-date in its idiom. In Italy I. Pizzetti has written severely classicist works, rather like a latter-day Cherubini, and G. F. Malipiero has renewed styles and traditions of the past, not unlike Stravinsky, but exclusively Italian and with more warmth.

To modern English opera Ralph Vaughan Williams has contributed a good deal, notably his setting of J. M. Synge's *Riders to the Sea* (1938), a concentrated and profoundly truthful tragic masterpiece in one act. With Benjamin Britten's *Peter Grimes* (1945), English opera conquered the cosmopolitan scene far more quickly than Purcell did and with much greater justification than Balfe. None of his later stage works made the same impression abroad, but they made opera once again seem worthy of the attention of British composers of genius. By 1954 others had written or were writing full-scale works for the stage, including A. Benjamin, Lennox Berkeley, Sir Arthur Bliss, A. Bush, M. Tippett and Sir William Walton.

In the middle of the century operatic output in the United States brought forward work either actually or potentially capable of being exported with success. G. Gershwin's only opera, *Porgy and Bess* (1935) was perhaps helped to widespread European appreciation by the previous vogue of his musical comedies and jazz pieces. Among other composers whose operas travelled abroad or seemed likely to do so in 1953 were G. C. Menotti, M. Blitzstein and V. Thomson.

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(E. W. Bm.)

OPHICLEIDE, a brass wind instrument with a cup-shaped mouthpiece and keys; in fact the bass of the now obsolete family of keyed bugles. The name (from Gr. ὄφις serpent, and κλεῖδες keys), applied to it by Jean Hilaire Asté, known as Halary, the patentee of the instrument, is hardly a happy one, for there is nothing of the serpent about it. The ophicleide is almost perfect theoretically, for it combines the natural harmonic scale of the brass wind instruments having cup-shaped mouthpieces, such as the trumpet, with a system of keys, 9 to 11 in number (a 12th added in 1822 never came into general use), producing a full chromatic scale, and it is capable of absolutely accurate intonation. Unfortunately its tone is not satisfactory, the lower register being rough, the medium coarse and the upper wild and unmusical; but for some special effects it served well (*e.g.,* the donkey's bray in Mendelssohn's *Midsummer Night's Dream* overture). It has been orchestrally superseded by the bass tuba and by the double bassoon and, in the military band, by the bombardon.

The invention of the ophicleide is sometimes falsely attributed to Alexandre Frichot, a professor of music at Lisieux. Actually the first idea of adding keys to instruments with cupped mouthpieces, unprovided with lateral holes, with the aim of filling up some of the gaps between the notes of the harmonic scale, goes back, according to E. L. Gerber, to Kölbel, a horn player in the St. Petersburg Imperial orchestra, about 1760. Anton Weidinger, trumpeter in the Austrian imperial band, improved upon this first attempt, and applied it in 1800 to the trumpet. In 1810 Joseph Halliday, bandmaster of the Cavan militia, patented a key bugle: a copy of it was ordered in Paris from Halary, a professor of music and instrument maker, who brought out in 1817 and patented in 1821 a set of three key bugles, the bass instrument of which he named *ophicléide,* with the misleading alternative *ou serpent à clef*. The instrument was never standardized, and the lack of a system of fingering helped to bring about its extinction.

OPHIR, an unidentified region famous in Old Testament times for its fine gold. Solomon's Tyrian sailors brought its gold for that monarch. The geographical list of Genesis X. associates it with Sheba and Havilah, the latter also being a recognized gold bearing region (Gen. ii. 11). Solomon's ships set forth from Ezion-Geber at the head of the Gulf of Akaba. Presumably then it lay somewhat to the south of Suez, but where?

(1) *East Africa.*—The extensive and imposing ruins discovered at Zimbabwe in Mashonaland, about 200m. inland from Sofala, have been acclaimed as marking the site of long lost Ophir. But careful investigation has resulted in depriving the ruins of any claim to great antiquity. An identification with Zanzibar has been suggested.

(2) *The Far East.*—The fact that three years were occupied in the voyage to Ophir (1 Ki. x. 22) as well as the nature of the cargoes (gold, silver, ivory, apes and peacocks) suggests a distant voyage, although attempts have been made to minimize these arguments. The Indus delta; Johore; Supara in Goa; Farther India; Malabar; Malacca; Sumatra have all been adduced.

(3) *Abyssinia.*—The territory on the Abyssinian coast from ancient Adulis to Bab-el-Mandeb whose inhabitants call themselves Aphar.

(4) *Arabia.*—The most common and, indeed, the most plausible view is that Ophir was somewhere in Arabia. It has been sought in West Arabia at Asyr between the Hejāz and Yemen; but the view that it is some district on the southern coast appears the most atractive.

The lack of sufficient data for identification has given and no doubt will continue to give scope for imagination. There have not been wanting wild and fanciful surmisings. Spain, Armenia, Phrygia and even Peru have had their advocates. (E. Ro.)

OPHITES. Strictly speaking, this is the name given to an obscure sect of Gnostics, of which our knowledge is derived mainly from Origen (*Contra Celsum,* vi. 25) supplemented by Irenaeus (*Adv. Haer.,* i. 30) and Epiphanius (*Haer.,* xxxviii); but the more important use of the term is as the comprehensive name for a group of Gnostic sects which resemble one another, first, because no name of any personal founder or leading teacher is associated with any of them; and further, because they attach religious importance to the serpent. The type of mythology may be illustrated from the account of Irenaeus. It begins with a triad, the highest deity, described as "primal Man"; intellect or reason, his Son, the "second Man"; and the Spirit, introduced as a female principle. Through her the Christ is begotten as "third Man." Christ ascended, with the Spirit, but in their ascent a ray of light fell on the waters. This was Sophia (prudence or wisdom) and from this contact came Ialdabaoth the "demiurge." He in turn produced six powers, and (from the dregs of matter) the serpent. Ialdabaoth then announced himself as the supreme Being; and when man (created by the six powers) gave thanks not to Ialdabaoth but to the primal Man, the former created a woman (Eve) to destroy him. Then Sophia sent the serpent (as benefactor) to persuade Adam and Eve to eat of the tree of knowledge and so break the commandment of Ialdabaoth, who banished them from paradise to earth. After a long war between mankind, aided by Sophia, and Ialdabaoth (this is the inner meaning of the Old Testament story), the Spirit sent the Christ to earth to enter the pure vessel, the virgin-born Jesus. Jesus Christ worked miracles and declared himself the Son of the primal Man. Ialdabaoth instigated the Jews to kill him, but only Jesus died on the cross, for Christ had departed from him. Christ then raised the spiritual body of Jesus, which remained on earth for 18 months, initiating a small circle of elect disciples.

This form of Ophitism is Christianized to a larger extent than others of the kindred sects, in most of which the Christian element is slighter and less essential. They are also far less impregnated with Greek philosophy than the "classic systems of Gnosticism"; and the early sources warrant the inference that the mythology itself is only a covering for observances (ritual, initiation, secret pass-words, incantations) characteristic of mystery-religions.

Notwithstanding the conclusion based by De Faye on his instructive investigations, the prevalent view holds the field, namely, that Ophitism represents a primitive phase of Gnosticism, which was gradually developed and transformed into various great speculative systems by a series of historic teachers.

See E. F. Scott, art. "Ophitism" in Hastings, *Encyclopaedia of Religion and Ethics;* Lichtenhahn, art. "Ophiten" in Herzog-Hauck, *Realencyklopädie;* E. de Faye, *Gnostiques et Gnosticisme* (1913); Reitzenstein, *Peimandres* (1904). *See* also GNOSTICISM. (S. H. M.)

OPHIUCHUS, in astronomy, a constellation of the northern hemisphere, anciently named Aesculapius, and mentioned by Eudoxus (4th century B.C.) and Aratus (3rd century B.C.). According to the Greek fables, it variously represents: Carnabon (or Charnabon), king of the Getae, killing one of the dragons of Triptolemus, or Heracles killing the serpent at the river Sangarius (or Sagaris), or the physician Asclepius (Aesculapius), to denote his skill in curing snake bites. Like Sagittarius (which it adjoins) it includes a region of the sky rich in globular clusters and diffuse nebulae. A very bright nova or new star was observed in Ophiuchus in 1604.

OPHIUROIDEA: *see* BRITTLE STARS.

OPHRYS, a genus of plants of the orchid family (*Orchidaceae*), comprising about 30 species native to Europe, western Asia and North Africa, including the bee-orchis (*O. apifera*), the spider-orchis (*O. aranifera*) and the fly-orchis (*O. muscifera*), the second of which is one of the few orchids that are self-fertilized.

(*See* ORCHIDS; also C. Darwin, *The Fertilisation of Orchids.*)

OPHTHALMOLOGY (*see* EYE, HUMAN). The science of ophthalmology deals with the processes by means of which the images of external objects are brought to our consciousness. It is therefore concerned with:

(*a*) the eye itself; (*b*) the nerve paths and tracts which convey visual impulses originating in the eye, through the different parts of the brain to the brain cortex, where these impulses are converted into conscious impressions; (*c*) the eyelids which cover and protect the eyes; (*d*) the tear glands and ducts; (*e*) the muscles that bring about the movements of the eyes and keep them trained in the desired direction; (*f*) the nerves and their complicated cerebral connections which supply these muscles; (*g*) the bony walls of the orbit; (*h*) the blood-vessels and lymph paths which maintain the nutrition of all these structures.

It treats of disease in these parts and derives importance from the fact that many diseases of the central nervous system and many general diseases manifest themselves by some derangement of function or structure which can be detected by the ophthalmic surgeon.

The eye is unique in the body in that its retina, which is available to minute examination by means of the ophthalmoscope, is the only portion of the brain available to inspection during life. Similarly, the arteries and veins which supply the retina can also be minutely examined during life, the diseases of them observed and followed in all their changes. The value of these observations is enhanced by the fact that the eye itself acts as a low-power microscope, providing a magnification of about 15 diameters for the examination of these structures. The eyes are the subject of a number of hereditary diseases, and form one of the most convenient media for the study of transmission of such diseases.

Affections of the Eye.—The function of the eyeball is to provide that a clear image of external objects shall be formed upon the retina, but in certain cases it departs from the normal and the acuity of sight is lowered. It may be too long, so that the retina lies behind the point at which the images of external objects are formed; this is myopia or short-sightedness, and may be compensated by the wearing of concave lenses in the form of spectacles. In other cases, the eyeball is too short and the retina lies in front of the point at which the image of external objects is formed. This is hypermetropia or long-sightedness; it can be compensated by the focusing muscle of the eye, making the lens more convex; or, preferably, by the wearing of appropriate convex lenses in the form of spectacles. In astigmatism the refractive power of the eye varies in different axes, so that, for instance, in an extreme case the vertical axis may be myopic whilst the horizontal axis is hypermetropic.

Normally the visual axes of the two eyes are parallel and images of external objects are formed upon corresponding points of each retina. This arrangement is largely responsible for stereoscopic vision, which enables us to judge the position of objects in space with accuracy. Should it be upset *e.g.* by paralysis of some of the muscles, stereoscopic vision is lost and double vision usually arises.

Eyeball and Camera Compared.—The eyeball may be likened to a photographic camera. Roughly speaking it is globular in shape and is an inch long in all dimensions. The front part, or cornea is curved, is perfectly transparent and functions as a lens. Behind it is a chamber filled by the aqueous humour—little more than water. Further back is the iris—the coloured part of the eye. The hole in its centre forms the pupil, and by contraction or dilation of the tissues of the iris the pupil can be varied in size through a wide range; it may be compared to the stop in the camera. In bright lights the pupil is small, and it becomes large in dull illumination. The iris rests behind upon the lens.

The lens is bi-convex, its back surface having the greater curvature. It is perfectly transparent, and the focusing of the eye for near or distant objects is brought about by alteration in its curvatures by contraction of the ciliary muscle. Here is an essential difference between the eye and the photographic camera, whose focus is adjusted by shifting the position of the lens. As age proceeds, opacities frequently develop in the lens; almost everyone at the age of 60 or over may be said to have the beginnings of cataract, though the sight is quite unaffected thereby. When, however, these opacities involve the centre of the lens, and render sight very imperfect, the term of cataract becomes applicable; in such a case the cataract can be removed by operation and the sight restored.

Vitreous Chamber and Retina.—Behind the lens is the vitreous chamber, which is occupied by a perfectly transparent, colourless substance, much like white of egg. Clothing the back of the eye, and extending forward some distance in front of its equator, is the retina. It rests upon a highly vascular membrane which is responsible for the nutrition of the greater part of it, namely the choroid; in man, however, the retina has its own blood vessels clearly visible with the ophthalmoscope. The retina may be likened to the sensitive plate of the camera for upon it images are formed which initiate impulses which, when conveyed to the cortex of the brain, give rise to the sensations of sight. Its sensitive layer is placed posteriorly, and is composed of delicate structures known as the rods and cones.

At the central spot or yellow spot of the retina, the point of distinct vision, cones alone are present. The rods are believed to be concerned with lights of lower intensities, and in accordance with this they alone are present in night-flying birds (*see* VISION or SIGHT).

Optic Nerves and the Cerebral Cortex.—The nerve fibres from the retina converge upon the optic disk, and leave the eye as the optic nerve, which traverses the orbit to enter the skull. Inside the skull the two optic nerves meet and each is divided into two parts, one part continuing to the mid-brain on the same side, the other part crossing over to the opposite side. This crossing forms the chiasma; in many animals, the birds for instance, the whole of each optic nerve crosses over in this way. Beyond the chiasma the nerve fibres are again collected into a compact bundle known as the optic tract, which terminates in the mid-brain. From here nervous impulses are relayed in two chief directions; some connect up with the nerves which control the movements of the eyes and others, forming the so-called optic radiations, make a long sweep backwards to reach the cerebral cortex, where, as already stated, the impulses are transformed to sensations of sight.

The exact area of the cerebral cortex, in which these fibres end, is known with great accuracy and forms the visual cortex. It is placed at the extreme hind end of the brain, and the adjoining mesial surface of each hemisphere, in the region of the calcarine fissure (*see* BRAIN). Should a minute portion of this cortex be cut out as the result of injury or blocking of its blood supply, the precise area of the defect which will be found in the vision can be stated with certainty. This accurate localisation was much advanced as a result of observations that were made during World War I.

General Diseases and the Eye.—Among the general diseases of the body in which important manifestations occur in connection with the eye a few may be mentioned.

In brain tumours or abscesses, swelling of the optic disk is seldom absent, and forms perhaps the most important sign in the diagnosis of the condition. In addition, the ocular nerves may have their functions interrupted, so that the movements of the eyes are interfered with, they no longer move in unison and double vision occurs. If nothing can be done for the brain tumour the optic nerve atrophies and blindness ensues. In advanced renal disease changes in the retina develop and convey a particularly grave prognosis, for patients seldom live as long as two years after their discovery.

In diabetes a similar change may also arise, which may greatly spoil the sight, and although of less serious import than in renal cases, it must be considered a bad omen. Venereal disease frequently attacks the eye, whether in the early or late stages, and is perhaps the most prolific source of blindness. Tuberculous disease occasionally occurs.

In diseases of the blood in general, eye signs are very common, and there are many other diseases where the diagnosis may be greatly assisted by the discovery of changes in some part of the ocular apparatus.

The introduction of the "slit lamp" has made possible many investigations which previously were quite outside the scope of an ophthalmologist. (R. F. M.)

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OPIE, AMELIA (1769–1853), English author, daughter of James Alderson, a physician in Norwich, where she was born on Nov. 12, 1769. Miss Alderson had inherited radical principles and was an ardent admirer of Horne Tooke. She was intimate with the Kembles and with Mrs. Siddons, with Godwin and Mary Wollstonecraft. In 1798 she married John Opie, the painter. In 1801 she produced a novel entitled *Father and Daughter,* which showed genuine fancy and pathos. She published a volume of graceful verse in 1802; *Adeline Mowbray* followed in 1804, *Simple Tales* in 1806, *Temper* in 1812, *Tales of Real Life* in 1813, *Valentine's Eve* in 1816, *Tales of the Heart* in 1818, and *Madeline* in 1822. In 1825 she joined the Society of Friends. She died at Norwich on Dec. 2, 1853.

A *Life,* by Miss C. L. Brightwell, was published in 1854.

OPIE, JOHN (1761–1807), English historical and portrait painter, was born at St. Agnes near Truro in May 1761. While quite young he won some local reputation by portrait-painting; and in 1780 he started for London, under the patronage of Dr. Wolcot (Peter Pindar), and was introduced to the town as "The Cornish Wonder," a self-taught genius. He became a fashionable portrait painter, but after a period of prosperity fell into neglect. He then set himself to make good the defects of his early education by studying Latin, French and the English classics as well as the technique of his art.

His first important historical subject to be exhibited was the "Assassination of James I.," followed by his "Murder of Rizzio" which secured his immediate election, in 1786, as associate of the Academy, of which he became a full member in 1787. He was employed on five subjects for Boydell's "Shakespeare Gallery"; and until his death on April 9, 1807, his practice alternated between portraiture and historical work. His painting shows breadth of handling and a certain rude vigour, individuality and freshness, but lacks grace and poetic feeling.

Opie's portraits of Mary Wollstonecraft, of himself, and the "Portrait of a Boy" are in the national collections. He also wrote a *Life of Reynolds* in Wolcot's edition of Pilkington and a *Letter on the Cultivation of the Fine Arts in England,* in which he advocated the formation of a national gallery. His Academy *Lectures* were published in 1809 with a memoir by his widow (*see* above). *See* also Claude Phillips,

"John Opie" (*Gazette des Beaux-Arts,* 1892, i, 299).

OPISTHOCOMUS HOAZIN: *see* HOATZIN.

OPISTHODOMOS: *see* EPINAOS.

OPITZ VON BOBERFELD, MARTIN (1597–1639), German poet, was born at Bunzlau, Silesia, on Dec. 23, 1597, and studied at Frankfurt-on-Oder, Heidelberg and Leyden. He led a wandering life in the service of various territorial nobles. In 1624 he was appointed councillor to duke George Rudolf of Liegnitz and Brieg in Silesia, and in 1625, as reward for a requiem poem composed on the death of archduke Charles of Austria, was crowned laureate by the emperor Ferdinand II who a few years later ennobled him under the title "von Boberfeld." He was elected a member of the *Fruchtbringende Gessellschaft* in 1629, and in 1630 went to Paris, where he made the acquaintance of Hugo Grotius. He settled in 1635 at Danzig, where Ladislaus IV of Poland made him his historiographer and secretary. Here he died of the plague on Aug. 20, 1639.

Opitz was the head of the so-called First Silesian school of poets, and was during his life regarded as the greatest German poet. He was the "father of German poetry," at least in respect of its form; his *Buch von der deutschen Poeterey,* written in 1624, put an end to the hybridism that had until then prevailed, and established rules for the "purity" of language, style, verse and rhyme. Opitz's own poems are in accordance with the rigorous rules which he laid down. They are mostly a formal and sober elaboration of carefully considered themes, and contain little beauty and less feeling. To this didactic and descriptive category belong his best poems.

Collected editions of Opitz's works appeared in 1625, 1629, 1637, 1641, 1690 and 1746. His *Ausgewählte Dichtungen* have been edited by J. Tittmann (1869) and by H. Oesterley (Kürschner's *Deutsche Nationalliteratur,* vol. xxvii. 1889). There are modern reprints of the *Buch von der deutschen Poeterey* by W. Braune (2nd ed., 1882), and, together with *Aristarchus,* by G. Witkowski (1888), and also of the *Teutsche Poemata,* of 1624, by G. Witkowski (1902). *See* H. Palm, *Beiträge zur Geschichte der deutschen Literatur des 16ten und 17ten Jahrhunderts* (1877); K. Borinski, *Die Poetik der Renaissance* (1886); R. Beckherrn, *Opitz, Ronsard und Heinsius* (1888). Bibliography by H. Oesterley in the *Zentralblatt für Bibliothekswesen* for 1885.

OPIUM. The drug known in commerce as opium is derived from the immature fruits of *Papaver somniferum* (fig. 1), family *Papaveraceae,* by slightly incising the fruits and collecting and drying the exuded milky juice.

There are several forms of the plant in cultivation for yielding opium. The truly wild plant (*var. setigerum*) is found on the northern coast of the Mediterranean. It has acutely toothed leaves, the lobes sharp-pointed, each ending in a bristle. The leaves, flower stalks and sepals are covered with scattered bristly hairs, and the stigmata are seven or eight in number.

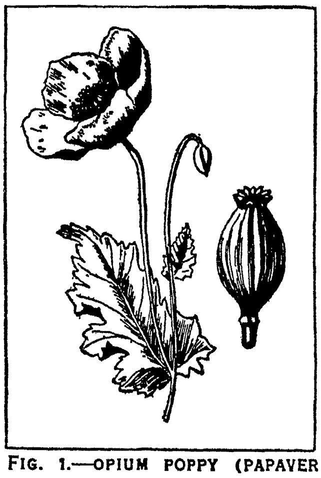

FIG. 1.—OPIUM POPPY (PAPAVER SOMNIFERUM)

The variety of the plant chiefly cultivated in Asia Minor and Egypt is distinguished by having a sub-globular fruit and 10 to 12 stigmata. It is glabrous and is known as *var. glabrum.*

The one cultivated in Persia is *var. album,* which has a fruit more or less egg-shaped; the pores below the stigmata do not open when the fruits are ripe. It varies in the colour and shape of the petals. Those (the majority) with white petals have usually white seeds, those with reddish or purple petals have usually slate-coloured seeds.

Cultivation.—The successful cultivation of the plant is only possible where there is not an excessive rainfall and where the climate is tropical or sub-tropical. The yield of opium is smaller in temperate than in tropical regions and the industry can only be profitably carried on where labour and land are sufficiently cheap and abundant.

The mode of cultivation adopted varies. In Turkey, from which the chief supplies of medicinal opium are obtained, the cultivation is carried on by peasant proprietors. A naturally light and rich soil is chosen, improved by manure and irrigation where necessary, and the land should be sloping and well drained, moisture in excess being injurious. The ground is ploughed twice, the second time crosswise. The seed is mixed with four times its weight of sand to prevent it being sown too thickly, $\frac{3}{4}$ to 1 lb.

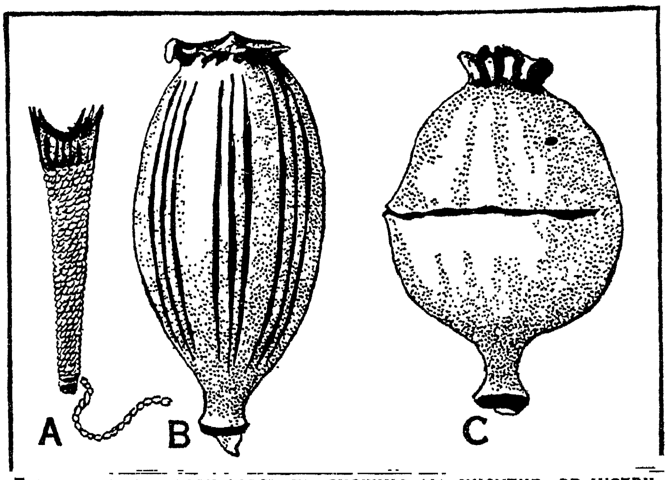

FIG. 2.—OPIUM POPPY CAPSULES, SHOWING (A) NUSHTUR, OR INSTRUMENT USED IN INDIA FOR MAKING THE INCISIONS, DRAWN FROM SPECIMENS IN THE MUSEUM OF THE PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, (B) CAPSULE AS INCISED IN INDIA, (C) MODE OF INCISION PRACTISED IN TURKEY

being used to every *toloom* (1,600 sq.yd.). The crop is very uncertain owing to droughts, ground-frosts and locusts. To avoid failure, and to allow time for collecting the produce, every toloom has three sowings from October to March, the crops thus coming to perfection in succession. In localities where there is hoar frost in spring, the seed is sown in September, or at latest in the beginning of October. The yield of opium and seed is then greater than if sown later. After sowing, the land is harrowed and young plants are hoed and weeded, chiefly by women and children, from early spring until the time of flowering. In the plains the flowers expand at the end of May, and on the uplands in July. At this period gentle showers are of great value, as they cause an increase in the subsequent yield of opium. The petals fall in a few hours, and the capsules grow so rapidly that in a short time—generally from nine to 15 days—the opium is fit for collection. This period is known by the capsules yielding to pressure from the fingers, by assuming a lighter green tint, and by exhibiting a kind of bloom called "cougak," easily rubbed off with the fingers; they are then about $1\frac{1}{2}$ in. in diameter. The incisions are made by holding the capsule in the left hand and drawing a knife two-thirds round it, or spirally beyond the starting point (fig. 2), great care being taken not to let the incisions penetrate to the interior, lest the juice should flow inside and be lost; in this case also it is said that the seeds will not ripen, and that no oil can be obtained from them. The operation is usually performed after the heat of the day, commencing early in the afternoon and continuing to nightfall, the exuded juice being collected next morning. This is done by scraping the capsule with a knife, transferring the concreted juice to a poppy-leaf held in the left hand, the edges of the leaf being turned up to avoid spilling the juice; the knife-blade is moistened with saliva by drawing through the mouth after every alternate scraping to prevent the juice from adhering to it. When as much opium has been collected as the size of the leaf will allow, another leaf or more is wrapped over the top of the lump, which is then placed in the shade to dry for several days. The pieces vary in size from about 2 oz. to 2 lb., being made larger in some districts than in others. The capsules are generally incised only once, but the fields are visited a second or even a third time to collect the opium from the poppy-heads subsequently developed by the branching of the stem. The yield of opium varies, even on the

same piece of land, from one-third to $7\frac{1}{2}$ *chequis* (or 1·62 lb.) per *toloom*, the average being $1\frac{1}{2}$ *chequis* of opium and 4 bushels (50 lb.) of seed. The seed, which yields 35 to 42% of oil, is worth about two-thirds the value of the opium. The whole of the operation must, of course, be completed in the few days, usually from five to ten, during which the capsules are capable of yielding the drug.

Macedonian Opium.—Four varieties of poppy are cultivated—two with white flowers and large oval capsules without holes under their "combs" (stigmata), and bearing respectively yellowish and white seed, and the other two having red or purple flowers and seeds of a slate colour with a reddish layer under the surface, one bearing small capsules perforated just below the top and the other larger capsules not perforated. The white varieties are recommended as bearing more abundant opium of superior quality. The yellow seed is said to yield the best oil; that obtained by hot pressure is used for lamps and for paint and the cold-pressed oil for culinary purposes.

Indian Opium.—The poppy grown in India is usually the white-flowered variety, but in the Himalayas a red-flowered poppy with dark seeds is cultivated. The land intended for poppy culture is usually near villages, in order that it may be more easily manured and irrigated. On a rich soil a crop of maize or vegetables is grown during the rainy season, and after its removal in September the ground is prepared for poppies. Under less favourable circumstances the land is prepared from July till October by ploughing, weeding and manuring. The seed is sown between Nov. 1 and 15, and germinates in 10 or 15 days. The fields are divided for purposes of irrigation into beds about 10 ft. square, which usually are irrigated between November and February; but if the season be cold, with hardly any rain, the operation is repeated five or six times. When the seedlings are 2 or 3 in. high, they are thinned out and weeded. The plants during growth are liable to injury by severe frost, excessive rain, insects, fungi and the growth of a root-parasite (*Orobanche indica*). The poppy flowers about the middle of February, and the petals, when about to fall, are collected for the purpose of making "leaves" for the spherical coverings of the balls of provision opium, or cannon ball opium as it is popularly called.

Persian Opium.—The variety grown in Persia appears to be *var. album*, having roundish ovate capsules. Several forms of this variety are grown. The best quality of Persian opium is said to be derived from the white-flowered form, which is the earliest to flower and most widely grown; a second quality from a bizarre flower with deeply cut petals and a central band of bluish-purple flanked with rich magenta; a third quality from a white flower with broad margins and an apex of salmon pink and magenta; a fourth from a dark scarlet flower with a central band of bluish purple to within a fifth of the apex of the petals; a fifth from a dark bluish purple flower; a sixth from a lilac flower suffused with faint purple colour, which is considered to yield a very poor quality indeed. The more fully exposed the plants are to the sun the finer the crop.

European Opium.—Experiments made in England, France, Italy, Switzerland, Greece, Spain, Germany, and even in Sweden prove that opium as rich in morphia as that of Eastern countries can be produced in Europe. In 1830, Young, a surgeon at Edinburgh, succeeded in obtaining 56 lb. of opium from an acre of poppies, and sold it at 36s. a pound. In France, the cultivation has been carried on since 1844 at Clermont-Ferrand by Aubergier. The juice, of which a workman is able to collect about 9·64 troy oz. in a day, is evaporated by artificial heat immediately after collection. The juice yields about one-fourth of its weight of opium, and the percentage of morphia varies according to the variety of poppy used, the purple one giving the best results. By mixing assayed samples he is able to produce an opium containing uniformly 10% of morphia. It is made up in cakes of 50 grammes but is not produced in sufficient quantity to become an article of wholesale commerce. Some specimens of French opium have been found by Guibourt to yield 22·8% of morphia, being the highest percentage observed as yet in any opium Experiments made in Germany by Karsten, Jobst, and Vulpius have shown that it is possible to obtain in that country opium of excellent quality, containing 8 to 13% of morphia. It was found that the method yielding the best results was to make incisions in the poppy-heads soon after sunrise, to collect the juice with the finger immediately after incision, and evaporate it as speedily as possible, the colour of the opium being lighter and the percentage of morphia greater than when the juice was allowed to dry on the plant. Cutting through the poppy-heads caused the shrivelling up of the young fruit, but the heads which had been carefully incised yielded more seed than those which had not been cut at all. Newly manured soil was found to act prejudicially on the poppy. The giant variety of poppy yielded most morphia.

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Medicine.—Of the opium alkaloids only morphine and codeine are used to any extent in medicine. Thebaine is not so used, but is an important and sometimes very dangerous constituent of the various opium preparations, which are still largely employed, despite the complexity and inconstant composition of the drug. Of the other alkaloids narceine is hypnotic, whilst thebaine, papaverine and narcotine have an action which resembles that of strychnine. So complex a drug as opium is necessarily incompatible with a large number of substances. Tannic acid, for instance, precipitates codeine as a tannate, salts of many of the heavy metals form precipitates of meconates and sulphates, whilst the various alkalis, alkaline carbonates and ammonia precipitate the important alkaloids.

The pharmacology of opium differs from that of morphine (*q.v.*) in a few particulars. The chief difference is due to the presence in opium of thebaine, which readily affects the more irritable spinal cord of very young children. In infants especially opium acts markedly upon the spinal cord, and, just as strychnine is dangerous when given to young children, so opium, because of the strychnine-like alkaloid it contains, should never be administered, under any circumstances or in any dose, to children under one year of age.

When given by the mouth, opium has a somewhat different action from that of morphine. It often relieves hunger, by arresting the secretion of gastric juice and the movements of the stomach and bowel, and it frequently upsets digestion from the same cause. Often it relieves vomiting, though in a few persons it may cause vomiting, but in far less degree than apomorphine, which is a powerful emetic. Opium has a more marked diaphoretic action than morphine, and is much less certain as a hypnotic and analgesic.

Toxicology. (*See* also DRUG ADDICTION and POISON).—Under this heading must be considered acute poisoning by opium, and the chronic poisoning seen in those who eat or smoke the drug. Chronic opium poisoning by the taking of laudanum—as in the familiar case of De Quincey—need not be considered here, as the hypodermic injection of morphine has almost entirely supplanted it.

The acute poisoning presents symptoms not easily distinguished from those produced by alcohol, by cerebral haemorrhage and by several other morbid conditions. The differential diagnosis is of the highest importance, but very frequently time alone will furnish a sufficient criterion. The patient who has swallowed a toxic or lethal dose of laudanum, for instance, usually passes at once into the narcotic state, without any prior excitement. Intense drowsiness yields to sleep and coma which ends in death from failure of the respiration. This last is the cardinal fact in determining treatment. The comatose patient has a cold and clammy skin, livid lips and ear-tips—a grave sign—and "pin-point pupils." The heart's action is feeble, the pulse being small, irregular and

often abnormally slow. The action on the circulation is largely secondary, however, to the all-important action of opium on the respiratory centre in the medulla oblongata. The centre is directly poisoned by the circulation through it of opium-containing blood, and the patient's breathing becomes progressively slower, shallower and more irregular until finally it ceases altogether.

Treatment.—In treating acute opium poisoning the first proceeding is to empty the stomach. The best emetic is apomorphine, which may be injected subcutaneously in a dose of about one-tenth of a grain. But the gastric wall is often paralyzed in opium poisoning, so that no emetic can act. It is therefore better to wash out the stomach, at half-hour intervals, with a solution containing about ten grains of salt to each ounce of water. If apomorphine is obtainable, both of these measures may be employed. Potassium permanganate decomposes morphine by oxidation, the action being facilitated by the addition of a small quantity of mineral acid to the solution. The physiological as well as the chemical antidotes must be employed. The chief of these are coffee or caffeine and atropine. A pint of hot strong coffee may be introduced into the rectum, and caffeine in large doses—10 or 20 grains of the citrate—may be given by the mouth. A 20th, even a 10th of a grain of atropine sulphate should be injected subcutaneously, the drug being a direct stimulant of the respiratory centre. Every means must be taken to keep the patient awake. He must be walked about, have smelling salts constantly applied to the nose, or be stimulated by the faradic battery. But the final resort in cases of opium poisoning is artificial respiration, which should be persevered with as long as the heart continues to beat.

OPIUM EATING AND OPIUM SMOKING. It is evident that the ancient Egyptians had no knowledge of the medicinal and other properties of opium, as there is no reference to it in their literature. Opium was taken to Greece, and Homer (9th century B.C.) appears to have referred to it in the *Iliad* as inducing forgetfulness of pain and sense of evil. Pedanios Dioscorides (1st century A.D.) described in detail the extraction of opium and its properties, which became universally known in the following centuries. Its use spread and the cultivation of the poppy in Asia Minor developed into a big industry. The Arab traders were chiefly responsible for transporting it to the remotest corners of Asia and spreading knowledge of its remarkable effects. Opium was probably introduced into India not earlier than the 9th century A.D., as there is no word equivalent to it in Sanskrit or Hindi. In the 15th century it was undoubtedly widely known and used both for medicinal and euphoric purposes. Opium was introduced into China by the Arabs in the 13th century; at first it was used entirely for medicinal purposes. In the 17th century opium smoking began and rapidly spread, and imports, especially from India, increased. In 1906, 27% of adult Chinese males smoked opium, and later, when the League of Nations was established, imports into China were curtailed and the use of opium restricted.

Habituation to Opium.—Certain properties of opium lead to its use in ever-increasing doses. The drug induces tolerance in the individual taking it, which means that the effects of the dose gradually decrease after it has been repeated for some time. Therefore the dose must be increased to give the same effects produced by the initial dose. Tolerance then becomes greater and the effective dose has to be correspondingly increased. In India there are records of individuals taking more than two ounces of opium a day for prolonged periods. Allied to toleration is the phenomenon of habituation, meaning psychical adaptation and mental conditioning to the repetition of an effect. This occurs also with other drugs, but is much more intense with opiates (*see* DRUG ADDICTION). The distortion of normal physiological processes resulting from prolonged use produces psychical dependence or habituation which manifests itself by requiring adequate amounts of the drug in the body to maintain physical and mental equilibrium. Once such dependence is established, the withdrawal of the drug is accompanied by abstinence phenomena. In man dependence gradually develops and although it may become extreme, it never arrives at a point when opiates are thereafter necessary to maintain life. In the initiated, habituation takes approximately six months, its development being favoured more by regular administration than by the quantity of the drug consumed.

Opium Eating.—This is mostly practised in Iran and India, and in the latter country on a larger scale than elsewhere. Studies by Sir R. N. Chopra show that in India little opium is used by the practitioners of indigenous and western medicine. It is, however, used extensively as a household remedy to relieve pain, especially in gastric and respiratory ailments. Though less common now, it is still the practice to give opium to infants to keep them quiet. Opium is usually taken in the form of a pill or as a solution in water. Because of restrictions on production and sale and an increase in price, its use greatly decreased after the early years of the 20th century. Indian addicts to opium eating can be divided into three groups: (1) About 50% take it for relief from ailments; (2) 20% to 30% take it to obtain escape from difficulty or worry; (3) 15% to 20% take it simply for pleasure. The dose taken by the first two groups is always small and not rapidly progressive, but in the third group it is large and ever-increasing. In a series of 1,000 cases, the average daily dose was found to be about ten grains. Habitual use of opium produces physical, mental and moral deterioration, proportional to the dose taken. Those taking small doses such as one to three grains daily show no apparent signs of the dulling of physical and mental faculties or the chronic toxaemia which are marked effects of larger doses.

Opium Smoking.—This is indulged in on a large scale in China, the Indian archipelago and India. It is the outcome of tobacco smoking and presents a serious problem. In India the habit was held in contempt, and stringent regulations were enacted against it. By 1950 opium smoking was, therefore, dying out in India, except in Assam and Madhya Pradesh where social and economic factors were responsible for its continuance. In Chopra's series of 300 cases, it was found that the habit had been contracted in 50% of the cases by association with other smokers purely for its euphoric (pleasurable) effects, in 33% for relief of ailments and in 17% to overcome worry and strain. Much larger quantities of opium were used for smoking than for eating, and the effect on the general health of even moderate smokers was much more marked. The dose ranged from 2 to 180 gr. a day, the average being 25 gr. The abstinence symptoms were also more severe. The racial factor was significant; although the average daily doses taken by a Chinese were two to three times larger than those of an Indian, the ill effects in the former were much less marked. In the case of the Indians, excessive indulgence seriously damaged health, caused loss of physical energy and deterioration of intellect and so reduced earning capacity and shortened life.

Opium is prepared for smoking by prolonged boiling with water and removing impurities in the form of scum, by evaporating and, lastly, by a process of toasting. In 1950 it was still not known whether the active principles become more potent through such a process. The preparations used in India are: (1) chandoo, which is opium prepared as above and which is also the form smoked in China; (2) madak, which is purified opium diluted with charred leaves of *Acacia arabica* (babal) (1 oz. opium = 2½ oz. madak); (3) opium dross, which is the residue left in the pipe after smoking and contains more than 7% of morphine and is smoked again. The smoker does not absorb more than one-tenth of the total amount of morphine contained in opium; there must, therefore, be other unrecognized factors responsible for the intense effects produced. The following table, compiled by W. E. Dixon and published in his article "The Drug Habit" in the *British Medical Journal*, vol. ii, p. 819 (1921), shows the composition of opium and tobacco smoke.

Analysis of Tobacco and Opium Smoke in Conditions Approximating Those Which Occur in Smoking

	Hydrocyanic acid	Pyridine	Nicotine	Ammonia	Carbon monoxide	Morphine
100 g. tobacco burnt as cigarettes	0 080 g.	0.146 g.	0.165 g.	0.360 g.	410 c.c.	—
100 g dross opium containing 7.35% morphine	0 010 g.	0.147 g.	—	0.395 g.	—	0.016 g. (0.1% chandoo smoke)

Source. W. E. Dixon, "The Drug Habit," *British Medical Journal*, 2:819 (1921).

Nicotine and carbon monoxide, which are the chief constituents of tobacco smoke responsible for its ill effects, are entirely absent in opium smoke. Morphine and pyridine bases are predominant and may be responsible for the profound effects by synergistic, or co-operative, action.

The method of smoking opium followed by the Chinese and Indian smokers is similar. The apparatus consists of a pipe, a stylet, a lamp and a headrest. The dose of prepared opium is heated over the flame at the end of the stylet until a small ball of roasted opium is formed. This is then pushed into the pipe head and the pipe is ready for smoking. The opium mass is held over a flame or live charcoal, while the smoker inhales deeply a number of times, taking the smoke well into the lungs. The actual smoking of the pipe takes about a minute; more prepared opium is taken if the smoker desires to continue. The effects produced are immediate since the lungs present a large surface for absorption.

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OPIUM TRAFFIC. The use of the poppy and the coca leaf is quite ancient. However, its organized use for the purposes of commerce and revenue seems to have developed after 1700, in spite of protests against its use for other than medical and scientific purposes.

In 1783 Warren Hastings pronounced opium to be "a pernicious article of luxury which ought not to be permitted but for the purpose of foreign commerce only!" A few years later the directors of the East India company wrote, "If it were possible to prevent the use of the drug altogether except strictly for the purpose of medicine we would gladly do it in compassion to mankind," and Lord Ashley in 1843 proposed a resolution in the British parliament to the effect that the continuance of the opium monopoly and opium trade "was utterly inconsistent with the honour and duty of a Christian kingdom." Yet in the 20th century there were still countries whose colonies obtained large revenues from such monopolies.

The importation of opium into China by foreign traders led to the war of 1840 between Great Britain and China. The Chinese, in spite of the fact that they were not the victors and despite any pressure brought to bear upon them, still refused to legalize the opium trade. China was now open to the world and a huge smuggling trade in opium sprang up which gave rise to endless difficulties, both to the Chinese and to the British governments.

The second war broke out between China and Great Britain, with France as its ally, 15 years later, and, after its close, not only was the cultivation of opium in China itself permitted, but the import of opium from India was also legalized. Yet the Chinese government still continued to regard the use of opium as an important moral and economic question and, in the year 1906, it decided to put an end to the use of the drug within ten years. For this reason, in the following year, China entered into what is known as the "Ten Years' Agreement with India," by which China should cease the cultivation of the poppy and forbid the consumption of opium on the understanding that the export of Indian opium to China should be reduced in equal proportion and cease altogether in ten years. At first this undertaking was carried out faithfully by both parties concerned, and according to a statement made by Sir John Jordan at one of the meetings of the opium advisory committee, China in 1917 had almost freed itself from the curse of the poppy. Political troubles, however, broke out, effective government in China was suspended, and the production of opium in China became not only a great national but also an international problem.

International Action.—It was first realized in 1906 that if the Chinese government were able to suppress the opium evil, it must be assisted by other nations. In 1909 Pres. Theodore Roosevelt proposed that an international investigation should be made. As a result, an international opium commission met that year at Shanghai, at which 13 powers were represented.

The recommendations made at this meeting formed the basis of the first opium convention, which was drawn up at The Hague in 1912. The articles of this convention may be summarized as follows:

1. The distribution of raw opium to be controlled and the use of prepared opium to be gradually suppressed.
2. The export of raw opium to countries prohibiting its entry to be stopped and its export to countries restricting its import to be controlled.
3. The export and import of prepared opium to be prohibited except to those countries not yet ready to suppress its use.
4. The use of alkaloids of opium and its derivatives to be confined to medical and legitimate purposes; a government licence to be obtained by all persons engaged in the manufacture, sale, distribution, import and export of the drugs.
5. The last chapter of the convention consisted of clauses dealing with assistance to China and with certain obligations undertaken by China itself.
6. Before the convention came into effect, the adherence of the 34 nonsignatory powers in Europe and America was required.

International opium conferences were held at The Hague in July 1913 and June 1914, at which a number of powers ratified the convention. During World War I all action in this connection was suspended until the Paris peace conference in 1919. In the peace treaties of 1919–20, the signatory powers agreed that the ratification of these treaties should constitute a ratification of the convention of 1912 and the protocol adopted by the third opium conference of 1914 (according to which the convention should come into effect upon its ratification regardless of the nonsignatory powers).

The Advisory Committee and the League of Nations.—Under the covenant (article 23c), the duty of supervising the execution of agreements with regard to the traffic in opium and other dangerous drugs devolved upon the League of Nations. In order to carry out this obligation, the first assembly of the League constituted an advisory committee on opium and other dangerous drugs.

The committee, which sat once a year except in special circumstances, obtained certain important and definite results, such as additional ratifications to The Hague convention and the adoption by a large number of countries of an important certificate system. Under this system no government could allow the export from its territories of any dangerous drugs covered by The Hague convention, except on the production by the exporter of a licence from the importing country, certifying that the drugs in question were required for legitimate purposes.

The Import Certificate.—The council, on the recommendation of the advisory committee, invited the governments and members of the League to prepare an estimate of total annual requirements for the inhabitants of their territories for medical, scientific and other uses, with a view to proposing at some future date to the states concerned a new distribution of production which would limit the total output of raw material to the amount required for legitimate medical and scientific purposes. Subsequently two conferences met during the latter part of 1924 and the early months of 1925.

The 1924 conference did not find it possible to recommend the immediate complete suppression of the use of prepared opium, but drew up an agreement which embodied the substitution of government monopoly for other systems in force. It was held by the majority of members of the conference that no rationing could be enforced or total suppression imposed as long as a large illicit supply of opium remained uncontrolled. To this the representative of China objected, protesting against the refusal of the majority to take immediate steps to suppress opium smoking until producing countries should find it possible to control smuggling. The conference, in a protocol to the agreement, decided to take any necessary measures not already taken for the entire suppres-

sion within a period of 15 years of the consumption of prepared opium in the territories under their authority, this period to begin as soon as the effective execution of the measures required to prevent illicit exportation of raw opium from their territories had been undertaken by the poppy-growing countries. Provision under the agreement was made for a League commission to decide when these measures had been effectively executed. The agreements reached took the form of an agreement, a protocol and a final act. Instruments of ratification were deposited by all states represented at the conference, other than China and Japan. The agreement was, therefore, put into effect.

The Convention of 1925.—The result of the deliberations and discussions of the conference of 1925 was a convention providing for the more effective restriction of the production and manufacture of narcotics, and establishing stricter control and supervision of the international trade.

Among the suggestions made in the convention was the creation of a central board, whose task it would be to follow the course of international trade and the general acceptation of the export and import certificate system. The conference also drew up a protocol by which the signatory states, recognizing their obligations to establish such control over the production, distribution and exportation of raw opium as would put a stop to illicit traffic, agreed to take within five years of the date of the coming into force of the protocol such measures as might be required to prevent the smuggling of opium seriously interfering with the effective suppression of the use of prepared opium in those territories where such use was temporarily authorized. A final act, containing further recommendations, was drawn up.

Among these special mention may be made of a request to the council to consider the possibility of sending a commission to various opium-producing countries to study the difficulties connected with the limitation of the production of opium, and to advise as to what measures should be taken to make it possible to limit the production of opium in those countries to the quantities required for medical and scientific purposes.

The result of this final act is shown in the League of Nations commission of inquiry sent to Iran to report on the possible substitution of crops for the existing opium crops. This commission, which consisted of one American, one Italian and one French expert, presented its report to the council of the League of Nations at its meeting in March 1927.

As a result of this report, the representative of Iran made a number of proposals on behalf of his government and submitted an extensive program to the *majlis,* with recommendation for its enactment into law.

After the conference of 1925, India also undertook to reduce its export of opium 10% a year, with a goal of ceasing all exports.

The Convention of 1931.—The international convention of 1931 for limiting the manufacture and regulating the distribution of narcotic drugs introduced the obligatory estimate system to carry out the principle of limiting the manufacture and trade of narcotic drugs to medical and scientific needs. Each country is required to furnish, annually, advance estimates of the narcotic drugs needed for these purposes. These estimates are binding and determine the maximum amounts to be manufactured or imported in any given year. They are examined by the supervisory body, which is composed of four experts who are not government representatives.

Limitation of Manufacture.—Actions to limit manufacture of narcotic drugs and control international distribution were taken through six international conventions and agreements concluded between 1912 and 1936, supplemented by two international protocols concluded under the auspices of the United Nations in 1946 and 1948 respectively. Seventy-one sovereign countries being parties to one or more of these treaties, their application became universal, as is the problem which is the subject of this international legislation.

United Nations Commission on Narcotic Drugs.—The United Nations took over from the League of Nations, and the governments signatory to the treaties, by the protocol of 1946, vested in the appropriate agencies of the United Nations the powers formerly held by the League agencies. The council no longer existed; the U.N. Economic and Social council was given its powers and duties; the U.N. general assembly took over powers and duties from the assembly of the League. The Opium Advisory committee became the Commission on Narcotic Drugs, appointed by the Economic and Social council, and other modifications in form were made to correspond with the new situation.

At the sixth session of the U.N. Commission on Narcotic Drugs, held in New York city in 1950, an agreement was reached on principles to limit the production of opium to medical and scientific needs. The producing countries, Turkey, Iran, Yugoslavia and India, agreed with the drug manufacturing and consuming countries to limit areas of production and stocks in accordance with estimates to be supplied by each country to an international body.

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OPON, a municipality (with administrative centre and 23 *barrios* or districts), on the small island of Mactan (area about 45 sq.mi.), province of Cebu, Republic of the Philippines. The island of Mactan, where Magellan was slain by the natives in March 1521, is separated from Cebu by a channel only about one mile wide. Pop. (1939) 33,426; 41 were whites. Opon is a shipping and commercial suburb of the municipality of Cebu, the harbour of which is sheltered by Mactan island. Its extensive groves of coconut trees afford supplies of copra, while maize (corn) and maguey are cultivated and fisheries are important. The vernacular is Cebuano, a dialect of Bisayan. Of the inhabitants aged 6 to 19 inclusive, 21.9% in 1939 attended school, while 35.1% of the population 10 years old and over was literate.

OPOPANAX. A gum resin obtained from the root of *Opopanax chironium,* formerly used as an antispasmodic medicine. The perfume known as opopanax is distilled from a *Commiphora.*

OPORTO, the second city of Portugal, about 3 mi. from the mouth of the Douro, in 41° 8′ N. and 8° 37′ W. Pop. (1930) 232,280; (1940) 262,309. The part of the city south of the Douro is known as Villa Nova de Gaia. Oporto is the see of a bishop. It is the true capital of northern Portugal, and the commercial and political rival of Lisbon, much as Barcelona is the rival of Madrid. Three main railway lines meet there—from Lisbon, from Valença do Minho on the northern frontier, and from Barca d'Alva on the northwestern frontier. Oporto is built chiefly on the north or right bank of the Douro; its principal suburbs are Bomfim on the east, Monte Pedral and Paranhos on the north, Villar Bicalho, Lordello and São João da Foz on the west, Ramalde, Villarinha, Matosinhos, Leça da Palmeira and the port of Leixões on the northwest. The mouth of the river is obstructed by a sandy spit of land which has been enlarged by the deposits of silt constantly washed down by the swift current; on the north side of this bar is a narrow channel varying in depth from 16 ft. to 19 ft. A fort in São João da Foz protects the entrance, and there is a lighthouse on a rock outside the bar. As large vessels cannot enter the river, a harbour has been made at Leixões (*q.v.*).

The approach to Oporto up the winding and fjordlike estuary is one of singular beauty. On the north the streets rise in terraces up the steep bank, built in many cases of granite overlaid with plaster, so that white is the prevailing colour of the city; on the south are the hamlets of Gaia and Furada, and the red-tiled wine lodges of Villa Nova de Gaia, in which vast quantities of port are manufactured and stored. The architecture of the houses and public buildings is often rather oriental than European in appearance. Palms, oranges and aloes grow side by side with the flowers and fruits of northern Europe, for the climate is mild and very equable, the mean temperatures for January and July—the coldest and the hottest months—being respectively about 50° and 70°. The design of some of the native river craft is peculiar—among them may be mentioned the *caicos,* high-prowed canoelike fishing boats, the *rascas* with their three lateen sails, and the *barcos rabello,* flat-bottomed barges with huge rudders, used for the conveyance of wine down stream. Two remarkable iron bridges, the Maria Pia and the Dom Luiz I, span the river. The first was built by Messrs. Eiffel and Company of Paris in 1876–77; it rests on a granite substructure and carries the Lisbon railway line across the Douro ravine at a height of 200 ft. The second was constructed in 1881–85 by a Belgian firm; its arch, one of the largest in Europe, has a span of 560 ft. The Douro is liable in winter to sudden and violent floods; in 1909–10 the water rose 40 ft. at Oporto, where it is confined in a deep and narrow bed.

The older quarters in the east are extremely picturesque, with their steep and narrow lanes overshadowed by lofty balconied houses. Overcrowding and dirt are common, for the density of population is nearly 13,000 per sq.m., or greater than in any other city of Portugal. The completion of the tramway system was long delayed. Ox-carts are used for the conveyance of heavy goods, and until late in the 19th century sedan-chairs were still occasionally used. As a rule the natives of Oporto are strong and of fine physique; they also show fewer signs of negro descent than the people of Lisbon. Their numbers tend to increase very rapidly; in 1864 the population of Oporto was 86,751, but in 1878 it rose to 105,838 and nearly doubled in the next half century. Many of the men emigrate to South America, where their industry usually enables them to prosper, and to return with considerable savings.

The cathedral, which stands at the highest point of eastern Oporto, on the site of the Visigothic citadel, was originally a Romanesque building of the 12th century; its cloisters are Gothic of the 14th century, but the greater part of the fabric was modernized in the 17th and 18th centuries. The interior of the cloisters is adorned with blue and white tiles, painted to represent scenes from the Song of Solomon. The Romanesque and early Gothic church of São Martinho de Cedo Feita is the most interesting ecclesiastical building in Oporto, especially noteworthy being the curiously carved capitals of its pillars. Though the present structure is not older, except in details, than the 12th century, the church is said to have been "hastily built" (*cedo feita, cito facta*) by Theodomir, king of the Visigoths, in 559, to receive the relics of St. Martin of Tours, which were then on their way hither from France. The Torre dos Clerigos is a granite tower 246 ft. high, built in the middle of the 18th century at the expense of the local clergy (*clerigos*); it stands on a hill and forms a conspicuous landmark for sailors. Nossa Senhora da Lapa is a fine 18th-century church, Corinthian in style; São Francisco is a Gothic basilica dating from 1410; Nossa Senhora da Serra do Pilar is a secularized Augustinian convent used as artillery barracks, and marks the spot at which Wellington forced the passage of the Douro in 1809. The exchange (*lonja*) is another secularized convent, decorated with coloured marbles. Parts of the interior are floored and panelled with polished native-coloured woods from Brazil, which are inlaid in elaborate patterns; there is a very handsome staircase, and the fittings of one large room are an excellent modern copy of Moorish ornamentation.

Other noteworthy public buildings are the museum, library, opera-house, bull-ring, hospital and quarantine station. The crystal palace is a large glass and iron structure built for the industrial exhibition of 1865. The English factory, built in 1790, has been converted into a club for the British residents—a large and important community whose members are chiefly connected with the wine and shipping trades. The English club gave its name to the Rua Nova dos Inglezes, one of the busiest streets, which contains many banks, warehouses and steamship offices. The Rua da Alfándega, skirting the right bank of the Douro and passing the custom house (*alfándega*), is of similar character; here may be seen characteristic types of the fishermen and peasants of northern Portugal. The Rua das Flores contains, on its eastern side, the shops of the cloth-dealers; on the west are the jewellers' shops, with a remarkable display of gold and silver filigree-work and enamelled gold. These ornaments are often very artistic, and are largely worn on holidays by women of the poorer classes.

Oporto is chiefly famous for the export of the wine which bears its name. An act passed on Jan. 29, 1906 defined "port" as a wine grown in the Douro district, exported from Oporto, and containing more than 16·5% of alcoholic strength. The vines from which it is made grow in the Paiz do Vinho, a hilly region about 60 m. up the river, and having an area of 27 m. in length by 5 or 6 in breadth. The trade was established in 1678, but the shipments for some years did not exceed 600 pipes (of 115 gallons each). In 1703 the British government concluded the Methuen treaty with Portugal, under which Portuguese wines were admitted on easier terms than French or German, and henceforward "port" began to be drunk (*see* PORT WINE). In 1747 the export reached 17,000 pipes. In 1754 the great wine monopoly company of Oporto originated, under which the shipments rose to 33,000 pipes. At the beginning of the 19th century the policy of the government more and more favoured port wine, besides which the vintages from 1802 to 1815 were splendid both in Portugal and in Madeira—that of 1815 has, in fact, never been excelled. For the next few years the grape crop was not at all good, but the 1820 vintage was the most remarkable of any. It was singularly sweet and black, besides being equal in quality to that of 1815. In 1852 the *Oidium* which spread over Europe destroyed many of the Portuguese vineyards. In 1865 *Phylloxera* did much damage, and in 1867 the second monopoly company was abolished. From this time the exports again increased. (*See* WINE.) A third of the population is engaged in the manufacture of cottons, woollens, leather, silk, gloves, hats, pottery, corks, tobacco, spirits, beer, aerated waters, preserved foods, soap or jewellery. The fisheries—chiefly of hake, bream and sardines—are extensive. Many tourists land at Oporto and visit Braga (*q.v.*), Bussaco (*see* BUSSACO, SERRA DE) and other places of interest, on their way to Lisbon.

The history of Oporto dates from an early period. Before the Roman invasion, under the name of Portus Cale, it was a town on the south bank of the Douro with a good trade; the Alani subsequently founded a city on the north bank, calling it *Castrum Novum*. About A.D. 540 the Visigoths under Leovigild obtained possession, but yielded place in 716 to the Moors. The Christians, however, recaptured Oporto in 997, and it became the capital of the counts of *Portucalia* for part of the period during which the Moors ruled in the southern provinces of Portugal. (*See* PORTUGAL: *History*.) The Moors once more became its masters for a short period, till in 1092 it was brought finally under Christian domination. The citizens rebelled in 1628 against an unpopular tax, in 1661 for a similar reason, in 1757 against the wine monopoly, and in 1808 against the French. The town is renowned in British military annals from the duke of Wellington's passage of the Douro, by which he surprised and put to flight the French army under Marshal Soult, capturing the city on the 12th of May 1809. Oporto sustained a severe siege in 1832–33, being bravely defended against the Miguelites by Dom Pedro with 7,000 soldiers; 16,000 of its inhabitants perished. In the constitutional crises of 1820, 1826, 1836, 1842, 1846–47, 1891 and 1908–10 the action of Oporto, as the capital of northern Portugal, was always of the utmost importance. In 1919 the monarchy was proclaimed at Oporto and lasted for three weeks. In Feb. 1927 it was the scene of an army rising and was bombarded during three days by government troops.

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OPOSSUM (DIDELPHIS VIRGINIANUS), HANGING FROM A TREE WITH YOUNG

OPOSSUM, the name of several American marsupials, also applied in Australia to the phalangers (*q.v.*). True opossums are found almost throughout America (*see* MARSUPIALIA). They form the family Didelphidae, distinguished by the opposable first hind toe and by the dentition. They are small, nocturnal animals, with long noses, ears and tails, the latter being usually naked and prehensile. The opposable first hind toe is clawless and the tip is expanded into a flat pad. The other digits all bear claws. Mainly arboreal, they feed on birds, insects and fruit. The best known species of the type-genus is *Didelphis virginianus*, which is very common in the United States. It is nearly the size of a cat, gray in colour, the fur being woolly. When caught, it feigns death (hence the expression "playing 'possum"). The ova of opossums have a thin horny shell, and many more are produced

than can survive. The female produces 6 to 16 young, after a period of gestation of 14 to 17 days. At birth the immature and helpless young, only about ½ in. long, are placed by the mother in her pouch, where they cling to the nipples by their mouths. When big enough to leave the pouch, the young are often carried on the mother's back, holding on to her fur or clinging to her tail by their own prehensile tails.

The water-opossum (*Chironectes minimus*) has webbed feet (*see* WATER-OPOSSUM). Numerous other species inhabit various parts of America, being especially numerous in the tropical parts.

OPPELN, a town in the Prussian province of Silesia, Germany, on the Oder, 51 mi. S.E. of Breslau, on the railway to Kattowitz and at the junction of lines to Ratibor, Neisse and Tarnowitz. Pop. (1939) 52,806. Oppeln was a flourishing place at the beginning of the 11th century, and became a town in 1228. It was the capital of the duchy of Oppeln and the residence of the duke from 1163 to 1532, when the ruling family became extinct. Then it passed to Austria, and with the rest of Silesia was ceded to Prussia in 1742. In the partition of Upper Silesia between Germany and Poland in 1921 (*see* SILESIA) Oppeln was retained by Germany. It is the seat of the provincial administration of Upper Silesia, and contains the oldest Christian church in the district, that of St. Adalbert, founded at the close of the 10th century. It has a 15th-century palace on an island in the Oder. The industries of Oppeln include the manufacture of Portland cement, beer, soap, cigars, chemicals, clogs and lime; trade is carried on by rail and river in cattle, grain and the vast mineral output of the district, of which Oppeln is the chief centre. The upper classes speak German, the lower Polish.

OPPENHEIMER, J. ROBERT (1904–), U.S. physicist and scientist, was born April 22 in New York city. He was graduated from Harvard university in 1925, studied at Cambridge university until 1926 and then at Göttingen university, where he received his Ph.D. degree in 1927. He became a professor of physics at the University of California and at the California Institute of Technology in 1929. Dr. Oppenheimer devoted considerable time to research on the nature of matter, electricity and radiation, and was an authority on the structure of the atom. During World War II, the U.S. government placed him in charge of a special laboratory dealing with the technical problems involved in putting together the components of the atomic bomb. Dr. Oppenheimer planned the construction of the laboratory in an isolated area at Los Alamos, 20 miles from Santa Fe, N.M., and organized and directed its activities after its completion. He arrived at Los Alamos in March 1943 and under his direction, a galaxy of scientific stars worked in what was described as "probably the best-equipped physics laboratory in the world." Of Dr. Oppenheimer's role in the creation of the atomic bomb, secretary of war Henry L. Stimson, in his statement of Aug. 6, 1945, declared: "The development of the bomb itself has been largely due to his (Dr. Oppenheimer's) genius and the inspiration and leadership he has given to his associates." Oppenheimer also was a member of a four-man advisory group of leading U.S. scientists that worked with a government interim committee on establishment of postwar organizations to direct and control the use of atomic energy.

In Oct. 1947 he became director of the Institute for Advanced Study, Princeton, N.J., and on April 20, 1951, he was appointed a member of the 11-man committee of scientists to advise the United States director of defense mobilization.

OPPIAN (Gr. Ὀππιανός), the name of the authors of two (or three) didactic poems in Greek hexameters, formerly identified, but now generally regarded as two different persons. (1) Oppian of Corycus (or Anabarzus) in Cilicia, who flourished in the reign of Marcus Aurelius (emperor A.D. 161–180). According to an anonymous biographer, his father was banished to Malta by Verus. Oppian, who had accompanied his father into exile, returned after the death of Verus (169) and went on a visit to Rome. Here he presented his poems to Aurelius and regained the imperial favour for his family. Oppian subsequently returned to his native country, but died of the plague at the age of 30. His poem on fishing (*Halieutica*), of about 3,500 lines, dedicated to Aurelius and his son Commodus, is still extant. (2) Oppian of Apamea (or Pella) in Syria. His extant poem on hunting (*Cynegetica*) is dedicated to the emperor Caracalla, so that it must have been written after 211. It consists of about 2,150 lines, and is divided into four books, the last of which seems incomplete. It is inferior to the *Halieutica*.

A third poem on bird-catching (*Ixeutica*, from ἰξός, bird-lime), also formerly attributed to an Oppian, is lost; a paraphrase in Greek prose by a certain Eutecnius is extant.

The chief modern editions are J. G. Schneider (1776); F. S. Lehrs (1846); U. C. Bussemaker (Scholia, 1849); (*Cynegetica*) P. Boudreaux (1908). The anonymous biography referred to above will be found in A. Westermann's *Biographi Graeci* (1845). On the subject generally *see* A. Martin, *Etudes sur la vie et les oeuvres d'Oppien de Cilicie* (1863); A. Ausfeld, *De Oppiano et scriptis sub ejus nomine traditis* (1876). There are translations of the *Halieutica*, in English by Diaper and Jones (1722), and in French by E. J. Bourquin (1877).

OPPIUS, GAIUS, an intimate friend of Julius Caesar. He managed the dictator's private affairs during his absence from Rome. According to Suetonius (*Caesar*, 56), many authorities considered Oppius to have written the histories of the Spanish, African and Alexandrian wars which are printed among the works of Caesar. It is now generally held that he may possibly be the author of the last (although the claims of Hirtius are considered stronger), but certainly not of the two first. He also wrote a life of Caesar and the elder Scipio.

For a discussion of the whole question, *see* M. Schanz, *Geschichte der römischen Literatur* (2nd ed., 1898); Teuffel-Schwabe, *Hist. of Roman Literature* (Eng. trans., 1900); *see* also Cicero, *Letters*, ed. Tyrrell and Purser, iv. introd. p. 69.

OPPOSITION, in logic, means the various relations which can exist between judgments or propositions having the same subject and predicate but differing in quality or quantity. *See* LOGIC.

OPTICS. The study of Optics is usually divided into three parts: *Physical Optics*, *Physiological Optics* and *Geometrical Optics*. *Physical Optics* is primarily concerned with the nature and properties of light itself and is treated under LIGHT. *Physiological Optics* deals with the mechanism of vision, and is treated under VISION.

Geometrical Optics, which is the subject of this article, is the name applied to that part of Optics which deals with the properties of optical instruments such as telescopes, microscopes, photographic lenses, spectroscopes and the elementary lenses, mirrors and prisms from which they are constructed. As geometrical methods have been widely employed in inquiries concerning optical instruments, the name is not without historical justification. Nevertheless we shall have occasion to take exception to the validity of these methods in this field. They are in fact only admissible to an extent which deprives the historical theory of much of its utility. A brief account of this theory can, however, hardly be omitted here both on account of its historical importance and because even at the present day the majority of the literature on the subject is still couched in geometrical terms.

The basic conception of geometrical optics in this theory is the ray of light. The fact that light travels in straight paths was well known to the Greek mathematicians and the transition from optics to pure geometry was thus simple. More precisely in geometrical optics we assume that the ray of light continues in the same straight line while it travels in the same homogeneous medium. When it encounters a surface separating this medium from another, for example the surface between air and water, the ray proceeds in another direction from the point in which it meets this surface, and again continues to follow a straight path until another surface is reached. The new path may be in either the original or the new medium. In the former event the ray is said to be reflected, and in the latter refracted, at the surface of separation. We regard the whole continuous path of the light as a single ray, but distinguish the original and final portions as the incident ray and the emergent ray respectively. We may also apply the terms reflected ray or refracted ray as the case may be

to the latter.

The new directions are determined by simple geometrical laws. The law of reflection states (1) the incident ray, the reflected ray, and the normal to the surface at the point of reflection lie in one plane; (2) the incident and reflected rays lie on opposite sides of the normal; (3) the angles made by the incident and reflected rays with the normal are equal. The law of refraction states (1)

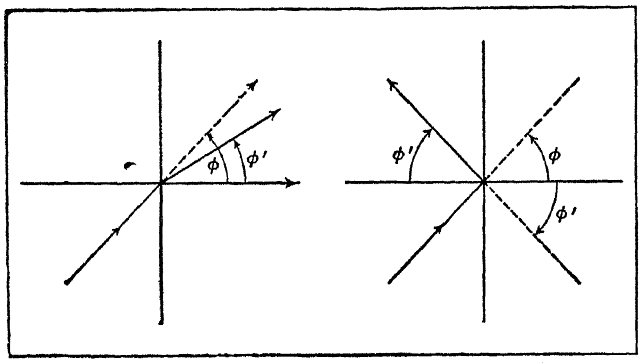

FIG. 1.—ANGULAR-SIGN CONVENTIONS, SHOWING (LEFT) REFRACTION: ANGLES OF INCIDENCE AND REFRACTION BOTH POSITIVE; AND (RIGHT) ANGLE OF INCIDENCE POSITIVE, ANGLE OF REFLECTION NEGATIVE

the incident ray, the refracted ray, and the normal to the surface at the point of refraction lie in the same plane; (2) the incident ray and the refracted ray lie on opposite sides of the normal; (3) the sine of the angle made by the incident ray with the normal bears a constant ratio to the sine of the angle made by the refracted ray with the normal. This ratio depends only on the composition of the two media separated by the surface, and is known as the relative index of refraction.

From a comparison of these two laws it will be seen that the law of reflection may be considered as a special case of the law of refraction, the relative refractive index being equal to either $+1$ or -1. Let us adopt the convention that angles are to be measured by the value of the anti-clockwise rotation needed to reach the ray position from the onward drawn normal. Thus in fig. 1a, the angles of incidence and refraction ϕ and ϕ' are positive, and if μ is the relative refractive index $\sin\phi = \mu\sin\phi'$. When reflection occurs the angle of reflection is opposed in sign to the angle of incidence (*see* fig. 1, right), and μ should therefore receive the value -1. It will be noted also that the reflected ray travels in the opposite direction to that contemplated in the law of refraction. As we shall see later all lengths entering into optical equations are either multiplied or divided by a refractive index and the double reversal of sign frees us from all difficulties regarding the signs of the quantities we employ. We are therefore enabled to dispense with any detailed consideration of reflecting instruments and can proceed to deal with refraction as an inclusive process.

For a reason which will become apparent later it is necessary for the reflecting and refracting surfaces used in optical instruments to approach very closely to ideal geometrical forms. The manufacturing processes by which the necessary degree of perfection can be reached impose severe limitations on the types of surface which may be employed, and in practice any surface but a portion of a sphere—with the plane as a special case—is rarely employed. We will therefore consider the refraction of light at a spherical surface

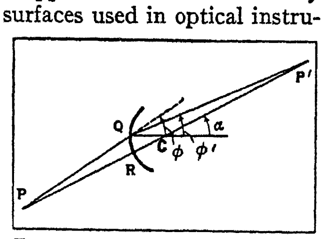

FIG. 2.—REFRACTION AT A SPHERICAL SURFACE

In fig. 2 let a ray passing through the point P be refracted at Q, a point on a spherical surface whose centre is at C. The refracted ray lies in the plane PQC containing the incident ray PQ and the normal QC, and it will therefore in general meet PC at some point P'. Let PC meet the surface in R and make an angle α with QC, and let ϕ and ϕ' be the angles of incidence and refraction. Then from the triangles PQC, $P'QC$

$$\frac{\sin\alpha}{\sin\phi} = \frac{PQ}{PC}, \quad \frac{\sin\alpha}{\sin\phi'} = \frac{QP'}{CP'},$$

and therefore by the law of refraction

$$\mu\,\frac{PQ}{PC} = \frac{QP'}{CP'}.$$

If now Q is near R, PQ and QP' differ from PR and RP' by small quantities of the second order, and the equation becomes

$$\mu\,\frac{PC-r}{PC} = \frac{r+CP'}{CP'}$$

or

$$\frac{\mu-1}{r} = \frac{\mu}{PC} + \frac{1}{CP'}$$

where r is the radius of the surface. It follows from this expression that all rays which, before refraction in the neighbourhood of R, pass through P, will afterwards pass through P'. Physically this means that light energy diverging from a particle of matter placed at P will converge to P' or alternatively will diverge in the new medium as though it were liberated at P'. The reunion of the rays at P' is thus of the greatest significance, and P' is called the image of the object P. If P' is so situated that the rays can actually pass through it the image is called real, but if it is so placed that they may merely be regarded as having originated there the image is called virtual. It should be observed that there is no need for the rays to have actually passed through the point P, that is to say we may deal with virtual objects as well as virtual images.

Consider now a succession of spherical surfaces which are all met by rays under the conditions just described. Corresponding to an object point P, real or virtual, the first surface forms an image at a definite point P_1. The point P_1 may be regarded as a source of rays falling upon the second surface, which forms an image P_2 of P_1. Each surface in turn forms a point image of that due to the preceding surfaces, and we conclude that the whole series of surfaces will form at a definite point P' in the final medium, an image, either real or virtual, of an arbitrary point P in the object space. The relation connecting P and P' may be shown to be unique and reversible, so that it is a matter of convention which of the spaces external to the system is regarded as the object space and which as the image space. It will be observed that we have not assumed axial symmetry in the system, so that this conclusion holds whether the centres of curvature of the various refracting surfaces are collinear or not.

Symmetrical Optical Instruments.—The refracting surfaces in a great majority of optical instruments are surfaces of

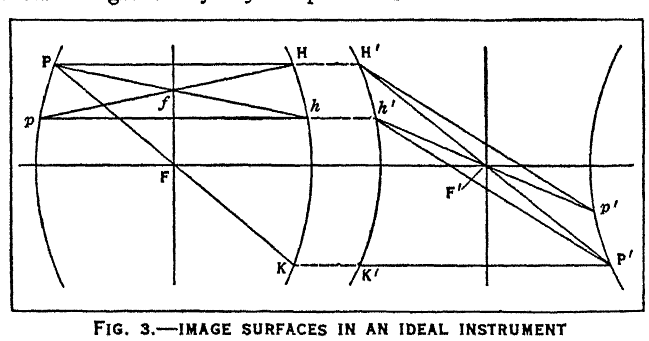

FIG. 3.—IMAGE SURFACES IN AN IDEAL INSTRUMENT

Determination of surfaces in which object and image are equal to one another, and also equal but inverted

revolution with a common axis of symmetry. In consequence of this rotational symmetry the theory of these instruments is particularly simple. Rays which lie initially in a plane containing the axis remain in that plane, and the general one-one correspondence between the points of the two spaces degenerates to a one-one correspondence between points of a plane.

The theory of the symmetrical instrument has been treated very comprehensively by Maxwell and later by Abbe on the assumption that this two dimensional point to point correspondence

holds. From symmetry it is clear that the image of each point on the axis is itself a point on the axis. Thus the axis is a self-conjugate ray for the system, that is to say the axis, regarded as a whole is its own image. Corresponding to the point at infinity on the axis in the object space there corresponds a point F' (*see* fig. 3), usually at a finite distance, in the image space. This is named the second principal focus of the system. Then all rays which in the object space are parallel to the axis will be refracted so as to pass through F' in the image space, and conversely all rays in the image space which pass through F' correspond to rays which are parallel to axis in the object space. Similarly there is a point F on the axis in the object space such that all rays passing through F emerge in the image space as rays parallel to the axis. This point is called the first principal focus of the system. Since the incident portion of any ray refracted parallel to the axis lies in the same axial plane as the emergent portion, the two will meet if produced in some point H. The point thus determined on the incident ray is at the same distance from the axis as the whole of the emergent portion of the ray, and the height of the image of an object extending from H to the axis is equal to the height of the object itself, a fact usually expressed by saying that the transverse magnification is 1. The locus of points H determined in this manner is therefore called the first unit surface. It is to be considered as situated entirely in the object space.

In a similar way by considering the intersections of the incident and emergent portions of rays which pass through F' in the image space we determine the second unit surface situated in the image space. Clearly these two surfaces have rotational symmetry about the axis and are conjugate to one another, that is, the one surface is the image of the other, and any ray striking the first unit surface in the point H will follow a path in the image space passing through H' in the second unit surface where HH' is parallel to the axis. Now let $PHH'F'P'$ and $PFKK'P'$ be two rays meeting in P and P', the former being parallel to the axis in the object space and the latter in the image space. Let these two parallel portions be at equal distances from the axis and on opposite sides of it. The image extending from P' to the axis is of equal height to an object lying between P and the axis, and is inverted. P and P' therefore trace out conjugate surfaces corresponding to the transverse magnification -1. F and F' are the mid-points of PK and $H'P'$ and the new surfaces are therefore precisely equal to the corresponding unit surfaces but face opposite ways. Now let $phh'F'p'$ be another ray parallel to the axis in the object space meeting the unit surfaces in h and h' and the negative unit surfaces in p and p'. From symmetry Ph and pH intersect in a point f situated in the plane through F normal to the axis of the system, and from the congruent triangles $h'F'P'$, $H'F'p'$, $h'P'$ and $H'p'$ are parallel. In other words the normal plane through F is conjugate to the surface at infinity in the image space, and similarly the normal plane through F' is conjugate to the infinitely distant surface in the object space. By taking a pair of rays whose distances from the axis are in any assigned ratio we can construct the conjugate surfaces for this magnification.

It is a simple matter to show that the object space surfaces are all similar and similarly situated about F, and the image space surfaces also similar and similarly situated about F'. Since we have taken the ratio of the distances of corresponding points from the axis as the measure of the magnification, any corresponding secondary elements of length (that is elements normal to the plane through the axis of symmetry) in the image and object surfaces are in this ratio. Now consider two parallel incident rays inclined to the axis, not intersecting it but situated symmetrically with respect to it, the separation between them being small. They determine on every constant magnification object surface a secondary element of unvarying length. In the image space these rays intersect in a point f' in the focal plane through F'. The lengths of the secondary elements intercepted on the constant magnification surfaces in the image space are therefore proportional to the distances of the points of intersection from f'. In other words these surfaces must be similarly situated with respect to any point f' in the focal plane.

It follows that all the constant magnification surfaces are planes normal to the axis, and that the magnification in every such plane is uniform in all directions. All the properties of the system may therefore be related to the points in which these planes meet the axis of symmetry. With the aid of rays passing through F and F' (fig. 4) we readily prove, if U and U' are the

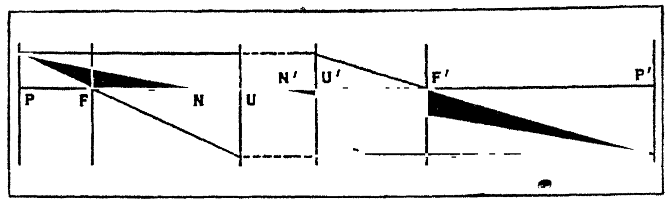

FIG. 4.—COLLINEAR IMAGERY SHOWING THAT ANY RAY THROUGH THE NODAL POINT N EMERGES IN A PARALLEL DIRECTION THROUGH N'

unit points, that is the points in which the unit planes meet the axis, and P and P' are any pair of conjugate axial points

$$\text{transverse magnification} = \frac{FU}{FP} = \frac{P'F'}{U'F'}$$

so that conjugate points are determined by $FP \cdot P'F' = FU \cdot U'F'$. If we draw through f a straight line fN, parallel to the direction of the emergent rays arising from f, to meet the axis in N, we have $FN = U'F'$. The conjugate point N' by the above relation is given by $N'F' = FU$. These points, from the circumstance that the incident and emergent rays through them are parallel to one another, are called the nodal points of the system. FU and $U'F'$ are named the first and second focal lengths of the system. When these two focal lengths are equal the unit points coincide with the nodal points and are frequently called the principal points.

It is easy to show with a system consisting of a single surface that if an object point is moved along the axis, the image moves in the same direction. It follows that this holds also for any compound instrument, and hence FU and $U'F'$ are always measured in the same direction. There are thus only two types of system—positive systems, illustrated in fig. 4, in which the principal foci F and F' are reached by proceeding from U and U' towards the real distant part of the corresponding space (the focal lengths thus being positive), and negative systems in which all these signs are reversed. The unit planes are usually situated close to or between the extreme refracting surfaces of the lens, and in a negative instrument all the real portions of the object space and of the image space are thus on a single side of the respective focal planes. It follows that such a negative system cannot yield a real image of a real object, and since the focal planes separate upright from inverted images, there is no inversion if either object or image is real. With a positive lens we can obtain a real inverted image of a real object, but if there is no inversion either the object or the image or both are virtual.

As we have based this discussion on the general correspondence of object and image points, the conclusions hold whenever the initial assumptions are satisfied irrespective of the way in which the system is constructed. Had we first considered the properties of a single spherical surface and extended the result to a combination of several such surfaces, our conclusions would not necessarily have applied to a system in which aspherical surfaces are employed.

Formulae are frequently used in which measurements are made from the unit points instead of from the principal foci. If we denote the transverse magnification by m, we have

$$\frac{PU}{FU} = 1 - \frac{1}{m}, \quad \frac{U'P'}{U'F'} = 1 - m, \quad \frac{U'P'}{PU} = -m\,\frac{U'F'}{FU}$$

and $\dfrac{FU}{PU} + \dfrac{U'F'}{U'P'} = 1$. When the two focal lengths have the common value f the last two equations become

$$m = -\frac{U'P'}{PU}, \text{ and } \frac{1}{PU} + \frac{1}{U'P'} = \frac{1}{f}.$$

Systems which yield on a uniform scale a plane image of a plane object (and incidentally a plane image of every plane object) are admirably fitted for many practical purposes, for example the photographic reproduction of maps. The scheme we have just described, which is known as collinear imagery, has therefore been widely used as a standard with which the performance of real instruments may be compared. It is of value as an artificial reference frame, rather than as a scheme to which real instruments tend to conform.

The Wave Theory and Lenses.—We will now consider the properties of lenses according to the wave theory of light. The postulates of this theory, which have been justified by the most varied experiments, are that monochromatic light may be regarded as an undulatory disturbance of unvarying period which spreads out in all directions from the source at a uniform speed which depends only on the medium in which it is travelling. In common with other forms of wave motion the disturbance at a given instant at any point may be obtained by replacing the actual wave system by a system of secondary sources of proper intensities and phases distributed over a surface. The statistical distribution of light energy is assumed to be that of the energy distribution of the wave system on the assumption that a long train of waves is involved. On this basis the phenomena observed in the neighbourhood of an optical image—that is the point where the energy of the wave motion has its greatest value through the contributions of the secondary sources arriving in the same phase—have been very satisfactorily accounted for. It is shown in treatises on Physical Optics (*see* LIGHT) that these assumptions involve the propagation of light in straight paths normal to the wavefront (so that the rays of the geometrical theory are to be regarded as normals to the wavefront), and changes in the directions of these paths in agreement with the laws of reflection and refraction provided the relative refractive index is made equal to the ratio of the times taken by light to travel equal distances in the new and old media. It would therefore appear that we should find agreement between the deductions to which we are led by the geometrical and the wave theories. This conclusion however is incorrect. An essential condition in deducing the law of rectilinear propagation is that the wavefront should be of considerable lateral extent. When light approaches a real focus this condition is violated, with the result that the direction of propagation in fact is not constrained to the straight paths assumed in the geometrical theory. It is therefore not surprising to find that while the geometrical theory indicates correctly the positions in which images are formed and the conditions which should be satisfied if an instrument is to yield images of the highest quality, it is misleading in the character of the image it leads us to expect, and the effects to be observed in the neighbourhood of the image. The two theories also differ in the course they would lead us to adopt when any of the conditions corresponding to perfect imagery are not satisfied.

Since the relative refractive index depends only on the relative speed with which light travels in the two media we may, by assigning the value unity arbitrarily as the refractive index of a suitable substance under specified physical conditions, obtain an absolute refractive index for any other substance. As an absolute standard medium empty space is taken, but for practical purposes the refractive index of air at standard temperature and pressure is adopted. We shall hereafter, when we speak of refractive index, imply the absolute refractive index of a substance on one or other of these conventions. We will now show that the two focal lengths of any symmetrical optical system are in the ratio of the refractive indices of the two external media.

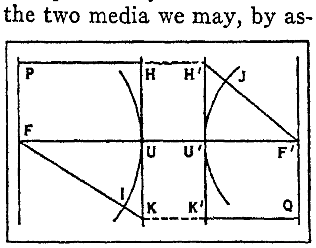

FIG. 5.—RATIO OF FOCAL LENGTHS

Let a plane wave normal to the lens axis in the object space of refractive index μ travel from the position PF, fig. 5, until, after being converted by the instrument into the spherical wave $U'J$, in the image space of refractive index μ', it reaches the principal focus at F'. Let another plane wave in the image space travel in the reverse direction from $F'Q$ to F. As different parts of the same wavefront take equal times to reach the focus, the time taken by the light to travel by the path $PHH'JF'$ is equal to that taken along the axial path $FUU'F'$, and similarly the paths $QK'KIF$ and $F'U'UF$ take equal times. The time taken to traverse the same axial path $FUU'F'$ is independent of the direction, and the times for all these paths are thus equal. Now the times taken along PH and FU are equal, and the times along the equal distances $U'F'$ and JF' in the same medium are equal. It follows that the time taken to travel from U to U' exceeds that between H and H' by the time needed to traverse the distance $H'J$. Similarly the time for the journey UU' exceeds that between K and K' by the time taken to cover the distance IK. Now if H and K are at equal distances y from the axis the time taken to travel between H and H', from the symmetry of the instrument, is equal to that taken between K and K'. It follows that $\mu\cdot IK=\mu'\cdot H'J$, or

$$\mu[\{(FU)^2+y^2\}^{\frac{1}{2}}-FU]=\mu'[\{(U'F')^2+y^2\}^{\frac{1}{2}}-U'F'];$$

that is, if the terms in y^4 and higher powers of y are negligible,

$$\tfrac{1}{2}\mu\,\frac{y^2}{FU}=\tfrac{1}{2}\mu'\,\frac{y^2}{U'F'},$$

and since this holds for finite values of y we must have

$$FU:U'F'=\mu:\mu'.$$

In particular if the two external media are composed of the same kind of matter the two focal lengths are equal to one another.

Let us now consider the possibility, according to the physical criterion of equality of time along the geometrical rays, of collinear imagery. Let $PQRS$ be four object points and $P'Q'R'S'$ their images. Denote by $\{AB'\}$ the distance light would travel in the medium of refractive index unity in the time taken to travel from A through the instrument to B'. Then since with geometrically perfect imagery the time between two conjugate points is equal by all paths,

$$\begin{aligned}
\{PP'\} &= \mu PQ + \{QP'\} = \mu PS + \{SP'\}\\
\{QQ'\} &= \{QR'\} + \mu' R'Q' = \{QP'\} + \mu' P'Q'\\
\{RR'\} &= \mu RS + \{SR'\} = \mu RQ + \{QR'\}\\
\{SS'\} &= \{SP'\} + \mu' P'S' = \{SR'\} + \mu' R'S'
\end{aligned}$$

or $$\mu(PQ+RS-PS-RQ)=\mu'(P'Q'+R'S'-P'S'-R'Q').$$

Now without altering the configuration of the figure $PQRS$ we may, if the focal lengths of the system are finite, make the scale of the figure $P'Q'R'S'$ as large or as small as we like by moving $PQRS$ as near or as far from the lens as we like. In particular we may make each dimension of the figure $P'Q'R'S'$ smaller than any assigned finite small length. This relation cannot therefore hold, and collinear imagery is not possible for a system of finite focal length. In other words it is impossible to construct an optical system having a finite focal length which will refract all rays from any given object point so as to pass through a single image point. Using terms significant in the wave theory, the time taken to travel through the instrument between a point in the object space and a point in the image space cannot be independent of the path followed for an arbitrary choice of the object point. When the focal length is not finite the image is a copy of the object on uniform transverse and longitudinal scales, and collinear imagery is achieved when the two refractive indices are numerically equal and the object and image are congruent figures. The most familiar example is afforded by reflection at a plane mirror, where we suppose the two external refractive indices differ only in sign. (*See* MIRROR.)

The Size of a Point Image: Resolving Power.—The extent of the divergence between the two theories may be illustrated by considering properties of importance to the user of the instrument. First we will consider the size of the image of a point source. Of the spherical wave which spreads out from the source only a portion can enter the instrument, and corresponding to the perfect reunion of the rays in an image point we have an emergent

wave of spherical form. In fig. 6, BAC represents a wave-front filling the aperture BC: the wave is in the form of a portion of a concave sphere of which F is the centre. According to geometrical optics the image is the point F, and is formed by rays filling the cone BFC of which AF is the axis and α is the semi-angle. By the principles of physical optics the disturbances produced by the train of waves are the same as would be produced by a suitable series of disturbances situated in the wave-front BAC. Now any disturbance at A gives rise to a spherical wave with A as centre. If we confine ourselves to a region around F of dimensions small compared with AF we may consider the wave from A to be a plane wave PP' at F. Similarly from B and C we get plane waves QQ' and RR' making angles $\pm\alpha$ with PP'. Now all parts of the wave front BAC are equidistant from F, and the component disturbances at F are therefore all in the same phase—that is to say, all the displacements are in the same direction and reach their maximum values at the same instant.

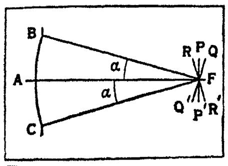

FIG. 6.—DEPENDENCE OF RESOLVING POWER ON APERTURE

The energy of the wave motion is therefore a maximum at F, for there the co-operation is as great as possible. The wave from B will, however, have already passed beyond P, and that from C will not yet have reached P by the time the wave from A has arrived at the position PFP'. To find the disturbance at P we therefore have to take the displacement at B when the wave-front BAC is short of the position shown by the distance PQ, and similarly the displacement at C when this wave-front has advanced beyond the position shown by the distance PR. That is to say the component displacements at P vary in phase, the total range being found by measuring the difference of path, *i.e.*, the length $2PF\sin\alpha$, along the train of waves in the direction of their motion. Now if P is near enough to F the differences of phase are small, and the displacements differ very little from those at F; in other words at points very close to F the light energy is practically the same as at F, so that the image is of finite dimensions, and not a point. As P moves farther away from F the range of phase increases, and at a certain stage we begin to receive contributions from points near B which tend to neutralize those contributed from points near C, so that the light energy as we pass through these positions of P diminishes rapidly. Finally we reach a position of P at which the range of phase is great enough for the various contributions to neutralize one another, or at least to so nearly neutralize one another that our impression on looking at this point is that we have reached or passed the edge of the image.

Since the changes of intensity are due wholly to differences of phase, the image edge will be reached when the difference of path is some constant θ times the wave length λ of the light, *i.e.*,

$$2PF\sin\alpha=\theta\lambda$$

or

$$\text{image diameter}=2PF=\frac{\theta\lambda}{\sin\alpha}=d.$$

If λ_0 is the wave length of the light in the standard medium $\lambda_0=\lambda\mu$, and the last fraction becomes $\theta\lambda_0/\mu\sin\alpha$. As the aperture which limits the light passing through the instrument is reduced, $\sin\alpha$ decreases, and the size of the image increases. If two near object points are to be distinguished on examining them through the instrument their images must be separate, and the resolving power of the instrument, as its capacity for rendering distinct images of near objects is called, is measured by the reciprocal of the image diameter, that is by $\mu\sin\alpha/\theta\lambda_0$. With light of a given wave length the denominator is invariable, and as $d\mu\sin\alpha$, as we shall see later, is unaltered by refraction, the resolving power of an instrument is measured by $\mu'\sin\alpha'$, where the accented quantities relate to the object space. On account of its importance in microscopy this quantity is known as the numerical aperture of the instrument. The utility of an optical instrument evidently depends upon the variation in path having a small value compared with the wave length of the light used. Since the wave length is very small, a very close approach to the theoretical form, as has already been mentioned, is necessary in the refracting surfaces.

Depth of Focus.—We will now consider according to the two theories how far we may expect to be able to depart along the axis of the instrument from the ideal focus F, and still retain a satisfactory image. According to geometrical optics light rays fill the cone BFC, fig. 7, and the image in the plane XY will be a circle of diameter IJ. The image is considered satisfactory if IJ does not exceed a certain diameter, say d, so that the permissible range for G is given by the condition

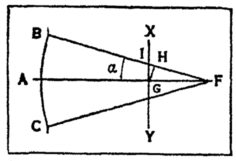

FIG. 7.—DEPTH OF FOCUS

$$FG=\tfrac{1}{2}d\cot\alpha$$

or very approximately

$$FG=d\cdot\frac{I}{a},$$

where I is the distance of the image from the principal point and a is the effective diameter of the lens aperture, supposed situated in the unit plane. The important feature of this formula is that the depth of focus is inversely proportional to the first power of the diameter of the aperture.

Let us now consider the same problem from the point of view of the wave-theory. Instead of relying on the geometrician's hypothesis we are able to rest on the well attested fact that an image begins to appear less sharp when the extreme difference between the phases of the component waves at the centre of the image reaches a definite value, that is to say when the path difference at G amounts to $\phi\lambda$ where ϕ is a definite number. This criterion differs from that considered on the geometrical theory less radically than might at first sight appear, for the existence of an appreciable phase difference at the image centre means that in this neighbourhood the light energy is less: but the total light energy of the waves is absorbed wherever the plane may be placed, and energy removed from the central regions must therefore appear in some other place. But to say that an appreciable amount of energy is found farther from the centre is only another way of stating that the image is sensibly enlarged.

Resuming, however, the determination of the range for G, the distance of this point from B differs by an unimportant amount from BH, where GH is perpendicular to BF. Since the extreme paths obviously arise from A at one limit and marginal points such as B at the other, and since all path lengths to F are equal, the extreme path difference is the difference between FG and FH, or $FG(1-\cos\alpha)$ or

$$FG=\frac{\phi\lambda}{1-\cos\alpha}$$

Now $a=2I\sin\alpha$, and therefore approximately

$$FG=8\phi\lambda\left(\frac{I}{a}\right)^2.$$

This formula indicates a law of a quite different type from that derived geometrically, the range varying inversely as the square of the aperture diameter, instead of as the first power.

The Depth of Field.—By reasoning of a character essentially similar to that of the foregoing section we can find expressions for the nearest and greatest distances x and x' at which objects may be situated from the lens for their images to appear sharp on a screen focussed for a distance X. According to the geometrical theory the conditions are

$$\frac{1}{x}-\frac{1}{X}=\frac{1}{X}-\frac{1}{x'}=\frac{d}{Ia},$$

and the conditions derived from a limiting difference of path are

$$\frac{1}{x}-\frac{1}{X}=\frac{1}{X}-\frac{1}{x'}=\frac{8\phi\lambda}{a^2},$$

where the symbols bear the same meanings as in the previous section. Thus assuming the objects are at a considerable distance from the lens, so that I is approximately equal to the focal length of the lens, according to geometrical optics the focal

length of the lens and the aperture are equally important, the range being inversely proportional to both. On the other hand according to the wave theory the focal length has nothing whatever to do with the question, and the range is inversely proportional to the square of the aperture. Both theories, it will be observed, indicate the selection of the same plane for the theoretical focus to secure the utmost sharpness for all objects between two given extreme planes.

It should be unnecessary to point out that the problems on which it has been shown that the two theories differ so widely, are of much practical importance in the use of optical instruments. As an example in photography, when considerable depth of focus is required, the geometrical formula is likely to lead to the use of an unnecessarily small stop, thereby involving not only a longer exposure, but also, through the tendency of a small stop to cause loss of sharpness, a poorer negative.

The Eikonal.—The examples we have just considered show that a complete investigation of the properties of lenses involves the determination of the time taken by light to reach any given point in the neighbourhood of the geometrically determined image, by both stationary and non-stationary routes (that is along "rays" and along other paths), as a preliminary to the calculation of the energy of the wave motion there. The computation of the time by non-stationary routes may be omitted if the surface where the secondary sources are placed is selected in the image space and the times from the source to this surface are determined for stationary routes only. In practice the energy distribution will not be determined in routine calculations, as typical calculations or observations will show the effects caused by departing from strict equality of path by different amounts, for each of the types of variation encountered in well-corrected systems.

All calculations will therefore relate to the geometrical paths, but variation in the lengths of these paths rather than their distances from a mean point in the neighbourhood of an image is to be regarded as the significant factor on which the quality of the image depends. The two sets of magnitudes are not independent, and we proceed to find the connection between them.

Take origins of rectangular co-ordinates in both object and image spaces. Suppose in the first space that a point source of light is situated at (x, y, z) in the object space. Light is radiated from this point in all directions, and some traverses the optical system and finds its way into the image space. Generally the wave-front in the image space will be a curved surface, and the normals or rays at different points of this surface differ in direction. A particular emergent ray may therefore be specified by its direction cosines. Let these be (L', M', N'), and suppose also that (ξ', η', ζ') is a point on this ray. The disturbance has taken a definite time to reach (ξ', η', ζ') from (x, y, z): let the corresponding optical path length, that is, the distance light travels in a standard medium in this time, be denoted by $\mathcal{V}$. Let $\mathcal{V}+\delta\mathcal{V}$ be the path length for a neighbouring ray starting from (x, y, z) and finishing at $(\xi'+\delta\xi', \eta'+\delta\eta', \zeta'+\delta\zeta')$, the final direction being $(L'+\delta L', M'+\delta M', N'+\delta N')$. If μ' is the refractive index of the final medium, the second path exceeds the first by

$$\mu'\{(L'+\delta L')\delta\xi'+(M'+\delta M')\delta\eta'+(N'+\delta N')\delta\zeta'\}$$

since the wave-front, which marks the locus of points optically equidistant from (x, y, z), is normal to the ray. Now suppose that the tangent planes to the wave-fronts at (ξ', η', ζ') and $(\xi'+\delta\xi', \eta'+\delta\eta', \zeta'+\delta\zeta')$ pass through the image space origin. Then

$$L'\xi'+M'\eta'+N'\zeta'=0,$$

$$(L'+\delta L')(\xi'+\delta\xi')+(M'+\delta M')(\eta'+\delta\eta')+(N'+\delta N')(\zeta'+\delta\zeta')=0,$$

and these conditions enable the expression we have found for the path difference to be written

$$-\mu'\{\xi'\delta L'+\eta'\delta M'+\zeta'\delta N'\}=\delta\mathcal{V} \qquad (1).$$

Now L', M', N' are connected by the relation

$$L'^2+M'^2+N'^2=1,$$

and therefore only two of them, say M' and N', may be regarded as independent variables. On eliminating L' (1) becomes

$$-\mu'\left(\eta'-\frac{M'}{L'}\xi'\right)\delta M'-\mu'\left(\zeta'-\frac{N'}{L'}\xi'\right)\delta N'=\delta\mathcal{V}.$$

Since $\mathcal{V}$ is now regarded as a function of M' and N', for any small variations of M' and N' we shall have

$$\delta\mathcal{V}=\frac{\partial\mathcal{V}}{\partial M'}\delta M'+\frac{\partial\mathcal{V}}{\partial N'}\delta N',$$

and, since M' and N' may be varied independently, we find, by comparing these equations,

$$\mu'\left(\eta'-\frac{M'}{L'}\xi'\right)=-\frac{\partial\mathcal{V}}{\partial M'},\quad \mu'\left(\zeta'-\frac{N'}{L'}\xi'\right)=-\frac{\partial\mathcal{V}}{\partial N'}.$$

Now $\eta'-\frac{M'}{L'}\xi'$ and $\zeta'-\frac{N'}{L'}\xi'$ are invariants for any given ray, and represent the y' and z' co-ordinates of the intersection of the ray with the plane $x'=0$. If we understand that y' and z' are the co-ordinates of a point in this plane we may write these equations

$$\mu'y'=-\frac{\partial\mathcal{V}}{\partial M'},\quad \mu'z'=-\frac{\partial\mathcal{V}}{\partial N'} \qquad (2)$$

If then we know $\mathcal{V}$ as a function of M' and N', that is to say if we know how the length of the optical path from the source to a plane through the image space origin varies as the direction of this plane alters, we can find where the common normal to this plane and the wave meets an arbitrary fixed plane through the origin.

If, instead of starting with a source of light at a known point of the object space, we had assumed it to be situated in the image space, some of the light diverging from this point would reach the lens and after refraction would emerge into the object space. We could take $\mathcal{V}'$ as a measure of the time taken by the light to reach a plane in the direction (L, M, N) passing through the object space origin, and obtain the equations

$$\mu y=\frac{\partial\mathcal{V}'}{\partial M},\quad \mu z=\frac{\partial\mathcal{V}'}{\partial N} \qquad (3)$$

for the point (y, z) in which the common normal to the wave-front and the plane $L\xi+M\eta+N\zeta=0$ meets the plane $x=0$. The change of sign which will be observed on comparing equations (2) and (3) is due to the assumption that the positive directions of the axes are unaltered, so that a positive displacement of (ξ, η, ζ) corresponds to a decrease in the time $\mathcal{V}'$.

The function $\mathcal{V}$ suffers from the grave disadvantage that it is unsymmetrical, the variables in the object space being point co-ordinates, and in the image space direction cosines. A function which is symmetrical is at once obtained by considering the particular case in which the source of light is at infinity. It is inconvenient to include in the function the infinite term representing the length of the path between the source and a reference position near the lens, so the path is measured from the wave-front which passes through the object space origin. Since all points on the same wave-front are at the same optical distance from the source, $\mathcal{E}$, the new finite path length, which is a function of (M, N, M', N'), differs from $\mathcal{V}$ only by a constant, and, as in the case of $\mathcal{V}$, the equations

$$\mu'y'=-\frac{\partial\mathcal{E}}{\partial M'},\quad \mu'z'=-\frac{\partial\mathcal{E}}{\partial N'} \qquad (4)$$

are satisfied. In a similar way from $\mathcal{V}'$, by placing the source at infinity in the image space in the direction L', M', N', and rejecting the constant infinite part of the path, we obtain a finite function $\mathcal{E}'$ having (M, N, M', N') as its variables and satisfying the equations

$$\mu y=\frac{\partial\mathcal{E}'}{\partial M},\quad \mu z=\frac{\partial\mathcal{E}'}{\partial N} \qquad (5)$$

Now $\mathcal{E}$ and $\mathcal{E}'$ measure the time taken by the light to travel between the same two planes in opposite directions along the stationary path. This stationary path between two planes is unique and independent of the curvature of the wave-front at either

plane. Moreover the speed of light is independent of direction. It follows that $\mathcal{E}$ and $\mathcal{E}'$ are equal, and, since they are expressed in terms of the same variables, they must be identical. This symmetrical function of the direction cosines, which is one of the Characteristic Functions introduced into Optics by Hamilton, will be referred to as the Eikonal, a name proposed by Bruns.

In the application of this function the planes $x=0$ and $x'=0$ will be chosen to coincide with the object and image planes, or at least to be parallel to them. Equations (4) and (5) then show how this function, which itself expresses the length of a path carried through the refracting surfaces, and is thus particularly suitable for investigations according to the wave theory, enables the points in which rays travelling in specified directions meet the object and image surfaces to be found.

Focal Lengths and Principal Foci.—The rays, being the normals to the wave front, are the loci of points for which the path is stationary for slightly displaced routes, and conjugate foci are points of a particular path between which the path length is stationary for larger deviations. In an axially symmetrical system we can see immediately that a pair of such points for a skew ray (that is to say, a ray which does not lie entirely in an axial plane) are the intersections of any axial plane with the incident and emergent rays. By considering a ray in an axial plane as the limiting position of a skew ray, we can extend the definition to all rays. We shall call such conjugate points secondary foci. We proceed to find the positions of the principal secondary foci and the magnitudes of the corresponding focal lengths.

Take the axes of x and x' in coincidence with the axis of symmetry, so that $\mathcal{E}$ may be regarded as a function of three variables only, viz., $\frac{1}{2}\mu^2(M^2+N^2)$, $\mu\mu'(MM'+NN')$ and $\frac{1}{2}\mu'^2(M'^2+N'^2)$. Denoting these by a, b, c respectively, and differentiation by the addition of a suffix, equations (4) give

$$y'+\mu M\mathcal{E}_b+\mu' M'\mathcal{E}_c=z'+\mu N\mathcal{E}_b+\mu' N'\mathcal{E}_c=0 \qquad (5)$$

that is to say, the ray goes through the point $(\rho' L', Y', Z')$ distant ρ' along the ray from the reference plane $x'=0$, where $\rho'=\mu'\mathcal{E}_c$ provided

$$Y'=-\mu M\mathcal{E}_b,\ Z'=-\mu N\mathcal{E}_b \qquad (6)$$

These equations show that at this point the ray goes through a point in the axial plane containing the infinitely distant origin of light (L, M, N). In other words the secondary principal focus lies on the ray at the distance $\mu'\mathcal{E}_c$ beyond its intersection with the reference plane $x'=0$. Similarly the secondary principal focus in the object space lies on the ray at a distance $-\mu\mathcal{E}_a$ from its intersection with the reference plane $x=0$, the measurement being made in the positive direction. By partial analogy with the properties associated with the nodal points of collinear imagery, if f is the object space secondary focal length, the y' and z' coordinates of the secondary image of the infinitely distant object (L, M, N) are Mf and Nf respectively. Equations (6) thus give $f=-\mu\mathcal{E}_b$, and similarly the image space secondary focal length is given by $f'=-\mu'\mathcal{E}_b$.

The secondary conjugate points corresponding to the magnification S must satisfy

$$\frac{Y'}{Y}=\frac{Z'}{Z}=s,$$

and if these points are distant ρ' and ρ from the corresponding principal foci, by equations (5) we have

$$\frac{\rho' M'-\mu M\mathcal{E}_b}{\rho M+\mu' M'\mathcal{E}_b}=\frac{\rho' N'-\mu N\mathcal{E}_b}{\rho N+\mu' N'\mathcal{E}_b}=s$$

or

$$\rho=-\frac{\mu\mathcal{E}_b}{s},\ \rho'=\mu'\mathcal{E}_b\cdot s$$

since for a skew ray M/M' and N/N' are not equal. The connection between the principal foci, the focal lengths, a pair of conjugate foci and the magnification for any ray thus correspond exactly to those found for the instrument as a whole in collinear imagery. The fact that this law is followed for lengths measured along the ray itself, and not their projections on the axis, clearly involves the failure of collinear imagery. The constant magnification surfaces in fact tend to be spherical rather than plane.

We will next determine the primary principal foci, which are the points of intersection of successive parallel incident rays lying in the same plane through the axis of the system. Without loss of generality we may suppose $z=z'=N=N'=0$, and the y' co-ordinate of the point in which the ray meets the plane $x'=X'$ is $\frac{M'}{L'}X'-\mu' M'\mathcal{E}_c-\mu M\mathcal{E}_b$. If this point is conjugate to the infinitely distant point (L, M), this value of y' will be unaltered by substituting $\left(L'-\frac{M'}{L'}\delta M',\ M'+\delta M'\right)$ for (L', M'). Since $\delta M'$ is finite, we see that we must travel along the ray from its intersection with the reference plane the distance

$$\frac{X'}{L'}=\mu' L'^2\{\mathcal{E}_c+2a\mathcal{E}_{bb}+2b\mathcal{E}_{bc}+2c\mathcal{E}_{cc}\}$$

to reach the primary principal focus. The corresponding distance for the object space is

$$-\mu L^2\{\mathcal{E}_a+2a\mathcal{E}_{aa}+2b\mathcal{E}_{ab}+2c\mathcal{E}_{bb}\}.$$

To determine the focal lengths we note from (5) that the ray $(M+\delta M, M')$ meets the reference plane in the point $y'+\delta y'$ where

$$\delta y'=-\mu\delta M\{\mathcal{E}_b+2a\mathcal{E}_{ab}+b(\mathcal{E}_{bb}+\mathcal{E}_{ac})+2c\mathcal{E}_{bc}\}.$$

Now the separation between these parallel emergent rays is $L'\delta y'$, and the angle between the two incident rays is $\delta M/L$. We define the focal length as the distance at which this separation is subtended by this angle, or

$$F=-\mu LL'\{\mathcal{E}_b+2a\mathcal{E}_{ab}+b(\mathcal{E}_{bb}+\mathcal{E}_{ac})+2c\mathcal{E}_{bc}\},$$

and similarly

$$F'=-\mu' LL'\{\mathcal{E}_b+2a\mathcal{E}_{ab}+b(\mathcal{E}_{bb}+\mathcal{E}_{ac})+2c\mathcal{E}_{bc}\},$$

where F and F' are the first and second primary focal lengths respectively. Substituting these values in generalised variations of (5) we find for points distant ρ and ρ' from the principal primary foci

$$L\delta Y-M\delta X=\rho\frac{\delta M}{L}-F'\frac{\delta M'}{L'},$$

$$L'\delta Y'-M'\delta X'=\rho'\frac{\delta M'}{L'}+F\frac{\delta M}{L},$$

showing that conjugate points for the transverse magnification p are given by $\rho=F/p$, $\rho'=-F'p$, in harmony with the laws found in other cases. Just as we extended the conception of secondary foci from skew rays to rays in an axial plane, we may extend the primary concept to rays in general by basing generalised definitions upon the expressions we have derived.

The Sine Law and the Cosine Law.—The conditions that must be satisfied for an instrument to yield a plane image of a plane object at the constant magnification G may now be investigated. Put

$$a=S^2A-SGB+G^2C,$$
$$b=2SA-(S+G)B+2GC,$$
$$c=A-B+C,$$

so that

$$(S-G)^2A=a-Gb+G^2c,$$
$$(S-G)^2B=2a-(S+G)b+2SGc,$$
$$(S-G)^2C=a-Sb+S^2c.$$

Adopting for the moment the ray conception of imagery,

$$y=\frac{\partial\mathcal{E}}{\mu\partial M}=\mu M\mathcal{E}_a+\mu' M'\mathcal{E}_b=$$

$$\frac{1}{(S-G)^2}\{(\mu M-G\mu' M')(\mathcal{E}_A+\mathcal{E}_B)+(\mu M-S\mu' M')(\mathcal{E}_B+\mathcal{E}_C)\}$$

$$y'=\frac{\partial\mathcal{E}}{\mu'\partial M'}=\frac{1}{(S-G)^2}\{(\mu M-G\mu' M')(G\mathcal{E}_A+S\mathcal{E}_B)$$
$$+(\mu M-S\mu' M)(G\mathcal{E}_B+S\mathcal{E}_C)\}$$

so that

$$y'-Gy=\frac{1}{S-G}\{(\mu M-G\mu'M')\mathcal{E}_B+(\mu M-S\mu'M')\mathcal{E}_C\}$$

and similarly

$$z'-Gz=\frac{1}{S-G}\{(\mu N-G\mu'N')\mathcal{E}_B+(\mu N-S\mu'N')\mathcal{E}_C\}$$

Thus, if the reference points lie in the planes conjugate to one another for magnification G, the presence of terms in B and C with finite coefficients involves displacements of the image points from their desired positions. The condition required is therefore that $\mathcal{E}$ should be a function of A only, that is the direction cosines only occur in the combination

$$(\mu M-G\mu'M')^2+(\mu N-G\mu'N')^2\,.$$

$\mu M-G\mu'M'$ and $\mu N-G\mu'N'$ must then be constant for all rays through a given object point. These are the generalised sine conditions. When the object point lies on the axis each of these quantities must vanish. In consequence of the axial symmetry only one condition, known as Abbe's sine condition, is in fact involved. If we write $G=\frac{l'}{l}$ where l and l' are conjugate lengths normal to the axis, and ψ and ψ' are the angles made by the ray with the axis, Abbe's condition takes the form $\mu l\sin\psi=\mu'l'\sin\psi'$, a result of which use has already been made in discussing the resolving power of optical instruments.

If $(0, y, z)$ is the point of intersection with the first reference plane of a ray A in the direction (L, M, N), and $(0, y+\delta y, z+\delta z)$ is the point in which a parallel ray B meets the same plane, the change of co-ordinates may be regarded as the result of a displacement through the distance σ in the direction l, m, n if $L\delta y=\sigma(Lm-Ml)$, $L\delta z=\sigma(Ln-Nl)$, which involve.

$$L(\delta y\delta M+\delta z\delta N)=\sigma L(l\delta L+m\delta M+n\delta N)-\sigma l(L\delta L+M\delta M+N\delta N)$$

whatever δL, δM, δN may be. If $(L+\delta L,\ M+\delta M,\ N+\delta N)$ is a neighbouring direction to (L, M, N) the equation becomes

$$\delta y\delta M+\delta z\delta N=\sigma(l\delta L+m\delta M+n\delta N).$$

Similarly if $(0, y', z')$, lies on ray A, and a parallel emergent ray C passes through $(0, y'+\delta y', z'+\delta z')$, and the displacement corresponds to a movement through the distance σ' in the direction (l', m', n'), we shall have

$$\delta y'\delta M'+\delta z'\delta N'=\sigma'(l'\delta L'+m'\delta M'+n'\delta N')$$

where $(L'+\delta L',\ M'+\delta M',\ N'+\delta N')$ is any direction near that of these two parallel rays. Now if the ray B emerges in the direction $(L'+\delta L',\ M'+\delta M',\ N'+\delta N')$ we have

$$\mu\delta y=\mu(y+\delta y-y)=\frac{\partial}{\partial M}(\mathcal{E}_{(B)}-\mathcal{E}_{(A)})=\mathcal{E}_{MM'}\delta M'+\mathcal{E}_{MN'}\delta N'+\cdots.$$

Similarly $\quad \mu\delta z=\mathcal{E}_{NM'}\delta M'+\mathcal{E}_{NN'}\delta N'+\cdots.$

Also if $(L+\delta L,\ M+\delta M,\ N+\delta N)$ is the direction of incidence of the ray C,

$$\mu'\delta y'=-\mathcal{E}_{MM'}\delta M-\mathcal{E}_{NM'}\delta N\cdots$$

$$\mu'\delta z'=-\mathcal{E}_{MN'}\delta M-\mathcal{E}_{NN'}\delta N\cdots$$

so that neglecting small quantities of the third order

$$\mu(\delta y\delta M+\delta z\delta N)+\mu'(\delta y'\delta M'+\delta z'\delta N')=0$$

or $\quad \mu\sigma(l\delta L+m\delta M+n\delta N)+\mu'\sigma'(l'\delta L'+m'\delta M'+n'\delta N')=0,$

that is $\quad \mu\sigma(\cos\theta_C-\cos\theta_B)+\mu'\sigma'(\cos\theta_B'-\cos\theta'_C)=0$

$$\mu\sigma\cos\theta_B-\mu'\sigma'\cos\theta_B'=\mu\sigma\cos\theta_C-\mu'\sigma'\cos\theta_C',$$

where θ and θ' are the angles made by the ray indicated with the directions (l, m, n) and (l', m', n') respectively. If then a small parallel displacement of a collection of incident rays, determined for example by their caustic surface, is to correspond to a parallel displacement of the emergent group, so that the caustic surface of the latter is to be translated without change of shape, the set of rays must all satisfy an equation of the form

$$\mu\cos\theta=p\mu'\cos\theta'+q$$

where p and q are constants, and the displacement in the image space will be p times as great as that in the object space. This cosine law is of wider application than the laws previously given, since no special assumptions, such as that the rays concerned all pass through a given point, have been made. The converse of this law, which has recently been extended in various directions, may also be proved. We can only consider here some specially simple applications.

The law of refraction is obtained by considering rays which pass through a point on the surface, the object and image displacements being necessarily equal. By considering a movement in the plane containing both rays we find, on writing ϕ and ϕ' for the complements of θ and θ', $\mu\sin\varphi=\mu'\sin\varphi'+q$, and q vanishes as φ and φ' vanish together. The analytical form may also be derived at once, for we must have

$$\mu(L\delta x+M\delta y+N\delta z)=\mu'(L'\delta x+M'\delta y+N'\delta z)+q,$$

where δx, δy, δz are the components of the common displacement, so long as $l\delta x+m\delta y+n\delta z=0$ where l, m, n are the direction cosines of the normal to the surface. That is to say $q=0$ and

$$\frac{\mu'L'-\mu L}{l}=\frac{\mu'M'-\mu M}{m}=\frac{\mu'N'-\mu N}{n}$$

is the formula required.

The Abbe Sine Law.—In a system symmetrical about an axis let there be no aberration in the image of a given point on the axis. The condition for the absence of aberrations in the image of a small object normal to the axis through this point is obtained by considering displacements normal to the axis. If ψ and ψ' are the angles made by an incident and the corresponding emergent ray with the axis, the condition is

$$\mu\sin\psi=p\mu'\sin\psi'+\text{constant}$$

where p is the transverse linear magnification. Since the axis itself is both an incident and emergent ray of the group forming the axial image, the constant is zero.

The Sine Law for Axial Displacements (Herschel's Condition).—In the previous system let displacements along the axis be considered. Then the condition that there should be no aberration in the image of a short element of length along the axis is

$$\mu\cos\psi=P\mu'\cos\psi'+\text{constant}.$$

Since $\psi=\psi'=0$ is a member of the group of rays, the constant is equal to $\mu-P\mu'$, and the condition may be written in the form

$$\mu^{\frac{1}{2}}\sin\tfrac{1}{2}\psi=P^{\frac{1}{2}}\mu'^{\frac{1}{2}}\sin\tfrac{1}{2}\psi'$$

which is inconsistent with the Abbe sine law unless $\psi=\pm\psi'$. Both conditions are satisfied by paraxial rays, and therefore $P=p^2\mu'/\mu$. This condition illustrates the proportionality of the longitudinal magnification to the square of the transverse magnification.

The Extended Sine Law.—If there is perfect imagery for the transverse plane for which the magnification is m, the displacement of the object and image point caustics must satisfy the cosine law for displacements in the directions of the y and z axes. Thus in the symmetrical system in which the axes of x and x' coincide with the axis of symmetry, and the axes of y and y' and of z and z' are respectively parallel to one another, the conditions for perfect imagery over the whole plane when there is no aberration on the axis are

$$\mu M-\mu'M'm=q$$

$$\mu N-\mu'N'm=q'$$

where q and q' are functions of y, z, the co-ordinates of the object point from which the rays arise. Symmetry shows that $q=yQ$, $q'=zQ$ where Q is a function of y^2+z^2.

The Construction of the Eikonal.—Before the expressions which have been derived can be applied the eikonal must be constructed. We proceed to show how this may be done.

Suppose that the surface whose homogeneous equation is

$f(a, x, y, z)=0$ separates media whose refractive indices are μ and μ' respectively. Let the reference planes for the two media both pass through the origin of co-ordinates and have direction cosines (L, M, N) and (L', M', N') respectively. Since for the stationary path the light travels perpendicularly to these planes, the distances of (x, y, z) from these planes for the light are $Lx+My+Nz$ and $L'x+M'y+N'z$ respectively. It readily follows that in the time taken by the light to travel from the plane (L, M, N) to the plane (L', M', N') via the point (x, y, z) the distance travelled in the standard medium is

$$\mathcal{E}=\mu(Lx+My+Nz)-\mu'(L'x+M'y+N'z).$$

If (x, y, z) determines the neighbourhood of the surface for which the time is stationary between the planes, we must have

$$(\mu L-\mu' L')\delta x+(\mu M-\mu' M')\delta y+(\mu N-\mu' N')\delta z=0$$

for all infinitesimal values of δx, δy, δz which satisfy

$$f_x\delta x+f_y\delta y+f_z\delta z=0.$$

That is to say we shall have

$$\frac{\mu L-\mu' L'}{f_x}=\frac{\mu M-\mu' M'}{f_y}=\frac{\mu N-\mu' N'}{f_z}$$

and each of these will be equal to

$$\frac{\mu(Lx+My+Nz)-\mu'(L'x+M'y+N'z)}{xf_x+yf_y+zf_z}.$$

Now, since f is homogeneous in a, x, y, z,

$$af_a+xf_x+yf_y+zf_z=0,$$

and therefore

$$\frac{\mathcal{E}}{af_a}=\frac{\mu' L'-\mu L}{f_x}=\frac{\mu' M'-\mu M}{f_y}=\frac{\mu' N'-\mu N}{f_z}$$

Now f_a, f_x, f_y, f_z are four homogeneous functions of a, x, y, z, between which the three ratios of these variables may be eliminated, giving

$$\phi(f_a,\ f_x,\ f_y,\ f_z)=0$$

where ϕ is a homogeneous function. It at once follows that $\mathcal{E}$ satisfies the equation

$$\phi(\mathcal{E}/a,\ \mathcal{L},\ \mathcal{M},\ \mathcal{N})=0$$

where $\mathcal{L}, \mathcal{M}, \mathcal{N}$ denote $\mu' L'-\mu L$, $\mu' M'-\mu M$, $\mu' N'-\mu N$ respectively. This equation expresses $\mathcal{E}$, the stationary path length between the planes (L, M, N) and (L', M', N'), in terms of their direction cosines, so that $\mathcal{E}$ is the eikonal.

Consider refraction at the paraboloid of revolution

$$y^2+z^2-4ax=0.$$

Here

$$\frac{f_a}{-4x}=\frac{f_x}{-4a}=\frac{f_y}{2y}=\frac{f_z}{2z},$$

so that

$$f_y^2+f_z^2-f_af_x=0$$

and
$$\mathcal{E}=a\,\frac{\mathcal{M}^2+\mathcal{N}^2}{\mathcal{L}}.$$

Again at the spherical surface

$$x^2+y^2+z^2-r^2=0$$

we have
$$\frac{f_x}{x}=\frac{f_y}{y}=\frac{f_z}{z}=\frac{f_r}{-r},$$

and therefore
$$f_x^2+f_y^2+f_z^2=f_r^2$$

or
$$\mathcal{E}=\pm r(\mathcal{L}^2+\mathcal{M}^2+\mathcal{N}^2)^{\frac{1}{2}}.$$

One root corresponds to the part of the surface which is convex, the other to the part which is concave, to the incident light.

By a similar process the equation of the refracting surface may be found when $\mathcal{E}$ is given as a homogeneous function of the first order in $\mathcal{L}, \mathcal{M}, \mathcal{N}$. The equation of the eikonal for the sphere may be written

$$\mathcal{E}=r[\mu'^2+\mu^2-2b-2(\mu^2-2a)^{\frac{1}{2}}(\mu'^2-2C)^{\frac{1}{2}}]^{\frac{1}{2}}=r(\mu'\cos\phi'-\mu\cos\phi)$$

where ϕ and ϕ' are the angles of incidence and refraction. If then we write $\kappa=\dfrac{\mu'\cos\phi'-\mu\cos\phi}{r}$, we have $\mathcal{E}=r^2\kappa$, $\mathcal{E}\mathcal{E}_b=-r^2$ or the secondary focal lengths are μ/κ and μ'/κ respectively, where κ is called the secondary power. The equations

$$\kappa\mathcal{E}_a=\frac{\mu' L'}{\mu L},\ \kappa\mathcal{E}_c=\frac{\mu L}{\mu' L'}$$

merely mean that the refracting surface is the unit surface. Again

$$\mathcal{E}_b+2a\mathcal{E}_{ab}+b\mathcal{E}_{bb}+b\mathcal{E}_{ac}+2c\mathcal{E}_{bc}=-\frac{\cos\phi\cos\phi'}{LL'\kappa}$$

so that the primary power is $\kappa\sec\phi\sec\phi'$; also

$$\mathcal{E}_c-L'^2\{\mathcal{E}_c+2a\mathcal{E}_{bb}+2b\mathcal{E}_{bc}+2c\mathcal{E}_{cc}\}=\frac{\sin^2\phi}{\kappa},$$

the quantity on the left when multiplied by μ' being the distance between the primary and secondary principal foci in the image space, that is to say the astigmatism. It is worth noting that at the two principal foci the astigmatism is inversely as the refractive index.

When the incidence is normal both powers become equal to $\dfrac{\mu'-\mu}{r}$, an expression of importance because in a symmetrical instrument incidence is normal for paraxial rays, that is rays which lie close to the axis of symmetry. As the unit in which powers are expressed, the dioptrie or dioptre, the inverse of a metre, is universally employed. Thus a lens of power 5 dioptries (written 5D.) has a focal length of 20 cm. in air.

The Combination of Systems.—Having found the eikonal for the separate surfaces of the instrument it is now necessary to find those for the combination. The process involved may be illustrated by combining two systems. Let O_0, O_1 and O_2 in media of refractive indices μ_0, μ_1 and μ_2 be the reference points on the axis, $\mathcal{E}_1$ the eikonal for the first portion between planes through O_0 and O_1, $\mathcal{E}_2$ that for the second part between planes through O_1 and O_2, and $\mathcal{E}_{12}$ that for the whole. From the definitions of the eikonal it follows that $\mathcal{E}_{12}=\mathcal{E}_1+\mathcal{E}_2$. Moreover

$$-\frac{\partial\mathcal{E}_1}{\partial M_1}=\mu_1 y_1=\frac{\partial\mathcal{E}_2}{\partial M_1},\ \text{or}\ \frac{\partial}{\partial M_1}(\mathcal{E}_1+\mathcal{E}_2)=0$$

with a similar equation involving N_1. These two conditions enable M_1 and N_1 to be eliminated from $\mathcal{E}_1+\mathcal{E}_2$, leaving $\mathcal{E}_{12}$ expressed in terms of the external variables only.

Paraxial Laws.—From the formulae reached in a previous section we see that the refraction of paraxial rays is determined by the part of $\mathcal{E}$ which is linear in a, b and c. Let us put

$$\mathcal{E}=\text{const.}+\alpha a+\beta b+\gamma c+\cdots;$$

then the conditions from which M_1 and N_1 are to be found are

$$\mu_0 M_0\beta_1+\mu_1 M_1\gamma_1+\mu_1 M_1\alpha_2+\mu_2 M_2\beta_2=0,$$
$$\mu_0 N_0\beta_1+\mu_1 N_1\gamma_1+\mu_1 N_1\alpha_2+\mu_2 N_2\beta_2=0.$$

Squaring and adding we find for the combination

$$\mathcal{E}=\text{constant}+\alpha_1 a-\frac{\beta_1^2 a+\beta_1\beta_2 b+\beta_2^2 c}{\gamma_1+\alpha_2}+\gamma_2 c+\cdots.$$

This expression shows that it we put

$$\alpha=\frac{A}{B},\ \beta=-\frac{1}{B},\ \gamma=\frac{C}{B},\ AC-BD=1$$

the paraxial constants of the compound instrument are given by the matrix law

$$\begin{pmatrix}A_{12} & D_{12}\\ B_{12} & C_{12}\end{pmatrix}=\begin{pmatrix}A_1 & D_1\\ B_1 & C_1\end{pmatrix}\begin{pmatrix}A_2 & D_2\\ B_2 & C_2\end{pmatrix},$$

the extension of which to any number of systems is simple. It is an easy matter to show that the equations for the points in which a ray meets the reference planes are given by

$$\begin{pmatrix}A & 1\\ 1 & C\end{pmatrix}\begin{pmatrix}\mu M & \mu N\\ -\mu' M' & -\mu' N'\end{pmatrix}=B\begin{pmatrix}y & z\\ y' & z'\end{pmatrix},$$

the converse relation by

$$\begin{pmatrix} A & 1 \\ 1 & C \end{pmatrix}\begin{pmatrix} -y' & -z' \\ y & z \end{pmatrix} = D\begin{pmatrix} \mu' M' & \mu' N' \\ \mu M & \mu N \end{pmatrix},$$

and the relation between axial conjugate points by

$$(\mu \quad x)\begin{pmatrix} A & D \\ B & C \end{pmatrix}\begin{pmatrix} x' \\ -\mu' \end{pmatrix} = 0.$$

If the system consists of a series of spherical refracting surfaces of powers $\kappa_1, \kappa_2, \kappa_3, \cdots$ and separations $\mu_1\tau_1, \mu_2\tau_2, \cdots$ between their vertices, the constants are calculated from the product

$$\begin{pmatrix} A & D \\ B & C \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ \kappa_1 & 1 \end{pmatrix}\begin{pmatrix} 1 & -\tau_1 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ \kappa_2 & 1 \end{pmatrix}\begin{pmatrix} 1 & -\tau_2 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ \kappa_3 & 1 \end{pmatrix} \cdots$$

where the reference points are at the points of intersection of the axis with the extreme surfaces and, for any surface separating media of refractive indices μ and μ', $\kappa = R(\mu' - \mu)$, R being the curvature of the surface at the vertex, considered positive if its convex side is presented to the incident light. In the special case in which all the refracting surfaces cross the axis at the same point this product reduces to the simple form

$$\begin{pmatrix} A & D \\ B & C \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ \kappa_1 + \kappa_2 + \kappa_3 + \cdots & 1 \end{pmatrix}.$$

Systems in which the overall axial depth is negligible are termed "thin." They are of much importance in the preliminary development of instruments owing to the simplicity of all formulae relating to thin systems and to the accident that it is nearly always the aim of the designer of optical systems to use no greater amount of glass, quartz or other transparent solid than is necessary.

Chromatic Aberrations.—We have hitherto regarded the refractive index as a property of the medium only. Optical instruments in general are used for the control of light of various wave-lengths, and as the nature of the light is changed the refractive index of the medium alters. It follows that A, B, C, D are liable to vary as the colour of the light changes and the position and size of the image of a given object likewise vary. Most instruments would not be of much value unless these variations could be reduced to very small amounts. We will determine the conditions that must be satisfied for them to be eliminated. We shall assume that the two media external to the system are alike and are the standard medium to which the value unity for the refractive index is conventionally ascribed for all wave-lengths.

The matrix for refraction at a single surface is

$$\begin{pmatrix} 1 & 0 \\ R(\mu' - \mu) & 1 \end{pmatrix},$$

and this may be replaced by the product

$$\begin{pmatrix} 1 & 0 \\ R(1 - \mu) & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ R(\mu' - 1) & 1 \end{pmatrix}$$

corresponding to refraction from the medium of index μ into the standard medium followed immediately by refraction from the standard medium into that of index μ'. We may therefore consider the system as a combination of a series of bodies, each bounded by two refracting surfaces, immersed in the standard medium. We call each of these elementary bodies a simple lens, and it is convenient to regard such lenses rather than the separate surfaces as the elements from which the instrument is built. The matrix for the instrument now takes the form

$$\begin{pmatrix} A & D \\ B & C \end{pmatrix} = \begin{pmatrix} A_1 & D_1 \\ B_1 & C_1 \end{pmatrix}\begin{pmatrix} 1 & -s_1 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} A_2 & D_2 \\ B_2 & C_2 \end{pmatrix}\begin{pmatrix} 1 & -s_2 \\ 0 & 1 \end{pmatrix} \cdots$$

where s_1, s_2 are separations in the standard medium between the vertices of successive lenses, and thus do not vary as the constitution of the light changes. If in consequence of a change in the wave-length of the light the matrix for a typical lens becomes

$$\begin{pmatrix} A + \delta A & D + \delta D \\ B + \delta B & C + \delta C \end{pmatrix},$$

the changes in the coefficients for the entire instrument to a first approximation will be given by

$$\begin{pmatrix} \delta A & \delta D \\ \delta B & \delta C \end{pmatrix} = \sum (P)\begin{pmatrix} \delta A_k & \delta D_k \\ \delta B_k & \delta C_k \end{pmatrix}(P')$$

where (P) and (P') denote the products of the matrices respectively preceding and following those of the lens κ in the matrix product for the entire system, and the summation extends to all the lenses.

Now
$$\begin{pmatrix} A & D \\ B & C \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ \dfrac{C-1}{D} & 1 \end{pmatrix}\begin{pmatrix} 1 & D \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ \dfrac{A-1}{D} & 1 \end{pmatrix},$$

and thus $\dfrac{C-1}{D} = R(\mu - 1)$, $\dfrac{A-1}{D} = R'(1-\mu)$, $D = -t/\mu$ where R, R', t are the curvatures of the two surfaces and the axial thickness of the single lens. It follows that for light of a different colour for which the refractive index is $\mu + (\mu - 1)/\nu$, where ν is a quantity regularly given by glass makers, the increments in A, C, D are given to the first order by

$$\delta\frac{A-1}{D} = \frac{A-1}{D\nu},\ \delta\frac{C-1}{D} = \frac{C-1}{D\nu},\ \delta D = -D\frac{\mu-1}{\mu\nu},$$

so that $\delta A = \dfrac{A-1}{\mu\nu}$, $\delta C = \dfrac{C-1}{\mu\nu}$, $\delta B = \dfrac{B}{\nu} + \dfrac{(A-1)\,(C-1)}{\mu\nu D}$,

that is to say the increment in the matrix is

$$\frac{1}{\nu}\begin{pmatrix} 0 & -D \\ B & 0 \end{pmatrix} + \frac{1}{\mu\nu}\begin{pmatrix} A-1 & D \\ \dfrac{(A-1)(C-1)}{D} & C-1 \end{pmatrix}.$$

When the thickness of the component is negligible only the first of these matrices is of consequence, and the only alteration is due to a proportional change in B. If all the components are thin lenses in contact, the properties of the system, so far as the paraxial terms are concerned, will be the same for light of the two wave-lengths if $\Sigma\dfrac{B}{\nu} = 0$. In particular for a system of two thin lenses in contact we have

$$\frac{B_1}{\nu_1} = -\frac{B_2}{\nu_2} = \frac{B_{12}}{\nu_1 - \nu_2}$$

as the sole condition for achromatism. In the more general case the expressions most frequently employed are that given for δB and

$$\delta\left(\frac{A}{B}\right) = -\frac{1}{\nu}\left\{\frac{A}{B} - \frac{(A-1)^2}{\mu D B^2}\right\},\ \delta\left(\frac{C}{B}\right) = -\frac{1}{\nu}\left\{\frac{C}{B} - \frac{(C-1)^2}{\mu D B^2}\right\}.$$

Alternatively we may divide the complete expression into the three parts

$$\frac{1}{\nu}\begin{pmatrix} 0 & -D \\ B & 0 \end{pmatrix} + \frac{1}{\mu\nu}\begin{pmatrix} A & D \\ B & C \end{pmatrix} - \frac{1}{\mu\nu}\begin{pmatrix} 1 & 0 \\ \dfrac{A+C-2}{D} & 1 \end{pmatrix}$$

where the first indicates a proportional increment in the power of the element and a decrement in its effective thickness, the second a proportional change in all constants of the complete system, and the last the subtraction of the change in these constants which would arise if the separation between the surfaces of the component were annihilated without any change in the curvatures of its surfaces. In actual calculations it is probably more convenient to replace the $-D$ in the first part by 0 and the 0 in the last part by $-t$.

In a large number of instruments having a small field of view the only condition to which close attention is paid is the coincidence of the principal focal planes for different colours corresponding to $\delta\left(\dfrac{C}{B}\right) = 0$. When the field is large the condition $\delta B = 0$ has to be closely satisfied also. In the older eyepieces consisting of two separated simple thin lenses (those nearest the objective and the eye being respectively named the field lens and the eye lens), no other chromatic condition was imposed on this part of the instrument. This leads to the definite value

$$\left(\frac{\nu_1}{\kappa_1} + \frac{\nu_2}{\kappa_2}\right) \Big/ (\nu_1 + \nu_2)$$

for the axial separation of the two lenses, and when both lenses are made from the same kind of glass the old rule that the separation should equal the mean of the focal lengths of the two lenses follows. Modern eyepieces have to cover larger fields than are suited to the older forms, and either the field lens, or the eye lens, or both are compound. Attention to all three conditions is comparatively rare, and is only of importance when good correction is desired in widely separated image planes. If the system is symmetrical end for end, $A=C$, and the three conditions fall to two. Since

$$\begin{pmatrix} A & D \\ B & C \end{pmatrix}\begin{pmatrix} C & \frac{D}{p} \\ pB & A \end{pmatrix}=\begin{pmatrix} AC+pBD & \left(1+\frac{1}{p}\right)AD \\ (1+p)BC & AC+\frac{1}{p}BD \end{pmatrix},$$

a complete system made from two similar components, not necessarily of equal focal length, with corresponding parts next to one another, will be achromatised if A/B and D/C remain unaltered as the colour changes, that is to say the separate components, must be corrected for the position in which light parallel to the axis between the components comes to a focus, and for the image of the centre of symmetry.

The discussion of the conditions which should be satisfied when the rays considered do not lie close to the axis does not differ in any essential feature from that just given.

Aberrations for Homogeneous Radiation.—We have seen earlier that a plane image of a plane object will only be secured when $\mathcal{E}$ is expressible as a function of $(\mu M-G\mu' M')$ and $(\mu N-G\mu' N')$ only, where G is the transverse magnification. In general other terms occur, and the characteristic effects due to them are called aberrations. The quadratic terms in $\mathcal{E}$ may be written in the form

$$-\tfrac{1}{2}\left[\sigma_0 A^2-2\sigma_1 AB+\sigma_2 B^2+2\left(\sigma_2+\frac{\omega}{\kappa}\right)AC-2\sigma_3 BC+\sigma_4 C^2\right]$$

where A, B, C denote the quantities previously defined and the σ's are known as the aberrational coefficients; σ_1 is the coefficient for distortion, σ_2 for astigmatism, ω for curvature of the field, σ_3 for coma, and σ_4 for central aberration. Central aberration is so named because the other aberrations disappear on the axis of the system. It must not be supposed that central aberration is not present over the whole field. The significance of these terms will be more fully appreciated if we note that the co-ordinates (Y, Z) of an image point when aberrations are absent are given by

$$Y\kappa=\mu M-G\mu' M',\ Z\kappa=\mu N-G\mu' N'.$$

If then (η, ζ) is the point in which the plane of the stop is met we may substitute

$$A=\frac{(Y^2+Z^2)\kappa^2}{2(S-G)^2},\ B=\frac{(Y\eta+Z\zeta)\kappa^2}{(S-G)^2},\ C=\frac{(\eta^2+\zeta^2)\kappa^2}{2(S-G)^2}$$

in either the expression for $\mathcal{E}$ or in

$$y'-Y=\frac{1}{(S-G)}(Y\mathcal{E}_B+\eta\mathcal{E}_C),\ z'-Z=\frac{1}{S-G}(Z\mathcal{E}_B+\zeta\mathcal{E}_C).$$

From the latter we see that a finite value of σ_1 implies only a fixed displacement of the image point from its ideal position, so that object and image are not geometrically similar; hence the description of this aberration as distortion. At the displaced image point there is no difference of phase. By writing

$$(Y^2+Z^2)(\eta^2+\zeta^2)=(Y\eta+Z\zeta)^2+(Y\zeta-Z\eta)^2$$

we see that the terms in B^2 and AC may be analysed into two components, for one of which the point of intersection with the stop lies in the same axial plane as the object point, and for the other in a perpendicular axial plane. It is easy to show that either of these divergences may be removed for a given object point by moving the image plane along the axis. The terms in fact denote that the primary and secondary image surfaces are curved, the curvatures at the axis being $3\kappa^2\sigma_2+\kappa\omega$ and $\kappa^2\sigma_2+\kappa\omega$ respectively. The common part $\kappa\omega$, which depends only on the Airy-Petzval sum, is known technically as the curvature. A finite value of σ_2 implies that the primary and secondary image surfaces differ in curvature, so that σ_2 measures their separation, *i.e.*, the astigmatism. The coma, which has σ_3 for its coefficient, differs from the others in that $y'-Y$ and $z'-Z$ change in sign with η and ζ. The geometrical trace of the rays is therefore unsymmetrical and the phase variation is also unsymmetrical. No change of focus will remove this defect, but the want of symmetry may be removed, for small apertures, by choosing a proper position for the stop. Such a change however also affects the aberrations we have already mentioned. It may easily be shown that the rays from any object point which pass through one half of a circular zone of the stop concentric with the axis, meet the image plane in a complete circle, touching two straight lines, making an angle of 60° with one another, which meet in the image point for light which has passed through the centre of the stop. The primary focus for rays in the axial plane is three times as far as the secondary focus from the ideal image point. The central aberration measured by σ_4 is symmetrical, the rays through concentric circular zones of the stop meeting the image surface in concentric circular zones of radii proportional to the cube of the radii of the former. The aberration implies that each zone has a separate surface on which the image is formed, owing to want of agreement of phase. The primary foci for light from a point on the axis lie on a semi-cubical paraboloid with the axis of the system for its axis of revolution; the axis itself is the locus of the secondary foci. The former are three times as far as the latter from the paraxial image plane. The coefficient σ_0, with a correction added, is the quantity which corresponds to σ_4 when the reference plane is moved to another position. It is interpreted as the central aberration at the middle of the stop.

We can obtain the addition laws very simply for these aberrations by noting that, since all the paraxial terms when eikonals are added are completely accounted for by substituting for the intermediate direction cosines expressions linear in the external direction cosines, we have only to make the same substitutions for A, B, C in these aberrational terms. The expressions obtained in this way are

$$(\sigma_p)_{1,n}=\Sigma(\sigma_p)_\kappa S_\kappa^{4-p} G_\kappa^p,\ (p=0, 1, 2, 3, 4),$$

where the component parts are n in number, of which κ is a typical member, and S_κ, G_κ are the magnifications which the images of the stop and of the object formed by lens κ undergo in the subsequent parts of the system. The quantity $\frac{\omega}{\kappa}$, where κ is the power of the system, is transformed according to the same law as σ_2, and in this case we are led to an expression which is well known on account of its simplicity. This is the so-called Petzval sum

$$(\omega\kappa)_{1,n}=\Sigma(\omega\kappa)_\kappa$$

where $\omega_\kappa=\frac{1}{\mu_\kappa\mu'_\kappa}$. A more correct name would be the Airy sum, using the name of its first discoverer.

If $\mathcal{E}$ and $\mathcal{E}'$ are the eikonals for the same system when the reference points correspond to two different magnifications G and G', we have

$$\mathcal{E}-\frac{\mu^2 L}{\kappa G}-\frac{\mu'^2 L' G}{\kappa}=\mathcal{E}'-\frac{\mu^2 L}{\kappa G'}-\frac{\mu'^2 L' G'}{\kappa},$$

and if A', B', C' are the effective variables in the latter expression corresponding to the A, B, C of the former, we obtain a linear transformation from the one system to the other, and the aberrational coefficients for any positions of the object and stop can be expressed in terms of those for standard positions. By paying special attention to the factor $4AC-B^2$ which can be separated in a large number of terms, we are enabled to classify the aberrations generally by order and by series, the latter classification deriving its importance from the fact that though the conditions for the disappearance of any given aberration depend on the magnification, the disappearance of all the aberrations of a given order and series for a given pair of object and stop positions involves their disappearance for all positions. To this rule there is only one exception—that of the zero series, comprised of terms

which do not contain $4AC-B^2$ as a factor. In the quadratic terms just considered we may write the terms in B^2 and AC in the form

$$-\frac{1}{6}\left(3\sigma_2+\frac{\omega}{\kappa}\right)(B^2+2AC)-\frac{\omega}{6\kappa}(4AC-B^2)$$

showing that the term involving ω belongs to series 1.

It is no less advantageous when considering aberrations than when dealing with the paraxial constants to take the simple lens rather than the single surface as the effective unit. We proceed to find expressions for the aberrational coefficients of a simple thin lens, taking as the standard conditions the stop in the unit surface and the object in the surface for magnification -1. This choice offers many advantages due to symmetry. If object and image space are interchanged the coefficients with an even suffix are unaltered and those with an odd suffix merely changed in sign.

If the origins are taken at the vertex of a single surface system of power κ_1,

$$\mathcal{E}_1=\frac{\mu_1-\mu_0}{2\kappa_1}\left[\frac{\mathcal{M}_1^2+\mathcal{N}_1^2}{\mathcal{L}_1}-\frac{\epsilon_1(\mathcal{M}_1^2+\mathcal{N}_1^2)^2}{2\mathcal{L}_1^3}+\cdots\right].$$

Adding a similar expression, the condition, $\dfrac{\partial}{\partial M_1}(\mathcal{E}_1+\mathcal{E}_2)=0$ gives $\mu_1M_1\kappa=\mu_0M_0\kappa_2+\mu_2M_2\kappa_1$, where $\kappa=\kappa_1+\kappa_2$.

Hence $$\mu_1M_1=\frac{\mu_0M_0+\mu_2M_2}{2}-\frac{\kappa_1-\kappa_2}{\kappa}\left(\frac{\mu_0M_0-\mu_2M_2}{2}\right),$$

$$\frac{\mathcal{M}_1}{\kappa_1}=\frac{\mathcal{M}_2}{\kappa_2}=-\frac{\mu_0M_0-\mu_2M_2}{\kappa}.$$

To secure reference points at the negative unit surfaces we have to add $2(\mu_2^2L_2+\mu_0^2L_0)/\kappa$ to $\mathcal{E}$. Write 1, μ, 1 for μ_0, μ_1, μ_2 and put $\kappa_1-\kappa_2=2(\mu-1)\rho\kappa$ so that $\rho\kappa$ is the common addition made to the curvature of both surfaces to derive its shape from the symmetrical form. Then on expansion we find

$$\begin{aligned}\mathcal{E}\kappa &=4-4A-2A^2-2B^2-4(1+\omega)AC-8\rho(1+\omega)BC\\ &-2\left[\frac{1}{(1-\omega)^2}+4\rho^2(1+2\omega)+(\epsilon_1+\epsilon_2-1)\left\{\frac{1}{(\mu-1)^2}+12\rho^2\right\}\right.\\ &\left.\qquad+(\epsilon_1-\epsilon_2)2\rho\left\{\frac{3}{\mu-1}+4\rho^2(\mu-1)\right\}\right]C^2+\cdots\end{aligned}$$

where $\omega=1/\mu$. If the surfaces are spherical $\epsilon_1=\epsilon_2=\frac{1}{2}$ and the last two terms disappear from the coefficient of C^2. If they are paraboloidal $\epsilon_1=\epsilon_2=0$ and the coefficient of C^2 becomes

$$-2\left[\frac{1+\omega}{1-\omega}-8\rho^2(1-\omega)\right].$$

Since the refracting surfaces are in contact the coefficient of A^2 must correspond to the absence of stop aberration. The absence of a term in AB indicates that there is no distortion. The coefficients which determine the curvature and astigmatism are not under control. The coma may be removed by giving the lens a symmetrical form—that is by making $\rho=0$. The central aberration can then only be controlled by giving the surfaces a suitable shape—viz., by making $\epsilon_1=\epsilon_2=-\frac{1}{2}(\mu^2-1)$. This fixes the eccentricity of the osculating ellipsoids.

Let us write 4β for the coefficient BC and -2γ for that of C^2. Then with the stop magnification S and the object magnification G, after moving the origins and introducing the appropriate changes in A, B, C, we find the following expression, most of the coefficients in which were first obtained by Airy.

$$\begin{aligned}\mathcal{E}\kappa=&-\frac{(1-G)^2}{G}+\frac{(S-G)^2}{G}A-\frac{(S-G)(S^3-G)}{2G}A^2\cdots\\ &-\tfrac{1}{8}[\gamma-4\mathcal{S}\beta+\mathcal{S}^2(3+2\omega)](1-S)^4A^2\\ &+\tfrac{1}{4}[\gamma-(3\mathcal{S}+\mathcal{G})\beta+3\mathcal{S}^2+\mathcal{S}(\mathcal{S}+\mathcal{G})\omega](1-S)^3(1-G)AB\\ &-\tfrac{1}{8}[\gamma-2(\mathcal{S}+\mathcal{G})\beta+\mathcal{S}(\mathcal{S}+2\mathcal{G})\\ &+\tfrac{1}{3}(\mathcal{S}^2+4\mathcal{S}\mathcal{G}+\mathcal{G}^2)\omega](1-S)^2(1-G)^2(2AC+B^2)\\ &-\frac{\omega}{12}(S-G)^2(4AC-B^2)\\ &+\tfrac{1}{4}[\gamma-(\mathcal{S}+3\mathcal{G})\beta+\mathcal{G}(2\mathcal{S}+\mathcal{G})+\mathcal{G}(\mathcal{S}+\mathcal{G})\omega](1-S)(1-G)^3BC\\ &-\tfrac{1}{8}[\gamma-4\mathcal{G}\beta+\mathcal{G}^2(3+2\omega)](1-G)^4C^2\end{aligned}$$

where $\mathcal{S}=\dfrac{1+S}{1-S}$, $\mathcal{G}=\dfrac{1+G}{1-G}$ and the terms in the first line correspond to the elimination of aberrations. We may now employ the addition formulae for these aberrational coefficients to obtain corresponding expressions for any number of thin lenses in contact. We then find that ω is the Airy-Petzval sum, and if $\rho\kappa$ is a common curvature addition made to all the surfaces from a standard form the preceding formulae apply without alteration except that β and γ take the forms

$$\beta=\beta_0+2\rho(1+\omega),\quad \gamma=\gamma_0+4\rho^2(1+2\omega).$$

These formulae are particularly advantageous in their application to lenses which are to be cemented together, so that the second surface of one lens has the same curvature as the first surface of the next succeeding lens. For example telescope objectives may be advantageously designed in this way, the conditions to be applied being $\sigma_3=\sigma_4=0$, that is $\beta=(2+\omega)\mathcal{G}$, $\gamma=(5+2\omega)\mathcal{G}^2$, where $\mathcal{G}=1$ for an infinitely distant object. The coma is eliminated by giving a suitable degree of "bending" to the lens as a whole, and the central aberration by the choice of suitable glasses, or by departing from the spherical form for the surfaces, or by distributing the lens powers suitably between three or more components. When there are only two component lenses the ratio of their powers is determined by the condition for the removal of the chromatic aberrations. For more complete information on these developments the reader is referred to numerous papers in the *Transactions of the Optical Society*.

When the lens is no longer thin expressions for the aberrations differing very slightly from those just given may be obtained by the same general procedure. As a rule it is unnecessary to repeat the calculations after such thicknesses as are necessary for the construction of an actual lens have been introduced, as it has been shown that over a wide range of constructions the aberrations of this order introduced by separating the surfaces are automatically compensated in the most advantageous way by the aberrations of the next higher order which become significant at the aperture the thickness is introduced to yield.

Formulae may be obtained for these higher order aberrations in a similar manner; the chief complication is due to the necessity for taking into account in the values of M_1 and N_1 terms depending on the lower order aberrations.

Main Types of Optical Instruments.—Optical instruments tend to assume one of a few forms. Telescopes are systems of very great or even infinite focal length; they may invariably be regarded as a combination of two systems of finite focal length placed with their inner principal focal surfaces nearly or exactly in coincidence. The one part, often of large absolute aperture and long focal length, usually conforms to the thin lens type and is corrected for coma and central aberration. In the other part, the eyepiece, attention is chiefly given to the curvature and astigmatism. Telescopes are essentially instruments for increasing the angle an object appears to subtend at an observer's eye, and in most of them the field of view is small. At the opposite extreme are microscopes, also divisible into objective and eyepiece, but the former is of short focal length and small absolute, but large numerical, aperture. In the higher powers (that is shorter focal lengths) the objectives tend to be very complex. As with telescopes the most important objective corrections are those for colour, central aberration and coma. The eyepiece is of simple construction. Only a small part of an object can be viewed at once. Camera lenses form a class in some respects intermediate between telescopes and microscopes. The field is large and the numerical aperture moderate. In general they are not separable into parts having distinct functions, and all aberrations must be considered. The use of lenses at appreciable axial separations is necessary for the attainment of satisfactory

corrections.

Ray Tracing.—The professional optical designer in evolving complex instruments finds it expedient to use formulae for the aberrational coefficients merely as a general qualitative or roughly quantitative guide to indicate the modifications he should make in a partially developed system to reduce as far as possible the remaining aberrations. The outstanding difficulty in the way of using algebraic expansions for the whole of his work is the uncertain value of the terms of the expansion he must neglect. As he aims at taking into consideration lengths as small as a quarter of a wave length or less, that is to say about one ten-thousandth of a millimetre, it will be appreciated that our knowledge of the higher order aberrations must be thorough before reliance can in general be placed on expansions. The method adopted by the designer is to trace step by step through the system a selected set of rays, and to infer from their positions in the image space the aberrations remaining in the system. For tracing these rays many methods have been devised, of which particulars may be obtained from practical treatises. They are usually entirely trigonometrical, and logarithmic tables are generally employed. The calculations for skew rays are necessarily much more troublesome than those for rays in an axial plane, and in practice skew rays are rarely computed. A method of computing rays in an axial plane, suitable for use with a calculating machine, is as follows.

The incident ray is defined by $\flat$, the length of the perpendicular to the ray from the vertex of the surface, and $\sin\psi$, where ψ is the angle between the ray and the axis. The refractive index is denoted by μ, the angle of incidence by ϕ, the curvature of the surface by R, and the separation between the vertices of this and the next surface by t. The same letters, with accents where necessary, are used for the refracted ray, and with the suffix 1 for the following surface.

In the customary methods of calculation ψ_1 is found by the angular relation

$$\psi_1=\psi'=\psi-\phi+\phi'$$

which necessitates references to tables. In the present method the use of these tables is avoided by first finding an approximate value $\sin\theta$ for $\sin\psi'$ given by

$$\sin\theta=\sin\psi-\sin\phi+\sin\phi'.$$

In the absence of aberration this value is correct, and also $\flat'=\flat$. In general aberration is present and corrections of aberrational magnitude are required. The working equations are

$$\begin{aligned}
\sin\phi&=\sin\psi+R\flat,\\
\sin\phi'&=\sin\phi\times\mu/\mu,\\
\sin\theta&=\sin\psi-\sin\phi+\sin\phi',\\
N&=\flat\,(\sin\phi-\sin\phi')\,(\sin\psi+\sin\phi'),\\
D&=\tfrac{1}{4}\{\sin^2\theta+(\cos\psi+\cos\phi+\cos\psi')^2-1\},\\
\flat'-\flat&=N/D,\\
\sin\psi'&=\sin\theta-R(\flat'-\flat),\\
\flat_1&=\flat'+t\sin\psi_1.
\end{aligned}$$

It is to be noted that $\frac{1}{2}N$ and $\frac{1}{2}N\mu\sin\phi$ are the linear first order coma and spherical aberration respectively for the single refraction, D is the ratio of twice the first order aberration to the total aberration, and

$$\frac{(\flat'-\flat)\mu\sin\phi}{\{(1+\cos\psi)\,(1+\cos\phi)\,(1+\cos\phi')\,(1+\cos\psi')\}^{\frac{1}{2}}},$$

which is represented at most refractions with ample accuracy by

$$\tfrac{1}{4}(\flat'-\flat)\mu\sin\phi,$$

is the difference in path between the route along the ray and that along the axis from their first to their second crossing point. Brief tables are used for finding D.

Graphical methods of representing the state of correction of the system are widely used. For example the central aberrations may be shown by taking as ordinate the distance from the axis at which a ray crosses the unit surface and as abscissa the distance of its intersection with the axis from a suitable fixed point. The type of curve thus secured is widely used. The paraxial portion of the curve touches the ordinate axis. A more useful curve is obtained by taking the square of the height at which the unit surface is crossed as ordinate. The inclination of this curve to the ordinate axis for rays near the axis depends on the lowest order central aberration, and the curvature gives higher order aberrations. Moreover if we draw through any point X on the abscissa axis a straight line parallel to the ordinate axis, the areas intercepted between this line and the curve measure the differences of path for light passing through the corresponding zones of the unit surface when the image point is at X. By choosing this ordinate so as to cut off alternately equal areas on opposite sides of the curve we can determine the point for which the differences of phase will be least. Corresponding to each geometrical figure a second curve may be drawn with the same ordinates, and the phase at a given image point as abscissa. When only first order aberration is present the geometrical figure is an inclined straight line, the phase curve is a parabola, and the best focus will be at the mid-point of the projection of the straight line on the abscissa axis. This result is at variance with the geometrical prediction that the best position of focus is three times as far from the position where the paraxial rays come to a focus as from the intersection of a marginal ray with the axis.

Aplanatic Surfaces.—Although some lenses designed in the last few years show marked improvements on any that were produced before the World War, no system has yet been evolved which yields over a wide surface an image entirely free from aberration. Points imaged without differences of phase for monorythmic (often called monochromatic) light have long been named aplanatic points. A more restricted interpretation of the term, now universally adopted, was introduced by Abbe, the change involving the absence of aberrations when the object point makes small excursions in a definite surface. Connected aggregates of object and image points each having this property form a pair of aplanatic surfaces. Until recently our knowledge of the conditions under which such perfect imagery is possible were very limited—they amounted to hardly more than the plane mirror reflection, in which the whole object space is imaged without aberration, the aplanatic spheres discovered by Thomas Young for refraction at a sphere, and the trivial case of any single surface at which refraction occurs. A more general result is obtained by noting that if $\mathcal{E}$ is given explicitly as a function of the direction cosines (L, M, N) and (L', M', N'), the points

$$\left(\frac{\partial\mathcal{E}}{\mu\partial L},\frac{\partial\mathcal{E}}{\mu\partial M},\frac{\partial\mathcal{E}}{\mu\partial N}\right)\text{ and }\left(-\frac{\partial\mathcal{E}}{\mu'\partial L'},-\frac{\partial\mathcal{E}}{\mu'\partial M'},-\frac{\partial\mathcal{E}}{\mu'\partial N'}\right)$$

are on the incident and emergent rays respectively. Let us now suppose that $\mathcal{E}$ is a homogeneous function of the first order of three variables α, β, γ, each of which is a linear function of the six direction cosines, so that

$$\alpha=\alpha_0+\alpha_1\mu L+\alpha_2\mu M+\alpha_3\mu N-\alpha_4\mu' L'-\alpha_5\mu' M'-\alpha_6\mu' N'$$

where α_0, α_1, $\cdots$ are constants, with corresponding expressions for β and γ. Then

$$x=\alpha_1\mathcal{E}_\alpha+\beta_1\mathcal{E}_\beta+\gamma_1\mathcal{E}_\gamma,\qquad x'=\alpha_4\mathcal{E}_\alpha+\beta_4\mathcal{E}_\beta+\gamma_4\mathcal{E}_\gamma$$

with similar equations for y, y' and z, z'. It follows that $\mathcal{E}_\alpha$, $\mathcal{E}_\beta$, $\mathcal{E}_\gamma$ can be found in terms of x, y, z, and thus definite values of x', y', z' obtained. That is to say we obtain a one-one correspondence between these points of the object and image spaces. They will be object and image points if the length of the optical path between them is constant. Now this path is

$$\mathcal{E}+\mu'(L'x'+M'y'+N'z')-\mu(Lx+My+Nz)$$

or substituting from the equations for x, y, z, x', y', z' the path length is

$$\mathcal{E}-(\alpha-\alpha_0)\,\mathcal{E}_\alpha-(\beta-\beta_0)\,\mathcal{E}_\beta-(\gamma-\gamma_0)\,\mathcal{E}_\gamma;$$

that is, since $\mathcal{E}$ is homogeneous of the first order in α, β, γ, the path is

$$\alpha_0\mathcal{E}_\alpha+\beta_0\mathcal{E}_\beta+\gamma_0\mathcal{E}_\gamma$$

which depends only on the object point (x, y, z). There is thus no aberration in the image of this point. Moreover the aggregate of these object points forms a surface. For $\mathcal{E}$ satisfies a homogeneous relation of the form $\theta(\mathcal{E}, \alpha, \beta, \gamma)=0$, to which we can add three homogeneous equations

$$\frac{\theta_\alpha}{\mathcal{E}_\alpha}=\frac{\theta_\beta}{\mathcal{E}_\beta}=\frac{\theta_\gamma}{\mathcal{E}_\gamma}=-\epsilon_g.$$

On eliminating the ratios α, β and γ bear to $\mathcal{E}$ between these four equations we obtain a relation of the form $\phi(\mathcal{E}_\alpha, \mathcal{E}_\beta, \mathcal{E}_\gamma)=0$, and if $\mathcal{E}_\alpha$, $\mathcal{E}_\beta$, $\mathcal{E}_\gamma$ are replaced by their values in terms of x, y, z and of x', y', z' we obtain the equations of the object and image surfaces. From the linear character of α, β, γ it follows that the image surface can at most be a regular deformation of the object surface.

The converse process of constructing the eikonal which will yield given aplanatic surfaces can be carried out. It is merely a slight generalization of the process by which the eikonal was constructed for a given refracting surface.

In general a given optical system can have only one pair of aplanatic surfaces, for $\mathcal{E}$ can only be expressed in one way as a homogeneous function of the direction cosines. Spherically symmetrical systems are exceptional. For example if

$$\mathcal{E}=(\alpha^2+\beta^2+\gamma^2)^{\frac{1}{2}}$$

where $\alpha=pL+qL'$, $\beta=pM+qM'$, $\gamma=pN+qN'$,

we may, in consequence of the identities

$$L^2+M^2+N^2=1=L'^2+M'^2+N'^2,$$

rewrite the equation in the form $\mathcal{E}=(\alpha'^2+\beta'^2+\gamma'^2)^{\frac{1}{2}}$ where

$$\alpha'=qL+pL',\ \beta'=qM+pM',\ \gamma'=qN+pN'.$$

Corresponding to the first form we have the conjugate surfaces

$$\mu^2(x^2+y^2+z^2)=p^2,\ \mu'^2(x'^2+y'^2+z'^2)=q^2,$$

and corresponding to the second the pair

$$\mu^2(x^2+y^2+z^2)=q^2,\ \mu'^2(x'^2+y'^2+z'^2)=p^2.$$

Thus with a sphere, since its surface is self-conjugate, we may put $p=\mu r$, $q=\mu' r$, and the alternative solution shows that the concentric spheres of radii $r\mu'/\mu$ and $r\mu/\mu'$ are respectively aplanatic conjugate object and image surfaces.

Asymmetrical Systems.—We have discussed at some length the properties of symmetrical lens systems because they form by far the most important section of geometrical optics. The expressions that have been given enable all the ordinary problems to be dealt with—for example the paraxial expressions are sufficiently accurate to determine how large any simple lens must be to pass the rays the instrument should transmit. It is also a simple matter to derive a number of well-known conclusions from the general laws that have been given—for example that the use of an optical instrument will not enable a brighter image of an object subtending an appreciable angle to be formed on the retina of an observer's eye. The reader is not likely to encounter any difficulty arising from the use of prisms inserted for the reflection of light at plane surfaces into the system, for they are equivalent to the insertion of a thick plate of glass with plane parallel faces. Methods of designing prisms to produce desired results cannot be considered in detail here. As a rule a trigonometrical procedure is adopted, but algebraic methods employing matrices appear to offer decided advantages.

There remain systems of much importance without axial symmetry. The theory of such systems, though not difficult, is much more involved than that of axially symmetrical systems. Taking systems in which all the surfaces are met normally by some straight line, and yield symmetrical sections when cut by any plane through this line, which may be called the axis, we find that in place of the second degree matrix for the axially symmetrical system we have to adopt a square matrix of the fourth degree, with sixteen constituent elements. Between these sixteen quantities six independent identities subsist, so that at most there are ten degrees of freedom for paraxial rays. For an account of these quantities, their connections with the positions of the rays and with various expressions giving the lengths of paths through the system, reference should be made to the *Transactions of the Optical Society*. When we proceed to higher order terms representing aberrations the complexity of the theory is enhanced. For example corresponding to the six coefficients for the lowest order monorythmic aberrations in axially symmetric systems we have in these unsymmetrical systems no less than thirty-five coefficients.

Experimental Methods.—The marked changes in the way optical instruments have come to be regarded in recent years is reflected in experimental applications of the theory. A good example is afforded by the use of modified types of Michelson interferometers for the testing of optical instruments. This application of interference is due to F. Twyman. An instrument of this type, equipped for varied work, has been constructed by Messrs. Adam Hilger, Ltd., for the National Physical Laboratory, at Teddington, England. Many other interference methods have recently been described. Space will not permit us to discuss many interesting points which arise in the use of these and other methods of investigating the properties of optical instruments experimentally. (*See* LENS.)

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More modern works are: S. Czapski and O. Eppenstein, *Grundzüge der Theorie der optischen Instrumente;* H. Geiger and K. Scheel, *Handbuch der Physik; XVIII. H. Konen, Geometrische Optik;* R. T. Glazebrook, *Dictionary of Applied Physics; IV. Optics;* R. S. Heath, *Geometrical Optics;* R. A. Herman, *Geometrical Optics;* M. von Rohr (trans. R. Kanthack), *Formation of Images in Optical Instruments;* J. P. C. Southall, *Principles and Methods of Geometrical Optics;* Steinheil and Voit (trans. J. W. French), *Applied Optics;* G. C. Steward: *The Symmetrical Optical System* (Tract); H. D. Taylor, *A System of Applied Optics.*

For the physical principles involved reference may be made to the optical papers of the late Lord Rayleigh. The writings of A. Gullstrand are important for the optics of spectacle lenses.

Most recent work has been described in journals devoted to optics, of which the chief are the *Transactions of the Optical Society, Revue d'Optique, Journal of the Optical Society of America,* and *Rivista d'Ottica.*

Valuable contributions will also be found in *Zeitschrift für Instrumentenkunde, Die Naturwissenschaften, Phil. Trans., Proceedings of the Physical Society,* and many others. An extensive bibliography is given by Czapski and Eppenstein. (T. SM.)

OPTIMISM, in philosophy, is the theory that the world is the best possible, or that life is worth living (to allude to the popular form of the problem).

For a discussion *see* PESSIMISM; PLATO; LEIBNITZ, GOTTFRIED WILHELM; HEGEL, GEORG WILHELM FRIEDRICH; also J. Sully, *Pessimism* (1877).

OPTION, the action of choosing, choice or the opportunity of choosing. In ecclesiastical law option was the right claimed by an archbishop to select one benefice from the diocese of a newly appointed bishop, the next presentation to which would fall to his, the archbishop's, patronage. This right was abolished in the early 19th century.

For the stock exchange options *see* OPTIONS (STOCK). Local option or local veto in politics is the power given to the electorate of a particular district to choose whether licences for the sale of intoxicating liquor shall be granted or not. (*See* LIQUOR LAWS AND LIQUOR CONTROL.)

OPTIONS (STOCK). Essentially, a stock option in security markets is a contract, paid for in advance, in which the holder has the right to buy (in the case of a "call" contract) or sell (in the case of a "put" contract) a specified number of shares of stock (generally 100) at a fixed price (normally the market price at the time the contract is made) at any time within the period covered

by the contract (usually 30, 60 or 90 days, or 6 months).

Consider the speculative possibility first. Let us assume the investor feels that XYZ stock is low priced at $70 a share and that it could advance to $85 a share in three months. To buy 100 shares under 75% margin rules would require a cash investment of $5,250. Unwilling to tie up this amount of cash and take the market risk that such a commitment involves, the investor buys a "call" option for $400, giving him the right to buy 100 shares at 70 within 90 days.

In that period, suppose XYZ climbs to 82. The investor could exercise his right to buy 100 shares at 70 from the endorser of the contract (a member firm of the New York Stock exchange) and immediately sell it in the open market at 82 for a profit of $1,200 less $400, the price of the contract, and usual brokerage commissions and taxes. If his judgment is wrong and XYZ drops to 50, his loss is limited to $400 as the price of the call option whereas an outright owner of the stock would have a paper loss of $2,000 and the possibility of further decline. At no time is the possible loss greater than the cost of the option contract.

To show the use of a put contract for speculation, let us consider the following. The investor feels that XYZ selling at 70 has a good chance of declining to possibly 50 in the next 90 days. He buys a "put" option contract at 70 good for 90 days for $350. If at any time in the 90-day period XYZ should decline to 50, he buys 100 shares in the market at 50 and delivers it to the maker of the put contract at 70, showing a profit of $2,000 less $350, the cost of the option contract less brokerage commissions and taxes.

The protective feature of options may be explained as follows. A person owns 100 shares of XYZ selling at 70; believing that some political or other event might change the course of the stock temporarily, he buys a put option at 70 for 90 days for $350. Now through his put contract, he is guaranteed that regardless of how low the stock should decline in the next 90 days, he can deliver his stock at 70 to the maker of the contract. On the other hand, if the expected decline does not take place and instead the market rises and the stock goes to 85, his profit from the advance in the value of the security has more than offset his cost of $350 for the protection.

The call option serves the same purpose in insuring against unlimited loss in connection with a short sale. For example: a man short 100 shares of stock at 70 with no protection of a call contract has an unlimited liability. But the man who, when he sells short at 70, protects his commitment with a call contract at 70 for 90 days at a cost of $400 knows that even if the stock should sell at 100 in 90 days he can cover his short position by calling for his stock at 70. Thus his loss is limited to $400 plus commissions instead of an actual market loss of $3,000.

A call contract can be useful to an owner of stock who, because of need for cash, desires to sell his security and still would like to have an interest in the stock. As an example, a man owns 100 shares of XYZ which he bought at 70 and is now selling at 85. He sells his stock in the market at 85 and buys a call option contract at 85 good for 90 days for $400. If after selling his stock XYZ continues to rise, he can in the 90 days recapture the stock at 85 through his call option.

If on the other hand, however, the stock should decline again to 70, he is in a position to buy back at 70 the stock which he sold at 85. While the cost of such "recapture protection" was $400, the gain afforded by the ability to buy back the stock 15 points lower than where it was sold made the purchase of the call worth while.

Makers of Options.—The put on XYZ mentioned above was probably sold by an individual or company who would be willing to issue a contract guaranteeing to the holder of the contract that for such $350 premium they would accept 100 shares of XYZ at 70 any time during the life of the contract.

If the stock should decline and the issuer of such a contract has the stock delivered to him at 70, his cost would be 70 less the $350 already received for the contract or a price of 66½. If the stock is not put to him, he has benefited by the $350 premium which he considered an adequate return in 90 days on the $7,000 investment.

The seller of a call on the other hand is probably one who owns XYZ and who for the sum of $400 would "give" someone a call on his stock at the current price of 70 good for 90 days. If the stock is called, the holder of the security loses his 100 shares at 70 plus the $400 already received. In other words, he has sold his stock at a price equivalent to 74. On the other hand, if the call is not exercised, the seller of the call has benefited by the $400 received in premium.

Practically, all of the put and call option business in the United States is handled by about 25 option dealers located in New York who operate through an association. Quotes on put and call option contracts may be obtained through local brokers or directly from a dealer in options. Orders to buy options may be placed in the same way. All of the contracts in which they deal are guaranteed or endorsed by member firms of the New York Stock exchange and this Association of Put and Call Brokers and Dealers, Inc., operates under the supervision of the Securities and Exchange commission. (Ht. F.)

OPTOMETRY is the science of vision care. The term, first adopted by the American Optometric association in 1904, also came into general use in Canada and Australia, and to some extent in England and other countries in designating those who are usually called refracting opticians in those countries.

Optometry performs three out of four ocular examinations in the United States, the remaining being performed by ophthalmologists and oculists who are physicians specializing in eye care.

Optometry emphasizes functional vision. It holds that both the visual examination and the corrective measures applied should take into account the patient's specific requirements. An office worker, for example, requires special attention to near-point vision because most of his critical seeing is within arm's length. A crane operator in industry, by contrast, requires special attention to distant vision because his critical seeing is at a distance of 20 ft. or more.

This functional emphasis led to the development of many examination techniques and corrective measures, going beyond the mechanistic theory that seeing is done solely by a cameralike eye. The common letter chart read at a distance of 20 ft. is only a small part of the comprehensive optometric analysis of a patient's vision. Visual skills tests are made which enable the optometrist to analyze visual performance for long periods of sustained concentration at near distances.

Organized optometry conducts extensive activities for the prevention of visual problems. These are directed toward school vision, occupational vision and highway vision. Stress is laid on the proper seeing environment in schools, factories and offices and more comprehensive examinations are urged for the purpose of discovering visual handicaps before they become serious. Psychological and neurological concepts led optometry to the application of visual training as a corrective measure for many anomalies that could not be corrected by lenses alone.

Scientific visual training, as applied by optometry and also by some medical practitioners, should not be confused with self-taught "eye exercises."

The minimum educational requirement for optometry in the United States is five years of college training. An applicant for state licensing board examination must be a graduate of a school or college of optometry accredited by the individual state board.

The American Optometric association, national organization of the profession in the United States, was formed originally in 1897 by opticians specializing in refraction. The first state to license optometry was Minnesota, which enacted an optometry statute in 1901. The American Academy of Optometry, dedicated to scientific and educational interests, was founded in 1922.

Among the founders of optometry as a specialized profession were Andrew Jay Cross (1855–1925) and Charles F. Prentice (1854–1946). Cross led in the development of education for optometry, and it was largely through his effort that Columbia university inaugurated its first two-year course in 1910 with Cross as an instructor.

Prentice was a leader in the enactment of state legislation to

maintain high standards by licensing optometrists.

(E. M. S.)

OPTOPHONE, an instrument invented by E. E. Fournier d'Albe in 1914 which enables the blind to read ordinary letterpress such as printed books or newspapers. The invention thus places within reach of the blind the entire range of world literature, while previously their only means of reading—by raised letter systems—necessitated special books, both bulky and expensive.

The instrument depends for its action upon the chemical element, selenium, the electrical conductivity of which varies greatly in accordance with the amount of light to which it is exposed. Such a light-sensitive selenium bridge is placed between two separate conducting lines of graphite resting on a porcelain tablet and the whole connected in series with an electric battery to a telephone receiver.

A beam of light is rendered intermittent by the interposition of a revolving siren disk and is then concentrated into a small bright point on the letter to be read. This is reflected back onto the selenium bridge. As the selenium bridge is exposed to the forms of letters in the line traversed, its changes in conductivity produce a succession of varying notes and chords in the telephone receiver, each letter having its characteristic sound. That is its simple form.

Actually in the regular instrument a row of five or six luminous points just filling up the size of the tallest letters to be read is substituted for a single point, and each point is given a different frequency by suitably perforating the disk. A blind reader does not analyze the resulting sounds, but soon comes to recognize the general sound of each letter and in time knows his alphabet of sounds.

Later in his practice the succession of sounds which make up certain words becomes familiar. Controlling apparatus to regulate the speed and position of the tracer is designed with a view to ease of manipulation by blind persons. After 1920 developments in amplification enabled the sounds to be made audible to any number in a room if desired, though individual receivers were retained for silent reading.

(*See* SELENIUM CELLS.)

OPUS ('Ὀποῦς), in ancient Greece, the chief city of the Opuntian Locrians; the walls of the city were built on a hill about 6 mi. S.E. of the modern Atalante and about 1 mi. from the channel which separates the mainland from Euboea.

It was mentioned in the Homeric catalogue among the towns of the Locrians, who were led by Ajax Oileus; there were games called Aiantea and an altar at Opus in honour of Ajax. Opus was also the birthplace of Patroclus.

Pindar's Ninth Olympian ode is mainly devoted to the glory and traditions of Opus.

Its founder was Opus the son of Zeus and Protogeneia, the daughter of an Elian Opus, or, according to another version, of Deucalion and Pyrrha, and the wife of Locros.

The Locrians deserted the Greek side in the Persian wars; they were among the allies of Sparta in the Peloponnesian War. In the struggle between Philip V of Macedon and the Romans, the town went over to the latter in 197 B.C.; however, the Acropolis continued to hold out for Philip until his defeat at Cynoscephalae (Livy xxxii, 32).

The town suffered from earthquakes, such as that which destroyed the neighbouring Atalante in 1894.

OPZOOMER, CORNELIUS WILLIAM (1821–1892), Dutch philosopher, was born in Rotterdam on Sept. 20, 1821. He studied at the University of Leyden, receiving the degree of doctor of law in 1845.

In 1846 Opzoomer was appointed professor of philosophy at the University of Utrecht, which position he held the remainder of his life. His specialty was jurisprudence and many of his numerous writings were in that field, notably *Scheiding van Kerk en Staat* (1875), in which he sustained the primacy of the civil power, and a commentary on the civil code of the Netherlands (11 vol., 1864–87).

His greatest influence, however, was in the field of philosophy. He was an empiricist of the positivistic type. His thought can best be traced in such of his writings as *Der Weg de Wetenschap* (1851), *Wetenschap en Wijsbegeerte* (1857), *Het Wezen der Kennis* (1863), *De Waarheid en hare Kenbronnen* (1863), *De Godsdienst* (1864), *Goethe's Godsdienst* (1868) and *Ein Nieuwe Kritick der Wijsbegeerte* (1871). He advocated expulsion of the unscientific from religion, believing that the latter would be left unimpaired, and that it would lead to the reconciliation of religion and science and bring about a new Reformation. Though vigorously opposed at first his views rapidly gained adherents and he became the leader of the liberals and the founder of modern theology in his country.

Opzoomer was also a widely read man of letters, translated the *Antigone* of Sophocles and the *Julius Caesar* of William Shakespeare into Dutch, and published (1872) a volume of critical studies on the great English dramatist. He died in Osterbeck on Aug. 23, 1892.

ORACH or MOUNTAIN SPINACH (also called sea purslane), known botanically as *Atriplex hortensis* (family, Chenopodiaceae), is a tall-growing hardy annual, whose leaves, though coarsely flavoured, are very often used as a substitute for spinach when young.

The white and the green are the most desirable varieties. The plant should be grown quickly in rich soil. It may be sown in rows two feet apart, and about the same distance in the row, about April, and for succession again in June. If needful, water must be given freely, so as to maintain a rapid growth. A variety, with reddish foliage, is a hardy annual three to four feet high and sometimes grown for ornament.

ORACLE, a special place where a deity is supposed to give a response, by the mouth of an inspired priest, to the inquiries of his votaries, or the actual response. (Lat. *oraculum,* from *orare,* to speak; the corresponding Greek word is μαντεῖον or χρηστήριον.) (*See* DIVINATION; MAGIC.) The whole question of oracles is bound up with that of magic. They are commonly found in the earlier stages of religious culture among different nations. But it is as an ancient Greek institution that they are most interesting historically.

A characteristic feature of Greek religion which distinguishes it from many other systems of advanced cult was the wide prevalence of a ritual of divination and the prominence of certain oracular centres which were supposed to give voice to the will of Providence.

An account of the oracles of Greece is concerned with the historical question about their growth, influence and career. But it is convenient to consider first the anthropologic question concerning the methods of divination practised in ancient Greece, their significance and the original ideas that inspired them.

In the Greek world the methods of divination were of great variety, but nearly all can be traced among other communities, primitive and advanced, ancient and modern. The most obvious and useful classification of them is that of which Plato was the author, distinguishing between: (1) the "sane" form of divination; and (2) the ecstatic, enthusiastic or "insane" form (Phaedrus p. 244). The first method appears to be cool and scientific, the diviner (μάντις) interpreting certain signs according to fixed principles of interpretation. The second is worked by the prophet, shaman or Pythoness, who is possessed and overpowered by the deity, and in temporary frenzy utters mystic speech under divine suggestion. To these we may add another form (3) divination by communion with the spiritual world in dreams or through intercourse with the departed spirit: this resembles class (1) in that it does not necessarily involve ecstasy, and class (2) in that it assumes immediate rapport with some spiritual power.

This article will first give typical examples of these processes of discovering the divine will; then the history of Delphi, the leading centre of divination, will be sketched.

Methods that fall under class (1) may be subdivided according as they deal with the phenomena of the animate or the inanimate world; although this distinction would not be relevant in the period of primitive animistic thought. The Homeric poems attest that auguries from the flight and actions of birds were

commonly observed in the earliest Hellenic period as they occasionally were in the later, but we have little evidence that this method was ever organized as it was at Rome into a regular system of state-divination, still less of state-craft. We can only quote the passage in the *Antigone* where Sophocles describes the method of Teiresias, who keeps an aviary where he studies and interprets the flight and the cries of the birds; it is probable that the poet was aware of some such practice actually in vogue. But normally the Greek augur drew omens from the cries or actions of some bird or beast casually met with (as Hom. *Il.* xiii. 521; Aesch. *Agam.* 109; Serv. Virg. *Aen.* iv. 377; Paus. ii. 19. 3); it is very rare to find such omens habitually consulted in any public system of divination sanctioned by the State. We hear of a shrine of Apollo at Sura in Lycia (Steph. Byz. *s.v.* Σοῦρα; Plutarch, *De sollert. anim.* p. 976 c; Ael. *Nat. anim.* xii. 1) where omens were taken from the movements of the sacred fish that were kept there in a tank; and again of a grove consecrated to this god in Epirus, where tame serpents were kept, and fed by a priestess, who could predict a good or bad harvest according as they ate heartily or came willingly to her or not (Ael. *Nat. anim.* xi. 2).

But the method of animal divination that was most in vogue was the inspection of the inward parts of the victim offered upon the altar, and the interpretation of certain marks found there according to a conventional code. A conspicuous example of an oracle organized on this principle was that of Zeus at Olympia, where soothsayers of the family of the Iamidae prophesied partly by the inspection of entrails, partly by the observation of certain signs in the skin when it was cut or burned (Schol. Pind. *Ol.* 6. 111). Another less familiar procedure that belongs to this subdivision is that which was known as divination διά κληωδόνν, which might sometimes have been the cries of birds, but in an oracle of Hermes at the Achaean city of Pharae were the casual utterances of men. Pausanias (VII. 22. 2) tells us how this was worked. The consultant came in the evening to the statue of Hermes in the market-place that stood by the side of a hearth-altar to which bronze lamps were attached; having kindled the lamps and put a piece of money on the altar, he whispered into the ear of the statue what he wished to know; he then departed, closing his ears with his hands, and whatever human speech he first heard after withdrawing his hands he took for a sign. The same custom seems to have prevailed at Thebes in a shrine of Apollo, and in the Olympian oracle of Zeus (Farnell, *Cults* iv. 221).

Of omens taken from what we call the inanimate world salient examples are those derived from trees and water. Both were in vogue at Dodona, where the ecstatic method of prophecy was never used; we hear of divination there from the bubbling stream, and still more often of the "talking oak"; under its branches may once have slept the Selloi, who interpreted the sounds of the boughs. (Hom. *Il.* xvi. 233, *Od.* xiv. 327; Hesiod, *ap.* Schol. Soph. *Trach.* 1169; Aesch. *Prom. Vinct,* 820). At Corope in Thessaly we hear vaguely of an Apolline divination by means of a branch of the tamarisk tree (Nicander, *Theriaka,* 612, Schol.), and there is a late record that at Daphne near Antioch oracles were obtained by dipping a laurel leaf or branch in a sacred stream (Robertson-Smith *Relig. Sem.* p. 128). We find water divination at Daphne, Taenarum and Patrae. Thunder magic, which was practised in Arcadia, is usually associated with thunder divination; but of this, which was so much in vogue in Etruria (*see* HARUSPICES) and at Rome, the evidence in Greece is singularly slight. Once a year watchers took their stand on the wall at Athens and waited till they saw the lightning flash from Harma, which was accepted as an auspicious omen for the setting out of the sacred procession to Apollo Pythius at Delphi; and the altar of Zeus Σημαλέος, the sender of omens, on Mount Parnes, may have been a religious observatory of meteorological phenomena (Paus. i. 32. 2). No doubt such a rare and portentous event as the fall of a meteor-stone would be regarded as ominous, and the State would be inclined to consult Delphi or Dodona as to its divine import.

We may conclude the examples of this main department of μαντική by mentioning a method that seems to have been much in vogue in the earlier times, that which was called ἡ διά ψήφων μαντική, or divination by the drawing or throwing of lots; these must have been objects, such as small pieces of wood or dice, with certain marks inscribed upon them, drawn casually or thrown down and interpreted according to a certain code. This was practised at Delphi and Dodona by the side of the more solemn procedure; we hear of it also in the oracle of Heracles at Bura in Achaea (Cic. *De div.* i. 76; Suid. *s. v.* πυδώ; Paus. vii. 25. 10). It is this method of "scraping" or "notching" (χράειν) signs on wood that explains probably the origin of the words χρησμός, χρῆσθαι, ἀναιρεῖν for oracular consultation and deliverance. In Italy, oracles by lot (*sortes*) are the only native kind of whose existence we are certain; that of *Fortuna* at Praeneste was the best known.

All these methods are world-wide, and may depend on belief in the *mana* of the bird, spring, lot, etc., or in the controlling influence of a spirit or god. And, again, if we are to understand the most primitive thought, we probably ought to conceive of it as regarding the omen not as a mere sign, but in some confused sense as a cause of that which is to happen. By sympathetic magic the flight of the bird, or the appearance of the entrails, is mysteriously connected, as cause with effect, with the event which is desired or dreaded. When of the three beasts over which three kings swore an oath of alliance, one died prematurely and was supposed thereby to portend the death of one of the kings (Plut. *Vit. Pyrrh.* c. 6), or when in the Lacedaemonian sacrifice the head of the victim mysteriously vanished, and this portended the death of their naval commander (Diod. Sic. xiii. 97), these omens would be merely signs of the future for the comparatively advanced Hellene; but we may discern at the back of this belief one more primitive still, that these things were somehow casually or sympathetically connected with the kindred events that followed.

The other branch of the mantic art, the ecstatic or inspired, has had the greater career among the peoples of the higher religions; it is no doubt of great antiquity, and it is found still existing at a rather low grade of savagery. Therefore it is unsafe to infer from Homer's silence about it that it only became prevalent in Greece in the post-Homeric period. It did not altogether supersede the simpler method of divination by omens; but being far more impressive and awe-inspiring, it was adopted by some of the chief Apolline oracles, though never by Dodona.

The most salient example of it is afforded by Delphi. In the historic period, and perhaps from the earliest times, a woman known as the Pythia was the organ of inspiration, and it was generally believed that she delivered her oracles under the direct afflatus of the god. The divine possession worked like an epileptic seizure, and was exhausting and might be dangerous; nor is there any reason to suppose that it was simulated. This communion with the divinity needed careful preparation. Originally, as it seems, virginity was a condition of the tenure of the office; for the virgin has been often supposed to be the purer vehicle for divine communication; but later the rule was established that a married woman over 50 years of age should be chosen, with the proviso that she should be attired as a maiden. As a preliminary to the divine possession, she appears to have chewed leaves of the sacred laurel, and then to have drunk water from the prophetic stream called Kassotis which flowed underground. But the culminating point of the afflatus was reached when she seated herself upon the tripod; and here, according to the belief of at least the later ages of paganism, she was supposed to be inspired by a mystic vapour that arose from a fissure in the ground. Against the ordinary explanation of this as a real mephitic gas producing convulsions, there seem to be geological and chemical objections (*see* Oppe, "The chasm at Delphi," *Journ. Hell. Stud.*, 1904); nor have the recent French excavations revealed any chasm or gap in the floor of the temple. But the strong testimony of the later writers, especially Plutarch (*De defectu Orac.* c. 43), cannot wholly be set aside; and we can sufficiently reconcile it with the facts if we suppose a small crack in the floor through which a draught of air was felt to ascend. This, combining with the other mantic stimulants used, would be enough to throw a believing medium into the condition, familiar enough nowadays, of a "trance." It is probable that what she uttered were only unintelligible murmurs,

and that these were interpreted into relevance and set in metric or prose sentences by the "prophet" and the "holy ones" or Ὅσιοι as they were called, members of leading Delphic families, who sat round the tripod, who received the questions of the consultant beforehand, probably in writing, and usually had considered the answers that should be given.

Examples of the same enthusiastic method can be found in other oracles of Apollo. At Argos, the prophetess of the Apollo Pythius attained to the divine afflatus by drinking the blood of the lamb that was sacrificed in the night to him (Paus. ii. 24. 1); this is obviously a mantic communion, for the sacrificial victim is full of the spirit of the divinity. And we find the same process at the prophetic shrine of Ge at Aegae in Achaea, where the prophetess drank a draught of bull's blood for the same purpose (Farnell, *op. cit.* iii. 11). In the famous oracle shrines of Apollo across the sea, at Clarus and Branchidae near Miletus (the prophetic fountain at Branchidae is attested by Strabo, p. 814, and in a confused mystic passage of Iamblichus, *De Myst.*, 3, 11), the divination was of the same ecstatic type, but produced by a simple draught of holy water. The Clarian prophet fasted several days and nights in retirement and stimulated his ecstasy by drinking from a subterranean spring which is said by Pliny to have shortened the lives of those who used it (*Nat. Hist.* ii. 232). Then, "on certain fixed nights after many sacrifices had been offered, he delivered his oracles, shrouded from the eyes of the consultants" (Iamb. *loc. cit.*).

The divination by "incubation" was allied to this type, because though lacking the ecstatic character, the consultant received direct communion with the god or departed spirit. He attained it by laying himself down to sleep or to await a vision, usually by night, in some holy place, having prepared himself by a course of ritualistic purification. Such consultation was naturally confined to the underworld divinities or to the departed heroes. It appears to have prevailed at Delphi when Ge gave oracles there before the coming of Apollo, and among the heroes Amphiaraus, Calchas and Trophonius are recorded to have communicated with their worshippers in this fashion. And it was by incubation that the sick and diseased who repaired to the temple of Epidaurus received prescriptions from Asclepius.

Turning now to the history of oracles in Greece, we know that the leading one, Delphi, was a seat of prophecy from the earliest days of Greek tradition. Ge, Themis and perhaps Poseidon had given oracles here before Apollo. But it is clear that he had won it in the days before Homer, who attests the prestige and wealth of his Pythian shrine; and it seems clear that before the Dorian conquest of the Peloponnese a Dryopian migration had already carried the cult of Apollo Pythius to Asine in Argolis. Also the constitution of the Amphictyones, "the dwellers around the temple," reflects the early age when the tribe rather than the city was the political unit, and the Dorians were a small tribe of north Greece. The original function of these Amphictyones was to preserve the sanctity and property of the temple; but this common interest early developed a certain rule of intertribal morality. By the formula of the Amphictyonic oath preserved by Aeschines, which may be of great antiquity, the members bound themselves "not to destroy any city of the league, not to cut any one of them off from spring-water, either in war or peace, and to war against any who violated these rules." We discern here that Greek religion offered the ideal of a federal national union that Greek politics refused to realize.

The next stage in the history of the oracle is presented by the legend of the Dorian migration. For we have no right to reject the strong tradition of the Delphic encouragement of this movement, which well accounts for the devotion shown by Sparta to the Pythian god from the earliest days; and accounts also for the higher position that Delphi occupied at the time when Greek history is supposed to begin.

We have next to consider a valuable record that belongs to the end of the 8th century or beginning of the 7th, the Homeric hymn to Apollo, which describes the coming of the Dolphin-god Δελφίνιος to Pytho, and the organization of the oracle by Cretan ministers. Of this Cretan settlement at Delphi there is no other literary evidence, and the Ὅσιοι who administered the oracle in the historic period claimed to be of aboriginal descent. Yet recent excavation has proved a connection between Crete and Delphi in the Minoan period; and there is reason to believe that in the 8th century some ritual of purification, momentous for the religious career of the oracle, was brought from Crete to Delphi, and that the adoption of this latter name for the place which had formerly been called Πυθώ synchronized with the coming of Apollo Delphinius.

The influence of Delphi was great in various ways. We may first consider its political influence upon the other states. The practice of a community consulting an oracle on important occasions undoubtedly puts a powerful weapon into the hands of the priesthood, and might lead to something like a theocracy. And there are one or two ominous hints in the *Odyssey* that the ruler of the oracle might overthrow the ruler of the land. Yet owing to the healthy temperament of the early Greek, the civic character of the priesthood, the strength of the autonomous feeling, Greece might flock to Delphi without exposing itself to the perils of sacerdotal control. The Delphic priesthood, content with their rich revenues, were probably never tempted to enter upon schemes of far-reaching political ambition, nor were they in any way fitted to be the leaders of a national policy. Once only, when the Spartan State applied to Delphi to sanction their attack on Arcadia, did the oracle speak as if, like the older papacy, it claimed to dispose of territory (Herod. i. 66)—"Thou askest of me Arcadia; I will not give it thee." But here the oracle is on the side of righteousness, and it is the Spartan that is the aggressor. In the various oracles that have come down to us, many of which must have been genuine and preserved in the archives of the State that received them, we cannot discover any marked political policy consistently pursued by the "holy ones" of Delphi. As conservative aristocrats they would probably dislike tyranny; their action against the Peisistratidae was interested, but one oracle contains a spirited rebuke to Cleisthenes, while one or two others, perhaps not genuine, express the spirit of temperate constitutionalism. As exponents of an Amphictyonic system they would be sufficiently sensitive of the moral conscience of Greece to utter nothing in flagrant violation of the "ius gentium." In one department of politics, the legislative sphere, it has been supposed that the influence of Delphi was direct and inspiring. Plato and later writers imagined that the Pythia had dictated the Lycurgan system, and even modern scholars like Bergk have regarded the ῥῆτραι of Sparta as of Delphic origin. But a severer criticism dispels these suppositions. The Delphic priesthood had neither the capacity nor probably the desire to undertake so delicate a task as the drafting of a code. They might make now and again a general suggestion when consulted, and, availing themselves of their unique opportunities of collecting foreign intelligence, they might often recommend a skilful legislator or arbitrator to a state that consulted them at a time of intestine trouble. Finally, a legislator with a code would be well advised, especially at Sparta, in endeavouring to obtain the sanction and the blessing of the Delphic god, that he might appear before his own people as one possessed of a religious mandate. In this sense we can understand the stories about Lycurgus.

There is only one department of the secular history of Greece where Delphi played a predominant and most effective part, the colonial department. The great colonial expansion of Greece, which has left so deep an imprint on the culture of Europe, was in part inspired and directed by the oracle. For the proof of this we have not only the evidence of the χρησμοί preserved by Herodotus and others, such as those concerning the foundation of Cyrene, but also the worship of Apollo Ἀρχηγέτης, "the Founder," prevalent in Sicily and Magna Graecia, and the early custom of the sending of tithes or thanksgiving offerings by the flourishing western states to the oracle that had encouraged their settlements.

Apollo was already a god of ways, Ἀγυιεύς, who led the migration of tribes before he came to Delphi. And those legends are of some value that explain the prehistoric origin of cities such as Magnesia on the Maeander, the Dryopian Asine in the Pelopon-

nese, as due to the colonization of temple-slaves, acquired by the Pythian god as the tithe of conquests, and planted out by him in distant settlements. The success of the oracle in this activity led at last to the establishment of the rule that Herodotus declares to be almost universal in Greece, namely, that no leader of a colony would start without consulting Delphi. Doubtless in many cases the priesthood only gave encouragement to a preconceived project. But they were in a unique position for giving direct advice also, and they appear to have used their opportunities with great intelligence.

Their influence on the state cults can be briefly indicated, for it was not by any means far-reaching. They could have felt conscious of no mission to preach Apollo, for his cult was an ancient heritage of the Hellenic stocks. Only the narrower duty devolved upon them of impressing upon the consultants the religious obligation of sending tithes or other offerings. Nevertheless their opportunity of directing the religious ritual and organization of the public worships was great; for Plato's view (Rep. 427A) that all questions of detail in religion should be left to the decision of the god "who sits on the *omphalos*" was on the whole in accord with the usual practice of Greece. Such consultations would occur when the State was in some trouble, which would be likely to be imputed to some neglect of religion, and the question to the oracle would commonly be put in this way—"to what god or goddess or hero shall we sacrifice?" The oracle would then be inclined to suggest the name of some divine personage hitherto neglected, or of one whose rites had fallen in decay. Again, Apollo would know the wishes of the other divinities, who were not in the habit of directly communicating with their worshippers; therefore questions about the sacred land of the goddesses at Eleusis would be naturally referred to him. From both these points of view we can understand why Delphi appears to have encouraged the tendency towards hero-worship which was becoming rife in Greece from the 7th century onwards. But the only high cult for which we can discover a definite enthusiasm in the Delphic priesthood was that of Dionysus. And his position at Delphi, where he became the brother-deity of Apollo, sufficiently explains this.

As regards the development of religious morality in Greece, we must reckon seriously with the part played by the oracle. The larger number of deliverances that have come down to us bearing on this point are probably spurious, in the sense that the Pythia did not actually utter them, but they have a certain value as showing the ideas entertained by the cultivated Hellene concerning the oracular god. On the whole, we discern that the moral influence of Delphi was beneficent and on the side of righteousness. It did nothing, indeed, to abolish, it may even have encouraged at times, the barbarous practice of human sacrifice, which was becoming abhorrent to the Greek of the 6th and 5th centuries; but a conservative priesthood is always liable to lag behind the moral progress of an age in respect of certain rites, and in other respects it appears that the "Holy Ones" of Delphi kept well abreast of the Hellenic advance in ethical thought. An oracle attributed to the Pythoness by Theopompus (Porph. *De abstinentia,* 2, 16 and 17) expresses the idea contained in the story of "the widow's mite," that the deity prefers the humble offering of the righteous poor to the costly and pompous sacrifice of the rich. Another, of which the authenticity is vouched for by Herodotus (vi. 86), denounces the contemplated perjury and fraud of a certain Glaucus, and declares to the terrified sinner that to tempt God was no less a sin than to commit the actual crime. A later χρησμός, for which Plutarch (*De Pyth. Or.,* p. 404 B) is the authority, embodies the charitable conception of forgiveness for venial faults committed under excessive stress of temptation: "God pardons what man's nature is too weak to resist." And in one most important branch of morality, with which progressive ancient law was intimately concerned, namely, the concept of the sin of homicide, we have reason for believing that the Apolline oracle played a leading part. Perhaps so early as the 8th century, it came to lay stress on the impurity of bloodshed and to organize and impose a ritual of purification; and thus to assist the development and the clearer definition of the concept of murder as a sin and the growth of a theory of equity which recognizes extenuating or justifying circumstances (Farnell, *Cults.* iv. 300). Gradually, as Greek ethics escaped the bondage of ritual and evolved the idea of spiritual purity of conscience, this found eloquent expression in the utterances imputed to the Pythia (Ael. *Var. Hist.* iii. 44; Anth. Pal. xiv. 71 and 74). Many of these are no doubt literary fictions; but even these are of value as showing the popular view about the oracular god, whose temple and tripod were regarded as the shrine and organ of the best wisdom and morality of Greece. The downfall of Greek liberty before Macedon destroyed the political influence of the Delphic oracle; but for some centuries after it still retained a certain value for the individual as a counsellor and director of private conscience. But in the latter days of paganism it was eclipsed by the oracles of Claros and Branchidae.

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Ancient Authorities.—Plutarch, *De Pythiae oraculis* and *De defectu oraculorum;* Cicero, *De divinatione;* Euseb. *Praep. Ev.* 4, 2, 14.
(X.; H. J. R.)

ORADEA MARE, a town of Transylvania; ceded to Hungary by Rumania in 1940. Pop. (1939) 82,687, mainly Magyar. It is situated in a plain on both banks of the river Crisul Repede, and is the seat of a Roman Catholic and of a Greek Uniate Bishopric (founded 1776). Among its principal buildings are the St. Ladislaus parish church, built in 1723, which contains the remains of the king St. Ladislaus (d. 1095), the Roman Catholic cathedral, built in 1752–1779, the Greek cathedral, the large rococo palace of the Roman Catholic bishop, built in 1778, and the archaeological and historical museum. There is a law academy, a seminary for priests, a modern school, a Roman Catholic and a Calvinistic gymnasium, a commercial academy, a training school for teachers and a secondary school for girls. Oradea Mare is an important railway junction; it possesses extensive manufactures of pottery and large distilleries, and carries on a brisk trade in agricultural produce, cattle, horses, fruit and wine.

Oradea Mare is a very old town; its bishopric was founded by St. Ladislaus in 1080. The town was destroyed by the Tatars in 1241. Peace was concluded here on Feb. 24, 1538 between Ferdinand I. of Austria and his rival John Zápolya, voivode of Transylvania. In 1556 it passed to Transylvania, but afterwards reverted to Austria. In 1598 the Turks besieged the fortress unsuccessfully, but took it in 1660 and held it till 1692. After World War I it was ceded to Rumania and in Aug. 1940 back to Hungary.

ORAKZAI, a Pathan tribe on the Kohat border of the North-West Frontier province of India. The Orakzais inhabit the mountains to the northwest of Kohat district, bounded on the N. and E. by the Afridis, on the S. by the Miranzai valley and on the W. by the Zaimukht country and the Safed Koh mountains. Their name means "lost tribes," and their origin is buried in obscurity; although they resemble the Afghans in language, features and many of their customs, they are rejected by them as brethren. One branch, the Ali Khel, has been traced to Swat, whence they were expelled by the other inhabitants, and it is not improbable that the whole tribe consists of refugee clans of the surrounding races. They are very wiry-looking mountaineers. (*See* Tirah).

ORAN, a city and port of Algeria, capital of the department and military division of the same name, stands at the head of the Gulf of Oran, on the Mediterranean, in 35° 44′ N., 0° 41′ W. The city is 261 mi. by rail W.S.W. of Algiers, 220 mi. E. of Gibraltar and 130 mi. S. of Cartagena, Spain. It is built on the steep slopes of the Jebel Murjajo, which rises to a height of 1,900 ft. The city was originally cut in two by the ravine of Wad Rehhi, now for the most part covered by boulevards and buildings. West of the ravine lies the old port, and above this rises what was the Spanish town, with the ancient citadel looking down on it. Few traces of Spanish occupation remain. The modern quarter rises, like an amphitheatre, to the east of the ravine. A ring of populous

suburbs, Montplaisant, Gambetta, Saint-Eugène, Eckmühl, encircle it from northeast to southwest. The Place d'Armes, built on the plateau above the ravine, contains a fine column commemorative of the battle of Sidi Brahim (1845), between the French and Abd-el-Kader. The Château Neuf, built in 1563 by the Spaniards and formerly the seat of the beys of Oran, is surrounded by the beautiful Promenade de l'Etang, which overlooks the port. The *kasbah* (citadel) or Château Vieux, used for military purposes, lies southwest of the Château Neuf. Behind the *kasbah* are Fort St. Grégoire and Fort Santa Cruz, crowning, at a height of 1,312 ft., the summit of the Aidur. The Grand Mosque (in rue Philippe) was erected with money paid as ransom for Christian slaves at the end of the 18th century, to commemorate the expulsion of the Spaniards.

Oran is the seat of a large trade. There is regular communication with Marseille, Cette, Barcelona, Valencia, Cartagena, Malaga, Gibraltar and the various ports on the Barbary coast. The harbour is sheltered by a large jetty stretching from west to east, parallel to the shore and more than 3,936 ft. long. The different basins which it protects include the old harbour (1868), the Aucour basin (1876), the Morocco basin (1914) and the Poincaré basin (1928). The surface of the water is about 100 ac., the length of the quays 6,879 ft., the extent of the platforms 1,722,240 sq.ft.; there is a dock railway station on the south quay. Oran is the terminus of the standard (4′8½″) gauge railway lines from Algiers and from Ujda via Tlemçen and Sidi-bel-Abbes, and of the 1.055-metre gauge line from Colomb-Bechar-Kenadsa, which penetrates 470 mi. toward the south. The construction of the standard gauge railway from Ujda to Fez, of the lines into eastern Morocco, and of the Trans-Saharan railway may be expected to increase the importance of the port. The tonnage of goods in 1938 totalled 3,046,884 (imports 1,440,447, exports 1,606,437).

The total population of Oran (1936) was 194,746 (46,157 natives and 148,589 Europeans.)

See Augustin Bernard, "Oran, port du Maroc et du Sahara," *Bull. Soc Géogr.* (Oran, 1928).

History.—Andalusian Arabs settled at Oran in the beginning of the 10th century. Important as a seaport, Oran was taken and retaken, pillaged and rebuilt, by the various conquerors of northern Africa. In the latter half of the 15th century under the sultans of Tlemçen it reached the height of its prosperity. Active commerce was maintained with the Venetians, the Pisans, the Genoese, the Marseilleais and the Catalans, who imported the produce of their looms, glasswares, tinwares and iron, and received in return ivory, ostrich feathers, gold-dust, tanned hides, grain and Negro slaves. Admirable woollen cloth and splendid arms were manufactured. The magnificence of its mosques and other public buildings, the number of its schools, and the extent of its warehouses shed lustre on the city; but luxury began to undermine its prosperity and its ruin was hastened by the conduct of the Moslem refugees from Spain, under whose influence the legitimate trade of the town gave place to piracy, Mers-el-Kebir becoming the stronghold of the pirates.

The Spaniards, animated by Cardinal Ximenes, determined to put a stop to the piracy. Mers-el-Kebir fell into their hands on Oct. 23, 1505, and Oran in May 1509. The latter victory, obtained with but trifling loss, was stained by the massacre of a third of the Mohammedan population. Cardinal Ximenes introduced the Inquisition, and also restored and extended the fortifications. The bey of Mascara seized Oran in 1708. The Spaniards recovered it in 1732, but found the maintenance of the place a burden rather than a benefit, the neighbouring tribes having ceased to deal with the Christians. The earthquakes of Oct. 8–Nov. 22, 1790, destroyed much of the town and a third of the garrison. Famine and sickness aggravated the situation when the bey of Mascara appeared before the town with 30,000 men. The Spanish commander held out till Aug. 1791. Bey Mohammed took possession of Oran in March 1792 and made it his residence instead of Mascara. The French army entered the city on Jan. 4, 1831, and took formal possession on Aug. 17.

In June 1940, at the time of the Franco-German armistice, a substantial portion of the French fleet took refuge at Oran and its naval base of Mers-el-Kebir. After fruitless negotiation by the British, with the purpose of preventing the vessels falling into axis hands, a British naval force made an attempt to destroy the ships (July 3, 1940). Several French vessels were sunk and others were severely damaged. Oran, one of the principal objectives in the Allied landings in North Africa, Nov. 8, 1942, was occupied Nov. 10, 1942, after the city had been encircled, against considerable resistance.

See M. D. Stott, *The Real Algeria* (1914). (P. W. I.)

ORANGE, HOUSE OF. The small principality of Orange, a district now included in the French department of Vaucluse, traces back its history as an independent sovereignty to the time of Charlemagne. William, surnamed *le Cornet,* who lived toward the end of the 8th century, is said to have been the first prince of Orange, but the succession is only certainly known after the time of Gerald Adhemar (*fl.* 1086). In 1174 the principality passed by marriage to Bertrand de Baux, and there were nine princes of this line. By the marriage of John of Châlons with Marie de Baux, the house of Châlons succeeded to the sovereignty in 1393. The princes of Orange-Châlons were (1) John I, 1393–1418, (2) Louis I, 1418–1463, (3) William VIII, 1463–1475, (4) John II, 1475–1502, (5) Philibert, 1502–1530. Philibert was a great warrior and statesman, who was held in great esteem by the emperor Charles V. For his services in his campaigns the emperor gave him considerable possessions in the Netherlands in 1522, and Francis I of France, who had occupied Orange, was compelled, when a prisoner in Madrid, to restore it to him. Philibert had no children, and he was succeeded by his nephew Réné of Nassau-Châlons, son of Philibert's sister Claudia and Henry, count of Nassau, the confidential friend and counsellor of Charles V. He too died without an heir in 1544 at the siege of St. Dizier, having devised all his titles and possessions to his first cousin William, the eldest son of William, count of Nassau-Dillenburg, who was the younger brother of Réné's father, and had inherited the German possessions of the family.

William of Orange-Nassau was but 11 years old when he succeeded to the principality. He was brought up at the court of Charles V and became famous in history as William the Silent (*q.v.*), the founder of the Dutch republic. On his assassination in 1584 he was succeeded by his eldest son, Philip William, who had been kidnapped by Philip II of Spain in his boyhood and brought up at Madrid. This prince never married, and on his death in 1618 his next brother, Maurice of Nassau (*q.v.*), stadtholder in the United Netherlands and one of the greatest generals of his time, became prince of Orange. Maurice died in 1625, also unmarried.

Frederick Henry, the son of Louise de Coligny, William's fourth wife, born just before his father's murder, now succeeded to the princedom of Orange and to all his brother s dignities, posts and property in the Netherlands. Frederick Henry was both a great general and statesman. His only son, William II (*q.v.*), was married in 1641 to Mary, princess royal of England, he being 15 and the princess 9 years old at that date, and he succeeded to the title of prince of Orange on his father's death in 1647. At the very outset of a promising career he suddenly succumbed to an attack of smallpox on Nov. 6, 1650, his son William III (*q.v.*) being born a week after his father's death.

A revolution now took place in the system of government in the united provinces, and the offices of stadtholder and captain- and admiral-general, held by four successive princes of Orange, were abolished. However, the counter revolution of 1672 called William III to the head of affairs. At this time Louis XIV conquered the principality of Orange and the territory was incorporated in France, the title alone being recognized by the treaty of Ryswick. For William III's accession to the throne of England, *see* ENGLISH HISTORY. He left no children, and a dispute arose among various claimants to the title of prince of Orange. The king of Prussia claimed it as the descendant of the eldest daughter of Frederick Henry; John William Friso of Nassau-Dietz claimed it as the descendant of John, the brother of William the Silent, and also of the second daughter of Frederick Henry. The result was that at the Peace of Utrecht in 1713, the king of Prussia aban-

doned the principality to the king of France in exchange for compensation elsewhere, and John William Friso gained the barren title and became William IV, prince of Orange. His sons, William V and William VI, succeeded him. William VI in 1815 became William I, king of the Netherlands (*q.v.*).

See Bastet, *Histoire de la ville et de la principauté d'Orange* (Orange, 1856). (G. E.)

ORANGE, a town of France, 18 mi. N. of Avignon on the P.L.M. railway. Pop. (1946) 13,978. Orange (*Arausio*), capital of the Cavari, was in 105 B.C. the scene of the defeat of a Roman army by the Cimbri and Teutones. It became after Caesar an important Roman colony. Its ramparts and fine buildings were partly destroyed by the Alamanni and Visigoths, and partly ruined by the erections of the middle ages. Orange was included in the kingdom of Austrasia, fell into the hands of the Saracens and was recovered by Charlemagne. It became the seat of an independent countship in the 11th century. The town had a university from the 14th century until the Revolution. Orange stands at some distance from the left bank of the Rhône, in the midst of meadows, orchards and mulberry plantations, watered by the Meyne, and overlooked by Mont Ventoux, 22 mi. to the east.

Orange has famous Roman remains. The triumphal arch ranks third in size and importance among those still extant in Europe; 72 ft. in height, 69 ft. in width, and 26 ft. in depth, it is composed of three arches supported by Corinthian columns. On three sides its sculptured decorations are well preserved. The arch seems to have been set up in honour of Tiberius, perhaps to commemorate his victory over the Gallic chieftain Sacrovir in A.D. 21. It was used as a donjon in the middle ages. The theatre, dating from the time of the emporer Hadrian and built against a hill on the summit of which a colossal figure of the Virgin stands, has a façade 121 ft. high, 340 ft. long and 13 ft. thick, which is pierced by three square gates surmounted by a range of blind arches and a double row of projecting corbels, with holes in which the poles of the awning were placed. Of the seats for the spectators, only the lower tiers remain. It was used as an outwork to the fortress built on the hill by Maurice of Nassau in 1622, and destroyed 50 years later by order of Louis XIV, who in 1660 captured the town. At the beginning of the 19th century it was filled with hovels and stables; the building has been cleared and restored, and now serves as a national theatre. Near the theatre traces have been found of a hippodrome; and there are statues, bas-reliefs and ruins of an amphitheatre. Notre Dame, the old cathedral, originally built by the prefect of Gaul, was ruined by the barbarians, rebuilt in the 11th and 12th centuries, and damaged by the Protestants.

There are manufactories of footwear, brooms, jewellery and beet sugar. The town deals largely in fruit, and millet stalks for brooms, as well as in wool, silk, honey and truffles.

ORANGE, a city of Orange county, Calif., U.S.A., 34 mi. S.E. of Los Angeles and 14 mi. from the Pacific ocean; served by the Pacific Electric, Santa Fe and Southern Pacific railways and Pacific Electric motorbuses. Pop. (1950) 10,027; (1940) 7,901 by the federal census. It is surrounded by orange and lemon groves. The average annual crop of citrus has a value of $20,000,000.

The city's industries include citrus and walnut packing houses and insulated copper wire, television antenna, twine, cordage, rope, machinery and gold-leaf manufacturers.

ORANGE, a town of Franklin county, Mass., U.S., on Millers river and the Boston and Maine railroad, 40 mi. N.W. of Worcester. Pop. (1950) 5,894; in 1940 it was 5,611. It has numerous and varied manufacturing industries.

The district of Orange was formed in 1783 from parts of Athol, Royalston and Warwick, and certain common lands, and in 1810 it was made a town.

ORANGE, a city of Essex county, N.J., U.S., 12 mi. W. of New York city, 4 mi. W. of Newark; served by the Erie and the Lackawanna railways, interurban trolleys and motorbus lines.

Pop. (1950) 38,037; (1940) 35,717 by the federal census. The city covers 2.2. sq.mi. at the base of the first Watchung mountain, in the heart of the great suburban residential community known as "the Oranges," completely surrounded by East, South and West Orange. There are approximately 90 manufacturing establishments in the city. The assessed valuation of property at mid-20th century exceeded $45,000,000. In 1914 the city adopted a commission form of government. Settlement began there soon after the founding of Newark in 1666, and the region was generally called Newark Mountain. In 1718 the people of "the mountain" severed connections with the church at Newark and formed an independent congregation. The neighbourhood was referred to as Orange Dale in 1782 and two years later Orange was in use. The township of Orange was set off from Newark and incorporated in 1806. It was incorporated as a town in 1860; the other Oranges were set off from it in 1861, 1862 and 1863; and in 1872 it was chartered as a city.

ORANGE, a city on the eastern boundary of Texas, U.S., at the head of navigation on the Sabine river; the county seat of Orange county. It is on federal highway 90; has an airport of 200 ac. and a 32-ft. channel which joins the city with the Gulf of Mexico; and is served by the Missouri Pacific and the Southern Pacific railways. The population was 21,174 in 1950 and 7,472 in 1940 by the federal census. The city is built around a deep hairpin bend in the river. It is surrounded by major gas and oil fields, huge forests of pine and cypress and a cultivated district devoted chiefly to rice farming, poultry and dairying. The port of Orange has facilities for accommodating all types of ocean-going vessels. Orange is headquarters of the Texas group, Atlantic reserve fleet. Industries include shipbuilding, kraft paper and paper bag manufacturing, creosoting, rice milling, industrial gas manufacturing, canning, lumber milling, woodworking, food processing and steel fabrication, and there are manufactures of nylon salts, methanol, adipic acid, ethylene-polythene plastics and other chemical intermediates. The city was founded as a trading post about 1600, and began expansion with the completion of harbour improvements in 1914 and the discovery of oil in 1920.

ORANGE, the longest river of South Africa, almost traversing the continent from ocean to ocean. It rises in Basutoland, less than 200 mi. from the Indian ocean, and flows west, with wide sweeps south and north, to the Atlantic. It drains, with its tributaries, an area estimated at more than 400,000 sq.mi., passing through more than twelve degrees of longitude or 750 mi. in a straight line from source to mouth. The valley of the river exceeds 1,000 mi., and the stream has a length of not less than 1,300 mi. Its headstreams are in the highest part of the Drakensberg range, the principal source, the Sinqu, rising, at an elevation of more than 10,000 ft., on the Mont aux Sources in 28° 48′ E., 28° 50′ S.

Rising on the inner slopes of the hills these rivulets all join the Sinqu, which receives from the north several streams which rise in the Maluti mountains. Of these the largest are the Semene and Sinqunyane (little Sinqu) and the best known the Maletsunyane, by reason of its magnificent waterfall—an unbroken leap of 630 ft. Increased by the perennial waters of these numerous torrents the Sinqu makes its way southwest across the upland valleys between the Maluti and Drakensberg ranges. After a course of some 200 mi., the Sinqu, already known as the Orange, receives the Makhaleng, or Kornet Spruit (90 mi.), which rises in Machacha mountain. The Orange here enters the great inner plateau of South Africa, which at Aliwal North, the first town of any size on the banks of the river, 80 mi. below the Kornet Spruit confluence, has an elevation of 4,300 ft. Forty miles lower down the Orange is joined by the first of its large tributaries the Caledon (230 mi.), which, rising on the western side of the Mont aux Sources, flows, first west and then south, through a broad and fertile valley. At the confluence the united stream has a width of 350 yd. Thirty miles lower down the Orange reaches, in 25° 40′ E., its southernmost point—30° 40′ S., approaching within 20 mi. of the Zuurberg range. In this part of its course the river receives from the south the streams, often intermittent, which rise on the northern slopes of the Stormberg, Zuurberg and Sneeuwberg ranges. Of these the chief are the Kraai, which joins the Orange near Aliwal North, the Stormberg and the Zeekoe (Sea Cow), the last named having a length of 120 mi.

From its most southern point the Orange turns sharply N.W. for

200 mi., when, having reached 29° 3′ S., 23° 36′ E., it is joined by its second great affluent, the Vaal (*q.v.*). There it bends south again, and with many a zigzag continues its general westerly direction, crossing the arid plains of Bechuana, Bushman and Namaqualands. Flowing between steep banks, considerably below the general level of the country, there about 3,000 ft., it receives, between the Vaal confluence and the Atlantic, a distance of more than 400 mi. in a direct line, no perennial tributary but on the contrary loses a great deal of its water by evaporation. In this region, nevertheless, skeleton river systems cover the country north and south. These usually dry, sandy beds, which on many maps appear rivers of imposing length, are deep and turbulent streams for a few hours or days following rare but violent thunderstorms.

In 28° 35′ S., 20° 20′ E., are the great waterfalls of the Orange, where in cataracts and cascades the river drops 400 ft. in 16 mi. The Aughrabies or Hundred falls, as they are called, are divided by ledges, reefs and islets, the last named often assuming fantastic shapes. Below the falls the river rushes through a rocky gorge, and openings in the cliffs to the water are rare. These openings are usually the sandy beds of dried-up or intermittent affluents, such as the Bak, Ham, Houm, Aub (or Great Fish) rivers of Great Namaqualand. Crossing the narrow coastal plain the river, with a southwesterly sweep, enters the ocean by a single mouth, studded with small islands, in 28° 37′ S., 16° 30′ E. A large sand bar obstructs the entrance to the river, which is not quite 1 mi. wide. The river when in flood, at which time it has a depth of 40 ft., scours a channel through the bar, but the Orange is at all times inaccessible to seagoing vessels. Above the bar it is navigable by small vessels for 30 or 40 mi.

Capt. Henry Hop first crossed the Orange in Sept. 1761, but shortly afterward returned. In 1777 Capt. (afterward Col.) R. J. Gordon, a Dutch officer of Scottish extraction, who commanded the garrison at Cape Town, reached the river in its middle course and named it the Orange in honour of the prince of Orange. Next year Lieut. W. Paterson, an English traveller, reached the river in its lower course, and in 1779 Paterson and Gordon journeyed along the west coast of the colony and explored the mouth of the river. F. Le Vaillant also visited the Orange near its mouth in 1784. Mission stations north of the Orange were established a few days later, and in 1813 the Rev. John Campbell, after visiting Griqualand West for the London Missionary society, traced the Harts river, and from its junction with the Vaal followed the latter stream to its confluence with the Orange, journeying thence by the banks of the Orange as far as Pella, in Little Namaqualand, discovering the great falls. These falls were in 1885 visited and described by G. A. Farini, from whom they received the name of the Hundred falls. The source of the Orange was first reached by the French Protestant missionaries T. Arbousset and F. Daumas in 1836.

The story of Hop's expedition is told in the *Nouvelle description du Cap de Bonne Espérance* (Amsterdam, 1778). Lieutenant Paterson gave his experiences in *A Narrative of Four Journeys into the Country of the Hottentots and Caffraria in the Years 1777–1778–1779* (London, 1789). *See* also Campbell, *Travels in South Africa* (London, 1815); Arbousset and Daumas, *Relation d'un voyage d'exploration au nord-est de la colonie du Cap de Bonne Espérance en 1836* (Paris, 1842); Farini, *Through the Kalahari Desert* (London, 1886).

ORANGE, several species of *Citrus* (family Rutaceae, subfamily Aurantioideae), the genus to which the lemon, grapefruit and lime also belong. The orange tree has shining broad evergreen leaves, fragrant white blossoms and nearly globose orange-coloured edible fruit. The species of orange most important commercially are the sweet or common orange (*C. sinensis*), the mandarin orange (*C. reticulata*), and the sour orange (*C. aurantium*). The species differ chiefly in shape, size, texture and flavour of fruit, and in tree characteristics.

The tree of the sweet orange (*Citrus sinensis*), which is also called the common or China orange, sometimes attains a height of 35 ft. Leaves are medium sized, ovate; petioles are less broadly winged than those of the sour orange. The pulp of the sweet orange is agreeably acidulous and sweet, the peel is comparatively smooth and the oil glands are convex. The usual shape of the sweet-orange fruit is round; certain varieties are greatly elongated; others are much flattened; several, *e.g.*, the Washington Navel, have a conical protuberance, the navel, at the apex.

The mandarin orange (*Citrus reticulata*), some varieties of which are called tangerines, was formerly classified as *C. nobilis*. Trees are smaller than those of sweet or sour orange; the twigs are slender and the leaves lanceolate. The fruits are depressed subglobose, with very thin loose peel easily separated from the segments and bright orange colour when ripe. Some varieties, especially the tangerines, are decidedly reddish tinted; the segments are readily separated from each other. The flavour is mild and pleasing. Some varieties, such as the Satsuma, are seedless.

The sour orange, also called the Seville, bigarade or bitter orange (*Citrus aurantium*), is a rather small tree, rarely exceeding 25 ft. in height. The green shoots bear sharp axillary thorns; leaves alternate, ovate, pointed at the tip, with margins entire or very slightly serrated; colour a glossy dark green; petioles more broadly winged than those of the sweet orange, articulated with the leaf. Fruits are subglobose, slightly depressed at both ends, sometimes nippled at apex; fruit surface is rough, dotted closely with concave oil glands; colour at maturity is brilliant orange with slight reddish tint; the pulp is only moderately juicy, relatively low in sugar and thus decidedly acid-flavoured (3.5% to 4.5% acid); seeds are numerous.

These three species of orange reproduce themselves true to type, in most cases, by seed; and, where hybridizing is prevented, the seedlings of the sweet, mandarin and sour oranges retain the more distinctive features of their respective parent plants.

History.—There is some doubt as to the place of origin of the orange. Though the orange is now the most widely cultivated of *Citrus* species and is grown in most of the warmer parts of the world, its diffusion has taken place in comparatively recent historical periods. To ancient Mediterranean agriculture the orange was unknown, although the later Greeks and Romans were familiar with the citron (*Citrus medica*) as an exotic fruit. The careful research of G. Gallesio indicated that India was the country from which the orange spread to western Asia and eventually to Europe. Oranges are found apparently wild in the jungles along the lower mountain slopes of parts of northern India. This fact, however, is only a partial proof that they originated there. Oranges and other citrus species have escaped from cultivation in several parts of the world, such as Florida, South Africa and Argentina; having thrived in the wild state, they have sometimes been erroneously considered indigenous. The wild plants are generally thorny, and present the other characters of the sour orange, but occasionally wild oranges occur with sweet fruit; it is, however, doubtful whether either the sweet or the sour species is really indigenous to Hindustan, and Alphonse de Candolle is probably correct in regarding south China and the Indochinese peninsula as the original home of the orange. Cultivated from a remote period in southeastern Asia, the orange was carried to southwestern Asia by the Arabs, probably before the 9th century, toward the close of which the sour orange (*C. aurantium*) seems to have been well known to that people; though, according to Masudi, it was not cultivated in Arabia until the beginning of the 10th century, when it was first planted in Oman, and afterward carried to Mesopotamia and Syria. It spread ultimately, through the agency of the same race, to Africa and Spain, and perhaps to Sicily, following everywhere the tide of Mohammedan conquest and civilization. In the 12th century the sour orange was abundantly cultivated in all the eastern Mediterranean countries, and the returning crusaders brought it from Palestine to Italy and southeastern France.

In Florida the sour orange has grown from an unknown period, in a wild state; but it seems certain that this orange was brought by the Spanish colonists to the West Indies and was transplanted to Florida soon after the first settlement, in 1565. The chief use of the sour orange in the western hemisphere is for rootstocks on which to graft sweet orange and other *Citrus* species.

There is no allusion to the sweet orange in European literature contemporary with the crusades, and the introduction of this fruit into Europe took place at a considerably later period, though

the exact time is unknown. The sweet orange was commonly cultivated in Italy early in the 16th century, and seems to have been known there previous to the expedition of Vasco da Gama (1497), as a Florentine narrator of that voyage appears to have been familiar with the fruit. The importation of this tree into Europe is usually attributed to the Portuguese, who first circumnavigated Africa and found the way to India and China, although Gallesio suspects that Genoese merchants of the 15th century, who must have found it growing abundantly then in the eastern Mediterranean region, may have introduced it.

The mandarin orange (*Citrus reticulata*), a native of southern China, was not introduced into Europe until after mediaeval times, even though it was known and extensively planted in China and Japan as early as the 12th century. Throughout China and in Japan, oranges have been grown from very ancient times, and they were found diffused widely when the East Indian archipelago was first visited by Europeans.

Cultivation.—Oranges are not strictly tropical plants and they thrive best where the trees are chilled somewhat by occasional slight night frosts in winter. The trees are semidormant at that season, and temperatures as low as 30° to 28° F. will not harm trees or fruits unless frost occurs early, before the trees have finished their annual growth. On the coldest sites, some means of heating the orchards is resorted to in California, and, to a lesser degree, in Florida. In such cases the critical temperature is 26° F. In California, the usual practice is to burn petroleum oil in small 5- to 8-gal.-capacity heaters (40 to 50 per acre); in Florida, pine or oak wood is the most widely used fuel.

The orange thrives in a wide range of soil conditions, from extremely sandy soils to rather heavy clay loams; it grows especially well in the intermediate types of soil. Orange orchards are generally planted in relatively deep soil where drainage is good. The orange trees are usually budded on stocks grown from the seed of selected trees of mandarin, sour or sweet orange, or the so-called Rough lemon. The seeds are sown in well-prepared soil in a lath house; after about 12 months' growth there, the seedlings are removed to a nursery. After 12 to 16 months in the nursery, the trees, then about ⅜ in. in diameter at a distance 6 in. above the ground, are usually large enough to bud. When the budded tops are one to two years old, the trees are large enough to plant in the orchard. The number of trees planted per acre in the United States ranges from 80 to 110, depending upon vigour and variety and upon the method of culture to be followed.

The ground between the young, newly planted trees is often used for vegetable crops such as beans, tomatoes or melons, the choice depending upon the market demand for such annual crops. The culture of intercrops helps to provide favourable conditions for the young orange trees for the first five or six years, until they reach the age of profitable production; after this, the entire land is usually devoted to the orchard. The growth of cover crops during the winter months in California, and during the summer months in Florida, prevents erosion damage and makes use of the seasonal rainfall for the production of organic matter to be incorporated into the soil. In addition to this organic material, it is essential to use relatively large amounts of fertilizers, such as various nitrogenous materials; in Florida, applications of phosphate and potash are essential. Some of the minor nutritional elements, especially zinc, copper, manganese and magnesium, are frequently lacking in citrus soils, and small applications are then necessary. In many areas where oranges are grown, it is necessary to supplement the rainfall with irrigation; this is generally the practice in California, Texas, Palestine, Spain, Morocco and in parts of South Africa. In the 18th century the orange tree became a favourite object of conservatory growth in England; in the open air, in protected locations, it has often stood the cold of many seasons in the southern counties and has occasionally borne abundant fruit. The orange has usually been cultivated in England for the beauty of the plant and the fragrance of the blossoms, however, rather than for the supply of edible fruit.

In garden culture in southern Europe, the orange is sometimes trained as an espalier, and with careful attention yields fruit in great profusion when thus grown. Orange trees will continue to bear abundantly from 50 to 80 years or even more, and some old orange trees, whose age must be reckoned by centuries, still produce crops; these very ancient trees are generally of the sour orange, and have probably been frozen back and then rejuvenated by sprouts from near the ground. Sweet-orange trees growing under orchard conditions occasionally acquire a considerable size; a 67-year-old sweet-orange tree near Pasadena, Calif., had a spread of 36½ ft.; its height was 33 ft.; its circumference, 1 ft. above ground, was 5 ft. 7 in.

Harvesting and Packing.—Oranges are picked when fully ripe for, unlike some deciduous fruits, they do not ripen or improve in quality after being picked. In the United States it is unlawful to sell oranges until they have reached a certain state of maturity, determined by the ratio of total soluble solids to acids in the fruit juice. In California, the fruit must attain a maturity ratio of soluble solids to acids of 8:1 before it may be lawfully sold. As 80% to 85% of the soluble materials are sugars, and citric acid is the principle which gives oranges the typical mildly acid flavour, this ratio is often erroneously spoken of as the sugar-to-acid ratio. In some sections oranges can be left on the trees for 5 to 6 months after they become mature enough to eat; during this period the sugars increase and the acids decrease, so that the ratio of soluble solids to acids at the end of the picking season is sometimes as high as 17:1. The vitamin content of oranges declines as the fruit becomes overmature.

Oranges are carefully handled during the picking and packing operations to prevent them from being punctured, scratched, bruised or scarred by abrasions. This care is necessary to prevent losses from decay caused by various moulds, such as blue mould and other fungus organisms, which are widely distributed. The normal unbroken surface of the peel of the orange is very resistant to such diseases, but they readily gain entrance to the very susceptible inner portion of the peel and to the pulp of the fruit if the surface of the peel is injured even in the most minute way. To prevent such injury, and to prevent scarring of the fruit by the fingernails, oranges are picked by well-trained workmen wearing cloth gloves. The orange is removed from the twig by clipping the stem as close to the fruit as is practicable. By this care in handling, which is somewhat comparable to the handling of eggs, millions of dollars worth of fruit is saved which would otherwise be lost by decay.

As the oranges pass through the packing house, they are handled largely by machinery, from the time the field boxes are dumped until the fruit is finally ready for packing in the shipping boxes. The following is an example of the usual processes through which the fruit goes in the packing house. It is (1) doused in hot soapy water (115° F.); (2) cleaned as it passes under revolving brushes; (3) rinsed in clear water and brushed simultaneously; (4) rinsed in water and borax solution; (5) rinsed in clear water; (6) dried by passing on a belt conveyor through a tunnel through which air is forced at a high velocity; (7) culled by hand as it passes over a belt conveyor; (8) graded for size; and (9) wrapped in tissue paper and packed by hand. In California many packing houses use supplementary aids, such as nitrogen trichloride gas or other fungicides or disinfectants, to prevent decay. A very thin layer of wax is applied to most oranges to prevent undue drying in transit or in the market. In the United States, oranges are packed in wooden boxes for shipment, California boxes holding approximately 77 lb. of fruit, and Florida boxes holding approximately 90 lb. Each box is packed with the same sized fruit throughout. A medium-sized orange is 2¾ in. in diameter and packs 176 to a California box.

Varieties.—In 1943 H. J. Webber described 97 varieties of sweet and mandarin oranges, which had been grown in the various subtropical parts of the world. Of the sweet oranges, the Washington Navel is the principal winter variety grown in California and Arizona, and the Valencia is the principal summer variety grown in these areas. The principal sweet varieties grown in Florida are: Hamlin, Pineapple, Parson Brown, Homosassa and Valencia. In Texas, the cultivation of the Valencia and Hamlin varieties increased greatly in the decade 1940–50. Blood oranges form another group of sweet oranges. They are char-

acterized by the deep-red tint of the pulp, and comprise some of the best varieties; they are grown extensively in the Mediterranean region, but have not become popular in the U.S.

The mandarin oranges, which include the tangerines, are grown more extensively in Florida than elsewhere in the United States; the variety most widely grown is the Dancy tangerine. The Temple, a loose-, thin-skinned fruit, especially desirable at one time in Florida, appears to be a hybrid between the mandarin and the sweet orange. Another loose-skinned type of orange, of the mandarin group, is the Satsuma, which was introduced into the United States in 1876 from Japan, where it is widely grown. The Satsumas ripen earlier in the fall and are more resistant to frost than other commercially grown citrus fruit. They have been rather extensively grown in certain areas bordering the Gulf of Mexico, where it is too cold for the production of sweet oranges; but freezes during the two decades 1922–42 greatly reduced the acreage. Mandarin oranges are highly prized as dessert fruits because of their attractive appearance and because their loose skin and easily separable segments make them easy to handle. The mandarins are lower in vitamin C content than are sweet oranges, lemons or grapefruit.

The sour orange is grown to some extent in all citrus-producing sections, but its production on a commercial scale has been mainly limited to southern Spain, where it was first planted years ago by the Moorish conquerors. The most important commercial use of the fruit is in the manufacture of marmalade. The sour orange in general is too acid and bitter for use as a fresh fruit; the juice, however, has a distinctive flavour which makes it a pleasing addition to certain beverages. The fruits are also used in making confections, liqueurs (curaçao) and other drinks. The fruit and leaves are used in making a number of medicinal preparations, and the flowers, leaves and fruits yield volatile oils (bigarade oils) of characteristic odour, much prized for perfumes. The oranges of the bergamot group (subspecies *Citrus bergamia*) are largely grown in southern Italy and Sicily for the essential oil which is expressed from the peel for making perfume. The bergamot group is thought to be of hybrid origin, with the sour orange as one of the parent species.

Diseases and Insect Pests.—Several diseases, of fungus or virus origin, are generally distributed over most of the subtropical areas where oranges are grown. One of the most troublesome of these diseases, brown-rot gummosis or foot rot, is caused by several species of fungi (*Phytophthora* species). This disease affects the lower trunk and the crown roots of the tree, and also produces a brown rot on the fruit, while it is still on the trees, in those years when weather is especially damp during the picking season. *Phytophthora* decays also cause loss of picked fruit. Spray mixtures in which copper is the lethal element are commonly used to spray the lower part of the tree, as the splashing of the rain spreads the fungus spores most readily to the low-hanging fruits. When the disease is present on the crown roots and trunk, the tree has a devitalized appearance characterized by poor growth, pale small leaves and more than the normal amount of dead twigs. The affected crown has dark-coloured areas from which gum exudes; beneath these areas the cambium is dead and discoloured. If not cut out and disinfected, the diseased areas continue to enlarge and finally girdle the tree. Preventive measures consist in avoiding both too deep planting and excessive water next to the trunk. The most devastating virus disease is quick decline, also known as *tristeza* in South America. It is spread by propagating from diseased trees and also by two species of aphids. As the name implies trees are killed suddenly by this disease. Another virus disease of oranges is psorosis, formerly called scaly bark in California. Seriously affected trees become valueless. The disease is spread largely by propagating from diseased trees, and may be avoided by care in selecting healthy trees from which to take buds.

Loss of fruit in storage and transit is caused by rots produced by *Phytophthora* species, green mould (*Penicillium digitatum*), blue mould (*P. italicum*), black rot (*Alternaria citri*) and others. Loss from these diseases is greatly reduced by the care exercised in handling the fruit during picking and packing.

The insect pests most commonly troublesome to oranges in California are five species of scale: black scale (*Saissetia oleae*), yellow scale (*Aonidiella citrina*), purple scale (*Lepidosaphes beckii*), red scale (*Aonidiella aurantii*) and citricola scale (*Coccus pseudomagnoliarum*). Several species of mealy bugs cause damage in particular cases and during some seasons, but, because of their insect parasites, they are not so generally harmful as the scale insects. In some districts in California, the citrus thrips (*Scirtothrips citri*) is a serious pest.

The citrus red mite or red spider (*Paratetranychus citri*), as well as aphids and other insects, causes damage in the coastal and intermediate areas if not controlled by insecticides. Other pests which are especially important are the Mexican fruit fly (*Anastrepha ludens*) in Texas and the citrus rust mite (*Phyllocoptes oleivorus*), citrus white fly (*Dialeurodes citri*), Florida red scale (*Chrysomphalus aonidum*) and also purple scale (*Lepidosaphes beckii*) in Florida. The control of insect pests in all citrus-producing areas is one of the most difficult and expensive factors in the commercial production of oranges.

One of the serious pests of oranges is the Mediterranean fruit fly (*Ceratitis capitata*), wherever it occurs in subtropical areas of the world. The fly lays its eggs in the peel of the fruit, and the larvae develop in the pulp. An infestation was found in Florida in the spring of 1929, but by late fall of 1930 it had been successfully exterminated, at an immense cost to the state and federal governments. With the exception of the mealy bugs, most of the insect pests, as well as the various mites, are usually controlled satisfactorily by spraying or dusting. These very effective operations are highly mechanized. The spray and dusting rigs are mounted on trucks or hauled by tractors. Dusting or mist spraying may also be done from an aeroplane. In one of the spray materials most commonly used, petroleum oil is the principal toxic agent. Highly refined, light-medium or medium oil emulsions applied at concentrations of $1\frac{1}{2}\%$ to 2%, mixed with water, are most in use. To the mixture an additional toxic material, such as rotenone or pyrethrum, is often added to increase the effectiveness of the spray. Lime-sulphur sprays, as well as sulphur applied as a dust, are important insecticides, especially for thrips and red mites. Other dust materials used as insecticides are some of the organic compounds, such as dinitro-o-cyclohexylphenol, which are especially toxic to red mites. Nicotine sulphate as a spray or a dust is used for aphid control (*The Citrus Industry*, vol. 2, 1948).

Production and Consumption.—The sweet orange and the mandarin orange are the principal species produced commercially in the following countries, listed in approximate order of importance: in 1951–52, the United States, Spain, Brazil, Italy, Argentina, Japan, Mexico, Algeria and Egypt. The world production of oranges, of these and other countries, ranges from the equivalent of 250,000,000 to 329,000,000 boxes (70 lb. net each) annually. This enormous production of oranges, in comparison with that of other citrus fruits, is evidence of their world-wide popularity. Florida, California, Texas and Arizona are the principal producing states in that order. The mandarin oranges are produced more extensively in Florida than in any other area of the U.S.

Prior to 1920 the orange was considered principally as a dessert fruit for winter use. The drinking of orange juice, in contrast with the eating of the fresh fruit, was a major factor in the increase in per capita consumption. Another important factor was the increase in knowledge, gained in this period throughout the whole world, of the dietary value of all citrus fruit. One of the primary reasons for the important dietary value of oranges is their high vitamin C content, which averages 54 mg. per 100 g. of juice. Of the other fruits and of the vegetables commonly constituting a part of the human diet, only the lemon exceeds the orange in vitamin C content.

The most important product made from oranges is concentrated juice. During 1952–53, frozen concentrated juice required 30.1% of the crop to produce 51,815,000 gal. of concentrate. Essential oils, pectin, candied peel and orange marmalade are among the important by-products. Stock feed is made from the waste material left from the processing of some of the aforemen-

tioned articles. This dried residue, known as orange meal, compares favourably with beet pulp and other semiconcentrates used as stock feeds and conditioners in preparing cattle for market. The wood of the orange tree is of a fine yellow tint; it is hard and close grained and is valued by the turner and the cabinetmaker for the manufacture of small articles.

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ORANGE, COUNCILS OF: *see* COUNCILS OF ORANGE.

ORANGEBURG, a city of South Carolina, U.S., the county seat of Orangeburg county; on the North Edisto river and federal highways 21, 178 and 301, at an altitude of 259 ft., 45 mi. S.E. of Columbia. It is served by the Atlantic Coast Line and the Southern railways. The population in 1950 was 15,322; in 1940 it was 10,521 by the federal census.

Orangeburg is the financial, commercial and industrial centre of a rich section of the Atlantic coastal plain, and is the seat of Claflin university (1869; Negro) and South Carolina State Agricultural and Mechanical college (1896; Negro). Cotton, grain, livestock, poultry, tobacco and pecans are leading products of the county, and the city has manufacturing industries. It operates under a commission form of government. In 1704 a trader and trapper built his cabin there, and in 1735 a colony of Germans and Swiss established a settlement, naming it in honour of William, prince of Orange. The town was incorporated in 1851 and was chartered as a city in 1883.

ORANGE FREE STATE, an inland province of the Union of South Africa. It is divided from Natal by the Drakensberg, from Basutoland by the Caledon river, from the Transvaal by the Vaal river and from the Cape Province by the Orange river and, in the west, by a line drawn across the veld from the Orange to the Vaal. It lies between latitudes 26° 30′ and 30° 40′ S. and between longitudes 24° 10′ and 29° 40′ E. Area, 49,647 sq.mi.

The country forms part of the inner plateau of South Africa, and most of it lies between 4,000 and 5,000 ft. above sea level. From the mountainous eastern districts it slopes gradually westward, no natural boundary marking its western frontier. The aspect of the country is that of vast, undulating, treeless plains, with a certain number of willows and thorn trees along the streams. The latter were formerly more widely spread but have nearly all been cut down for fuel. The Australian black wattle, gums and the pepper tree have been successfully introduced and are grown along the streets of the towns and in plantations on farms, especially in the eastern districts, to provide shelter, poles and firewood.

The general level of the surface is broken by low ridges and isolated table mountains, the latter attaining considerable elevation above the plain. They are particularly numerous and well developed in the east and are caused by the outcrop of beds of sandstones and dolerites. The rivers, except the Orange, Vaal and Caledon, are dry or nearly dry for three or four months during the dry winter season; but after rain even the small spruits may become raging torrents. (For geology, climate, flora and fauna, *see* SOUTH AFRICA, UNION OF.) (R. U. S.)

HISTORY

At the beginning of the 19th century the great plateau between the Vaal, the Orange and the Drakensberg mountains was a no man's land, and the passes over the Drakensberg the haunt of cannibals and assassins. The indigenous tribal structure, mainly Bechuana, had been broken by refugee Zulu impis that attacked and despoiled one another in the wilderness that they created. Matiwane between 1818 and 1829 ravaged the whole of the territory, annihilated Mpanazita at Mekwatleng (20 mi. N. of Ladybrand) and scattered the remnants of his tribe from the Vaal to Queenstown. Pursued by Shaka's impis, he fled across the Orange. His forces harried Pondoland but, mistaken for Shaka's, were dispersed by an expedition from the Cape. Equally formidable was the young Sikonyela and his mother Mantatisi, the amazon and witch who guided the last stand of the Batlokua.

There seem to have been only two stable focal points in the area. Immediately north of the Orange river, on both sides of the Vaal (in the Campbell lands; in the modern Griqualand West; and round Philippolis between the Orange and the Riet) there were contiguous Griqua settlements, protected by the formidable John Philip and encouraged by the government at the Cape as a buffer against incursions from the north. The Griqua frontiers fluctuated with their power, which, as they were the only people north of the Orange armed with rifles and as they were used to commando tactics, was greater than their numbers (*see* GRIQUALAND EAST AND GRIQUALAND WEST). The second nebular state was to the east, where, on the rocky slopes of the Drakensberg, Moshesh (Msheshwe) had rallied shattered groups of Bechuana and was forging the Basuto nation. Within his fortress kraal at Thaba Bosigo he had an impregnable refuge from which he defied Sikonyela and even the great Zulu Mzilikazi (Mosilikatze). Patron of missionaries, chiefly French, gifted not only with military skill but also with Machiavellian astuteness, Moshesh held out between Mzilikazi and a horde of lesser chiefs on the west and Dingaan across the mountains to the east. When times were favourable, his family with their followers diffused over the fertile Caledon plains and peacefully surrounded the territories of minor rivals. Moshesh used tribal structure as the basis of a new diplomacy at a time when the whole political geography of the Transorangia was fluid and chaotic.

In the 1830s systematic penetration of the lands across the Orange river began from the south. Missionaries, mainly Wesleyan in the west and Paris evangelicals in the east, embarked on a double and often rival program of conversion and settlement for displaced tribal groups. But even earlier than the Griqua settlement (1803) and the missionary penetration, a new kind of infiltration had begun, also from the south. Hunters and explorers had reported that there were great uninhabited plains north of the Orange river and fertile soil in the Caledon area. The Trek-Boers, ever questing after new pastures and new land to farm, began seasonal grazing across the Orange and then, by what they defined as grant and purchase (though often there was no written deed), procured lands from the Griquas or squatted in the Caledon area. Thus, while the Cape government strove to make a stable frontier at the Fish river, the frontier became increasingly an administrative myth. Then, in 1835, Lord Glenelg advised Sir Benjamin d'Urban to abandon the newly annexed province of Queen Adelaide, and the retraction of the frontier was the signal for the Great Trek (*see* CAPE PROVINCE). North of the Orange river the cautious probing of the Trek-Boers was engulfed in the exodus of about 2,000 frontier folk, mainly Boers, lured by the prospect of more land and impelled by resentment against British colonial policy in the Cape. It was the beginning of an invasion and revolution that altered the structure and to a great extent determined the future development of Transorangia.

The trekkers were assisted by the Barolong chief Moroka at Thaba Nchu, and it is said that, until his death, A. H. Potgieter was the friend of the Barolong. After initial reverses the trekkers mapped out and planned a republic, but dissensions led to a forking of their enterprise. While a core remained in the Winburg region, one branch pushed north across the Vaal and another, under Potgieter and Piet Retief, crossed the Drakensberg into Zululand and Natal (*qq.v.*). After the massacre of Retief's party, the Natal trekkers made a treaty with Panda, who overthrew his brother Dingaan and rewarded them with the cession of most of Natal, then denuded of inhabitants by the flight of the victims of the Zulu wars. There the trekkers organized a republic with its capital at Pietermaritzburg. Exiled tribes flocking back perturbed the trekkers, whose proposal to resettle them south of Natal in territory flanking Pondoland threatened a shunting movement that would have reacted on the frontier structure of the Eastern province. Though a philanthropic native policy was one of their objectives, it was probably this threat and, above all, commercial interests that induced the British to annex Natal in 1843. This, coupled with the announcement that there would be no colour bar in Natal and with the British attempt to resettle displaced Zulus there, determined many trekkers to abandon Natal

as they had abandoned the Cape. The Boers recrossed the Drakensberg and concentrated, some across the Vaal and some at Winburg. Thus Winburg in 1843 as in 1837 was the axis of Boer republicanism. In the same way, for different reasons, Transorangia became the axial point of British colonial policy.

Legally the attitude of the British government was based on the Cape of Good Hope Punishment act, passed in 1836 to extend criminal jurisdiction to all British subjects as far north as latitude 25° S. In political terms, this meant that the emigrants were not considered to have shed their allegiance by shaking the dust of the colony off their feet. Such, however, was the sole object of a resolute body of the trekkers; and men like Andries Pretorius, who abandoned ten farms in Natal to struggle back across the Drakensberg, made desperate sacrifices for their ideals. But British policy also had ideals, namely the controlled sale of crown lands so that some were held in trusteeship, the protection and civilization of native peoples and the extension of democratic institutions in areas of consolidated white settlement. The principles of British policy, especially in the "hungry forties," were crippled by lack of financial resources and by the interplay of crosscurrents of opinion on a disintegrated party structure in Great Britain. Ill-informed but sincere and powerful missionary interests in England demanded ever more protection for natives, while the equal eloquence of the Manchester school of economists demanded retrenchment and reform. In the swirl a policy coherent in principle was often impotent, sometimes mischievous in practice. Logically the annexation of Natal should have been preceded by the annexation of Transorangia. Instead the period 1837–48 was a disastrous interregnum which helped to jeopardize the experimental annexation between 1848 and 1854.

Between 1837 and 1848 the British fumbled to find means of enforcing the Punishment act and stabilizing native territories without incurring the responsibilities of sovereignty. In 1843 the Napier treaties with Adam Kok III (allied since 1838 to Waterboer) and with Moshesh tried to fix frontiers and tenures which in fact ignored Boer claims as well as the claims of minor chieftains in the centre. The signatories were to enforce the Punishment act. This led to armed protest from the Boers and almost consolidated a Boer front against Great Britain, until armed clash was followed in June 1845 by the Maitland treaties at Touwfontein. These planned to divide native lands into two: an inalienable tribal block; and lands which could be leased, the quitrents from which were to be divided between the chief and the expenses of a British resident to be established in the territory. This was a step forward; but many Boers had already purchased land outright, the frontiers claimed by Adam Kok were dubious, and Moshesh, who claimed inalienable sovereignty over lands wherever his people had fought or planted, was systematically surrounding the lesser chiefs between the Basutos and the Griquas with Basuto settlers. Inevitably the treaties failed to give stability or security. Though H. D. Warden was installed as resident at Bloemfontein, he had no white garrison in the whole of the area. More and more Boers relied on private enterprise, indifferently co-ordinated by Winburg.

When in Dec. 1847 Sir Henry Smith was made governor of the Cape and high commissioner for South Africa, it seemed as if the problem of South Africa was to be treated as a whole and no longer in segments. He had vigour and popularity and, up to the limits allowed by the colonial office, the courage of his convictions. He rounded off the seventh Kaffir war by annexing the Stormberg area and Kaffraria to the Cape; he speeded up the land commission in Natal with consideration for Boer demands there; and, after a tour that included an interview with Andries Pretorius at the Tugela Drifts, he annexed Transorangia to the crown and in Feb. 1848 proclaimed the Orange River sovereignty.

The Orange River Sovereignty, 1848–54.—Between 1848 and 1854 Great Britain sought to evolve an effective policy that would satisfy all groups at home and give firm ground to all in the quicksands of the new sovereignty. On frontier policy, all settlers on the fringes tended to think alike, whether Boer, Scots or English, so that a local patriotism independent of racial or political theory tended to crystallize at Bloemfontein as it had done in the Eastern province. When the annexation was proclaimed, because it seemed to promise security it was on the whole welcome to the majority of the white settlers. The Boer settlers seem to have fallen into two groups (apart from an indeterminate and scattered number of pioneers, who were not politicians) the pre-Great Trek settlers and loyalists; and the minority of irreconcilables, concentrated mainly in the Winburg area, who were moved by almost religious conviction that the theory of British policy was wrong and that their spiritual freedom lay in their political extrication from its clutches. It was this Winburg section that summoned Pretorius from Magaliesburg to lead revolt. To make that revolt successful, negotiations were conducted not only with Moshesh but with Panda, their former ally.

Such a tactic, if successful, would have exposed the whole of the sovereignty to the ravages of Zulu impis. The means could neither have justified nor served the end. More, extremists like Willelm Jacobs and Gert Kruger resolved at Winburg (Feb. 1848) to punish with fine, confiscation and death Boers who refused to cooperate. Many who joined the revolt did so because of compulsion; others claimed that they had thought an armed remonstrance was all that was intended; Potgieter sent no assistance from Ohrigstad across the Vaal. Pretorius and his party, having evicted British officials from Winburg, drove the embryo administration out of Bloemfontein and across the Orange, while loyalist Boers went into laager. When troops were available, Smith made a leisurely crossing of the Orange and advanced until attacked by Pretorius at Boomplaats (Aug. 1848). A vigorous skirmish of three hours culminated with the withdrawal of Pretorius across the Vaal with a price on his head. Two rebels taken in arms were shot and fines were levied, but there was no wholesale policy of total eviction. In the Cape, the children of Pretorius kept their extensive farms. Boomplaats, which was later to assume a distorted significance, cleared the air at the time; and when in Jan. 1852 the Sand River convention with Pretorius secured the Klip river and Harrismith to the sovereignty, it was possible for the latter to develop as a distinct geographical and political entity.

The Orange River sovereignty was divided into four administrative districts, Bloemfontein, Smithfield (Caledon River), Winburg and Harrismith. Each was equipped with a minimum official staff, but only Bloemfontein maintained a garrison. The colonists were responsible under their field cornets for their own defense. Quitrents and traders' licences were the main source of the sovereignty's revenue. There was a central legislative council, nominated but two-thirds burgher. There was, however, no burgher representation on the executive until July 1853. Thus the official government tended to get out of touch with burgher sentiment when it sought to tackle the land question. In the 20th century the plan of administration would be described as one of reciprocal *apartheid:* the native chiefs were to remain undisturbed within surveyed frontiers, while their "foreign relations" one with another were subject to British control; they were otherwise to be "self-governing" through tribal structure, which, however, it was hoped would be modified by missionary guidance. But this ambitious policy could not be enforced by an understaffed administration. Moroka and Sikonyela and other minor chiefs, supported in some cases by their several missionaries, contested the frontiers claimed by Moshesh and his missionaries. No less than six frontiers were proposed to edge the Basuto lands off, and the Warden line (1849) satisfied no one—least of all the white settlers, because it cut through the fertile Caledon farming area. Bickering led to a series of local wars in the course of which Moshesh smashed his rivals (including Sikonyela). The administration was helpless, as the burghers were reluctant in disturbed times to abandon their farms for commando duty to enforce a policy of delimitation that, though it gave them full legal title to their farms, ran contrary to their traditions.

Given time, resources and sympathy, a solution was, though difficult, not inconceivable in the sovereignty. Warden laid the foundation stone of the Dutch Reformed church in Bloemfontein in 1849 and that of St. Andrew's cathedral in 1850. Settlers both Boer and British were trickling in, together with a sprinkling of foreign immigrants. The *Friend of the Sovereignty* was be-

ing printed in both Dutch and English. Special Commissioners W. S. Hogge and Mostyn Owen, who had sponsored Transvaal independence, could urge that the case of the sovereignty was different and that its evacuation would be a betrayal of responsibility. But like Earl Grey, his counterpart at the colonial office, Sir George Cathcart, who became high commissioner on Sir Henry Smith's recall in March 1852, was bent on withdrawal after an abortive attack on and defeat by Moshesh at the Berea (Dec. 1852). In Sept. 1853 Sir George Clerk arrived with special powers to "settle and adjust the affairs of the Sovereignty." This was a euphemism for abandonment, a decision which the spectacle of Moshesh's private wars served to harden. A convention, elected on universal manhood suffrage, refused to vote itself into a republic. A public subscription raised enough to send the Rev. Andrew Murray and A. J. Fraser to England to protest against abandonment. Before they arrived in England, the die was cast. Clerk began importing supporters from the Transvaal to cabal for the negation of British policy in the sovereignty. A contrived assembly accepted the convention of Bloemfontein, which thrust independence on what was now the Free State, in Feb. 1854. Ten months later, Sir George Grey arrived in South Africa as high commissioner, a year too late to save the sovereignty. Great Britain abandoned not only the sovereignty but also all existing treaties with native states north of the Orange river, save only those with Adam Kok. Clerk undertook to "establish affairs in Griqualand," but neither then nor in 1861 (when Kok sold the remnants of his land to the Free State) were the Griqua lands defined.

The Orange Free State to 1900.—The constitution devised by the burghers in April 1854 was a blend of traditional Boer institutions with U.S. and Dutch constitutional theory. The unicameral *volksraad* had parliamentary sovereignty with control over taxation and over legislation and the right to ratify treaties and to declare war. No constitutional change could be made without a three-quarter majority in favour in each of two succeeding annual sessions (in 1885 the high court was given power to decide whether a law was against the constitution). Franchise depended on the possession of burgher rights, which were limited to adult male Europeans, qualified either by birth or by property or by residence. Executive power was vested in a president and an executive council. The president was elected by direct vote of qualified burghers for five years and was eligible for re-election. Roman Dutch law was declared the law of the land, Dutch the official language. Equality before the law, freedom of association and freedom of the press were among the rights secured to burghers. The Dutch Reformed Church was to be promoted by the *volksraad*. Local government and defense turned on the traditional election of field cornets and all burghers were liable for commando duty. The judicial structure, central and local, and the provision of municipal boards followed the Cape pattern. The constitution was liberal and worked well. The small quorum of 12, however, tended at times to let power slip into the hands of an inner circle; but as new districts were created and controversial issues were raised, burghers in the outlying areas, who had at first regarded the constitution as a superfluous addition to the Ten Commandments, took a more active part in politics (since, moreover, the representative structure of single-member constituencies was related not to population but to districts, a small town like Hoopstad with 30 voters came by the end of the century to have as much weight as a large city like Bloemfontein).

Until 1871, and to a certain extent throughout its existence, the Free State had the same problems that the sovereignty had had. The southern area looked to the Cape for its commerce and was influenced by Cape traditions, while the eastern and northern parts were dependent on the Harrismith route to Natal and had even closer links with the Transvaal—a cleavage corresponding to that between the Winburg and the sovereignty men. But wise leadership and the facing of common dangers welded the Free State for a time into what James Bryce defined with confidence as a model state.

The first president was J. H. Hoffman (1854–55), chosen for his reputed ability to cope with Moshesh; but his diplomatic present of a keg of gunpowder to the chief raised the outcry that forced him to resign. He was followed by the *voortrekker* J. N. Boshoff, formerly secretary to the Natal *raad*. M. W. Pretorius, of Potchefstroom, heir to the Winburg policy of his father Andries, tried by a coup at Rhenoster river (1857) to force the alignment of the Free State with Potchefstroom (Transvaal), but force was met by force and in June peace was made between the two republics, through whose histories, however, the idea of fusion was to run like a theme. Peace was timely, for Moshesh had seized the opportunity to pounce again. A bold Free State move against Thaba Bosigo failed so completely that Boshoff appealed both to Pretorius and to Grey, and the *volksraad* passed a resolution in favour of confederation with the Cape. Grey, convinced that the conventions had been a blunder because it was bad strategy to handle the native question piecemeal, responded by arbitrating the first treaty of Aliwal North (Sept. 1858) on the basis of adjusting the Warden line to give the Basuto more land in the Caledon area. This made explicit what the convention of Bloemfontein had evaded, namely that the western frontier of Basutoland marched with the eastern frontier of the Free State, and neither state had jurisdiction over the lands of the other.

Thereafter constant encroachments on both sides led to outrages, murder and undeclared war. The issues were complicated by Basuto family and tribal politics. Moshesh's sons Molapo and Masupha favoured a forward policy that Moshesh professed, perhaps insincerely (*cf.* his proven intrigues with native chiefs in the northern Cape and Pondoland), to eschew. Not the least subtle part of Moshesh's propaganda was the insinuation that the Boers in the Free State were the common enemy of the Basuto and the British. With the Cape government in difficulties in the Transkei and the Transvaal disunited and menaced on two fronts, Moshesh awaited the attack that he had provoked.

The third president of the Free State, M. W. Pretorius (1859–63), who for a short time combined the presidencies of the Free State and of the Transvaal, achieved a brilliant coup when, in 1861, he purchased the lands of Adam Kok III, the Griqua, for £4,000, albeit on ambiguous terms (*see* below). But Pretorius found that he could not keep his grip on the Free State without forfeiting his position in the Transvaal and resigned the presidency of the Free State in 1863, to be succeeded by J. H. Brand.

President Brand (1864–88) declared war on Moshesh in 1865. When the Free State forces were victorious (a belated Transvaal commando did little more than rescue for itself the lion's share of the booty), Moshesh played his last card and bestowed Basutoland as a Greek gift on Queen Victoria; but meanwhile he had accepted the treaty of Thaba Bosigo, which gave the Free State half his land. The Free State, however, was too weak to enforce the treaty, and guerrilla war was resumed. In March 1868 Sir Philip Wodehouse annexed Basutoland. Brand protested vigorously, but farmers who tried to move in on their allotted farms were often unable to hold them against Basuto raiders; and in safer zones those who had no share of the spoils protested that speculators in the new lands depressed land values in the old. Moreover, in the southwest of the Free State, the frontier resulting from Pretorius' Griqua purchase still needed definition. In 1869, then, Brand signed the second treaty of Aliwal North, which reiterated the convention of 1854 and drew a final frontier between the Free State and Basutoland, by which a substantial portion of the conquered territories remained to the Free State. The *volksraad* ratified the treaty with one dissentient, even though it cut off a possible outlet to the sea via Pondoland.

On the whole, by 1868, though coin was short and credit low, the Free State had made remarkable progress. The Grey college, nucleus of the future university, had been founded, churches were established and municipal boards created. The resources of the state were greater than its assets, for it had steadily extended its land. The new Basutoland frontier left the bulk of the wheatlands to the Free State. Most of the native enclaves were in the process of disintegration, partly because of the early wars of Moshesh, partly because of European purchase and diplomacy. In marked contrast to practice in the Cape and Natal, native ownership was forbidden, while only two substantial reserves, at Thaba

Nchu and at Witzieshoek, were destined to survive under Free State protection.

Even before he had resolved the Basutoland crisis Brand found himself involved in the ambiguities of Pretorius' Griqualand purchase. Adam Kok denied from the first that the purchase included the Campbell lands which Cornelis Kok had bequeathed to him. More vociferously, Waterboer, in Griqualand West, claimed that, whatever his intentions, Adam Kok had had no power to sell them or Cornelis any right to bequeath them, since he, Cornelis, held the lands merely as vassal of Waterboer. The Campbell lands sprawled across both sides of the Vaal river, the eastern portion having in practice been administered by Warden from Bloemfontein and by the Free State from Jacobsdal. Quite apart from the claims of Waterboer, the British high commissioner was anxious to secure either for Great Britain or for the Cape the missionary-merchant road to the north; the Transvaal coveted most of the land west of the Vaal between the Langeberg mountains and the Molopo river; and the Free State could advance a common-sense claim to land in the angle of the Vaal and Orange rivers to reinforce its interpretation of the purchase of 1861.

The discovery of diamonds, first on both sides of the Vaal river and then in the dry diggings (1870), sharpened the conflict and made a leisurely solution impossible. There was the immediate problem of jurisdiction over the congested cosmopolitan diggings; there was the problem of controlling native and coloured vagrants and labourers, who flocked from every quarter; there was the question of trade and transport development; and there was the question of the ownership of the diggings, which was now tossed like an apple of discord by Waterboer to Great Britain. The British government made two separate but not unrelated decisions: to enforce the Keate award (1871) against the Transvaal (*q.v.*); and to annex Griqualand West. To the Free State this could only seem peremptory and, as evidence which was not brought forward until after the annexation suggested, unjust.

In 1876 Brand visited London on the invitation of the secretary of state for the colonies, the earl of Carnarvon. Understandably, the Free State was at that point averse to schemes of federation, and Brand took no part in the discussions of them. He did, however, secure £90,000 in compensation; and the Free State was promised a further £15,000 if a railway linked either with the growing Cape system or with the Natal line were completed in five years. The compensation had the present advantage of liquidating the public debts of the Free State. The blow was further softened by the discovery of diamonds at Koffiefontein (1875) and at Jagersfontein (1878), well within the state boundaries. The Free State was no longer terra incognita, but a busy highway to the diamond fields and a transport riders' paradise. Frontier security as well as the leaven of relative prosperity stimulated farming. It was during this diamond decade that, as a result of the work of J. Brebner, the first inspector general of education, the sound foundations of a general system of primary education were laid.

Brand saw more clearly than most of his contemporaries the importance of railways; he also perceived the sound strategic position of his state in the economic development of the hinterland, especially when the Rand gold rush succeeded the Lydenburg (*see* TRANSVAAL throughout). But he also understood the temper of the Free State and how to make haste slowly. His first Railway bill was introduced in 1876. Thereafter, for 12 years it was a hardy annual. Brand's patience, imperturbability and concern for his people, which won and held their confidence, stood him in good stead during the sustained crisis of the first British annexation of the Transvaal (1877–81) and the climax at Majuba, where he mediated between the belligerents. He was troubled during the last decade of his presidency by the renaissance of old cleavages in a new guise. The pressure of the Afrikander Bond emphasized the divergences of the two white races. The political strategy of Paulus Kruger in the Transvaal was a more formidable version of the policy of Pretorius and aimed at building an exclusive republican axis against both the Cape and Natal. A growing minority in the Free State favoured the Delagoa bay railway policy of Kruger, whereas Brand had to consider not merely the unity of his state as a political entity but also the geographical, economic and cultural links with the Cape. Brand worked unceasingly for the closer co-operation of the four white communities but was not prepared to make the Free State the footstool of any one of them. For him the immediate problem was that of railway construction, to which the whole question of transit rates and of customs duties at the ports was allied. An understanding in clause viii of the convention of Bloemfontein that the Cape would allow a customs rebate on goods in transit to the Free State had, for reasons of Cape finance and parochial politics, not been fulfilled. Brand therefore prepared the ground for a customs agreement with the Cape, from which in the next decade the Free State was to reap substantial rebates. One week before his death, he secured the belated approval of the *volksraad* for the extension of the Cape railway system to Bloemfontein. Even then it was only secured because the chairman, Sir John Fraser, used his casting vote. Opinion in the Free State, never well-informed on economic issues but instinctively averse to the cosmopolitan commercialism of the new era, was falling back on the trekker tradition of occlusiveness. Old antagonisms revived, nourished on inbred misunderstandings now made manifest in the conflict between the South Africa of Kruger's dreams and the South Africa of Cecil Rhodes' calculations.

During the presidencies of F. W. Reitz (1889–95) and of M. T. Steyn (1896–1900) a metamorphosis took place in Free State politics and opinion. From one point of view this was but a local example of tendencies current in contemporary Europe, namely the basing of political loyalties on racial ties. From the Free State point of view, it was the revival of old traditions to meet new challenges. Frontier security, increased profits and greater literacy tended to give farmers in the outlying districts leisure for politics and to revel in the propaganda of the Bond with its program of an Afrikander renaissance. Conflict between Transvaal and Cape economic interests, even earlier than conflict between the Transvaal and Great Britain, tended to split Free State opinion. The determinant, though, was the policy of Kruger in the Transvaal. His object was to secure an alliance or, if necessary, a federal as distinct from an incorporating union with the Free State. The alliance was concluded by Reitz in March 1889 and ratified by the *volksraad*. At first the implications which Fraser and Barlow had foreseen were not apparent. The customs union with the Cape was fulfilled. In 1892 the Natal-Harrismith line was completed. In 1893 the first train from Cape Town to Pretoria crossed the Free State, while the line from Kimberley to Mafeking and the north skirted the Free State on the west. For the first time the economic integration of southern Africa was possible. But the drifts crisis and then the Jameson raid (Dec. 1895) inflamed public opinion, and the year 1896 opened with Free State commandos manning the frontiers, prepared and even anxious to assist President Kruger in the Transvaal.

For the Free State, the raid was a psychological shock and a political blunder. M. T. Steyn was elected president in Feb. 1896 on the crest of a wave of pro-Transvaal sentiment, though the opposition candidate, Fraser, knew that even before the raid his chances had been slender. Thenceforward, as the crisis in the Transvaal mounted, while still counselling moderation almost to the end, Steyn, with a clear majority behind him, kept both lines open in theory but so strengthened the links with the Transvaal that the legal obligations of the Free State government reflected the instinct and opinion of the majority. Steyn's move to introduce a referendum with its connotation of popular sovereignty failed; but the qualifications for obtaining burgher rights were stiffened, the arming of commandos was brought into line with Transvaal practice and equipment and a commission was appointed to study federal union with a view to bringing the legal structure of both states to move on parallel lines. Several Free Staters, among them Gregorowski and former President Reitz, entered the service of the Transvaal. Steyn urged Kruger to accept any compromise that would avert war without actually injuring the Transvaal and strove for peace at the Bloemfontein conference of May-June 1899 and for conciliation even after the ultimatum of October; but the Free State's refusal to accept the

British offer of neutrality turned not on diplomacy but on the conviction that, once the issue was joined, moral obligation determined conduct. (For the events of the war *see* SOUTH AFRICAN WAR and SOUTH AFRICA, UNION OF.)

The Orange River Colony (May 1900–May 1910).—Lord Roberts occupied Bloemfontein in March 1900; and on May 28 the Free State was annexed by Great Britain as the Orange River colony. For two more years Generals Christian de Wet and J. B. M. Hertzog blazed the commando trail in the Cape until definitive peace was concluded at Vereeniging on May 31, 1902, when British sovereignty was acknowledged. In June that year a nominated legislative council was set up and on this prominent burghers served as unofficial members. "It would take the pen of a Joshua and a Jeremiah," wrote Jan Christiaan Smuts, "to picture the condition of the Free State": it was a picture the more shocking in that, in spite of native wars, South Africa had never before experienced total war between equal contestants. Farms were denuded of crop and stock, fences were down, houses in ruin. It is true that by grant and loan much was done to accelerate recovery and to lay new foundations. For Bloemfontein an extension to the power station and new waterworks at Mazelspoort made civic development possible; but even as late as 1904 the yield of wheat and of wool and the number of cattle were strikingly less than they had been before the war. A reconstruction loan in 1903 led to the establishing of 556 new settlers, but even Viscount Milner's administrative genius could not with the stroke of a pen restore the ravaged veld.

By 1904 two groups, the nationalist Orangia Unie and the so-called Constitutional group led by Fraser and Barlow, were agitating for constitutional government. The latter group had the ear of the British Liberal party, which was returned to office at the end of 1905. The change in government in Great Britain meant a fresh approach to South African affairs.

Lord Selborne, who had already replaced Milner as high commissioner and governor of the Transvaal and of the Orange River colony, was retained, and the intercolonial conferences, begun with those on native affairs and education, were continued; but the granting of the promised self-government was expedited. In July 1907 royal letters patent conferred full responsible government on the Orange River colony, and the first postwar election was held in Nov. 1907.

Sir H. J. Goold-Adams, hitherto lieutenant governor of the colony, now became governor; his relationship to the new parliament was defined by well-established conventions such as had been observed, in the Cape for instance, since 1872. Of 38 seats in the new parliament, the Orangia Unie won 29. A. Fischer was prime minister, General Hertzog attorney general and minister of education, Cornelius Wessels commissioner of public works and General de Wet minister of agriculture. It was an able if somewhat uneasy team, whose task had been greatly simplified by five years' postwar economic rehabilitation. But the British administration was to reap where it had sown. In 1902 men like Brebner and Ryk de Villiers had been purged from the state service; in 1908 the new anglophile bureaucracy was in its turn winnowed.

Under Milner's administration education had been made free, compulsory and nonsectarian and the whole structure of the schools had been altered; but administration had been ruthlessly centralized, and English had become the medium of instruction, while the reliance in the main on English-speaking teachers meant that little use could be made of the five hours allocated to the teaching of the Dutch language, since the teachers did not understand it. It was to meet this situation that voluntary Christian National schools were founded.

When the colony was granted self-government, the pendulum swung back. While denouncing the Dutch Reformed Church, which he accused of "setting up a papacy in every village," Hertzog allowed dogmatic instruction in the schools; and while theoretically allowing for parallel dual medium instruction where numbers warranted, in practice he made Dutch increasingly the medium of instruction, so that by 1910 English children were being withdrawn into private schools. For Hertzog was a passionate devotee of Afrikander culture and claimed, understandably if inaccurately, that it had made the Free State.

The chief constructive work of the cabinet was continued participation in intercolonial consultation, notably the customs and railway conference of 1908 and full and constructive participation in the national convention (*see* SOUTH AFRICA, UNION OF) which began in Oct. 1908. The outstanding personality from the Orange River colony was former President Steyn, who was conspicuously successful as a mediator and who secured that the future appeal court of the Union should sit at Bloemfontein, which was to become the judicial capital of the proposed Union. The bill for union was passed simultaneously by the parliaments of each of the four colonies and was enacted, in the form then submitted, by the imperial parliament in 1910, and the colony entered the Union under the style of Orange Free State province.

The Province of the Orange Free State.—The new Free State, like the other provinces, preserved historical continuity by retaining its entity as a province. Like Natal, it was to send 25 members to the house of assembly in Cape Town; and from the time when Fischer and Hertzog entered the first Union cabinet, Free State members, conspicuously Hertzog and N. J. van der Merwe (1880–1940), played an important role as leaders of a compact phalanx.

It was from the Free State that the revolt of De Wet in 1914 drew its main strength; and the province followed two successive leaders of Afrikander nationalism, namely Hertzog and D. F. Malan. In the election of 1953, all 25 seats, including for the first time Bloemfontein city, were won by the Nationalist party. In some ways the Redistribution act of 1952 accentuated certain anomalies, since 81,329 votes were sufficient to return 25 Nationalists, whereas the 31,647 votes cast for the United party (25% of the total poll) were swamped. (W. A. ML.)

POPULATION, ADMINISTRATION AND ECONOMY

Population.—The population of the Orange Free State amounted to 1,018,207 according to the census of 1951. The total comprised 775,702 Africans, 227,587 Europeans and 14,069 others (mainly persons of mixed blood but including 16 Asians) and constituted 12.4% of the total population of the Union of South Africa. The average density was 20.5 per square mile. The major concentrations are in the eastern and better-watered districts. The towns are mostly small administrative and provisioning centres for their surrounding districts. Bloemfontein (the capital of the province and the axis of the Union's road, rail and air communications), Kroonstad, Ladybrand, Harrismith and Ficksburg are described in separate articles. Bethlehem is a prosperous centre in the northeast. Parys (population 8,103, including 3,906 Europeans, in 1951), on the Vaal river, is a pleasure resort.

The largest element of the African population is constituted by the southern Sotho (Basuto), who are scattered widely over the province. A considerable number of Tswana (Bechuana) live in the district of Thaba Nchu; the Zulu are well represented, chiefly in the northeastern area adjoining Zululand; and the Xosa are numerous in the southern and western districts. As a result mainly of the historical development of the Free State and of the trekkers' policy of defeat and dispersal of the African populations, only about 26,000 of the total number of Africans in the province live in the reserves of Witzieshoek and of Thaba Nchu (the latter was impressively rehabilitated by the Union native affairs department); the rest are either in urban locations or squatters on European farms. Little has been done to purchase more land in terms of the Native Land Trust act; and surveys such as the Fagan report (1948) make it clear that to provide land in the Free State for Africans more than 25 times as numerous as those already in reserves is impossible. Nor is land available in adjacent Basutoland, where the movement of migration is outward, not inward, and where the direction of labour, because of working conditions and wages, is from agriculture to industry.

Administration.—The provincial council of 25 elected members meets under the presidency of the administrator who is nominated by the governor general. Members hold office for five years. A provincial ordinance has effect so long as it is not re-

pugnant to an act of parliament, and it must have the assent of the governor general in council (since the governor general acts constitutionally on the advice of his ministry this may lead to oblique control of the provinces by the ministry of the day). Provincial powers are mainly defined by sections 85–91 of the South Africa act together with the Financial Relations Consolidation act of 1945. Provincial ordinances deal mainly with local affairs, such as hospitals, roads, etc.

Education, other than higher, has been the main field of provincial initiative. The South Africa act secured equal rights for both Dutch and English languages. An act of the Union parliament in 1912 stipulated that in the lower standards the medium of instruction should be in the home language of the pupils; but provinces differ in their administrative definition of home language, and the Free State still bears the impress of Hertzog's educational policy. In 1920 the Free State was the first province to sponsor the substitution of Afrikaans for Dutch, anticipating Union policy by six years.

The province is divided into 57 school districts, in each of which is an advisory board consisting of elected members and having certain powers of supervision. In 1950 there were 375 primary and secondary schools for Europeans (with 45,902 pupils) and 569 primary and secondary schools for non-Europeans (with 74,000 pupils). In 1953 the Eiselen report proposed that, since provincial finance was inadequate to meet the cost of native education, native education should be extricated, as was native policy, from provincial control and put under the administrative as well as the financial control of the Union.

Agriculture and Stock Raising.—The most fertile part of the country lies in the valley of the Caledon river. There a considerable quantity of wheat is grown, especially in the districts of Ladybrand, Ficksburg, Bethlehem and Rouxville. The same districts and Harrismith also produce oathay. There, too, are extensive apple and plum orchards, the apples being among the best grown in South Africa. Potatoes, tobacco, pumpkins, etc., are also grown. The province's most important crop, however, is maize, the districts of Heilbron and Frankfort, in the north, forming part of the South African maize belt (toward the west the area sown with maize varies greatly from year to year, according to the incidence of the rains). The Free State produces more than one-third of the Union's maize crop and might even treble its yield through a better use of fertilizers.

The country is also healthy for livestock. It is little affected by horse sickness and the number of horses in 1950 was 217,578. Cattle, numbering 1,981,518 in 1950, are most numerous in the eastern districts, especially about Ficksburg. Woolled sheep, totalling 6,594,060 in 1951, are most abundant in the Rouxville, Wepener and Smithfield districts, while goats (34,035) are either kept by natives or concentrated in the dry southwestern area about Philippolis.

Mining and Industry.—The discovery of gold fields in the Odendaalsrust area, where the Welkom and St. Helena mines began production in 1952, seemed likely to transform the industrial structure of the province. In all of the seven developing mines, moreover, the production of uranium oxide from residue ore after gold extraction was authorized. The proximity of the field to the power station at Viljoensdrift suggested that the Free State might indeed be on the edge of an industrial revolution.

The province's output of diamonds amounted to 140,357.75 carats in 1951. Diamonds are found around Jagersfontein (the chief mine) and Koffiefontein in the southwest, around Boshof in the west, around Theunissen toward the centre of the province and around Kroonstad; and alluvial diamonds of great purity occur in the gravels of the Vaal and some of its tributaries. About 3,370,000 tons of coal were produced in 1951, the chief collieries being the Cornelia on the Vaal opposite Vereeniging and the Clydesdale 15 mi. S.; but the coal is not of the best quality. Salt is obtained from the waters of certain "pans" in the western districts, evaporated in most cases by solar heat.

The construction of grain elevators and the opening of mills and of creameries fostered subsidiary industrial enterprises. The census of industrial undertakings for 1946 (published in 1949), while confirming that the Free State was the least industrialized of the four provinces, showed an increasing variety of such undertakings on an increasing scale. (R. U. S.; W. A. Ml.)

ORANGEMEN. In 1795, after a violent conflict between Protestants and Roman Catholics in County Armagh, Ireland, known as the battle of the Diamond, a Protestant Orange society, called after William of Orange, was formed "to maintain the laws and peace of the country and the Protestant constitution." The Orange society spread its branches, called lodges, and by 1797 it had about 200,000 members. It was joined by many of the gentry and it counteracted the influence of the United Irishmen, particularly in Ulster. During the early and middle years of the 19th century the movement fell into some obscurity and disrepute; but when Gladstone declared in favour of Irish home rule in 1885, the Orange order, as it came to be called, provided a core of resistance. The order had a great influx of new members, especially in Ulster. Through the controversies which followed, it provided both a means of expression and a restraining discipline for many Unionists. The membership in Ulster at mid-20th century contained a large proportion of farmers and skilled workers and a good many professional men, and there were lodges for women. The ethical obligations of membership are high. The movement is also active in Glasgow, Liverpool, Toronto, Ont., and many other places, but the social background and ethos of the movement are somewhat different outside Ulster. July 12, the anniversary of the battle of the Boyne, is celebrated by Orangemen each year. (Hu. S.)

ORANGUTAN ("man of the woods"), the giant red manlike ape of Borneo and Sumatra (*Pongo pygmaeus*). The reddish colour of the long, coarse hair distinguishes the mias, as the Dyaks call it, from African apes; the arms are such that the animal in the upright posture can rest on its bent knuckles. In some races, in the old males, which may stand 5½ ft. high, there is a large expansion of the cheeks, caused by growth of fibrous tissue and producing a broad and flattened type of face. Another peculiarity of the males is the presence of a huge throat sac on the front of the throat and chest, which may extend even to the armpits; although present in females, it does not reach nearly the same dimensions in that sex. More than half a dozen separate races of orangutan are recognized in Borneo where the red ape inhabits the swampy forest tract at the foot of the mountains. These apes are comparatively slow and deliberate in their movements; they construct platforms of boughs in the trees, which are used as sleeping places, apparently occupied for several nights in succession. Durian, the tough spiny hide of which is torn open with their strong fingers, forms their chief food. They also eat the mangustin and other fruits. (*See* Primates.)

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ORANGUTAN (PONGO PYGMAEUS)
A giant red ape of Borneo and Sumatra

ORANIENBAUM, renamed Lomonosov after World War II, a city of the Russian S.F.S.R. in the Leningrad oblast, in 59° 54′ N., 29° 48′ E., lying 100 ft. above the sea on the south coast of the Gulf of Finland, opposite Kronstadt. Pop. (1926) 7,061. It was formerly a summer residence of the imperial family. The site was given to Menshikov in 1714 by Peter the Great, and the palace he erected still stands. Confiscated in 1727, it became an imperial residence. In 1743 the empress Elizabeth presented Oranienbaum to the future Tsar Peter III, who built there a castle, now destroyed, for his Holstein soldiers. The palace became a hospital during World War I, and was later made a rest home for workers. A school of forestry was established in one of the wings. A railway was built to link the town with the fort of Krasnaya Gorka, standing guard at the entrance to Kronstadt bay. There were established flour mills and brickworks, the sawmilling industry also being important.

ORAON, an aboriginal tribe of the Chota Nagpur plateau, India, also known as Dhangars. They call themselves *Kurukh,* but being divided into various groups are apt to be designated by

group names (*e.g.*, Modi, "navvy," Kisan, "cultivator") when they emigrate. A short, sturdy race of Dravidian type, they are in demand as labourers. As Oraon mothers shape their babies' heads their dolichocephaly may be to some extent artificial. The village organization is advanced. Their speech is akin to Kanarese. Their religion is a mixture of nature worship and magic, thinly overlaid with Hinduism, Dharmes being the supreme god.

A religious movement, influenced by Christianity as well as by Brahmanism, known as the Tana Bhagat movement and manifesting itself in ghost hunting and the addition of German Baba to the pantheon, caused some excitement in 1915. It had begun with a crusade against belief in ghosts and was largely a revolt against social degradation and economic depression.

See Sarat Chandra Roy, *The Oraons of Chota Nagpur Ranchi* (1915), for a full history and valuable information; *Man in India,* I (1921).

ORATOR, one who speaks in public, especially an eloquent public speaker. *See* RHETORIC and separate articles on eminent orators, such as DEMOSTHENES; ISOCRATES; etc.

A statesman of modern times, Sir Winston Churchill, won international acclaim for his effective oratory. His skill and power as an orator were recognized by the Swedish academy, which announced on Oct. 15, 1953, that Churchill had received the Nobel prize for literature not only for his historical and biographical works but also for "the scintillating oratory in which he has stood forth as a defender of eternal human value." It was the first time that oratory had been cited as the partial basis for the Nobel award in literature.

The term also refers to an officer of the universities of Cambridge and Oxford, the orator speaking in the name of, as well as on behalf of, the university on various public and special occasions.

ORATORIO, the name given to a form of religious music with chorus, solo voices and orchestra, independent of, or at least separable from the liturgy, and on a larger scale than the cantata (*q.v.*). Its history is involved in that of opera (*see* ARIA and OPERA), but its antecedents are more definite. The term is almost certainly (but *see* Schütz's "stilo Oratorio" on p. 844) derived from the fact that St. Filippo Neri's Oratory was the place for which Animuccia's settings of the *Laudi Spirituali* were written; and the custom of interspersing these hymns among liturgical or other forms of the recitation of a Biblical story is one of several origins of modern oratorio. A more ancient source is the use of incidental music in miracle plays and in such dramatic processions as the 12th century *Prose de l'Âne,* which on Jan. 1, celebrated at Beauvais the Flight into Egypt. But the most ancient origin of all is the Roman Catholic rite of reciting, during Holy Week, the story of the Passion according to the Four Gospels, assigning the words of the Evangelist to a tenor, distributing all *ipsissima verba* among appropriate voices, and giving the *responsa turbae,* or utterances of the whole body of disciples (*e.g.*, "Lord, is it I?") and of crowds, to a chorus. The only portion of this scheme that concerned composers was the *responsa turbae,* to which it was permitted to add polyphonic settings of the Seven Last Words or the eucharistic utterances of the Saviour. The narrative and the parts of single speakers were sung in the Gregorian tones appointed in the liturgy. Thus the settings of the Passion by Victoria and Soriano represent a perfect solution of the art-problem of oratorio. "Very tame Jews" is Mendelssohn's comment on the 16th century settings of "Crucify Him"; and it has been argued that Soriano's and Victoria's aim was not to imitate the infuriated Jews, but to express the contrition of devout Christians telling the story. On the other hand, ancient tradition ordained a noisy scraping of feet on the stone floor to indicate the departure from the place of the judgment seat! And so we owe the central forms of Bach's Lutheran Passion-oratorios to the Roman Catholic ritual for Holy Week.

With the monodic revolution at the outset of the 17th century the history of oratorio as an art-form wholly controlled by composers begins. There is nothing but its religious subject to distinguish the first oratorio, Emilio del Cavalieri's *Rappresentazione di anima e di corpo* from the first opera, Peri's *Euridice,* both produced in 1600. Differentiation was brought about primarily by the fact that oratorios without stage-presentation gave opportunity for a revival of choral music. And oratorios on the stage discouraged, by reason of their sacred subjects, whatever vestiges of dramatic realism could survive the ascendancy of the aria (*q.v.*). For lesser composers than Bach and Handel this ubiquitous form represented almost the only possibility of keeping music alive, or at least embalmed, until the advent of the dramatic and sonata styles. The efforts of Carissimi (d. 1674) in oratorio clearly show how limited a divergence from the method of opera was possible when music was first emancipated from the stage. Yet his art shows the corruption of Church music by a secular style rather than the rise of Biblical music-drama to the dignity of Church music. Normal Italian oratorio remains indistinguishable from serious Italian opera as late as *La Betulia liberata,* which Mozart wrote at the age of 15. Handel's *La Resurrezzione* and *Il Trionfo del Tempo* contain many pieces simultaneously used in his operas, and they contain no chorus beyond a perfunctory operatic final tune. *Il Trionfo del Tempo* was a typical morality play, and it became a masque, like *Acis and Galatea* and *Semele,* when Handel at the close of his life adapted it to an English translation with several choral and solo interpolations from other works. Yet between these two versions of the same work lies half the history of classical oratorio. The rest lies in the German Passion-oratorios that culminate in Bach; after which the greatest music avoids every form of oratorio until the two main streams, sadly silted up, and never afterwards quite pure, unite in Mendelssohn.

Luther was so musical that while the German Reformation was far from conservative of ancient liturgy, it retained almost everything which makes for musical coherence in a Church service; unlike the English Church, which with all its insistence on historic continuity, so rearranged the liturgy that no possible music for an English Church service can ever form a coherent whole. The four *Passions* and the *Historia der Auferstehung Christi* of H. Schütz (who was born in 1585, exactly a century before Bach) are as truly the descendants of Victoria's Passions as they are the ancestors of Bach's. They are Protestant in their use of the vulgar tongue, and narrative and dialogue are set to free composition instead of Gregorian chant, although written in Gregorian notation. The *Marcus Passion* is in a weaker and more modern style and stereotyped in its recitative. It may be spurious. But in the other Passions, and most of all in the *Auferstehung,* the recitative is a unique and wonderful language. It may have been accompanied by the organ, though the Passions contain no hint of accompaniment at all. In the *Auferstehung* the Evangelist is accompanied by four viole da gamba in preference to the organ. The players are requested to "execute appropriate runs or passages" during the sustained chords. A final non-scriptural short chorus on a chorale-tune is Schütz's only foreshadowing of the contemplative and hymnal element of later Passion oratorios.

The *Auferstehung,* the richest and most advanced of all Schütz's works, has one strange convention, in that single persons, other than the Evangelist, are frequently represented by more than one voice. If this were confined to the part of the Saviour, it would have shown a reverent avoidance of impersonation, as in Roman Catholic polyphonic settings of the Seven Words. But Schütz writes thus only in *Die Auferstehung* and there on no particular plan. While the three holy women and the two angels in the scene at the tomb are represented naturally by three and two imitative voices, Mary Magdalene is elsewhere always represented by two sopranos.

Shortly before Bach, Passion oratorios were represented by several remarkable works of art, most notably by R. Keiser (1673–1739). Chorale-tunes, mostly in plain harmony, were freely interspersed in order that the congregation might take part in what was, after all, a church service for Holy Week. The meditations of Christendom on each incident of the story were expressed in accompanied recitatives (*arioso*) leading to arias or choruses, and the scriptural narrative was sung to dramatic recitative and ejaculatory chorus on the ancient Roman plan. On slightly different lines was Graun's beautiful *Tod Jesu,* which was famous when the contemporary works of Bach were ignored.

The difference between Bach's Passions and all others is simply the measure of his greatness. Where his chorus represents the

whole body of Christendom it has as peculiar an epic power as it is dramatic where it represents tersely the *responsa turbae* of the narrative.

In the Matthew Passion the part of Christ has a special accompaniment of sustained strings, generally at a high pitch, though deepening at the most solemn moments. And at the words "Eli, Eli, lama sabacthani" this musical halo has vanished. In power of declamation Bach was anticipated by Keiser; but no one approached him in sustained inspiration and architectonic greatness. The forms of Passion music may be found in many of Bach's Church cantatas; a favourite type being the *Dialogue*; as, for instance, a dispute between a fearing and a trusting soul with, perhaps, the voice of the Saviour heard from a distance; or a dialogue between Christ and the Church, on the lines of the Song of Solomon. The Christmas Oratorio, a set of six Church cantatas for performance on separate days, treats the Bible story in the same way as the Passions, with a larger proportion of non-dramatic numbers. Many of the single Church cantatas are called oratorios, a term which by Bach's time seems definitely to have implied dialogue, possibly on the strength of a false etymology. Thus Schütz inscribes a monodic sacred piece "in stilo Oratorio," meaning "in the style of recitative." The further history of oratorio radiates from the heterogeneous works of Handel.

There are various types and several mixtures of style in Handelian oratorio. The German forms of Passion music evidently interested Handel, and it was after he came to England, and before his first English oratorio, that he set to music the famous poetic version of the Passion by Brockes, which had been adopted by all the German composers of the time, and which, with very necessary improvements of taste, was largely drawn upon by Bach for the text of his Johannes-Passion. Handel's Brockes Passion does not appear ever to have been performed, though Bach found access to it and made a careful copy; so Handel must have composed it for his own edification. He soon discovered that many kinds of oratorio were possible. The emancipation from the stage admitted of subjects ranging from semi-dramatic histories, like those of *Saul, Esther* and *Belshazzar,* to cosmic schemes expressed entirely in the words of the Bible, such as *Israel in Egypt* and *The Messiah.* Between these types there is every gradation of form and subject; besides an abrupt contrast of literary merit between the mutilated Milton of *Samson* and the amazing absurdities of *Susannah.*

The very name of Handel's first English oratorio, *Esther,* and the facts of its primary purpose as a masque and the origin of its libretto in Racine, show the transition from the stage to the Church; and, on the other hand, Haman's lamentation on his downfall is scandalously adapted from the most sacred part of the Brockes Passion.

We may roughly distinguish three main types of Handelian oratorio, not always maintained singly in whole works, but always available as methods. First, there is the operatic method, in which the arias and recitatives are the utterances of characters in the story, while the chorus is a crowd of Israelites, Babylonians or Romans (*e.g., Athalia, Belshazzar, Saul,* etc.). The second method retains the dramatic rôles both in solos and in choruses, but (as, for instance, in "Envy, eldest born of Hell," in *Saul*) also uses the chorus as the voice of universal Christendom. Handel's audience demanded plenty of arias, most of which are accounted for by futile, when not apocryphal, love affairs. The haughty Merab and the gentle Michal are characterized with fatal ease, and make parts of *Saul* almost as impossible as most of *Susannah.* The third Handelian method is a series of choruses and numbers on a subject altogether beyond the scope of drama, as, for instance, the greater part of *Solomon* and, in the case of *The Messiah* and *Israel in Egypt,* treated entirely in the words of Scripture, and those not in narrative but in prophecy and psalm.

After Bach and Handel, oratorio fell upon evil days. The rise of the sonata style, which brought life to opera, was bad for oratorio; since not only did it accentuate the fashionable dislike of that polyphony which is essential even to mere euphony in choral writing, but its dramatic power became more and more disturbing to the epic treatment that oratorio naturally demands.

Philip Emanuel Bach's oratorios, though cloying in their softness and sweetness, achieved a true balance of style in the earlier days of the conflict; indeed, a judicious selection from *Die Israeliten in Wüste* (1769) would perhaps bear revival almost as well as Haydn's *Tobias* (1774).

The Creation (*Die Schöpfung*) and *The Seasons* (*Die Jahreszeiten*) will always convey to unspoilt music-lovers the profound message of the veteran Haydn, who could not help "worshipping God with a cheerful heart." This spirit was well known to Bach, the composer of *"Mein glaübiges Herze,"* and it is compatible with the romantic sound-pictures and Handelian sublimity of the opening Representation of Chaos and the great chord of C major at the words "and there was light." The childlike gaiety of much of the rest ought not to blind us to its fundamental greatness, which brings the naïvely realistic birds and beasts of *The Creation* into line with even the wine-chorus in the mainly secular *Seasons,* and removes Haydn from the influence of the vile taste which henceforth pervaded oratorios, until Mendelssohn effected a partial improvement. Haydn strenuously resisted the persuasion to undertake *The Seasons* which had a close connection with Thomson's poem, as *The Creation* had a distant connection with *Paradise Lost.* He thought the whole scheme "Philistine" (his own word) and, both before he yielded to persuasion and after he had finished the work, said all the hard things about it that have ever been said since.

Roman Catholic oratorio was under the disadvantage that it was not permitted to take Biblical texts except in the Latin language. Jomelli's *Passione* for once had the benefit of a meditative text with some distinction of style; and in closing the first part with a dominant seventh on the word *"pensaci"* he achieved a stroke of genius which at the present day would still startle the listener and leave his mind in the desired frame of meditative astonishment.

But words fail to characterize the libretto of Beethoven's unfortunate *Christus am Oelberge* (*c.* 1800). The texts of Lutheran church-music had often been grotesque and even disgusting; but their barbarity was pathetic in comparison with the sleek vulgarity of a libretto in which not only is the agony of the garden of Gethsemane represented by an aria (as in Handel's lamentation of Haman), but Christ sings a brilliant duet with the ministering angel. In after years Beethoven had not a good word for this work, which, nevertheless, contains some beautiful music exquisitely scored. And justice demands praise for the idea of making a Hallelujah chorus conclude the work as soon as the betrayal of Christ has been accomplished, thus compensating for the irreverent opening by avoiding all temptation to treat the rest of the passion-story with the same crassness. A well-meant effort was made to provide the *Mount of Olives* with an inoffensive subject in English, but the stupidity of *Engedi: or David in the Wilderness* passes belief.

Schubert's interesting fragment *Lazarus* is strangely prophetic of Wagnerian continuity and has a morbid beauty that transcends its sickly text. There are signs that the despair of the Sadducee was going to be treated with some power. The result might have been a masterpiece; but fate ruled that the next advance should again be Protestant.

Bach's Passions were rediscovered by the boy Mendelssohn after a century of ignorance of their very existence; and in *St. Paul* (*Paulus*) and *Elijah* (*Elias*) rose upon the early middle 19th century like the sunrise of a new Handel.

To-day *St. Paul* has almost sunk below the horizon; and *Elijah,* which still shares with *The Messiah* the Christmas repertoire of every British urban choral society, is in many points an easy target for criticism. Yet the ascendancy of Mendelssohn is the one redeeming feature in the history of oratorio during the first three quarters of the 19th century. Let us admit the defects of *Elijah;* the all too lifelike tiresomeness of the widow (achieved after strenuous revision), the parochial softness of the double quartet, the Jewishness of the Jews (but is this a defect?), and the snorts of the trombones whose third summons causes the Almighty to capitulate: when all these unconscious profanities are discounted, there remains a vivid and coherent oratorio that, musically and

dramatically, towers above later works by many accomplished composers who despise it. (*See* MENDELSSOHN-BARTHOLDY, JAKOB LUDWIG FELIX.) Spohr is the only contemporary of Mendelssohn whose sacred music is still known. So tremendous a subject as that of *The Last Judgment* ought, indeed, to be treated with reserve; but the softness and slowness which pervades nine-tenths of Spohr's work is not reserve but self-indulgence. Spohr has moments of vision; but an almost random glance at the pages of *St. Paul* shows that even in eclipse Mendelssohn has characterization, movement and the capacity for dramatic moments.

In England, the influence of Mendelssohn completed the devastation begun by our inveterate habit of praising the inspired literary skill of the sacred narrative, as a preface to our restatement of it in 40 times as many words of our own. Deans and chapters listened in graceful official pride and imperfectly secret glee to the strains in which the cathedral organist celebrated with equal realism the destruction of Sennacherib's hosts and his own octuply-contrapuntal doctorate of music. Before 1880 our composers had, as Dr. Walker says, "set with almost complete indiscrimination well-nigh every word of the Bible." Had they confined themselves to the second chapter of Ezra they would have escaped dangers of unconscious humour that lurk in the opportunities for "naturalness" in declaiming the dialogues and illustrating the wonders of scriptural narrative.

Neither Sterndale Bennet nor Macfarren improved matters; but Parry and Stanford, towards the end of the century, completely changed the situation. Stanford's *Eden* has a libretto by Robert Bridges. The disgruntled professional librettists, who were also musical critics, had the effrontery to say that this magnificent poem would be the better for extensive cuts. The real truth is that Stanford's music, especially in its orchestral introductions, is diffuse. But it has many beautiful features, and achieves a coherent scheme on exactly such lines of Wagnerian continuity as can be applied to oratorio. Parry preferred to be his own librettist, and by this means he achieved more significant results. The lapses of the amateur poet are less distressing than the *clichés* of the ordinary professional librettist; and the works of Parry and Stanford permanently raised English oratorio from squalor and made it once more an art-form which educated people could enjoy. Some of Parry's architectonic and dramatic ideas will never lose the power to thrill, if only the works as wholes can live in spite of a certain dryness of melody and heaviness of texture. For example, the exploit of Judith is shown with a total avoidance of the cheap and salacious opportunity for a scene between her and Holofernes. Instead, we listen to the watchmen anxiously making their circuit of the city walls in darkness. The music of their march is at a low pitch. It is reaching a normal close when, high above the tonic chord, the cry of Judith bids the watchmen open the gates to her. If this moment cannot thrill, there is no meaning in art. In *King Saul* Parry made a significant discovery as to the emancipation of dramatic oratorio from the stage conditions of time and space. The Witch of Endor prophesies the battle of Gilboa. Her tale becomes real in the telling and is immediately followed by the final dirge.

As with opera, so, but more easily, with oratorio, the method of Wagnerian continuity at last enabled composers to take extant poems and set them to music in their entirety. Thus the fragrant mysticism of Roman Catholic oratorio, dimly adumbrated in Schubert's *Lazarus,* at last came to fruition in Elgar's wonderful setting of Newman's *Dream of Gerontius,* while the old miracle play *Everyman* was very successfully composed by Walford Davies. In his later works, *The Apostles* and *The Kingdom,* Elgar pursues a comprehensive religious design on texts arranged by himself. Oratorio on the basis of Wagnerian continuity and *Leit-motif* is unquestionably a living art-form. Its greatest difficulty is its fatal facility. The oratorio-composer is lost who omits to transcend the limits of the stage; yet when these are transcended only the stedfastness of genius can prevent the composer from sinking to the fashion-storming eclecticism of Honegger's *Le Roi David* which, with the aid of a reciter to read the Bible, takes up the arts of all periods from Handel on and drops each of them before anything like an art-problem arises.

Why not follow more often the method of *The Messiah* and of *Israel in Egypt;* and deal with religious subjects in terms of prophecy and psalm? Brahms's *Deutsches Requiem* is really an oratorio; and since its production (all but one later movement) in 1866 it continues year by year to tower over all other choral music since Beethoven's Mass in D. Form, disciplined form, is not the only thing needed to save future oratorios from the limbo of vanity; but it is their first need. (D. F. T.)

ORATORY, the art of speaking eloquently or in accordance with the rules of rhetoric (*q.v.*).

ORATORY OF ST. PHILIP NERI, CONGREGATION OF THE, or ORATORIANS, a religious order consisting of a number of independent houses, first organized in 1575 by the Florentine priest, Philip Neri (*see* NERI, PHILIP.)

ORBIGNY, ALCIDE DESSALINES D' (1802–1857), French palaeontologist, was born at Couërzon, Loire Inférieure, on Sept. 6, 1802, and was educated at La Rochelle. His first appointment was as travelling naturalist for the Museum of Natural History at Paris. He went in 1826 to South America, and gathered much information on the natural history and ethnology, embodying the results in his great work *Voyage dans l'Amérique Méridionale* (1839–1842). Then, in 1840 he began to publish his *Paléontologie Française, ou description des fossiles de la France,* a monumental work, accompanied by figures of the species. Eight volumes were published by him dealing with Jurassic and Cretaceous invertebrata, and since his death many later volumes have been issued. In 1853 he was appointed professor of palaeontology at the Museum of Natural History in Paris, but died on June 30, 1857, at Pierresitte, near St. Denis.

His works include *Cours élémentaire de paléontologie et de géologie stratigraphiques* (3 vols., 1849–52), and *Prodrome de paléontologie stratigraphique* (3 vols., 1850–52).

ORBIT, in astronomy, is the path of a heavenly body revolving around an attracting centre (from Lat. *orbita,* a track, *orbis,* a wheel); in particular, it denotes the path of a planet or comet around the sun, or of a satellite around its controlling planet.

Kepler's Laws.—In 1609 Johann Kepler announced two laws of planetary motion, and by 1619 he added a third. Kepler's first law is as follows:—A planet moves around the sun in an elliptic orbit, the sun being situated in one focus of the ellipse. If the straight line joining any two points S and T is produced equal distances beyond S and T to A and B, and if P is any point such that the sum of the distances P S and P T is equal to the distance A B, then the aggregate of all such points as P is the curve known as the ellipse. The points S and T are the foci. The curve passes through A and B and A B is called the major axis of the ellipse. If C is the mid-point of A B, the ratio

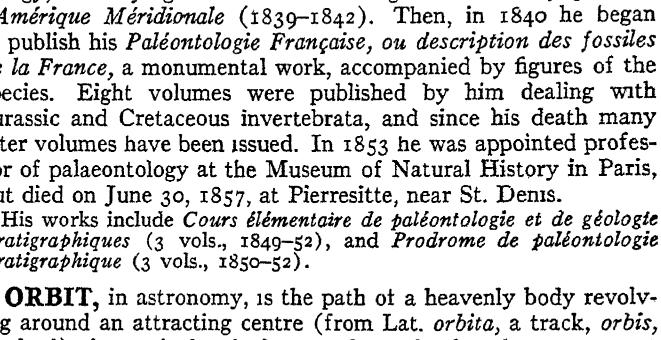

FIG. 1.—DIAGRAM ILLUSTRATING KEPLER'S LAWS OF PLANETARY MOTION

of the length of C S to the length of C A is called the eccentricity. The ellipse then is specified by means of (i) the semi-major axis and (ii) the eccentricity. If the eccentricity happens to be zero, the two foci must coincide at the centre C and the resulting curve is simply a circle; if the eccentricity is precisely unity, then the curve is known as a parabola. Kepler's first law simply states that if the sun is supposed situated at the focus S, the planet's path around the sun—in other words, its orbit—is an ellipse such as is represented in the diagram above. The time required for a complete revolution in the ellipse is the planet's

revolution period; for example, the earth's period of revolution is a little over 365 days; Mercury describes its orbit in 88 days, and Neptune requires 165 years. At A—the point of the ellipse nearest S—the planet is said to be in *perihelion*, and when it reaches B, the most remote point of the ellipse from S, it is said to be in *aphelion*.

Kepler's second law states that the straight line joining the sun to the planet (the radius vector) sweeps out equal areas in equal times. In the preceding figure let D be the position of the planet in its elliptic orbit a month after it reached perihelion (A); similarly let E F be two positions of the planet separated by an interval of a month; the pair of points X, Y are defined in the same way. The shaded area S D A, for example, is the area swept out by the radius vector in one month and by the second law the three shaded areas are equal. Now it is clear from the figure that the arc A D is greater than the arc X Y, for the areas S D A and S X Y are equal and S A and S D are less than S X and S Y; consequently, the velocity of the planet in its orbit must be greater between A and D than between X and Y. More definitely, the velocity of the planet is greatest at perihelion, decreasing gradually until aphelion is reached and thereafter increasing to a maximum again at perihelion.

The figure also shows that the angles described in equal intervals of time by the radius vector vary throughout the orbit; for example the angle D S A is clearly greater than the angle X S Y. The angular velocity is greatest at perihelion and least at aphelion. In one complete revolution around the sun, the radius vector sweeps out 360° and as the period of revolution is accurately known, the average angular velocity is easily deduced. This is known as the "mean motion" and is expressed as so many degrees (or seconds of arc) per day.

Kepler's third law is a relation connecting the semi-major axes of the several planets with their periods of revolution. In Kepler's time, the mean distance of any one planet from the sun was not known in miles but it was known fairly accurately in terms of the earth's mean distance from the sun regarded as the unit of the distance; in other words, the planetary system had been fairly correctly mapped out but the scale of the map was lacking. Also, the periods of the several planets were known with considerable accuracy. The third law expressed in words is: the cube of the semi-major axis of any planetary orbit divided by the square of the period of revolution is the same whatever planet is considered. If the year is regarded as the unit of time and the earth's mean distance from the sun as the unit of distance (this is known as the astronomical unit of distance) the quotient above for the earth is plainly unity and consequently by the third law the cube of the semi-major axis of any other planet (expressed in terms of the astronomical unit) must be equal to the square of the planet's period (expressed in years).

The Orbit in Space.—We have seen that the elliptic orbit of a planet is specified by the eccentricity and the semi-major axis. To apply Kepler's first and second laws to predict the positions of the planet in its orbit at any time it is necessary to know in addition the time when it occupied any definite position in the orbit or the time when it passed through perihelion. The eccentricity, the length of the semi-major axis and the time of perihelion passage constitute three elements of the planet's orbit.

The planetary motions do not all take place in the same plane and consequently the plane of the orbit of a particular planet must be specified with reference to some fundamental plane: the plane chosen is that of the earth's orbit and is called the plane of the ecliptic. Imagine a sphere drawn with the sun at the centre. The plane of the earth's orbit will cut the sphere in a circle (the ecliptic) and the orbital plane of any other planet will cut the sphere in another circle inclined at some definite angle to the plane of the ecliptic. The two circles intersect at two points N and M—called the Nodes. Let V denote a definite reference point on the ecliptic—the direction S V may be thought of as the direction of a particular star as seen from the sun. The point V is known as the "vernal equinox" or "First point of Aries"; it is not necessary here to specify it more particularly. The plane of the planet's orbit is completely specified—with reference to the ecliptic and the point V—by (i) the inclination of the planet's plane to the plane of the ecliptic and (ii) the position of the node N with respect to the point V. The latter is evidently given by the angle subtended at the sun by the radii S V and S N, and this angle is known as the longitude of the node. One thing more requires to be done and that is to specify the orientation of the orbital ellipse in its plane; this is accomplished by specifying the direction of perihelion—in the figure this is indicated by the direction S A. The sum of the angles subtended at S by the arcs V N and N A is called the longitude of perihelion. It should be noticed that there is an ambiguity as to the meaning of the expression "longitude of the node" for there are two nodes N and M. If the upper hemisphere in the figure contains the north pole of the heavens, the radius vector of the earth's orbit moves in the direction S V towards S N as indicated by the arrow; and if the radius vector of the planet moves in the direction S N towards S A, as indicated by the arrow, then N is called the ascending node and M the descending node and (ii) above more precisely should be "the longitude of the ascending node." The ambiguity consequently disappears.

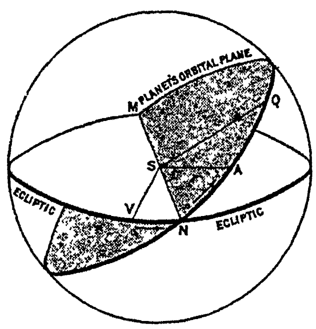

FIG. 2.—PLANET'S ORBITAL PLANE IN RELATION TO THE ECLIPTIC

To summarize; a planet's orbit in space is completely specified by the six elements: (i) the semi-major axis, (ii) the eccentricity, (iii) the time of perihelion passage, (iv) the longitude of the ascending node, (v) the longitude of perihelion, (vi) the inclination of the orbital plane to the plane of the ecliptic.

When the six elements of a planet's orbit are known the position of the planet (the effects of the attractions of the other planets not being taken into account) with reference to the sun and the fundamental plane (the ecliptic) can be calculated for any future date by principles essentially contained in Kepler's laws. The earth's orbit also being known, the position of the planet in the heavens, as seen from the earth, can then be deduced.

The Orbit from Observations.—The reverse problem is to determine the elements of the orbit from actual observations of position made from the earth. When a minor planet or comet is discovered it is important to determine the six elements of its orbit, thus enabling the astronomer to follow subsequently its wanderings even without the aid of observational appliances. A single complete observation of a planet consists in determining its right ascension and declination; three such complete observations at intervals, say, of a month are sufficient to allow the calculation of the six orbital elements.

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ORCAGNA (*c.* 1308–*c.* 1368), Italian painter, sculptor, worker in mosaic and architect, whose full name was ANDREA DI CIONE, called ARCAGNUOLO, was the son of a Florentine goldsmith, Maestro Cione, said to have been one of the principal artists who worked on the magnificent silver frontal of the high altar of San Giovanni, the Florentine Baptistery. The result of Orcagna's early training in the use of the precious metals may be traced in the extreme delicacy and refined detail of his principal works in sculpture. His brothers, Lionardo or Nardo, the eldest, a painter; Matteo, a sculptor and mosaicist, and Jacopo, also a painter, were often associated with Orcagna in his varied labours.

From the time of Giotto to the end of the 14th century Orcagna stands pre-eminent among the many excellent artists of that time.

1. *Orcagna as a Painter.*—He was admitted to the guild of the Medici and Speziali, where his name first occurs in the documents of 1344. His chief works in fresco were at Florence, in the church of Sta. Maria Novella. He covered the walls of the retro-choir

with scenes from the life of the Virgin. These, unfortunately, were much injured by damp very soon after their completion, and towards the end of the following century were replaced by other frescoes of the same subjects by Ghirlandaio, who, according to Vasari, made much use of Orcagna's motives and invention. Vasari says that Orcagna also painted the Strozzi chapel in the same church in company with his brother. But Ghiberti attributes these works to his brother Nardo alone. These frescoes still exist though much restored; modern criticism is inclined to attribute them to Nardo. The finest composition is that on the west wall, unbroken by any window. It represents paradise, with Christ and the Virgin enthroned in majesty among rows of brilliantly coloured cherubim and seraphim tinged with rainbow-like rays of light. Here Andrea Orcagna may have had a share in the execution.

In 1357 Orcagna painted one of his finest panel pictures, as a retable for the altar of the same chapel, where it still remains. In the centre is Christ in majesty between kneeling figures of St. Peter and St. Thomas Aquinas, attended by angel musicians; on each side are standing figures of three other saints. It is painted with extreme miniature-like delicacy, and is on the whole very well preserved. This retable is signed, "An. dni. mccclvii. Andreas Cionis de Florentia me pinxit." It is the only certified painting by Orcagna in existence. According to Vasari, he also painted some very fine frescoes in Sta. Croce. Of these only a small fragment remains. Orcagna's figures are plastically conceived, and clearly defined by a firmly drawn contour. They stand out against the background like statues.

2. *Orcagna as a Sculptor and Architect.*—Orcagna was admitted as a member of the Sculptors' Gild in 1352. His name occurs in the roll as "Andreas Cionis vocatus Arcagnolus, pictor." According to Vasari, Orcagna worked under Andrea Pisano as a pupil in sculpture. His style, however, constitutes an advance on Andrea's art and prepares the way for the coming Renaissance. In 1359 he completed the great marble tabernacle for the chapel of Or San Michele. This, in its combined splendour of architectural design, sculptured reliefs and statuettes, and mosaic enrichments, is one of the most important and beautiful works of art which even rich Italy possesses.

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ORCHARDSON, SIR WILLIAM QUILLER (1832–1910), British painter, was born in Edinburgh on March 27, 1832. At 13½ he went to the Trustees' academy. At 20, Orchardson had mastered the essentials of his art, and for seven years after this he worked in Edinburgh, devoting himself partially to "black and white." In 1862 he came to London, and established himself in 37, Fitzroy square, where his friend John Pettie joined him.

The English public was not immediately attracted by Orchardson's work, which was too quiet to compel attention at the Royal Academy, and Pettie, Orchardson's junior by seven years, at first outshone him. Orchardson confined himself to the simplest themes and designs and the most reticent schemes of colour. In 1865 Pettie married, and the Fitzroy square *ménage* was broken up. Orchardson married Miss Helen Moxon in 1873. In 1868 he was elected A.R.A. and in 1877 R.A. He died on April 13, 1910.

Orchardson's first great success was gained in 1881, when he exhibited "On Board the 'Bellerophon'" (now at the Tate gallery) at the Royal Academy, and for the next ten or twelve years his exhibits enjoyed unfailing popularity. "The Voltaire" (1883) (now in the Kunsthalle, Hamburg) is perhaps his finest composition. The "Mariage de convenance" (1884) and "A Tender Chord" (1886) were two of his most famous paintings, and about this time he exhibited a series of period pictures.

Among his portraits are "Master Baby," "The Provost of Aberdeen" and "Sir Walter Gilbey, Bart." Other paintings are "After" (sequel to "Mariage de convenance"), and "The Young Duke."

ORCHESTRA. In ancient Greece the ὀρχήστρα was the space between the auditorium and the proscenium or stage, in which were stationed the chorus and the instrumentalists. In its modern acceptation the word means either that portion of a theatre or concert-hall provided for the accommodation of the instrumentalists or the body of instrumentalists itself; by extension in the U.S.A. it means the main floor of the theatre.

The modern orchestra is composed of (1) a basis of strings—first and second violins, violas, violoncellos and double basses; (2) flutes, sometimes including a piccolo; (3) the reed contingent, consisting of two complete families, (*a*) the oboes with their tenors and basses (the cor anglais, the fagotto or bassoon and the contrafagotto or double bassoon), (*b*) the clarinets with their tenor and basses (the basset horn and the bass and pedal clarinets), with the addition sometimes of saxophones; (4) the brass wind, consisting of the horns, a group sometimes completed by the tenor and tenor-bass Wagner tubas, the trumpet or cornet, the trombones (tenor, bass and contrabass), the tubas (tenor, bass and contrabass); (5) a harp or harps; (6) the percussion instruments, including the kettledrums, bells, Glockenspiel, cymbals, triangle, etc.; to which are sometimes added a celesta and a pianoforte, to say nothing of such "extras" as the rattle employed by Richard Strauss in *Till Eulenspiegel,* the wind machine required by the same composer in *Don Quixote,* the iron chains introduced by Schönberg in his *Gurrelieder,* and so on.

Although most of the instruments from the older civilizations of Egypt, Chaldea, Persia, Phoenicia and of the Semitic races were known to the ancient Greeks, they did not share in any way their neighbours' love of orchestral effects, obtained by combining harps, lyres, guitars, tanburs, flutes, trumpets, bagpipes, cymbals, drums, etc., playing in unison or in octaves. The Greeks only cultivated to any extent the various kinds of citharas, lyres and auloi, and these were seldom used in concert. To the predilection of the Romans for wind instruments of all kinds we owe nearly all the wind instruments of the modern orchestra, each of which had its prototype among the instruments of the Roman empire: the flute, oboe and clarinet, in the tibia; the trombone and trumpet in the buccina; the tubas in the tuba; and the French horn in the cornu and buccina.

The 4th century A.D. witnessed the downfall of the Roman drama and the debasement of instrumental music, which was placed under a ban by the Church. During the convulsions which the migrations of Goths, Vandals and Huns caused in Europe after the fall of Rome instrumental music was preserved from absolute extinction by wandering actors and musicians.

The earliest instrumental compositions extant are certain 15th century dances and pieces in contrapuntal style preserved in the libraries of Berlin and Munich. The late development of notation, which long remained exclusively in the hands of monks and troubadours, personally more concerned with vocal than with instrumental music, ensured the preservation of the former, while the latter was left unrecorded. But indications are not wanting of an independent energy and vitality which must surely have existed in unrecorded mediaeval instrumental music, since there is such evidence of this in the instruments themselves. It is, for example, significant of the attitude of the 10th century instrumentalists towards musical progress that they at once assimilated Hucbald's innovation of the *organum,* a parallel succession of fourths and fifths, accompanied sometimes by the octave, for two or three voices respectively, and that they produced in the same century the *organistrum,* named after Hucbald's *organum.*

At the time of the revival of the drama with music, afterwards modified and known as opera, at the end of the 16th century, there was as yet no orchestra in our sense of the word, but merely an abundance of instruments used in concert for special effects, without balance or grouping; small positive organs, regals, harpsichords, lutes, theorbos, archlutes, chittarone (bass and contrabass lutes), guitars, viols, lyras *da braccio* and *da gamba,* psalteries, citterns, harps, flutes, recorders, cornets, trumpets and trombones, drums and cymbals.

Monteverde was the first to see that a preponderance of strings is necessary to ensure a proper balance of tone. With the perfected models of the Cremona violins at his disposal, a quartet of strings was established and all other stringed instruments not played with the bow were ejected from the orchestra, with the exception of the harp. Under the influence of Monteverde and his

successors, Cavalli and Cesti, the orchestra won for itself a separate existence with music and laws of its own. As instruments were improved, new ones introduced, and old ones abandoned instrumentation became a new and favourite study in Italy and in Germany, and musicians began to find out the capabilities of the various families of instruments and their individual value.

At first the orchestra was an aristocratic luxury, performing privately at the courts of the princes and nobles of Italy; but in the 17th century performances were given in theatres, and Germany eagerly followed. Dresden, Munich and Hamburg successively built opera houses, while in England opera began with the masque, and in France Lully, with the collaboration of Molière, also greatly raised the status of the entertainments known as *ballets,* interspersed with instrumental and vocal music.

The revival of the drama seems to have exhausted the enthusiasm of Italy for instrumental music and the field of action was shifted to Germany, where the perfecting of the orchestra was continued. Most German princes had at the beginning of the 18th century good private orchestras or *Kapelle,* and they always endeavoured to secure the services of the best available instrumentalists. Kaiser, Telemann, Graun, Mattheson and Handel contributed greatly to the development of German opera and of the orchestra in Hamburg during the first quarter of the century. Gluck, the reformer of opera, and Mozart; Haydn, the father of the modern orchestra and the first to treat it independently as a power opposed to the solo and chorus, by scoring for the instruments in well-defined groups; Beethoven, who individualized the instruments, writing solo passages for them; Weber, who brought the horn and clarinet into prominence; Schubert, who inaugurated the conversations between members of the wood wind—all left their mark on the orchestra, leading the way up to Wagner, Strauss and their successors.

ORCHESTRATION: *see* INSTRUMENTATION.

ORCHESTRION, a name applied to three different kinds of musical instruments: (1) a chamber organ, designed by Abt Vogler at the end of the 18th century; (2) a pianoforte with organ pipes attached, invented by T. A. Kunz of Prague in 1791; (3) a mechanical wind orchestra, automatically played by means of revolving cylinders, invented in 1851 by F. T. Kaufmann of Dresden.

ORCHHA (also called *Tehri* or *Tikamgarh*), an Indian state in the Bundelkhand agency of Central India. It is the oldest and highest in rank of all the Bundela principalities, and was the only one not held in subjection by the peshwa. Area, 1,999 sq.mi., pop. (1941) 363,405. The maharaja, Shri Vir Singh Deo, K.C.S.I. (born in 1899, succeeded in 1930), bears the hereditary title of "First of the Princes of Bundelkhand." The state exports grain, *ghi,* and cotton cloth, but trade suffers from imperfect communications.

The town of Orchha, the former capital, is on the river Betwa, not far from Jhansi. It possesses an imposing fort, dating mainly from the early 17th century, with two magnificent palaces—the Rajmandir, a massive square erection of which the exterior is almost absolutely plain, and the Jahangirmahal, a singularly beautiful specimen of Hindu domestic architecture. Elsewhere about the town are fine temples and tombs, among which may be noticed the Chaturbhuj temple on its vast platform of stone. The town of Tehri or Tikamgarh, where the chief now resides, is about 40 mi. S. of Orchha; population 14.096. The maharaja has a salute of 15 guns.

ORCHIDS, the name given to members of the orchid family (Orchidaceae), one of the most numerous and interesting groups of flowering plants, usually with beautiful and often with exceedingly handsome and highly fragrant flowers. Orchids are found in most climates throughout the world, except in the polar regions, but they occur in by far their greatest diversity and abundance in humid tropical forests. The orchids are all perennial herbs or vines, as in *Vanilla,* and are comprised in two groups: (1) terrestrial orchids, which grow in the ground, and (2) epiphytic orchids, epiphytes, which grow perched upon trees, found in the tropics, where they form an important feature of the vegetation. Most orchids of the temperate zone are terrestrial.

Floral Structure.—The flowers of orchids, though extremely diverse within certain limits, are all formed upon one common plan, which is only a modification of that observable in such flowers as those of the narcissus. Such flowers consist essentially in the presence of a six-parted perianth, the three outer segments of which correspond to a calyx, the three inner ones to a corolla. These segments spring from the top of the ovary which is inferior instead of superior as in the lily. Within the perianth, and springing from its sides, or apparently from the top of the ovary, are six much modified or suppressed stamens. These stamens encircle a style which is the upward continuation of the ovary and which shows at its free end traces of the three originally separate but now blended carpels of which the ovary consists.

An orchid flower has an inferior ovary, but with the ovules on the walls of the cavity (not in its axis or centre), a six-parted perianth, a stamen or stamens and stigmas. The main distinguishing features consist in the fact that one of the inner pieces of the perianth becomes in course of its growth much larger than the rest, and usually different in colour, texture and form. So different is it that it receives a distinct name, that of the "lip" or "labellum." In place of the six stamens we commonly find but one (two in *Cypripedium*), and that one is raised together with the stigmatic surfaces on an elongation of the floral axis known as the "column." Moreover, the pollen, instead of consisting of separate cells or grains, consists of cells aggregated into usually sticky "pollen masses," the number varying in different genera, but very generally two, four or eight. In *Cypripedium* all three stigmas are functional, but in most orchids only the lateral pair form receptive surfaces, the third being sterile and forming the rostellum, which plays an important part in the process of pollination, often forming a peculiar pouch-like process in which the viscid disk of the pollen masses is concealed.

It would appear, then, that the orchid flower differs from the more general monocotyledonous type in the irregularity of the perianth, in the suppression of five out of six stamens, and in the union of the one stamen and the stigmas. In addition to these modifications, which are common to nearly all orchids, there are others generally but not so universally met with; among them is the displacement of the flower arising from the twisting of the inferior ovary, in consequence of which the flower is so completely turned round that the "lip," which originates in that part of the flower conventionally called posterior, or that nearest to the supporting stem, becomes in course of growth turned to the anterior part of the flower nearest to the bract. Other common modifications arise from the union of certain parts of the perianth to each other, and from the varied and often very remarkable outgrowths from the lip. These modifications are associated with the structure and habits of insects and their visits to the flowers.

Cross-Pollination by Insects.—In the common orchids of British meadows, *Orchis maculata, O. mascula* (Shakespeare's long purples), etc., the general structure of the flower is as described. In addition there is in this particular genus, as indeed in many others, a long tubular spur or horn projecting downwards from the back of the lip, whose office it is to secrete and store a honeyed juice; the forepart of the lip forms an expanded plate, usually larger and more brightly coloured than the other parts of the flower, and with hairs or ridges and spots of various kinds according to the species. The remaining parts of the perianth are much smaller, and commonly are so arranged as to form a hood overarching the "column." This column stands up from the base of the flower, almost at right angles to the lip, and it bears at the top an anther, in the two hollow lobes of which are concealed the two pollen-masses, each with its caudicle terminating below in a roundish gland, concealed at first in the pouch-like rostellum at the front of the column. Below the anther the surface of the column in front is hollowed out into a greenish depression covered with viscid fluid—this is the two united stigmas.

In the process of pollination a bee alights on the lip. There, guided by the hairs or ridges, it is led to the orifice of the spur with its store of honeyed juice. The position of this orifice, as we have seen, is at the base of the lip and of the column, so that the in-

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EIGHT VARIETIES OF CULTIVATED ORCHIDS

The orchid family, one of the most interesting groups of flowering plants, comprises upwards of 7,000 species, found most abundantly in the Tropics. Several hundred species are grown in greenhouses; from these, gardeners have developed many varieties and an immense number of hybrid forms

1. Thwaites' Dendrobium (*Dendrobium Thwaitesiae*). 2 Venus Dendrobium (*D. Falconeri* x *nobile*). 3. Moth orchid (*Phalaenopsis Lueddemanniana*) 4. Alexander's Cymbidium (*Cymbidium Alexanderi*). 5. Argus lady slipper (*Cypripedium Argus*). 6. Sander's lady slipper (*Cypripedium insigne Sanderae*). 7. Queen Cattleya (*Cattleya Dowiana aurea*). 8. Triana Cattleya (*Cattleya Trianae*)

sect, if of sufficient size, while bending its head to insert the proboscis into the spur, almost of necessity displaces the pollen-masses. Liberated from the anthers, these adhere to the head or back of the insect by means of the sticky gland at the bottom of the caudicle. Having sipped the nectar the insect withdraws, taking the pollen-masses with it, and visits another flower. The two anther-cases in an orchis are erect and nearly parallel to each other; the pollen-masses within them are of course in the like position. Immediately, however, the pollen-masses are removed, movements take place at the base of the caudicle so as to effect the bending of this stalk, bringing the pollen-mass in a more or less horizontal position, or, as in the case of *O. pyramidalis,* the two pollen-masses originally placed parallel diverge from the base like the letter V. The movements of the pollen-masses may readily be seen with the naked eye by thrusting the point of a needle into the base of the anther, when the disks adhere to the needle as they would to the antenna of an insect, and may be withdrawn. Sometimes the lip is mobile and even sensitive to touch, as are also certain processes of the column. In such cases the contact of an insect or other body with those processes is sufficient to liberate the pollen often with elastic force, even when the anther itself is not touched.

In other orchids movements take place in different ways and in other directions. The object of these movements will be appreciated when it is remembered that if the pollen-masses retained the original direction they had in the anther in which they were formed, they would, when transported by the insect to another flower, merely come in contact with the anther of that flower, where of course they would be of no use; but owing to the divergences and flexions above alluded to, the pollen-masses come to be so placed that, when transplanted to another flower of the same species, they come in contact with the stigma and so effect the pollination of that flower. The adaptions of orchid flowers to fertilization by insects are very numerous and often remarkably complicated. Darwin devoted two volumes to the subject.

Propagation and Growth.—The fruit of orchids is a capsule which usually splits by three lengthwise slits, forming valves that remain united above and below. The seeds, minute and innumerable, are well-adapted to wind dissemination. In many species the seeds lose their viability after a few months and often are slow and difficult to germinate after planting, some requiring from three months to two years. The roots of terrestrial orchids are often bulbous and still more frequently more or less tuberous, the tubers being partly radical and partly budlike, so that propagation of new individuals by division from the parent takes place. Often there is a marked alternation in the production of vegetative and flowering shoots; sometimes the flowering shoots are not produced for several years in succession. This accounts for the profusion with which various orchids are found in flower in some seasons and for their scarcity in others.

Tropical orchids are mostly epiphytal—that is, they grow upon trees without deriving nourishment from them. They are frequently provided with pseudobulbs, large solid swellings of the stem in the tissues of which water and nutritive materials are stored. They derive this moisture from the air by means of aerial roots developed from the stem and bearing an outer spongy structure, or *velamen,* consisting of empty cells kept open by spiral thickenings in the wall; this sponge-like tissue absorbs dew and rain and passes it on to the internal tissues.

Classification.—In number of species the orchid family is exceeded by only two or three other families of flowering plants. Conservatively stated, it contains at least 7,500 species comprised in 450 genera; some authorities place the number of species as high as 15,000.

The family is divided into two main groups based on the number of the stamens and stigmas. The first, Pleonandrae, has two or rarely three fertile stamens and three functional stigmas. It contains two small genera of tropical Asia and Africa with almost regular flowers, and the large genus *Cypripedium,* containing about 350 species in the north temperate zone and tropical Asia and America. In *Cypripedium* two stamens are present, one on each side of the column, instead of one only at the top, as in the group Monandrae, to which belong the remaining genera in which also only two stigmas are fertile.

The Monandrae have been subdivided into 20 tribes, the characters of which are based on the structure of the anther and pollinia, the nature of the inflorescence, whether terminal or lateral, the vernation of the leaf and the presence or absence of a joint between blade and sheath, and the nature of the stem. The most important are the following:

Ophrydeae, terrestrial orchids, mainly north temperate, including the genera *Orchis, Aceras, Ophrys, Herminium, Gymnadenia* and *Habenaria.*

Neottieae, also terrestrial, contains 13 more or less widely distributed tropical or subtropical subtribes; one, *Cephalanthereae,* which includes the genera *Cephalanthera* and *Epipactis,* is chiefly north temperate. The genera *Spiranthes, Listera* and *Neottia* are also included in this tribe, as is also *Vanilla,* the elongated stem of which climbs by means of tendril-like aerial roots.

Coelogyneae, mostly epiphytes, and inhabitants of tropical Asia. A single internode of each shoot is swollen to form a pseudobulb.

Liparideae, terrestrial, two, *Malaxis* and *Corallorhiza,* are Eurasian and North American. *Liparis* is a large genus widely distributed in the tropics.

Pleurothallidieae, natives of tropical America, one of which, *Pleurothallis,* contains about 500 species. *Masdevallia* is common in cultivation and has often brilliant scarlet, crimson or orange flowers.

Laelieae, natives of the warmer parts of America, including three of those best known in cultivation, *Epidendrum, Cattleya* and *Laelia.*

Phajeae, chiefly tropical Asiatic, some—*Phajus* and *Calanthe*—spreading northward into China and Japan.

Cyrtopodieae, tropical, but extending into north temperate Asia and South Africa; *Eulophia* and *Lissochilus* are important African genera.

Cataseteae, with tropical American genera, two of which, *Cataselum* and *Cycnoches,* have di- or tri-morphic flowers.

Dendrobieae, in the warmer parts of the old world; the chief genus is *Dendrobium,* with 750 species, often with showy flowers.

Cymbidieae, in the tropics of the old world. The leaves are generally long and narrow. *Cymbidium* is well known in cultivation.

Oncidieae, in the warmer parts of America. *Odontoglossum* and *Oncidium* include some of the best-known cultivated orchids.

Sarcantheae, in the tropics. *Vanda* (Asia) and *Angraecum* (Africa and Madagascar) are known in cultivation. The flower of *Angraecum sesquipedale* has a spur about 1 ft. in length.

British Orchids.—The family is well represented in Great Britain by nearly 40 species representative of 18 genera; among these are several species of *Orchis, Gymnadenia* (fragrant orchis), *Habenaria* (butterfly and frog orchis), *Aceras* (man orchis), *Herminium* (musk orchis), *Ophrys* (bee, spider and fly orchis), *Epipactis* (helleborine), *Cephalanthera, Neottia* (bird's-nest orchis), one of the few saprophytic genera, which have no green leaves but derive their nourishment from decaying organic matter in the soil, *Listera* (tway blade), *Spiranthes* (lady's tresses), *Malaxis* (bog-orchis), *Liparis* (fen-orchis), *Corallorhiza* (coral root), also a saprophyte, and *Cypripedium* (lady's slipper), represented by a single species, now very rare, in limestone districts in the north of England.

North American Orchids.—In North America north of Mexico about 140 species of orchids are found, representing some 40 genera (*see* O. Ames, *An Enumeration of the Orchids of the United States and Canada,* 1925). Many are widely distributed across the continent, some extending to Alaska and even to Greenland, but they occur most numerously in the eastern and especially the southeastern states. The generic groups having the largest number of species are the rein-orchises (*Habenaria*), 40 species; lady's-tresses (*Spiranthes*), 15 species; lady's-slippers (*Cypripedium*), 14 species; and bog-orchises (*Malaxis*), 8 species. The tropical epiphytes are represented by *Epidendrum,* 9 species, and *Oncidium,* 6 species, found in Florida. Among the many attractive

orchids native to the eastern states and provinces are the showy lady's-slipper (*C. reginae*), the yellow lady's-slipper (*C. parviflorum*), the moccasin-flower (*C. acaule*), the showy orchis (*Orchis spectabilis*), the shin plasters (*O. rotundifolia*), the white-fringed orchis (*H. blephariglottis*), the yellow-fringed orchis (*H. ciliaris*), the small purple-fringed orchis (*H. psycodes*), the rose-pogonia or snake-mouth (*Pogonia ophioglossoides*), the dragon's-mouth (*Arethusa bulbosa*) and the grass-pink (*Calopogon pulchellus*).

In the Rocky mountain region and adjacent plains some 40 species of orchids occur; fully half of these are found also in the eastern states and a dozen or more extend northward to Alaska. Among them are the mountain lady's-slipper (*Cypripedium montanum*), the oval-leaved orchis (*Habenaria Menziesii*). About 35 species of orchids occur in the Pacific states; among these are the California lady's-slipper (*Cypripedium californicum*), the Sierra rein-orchis (*Habenaria leucostachys*), the giant helleborine (*Epipactis gigantea*) and the rare phantom orchis (*Cephalanthera Austinae*).

Cultivation.—The only orchid of substantial economic importance, furnishing a staple article of extensive use, is vanilla (*q.v.*). But the number of tropical orchids grown in greenhouses in Europe and North America for the flower markets, and as objects of horticultural and scientific interest, is immense. More than 3,000 species, many of them epiphytes, are in cultivation, as well as many thousand hybrid forms derived from them. Among the genera thus represented in orchid culture are *Cattleya, Cypripedium, Dendrobium, Epidendrum, Laelia, Odontoglossum* and *Phalaenopsis*. Many bi-generic hybrids have been developed by orchid fanciers. Propagation of these cultivated forms is by division, cuttings and growth from seed. Many terrestrial orchids practically defy all efforts at cultivation, due to lack of knowledge regarding soil conditions, to saprophytic habits, and to their growth in association with special fungi (*see* MYCORRHIZA).

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ORCHOMENUS (on coins and inscriptions, *Erchomenos*), the name borne by two cities of ancient Greece.

1. A Boeotian city, between the Cephissus river and its tributary, the Melas, on a long, narrow hill projecting south from Mt. Acontium, on every side admirably situated to be the stronghold of an early kingdom. The acropolis is situated at the north end of the ridge.

In prehistoric times Orchomenus is revealed alike by archaeological finds and by legends, as one of the most prosperous towns of Greece, once a continental and a maritime power. It controlled the greater part of Boeotia, especially the fertile lowlands of Lake Copaïs, upon the drainage of which its early kings bestowed great care. Its original inhabitants, the Minyae, were a seafaring people, and Orchomenus remained a member of the Calaurian League of naval States till historical times. Then, however, Orchomenus no longer figures as a great commercial State, and its political supremacy in Boeotia has passed to the people of Thebes. Nevertheless, it long exercised some overlordship over towns of northern Boeotia, and an independent policy within the Boeotian League. In 447 it was the headquarters of the oligarchic exiles who freed Boeotia from Athenian control. In the 4th century Orchomenus was actuated throughout by an anti-Theban policy, partly a recrudescence of old rivalry, but chiefly inspired by aversion to the new democracy at Thebes. In the Corinthian war the city supported Lysander and Agesilaus in their attacks upon Thebes, and Orchomenus again sided with the Spartans in 379. After the battle of Leuctra the Thebans, first, on Epaminondas's advice, readmitted it into the Boeotian League, but in 368 destroyed the town. By 353 it had been rebuilt, probably by the Phocians, as a bulwark against Thebes. After the subjection of the Phocians in 346 it was again razed by the Thebans, but was restored by Philip of Macedon as a check upon Thebes (338). In 85 B.C. Orchomenus provided the battle-field on which the Roman general Sulla destroyed an army of Mithridates VI. of Pontus. But its later history is obscure, and its decadence is attested by the encroachments of Lake Copaïs. Since mediaeval times the site has been occupied by a village named Skripou. Since 1867 drainage operations have been resumed, and an English company has reclaimed much fertile land. The so-called "treasury of Minyas," outside the ancient city at Mycenae (*see* MYCENAE), is almost exactly the same size as the "treasury of Atreus." The admiration of Pausanias is justified by the beautiful ornamentation of the roof of the inner chamber brought to light by Schliemann. Excavation by Doctors Furtwängler and Bulle revealed three prehistoric settlements, superposed. The first represents the Neolithic "painted-ware" culture of Thessaly and other parts of north-east Greece; in the second, oval huts replace the earlier round ones, and dull smeared pottery ("Urfirniss") the painted ware; the third has rectangular houses and characteristic grey "Minyan" pottery, finely modelled but without ornament. All these cultures precede the "Late Minoan" occupation, to which the great "Treasury" tomb belongs.

The worship of the Charites (*see* GRACES) was the great cult of Orchomenus, and the site of the temple is now occupied by a chapel of the Virgin (Κοίμηδις τῆς Παναγίας). The Charites were worshipped under the form of rude stones, which had fallen from heaven during the reign of Eteocles; and it was not till the time of Pausanias that statues of the goddesses were placed in the temple. Near this was another temple, dedicated to Dionysus, in whose festival, the *Agrionia* (*q.v.*), are apparent the traces of early human sacrifice.

2. An Arcadian city north of Mantineia and west of Stymphalus. Its district was mountainous, but had two valleys—the northern containing a lake drained by a *katavothron;* the southern below the city, separated from Mantineia by the ridge Anchisia. The old city, in a strong situation, was a ruin in Strabo's time. Till the late 7th century the kings of Orchomenus held some sort of sovereignty over all Arcadia. In the 5th century it was overshadowed by Mantineia, and in 418 B.C. Orchomenus fell for a time into its power; in 370 it held aloof from the new Arcadian League which Mantineia was organizing. About this time it also lost some possessions on the east to the new Arcadian capital, Megalopolis. In the 3rd century it belonged in turn to the Aetolian League, to the Lacedaemonians, and, since 222, to the Achaean League. Its history after it passed under the Roman rule is quite obscure.

ORCINOL, a homologne of resorcinol (*q.v.*), found in many lichens, e.g., *Rocella tinctoria, Lecanora,* and formed by fusing extract of aloes with caustic potash. It is 3:5-dihydroxy-1-methylbenzene ($C_6H_3(CH_3)(OH)_2$). It may be synthesized from toluene; or from acetonedicarboxylic ester by condensation with the aid of sodium. It crystallizes in colourless prisms with one molecule of water, which redden on exposure. Ferric chloride gives a bluish-violet coloration with the aqueous solution. Unlike resorcinol it does not give a fluorescein with phthalic anhydride. Oxidation of the ammoniacal solution gives *orcein*, $C_{28}H_{24}N_2O_7$, the chief constituent of the natural dye archil (*q.v.*). Homopyrocatechol is an isomeride ($CH_3:OH:OH=1:3:4$), found as its methyl ether (creosol) in beech-wood tar.

ORDEAL, a term of varying meaning but bearing the special sense of the mediaeval Lat. *Dei iudicium,* a miraculous decision as to the truth of an accusation or claim. The ordeal in principle, and often in the very forms used, belongs to ancient culture. Some ordeals, which possibly represent early stages of the practice, are simply magical, being processes of divination turned to legal purpose. Thus in Burma suits are sometimes still determined by plaintiff and defendant being each furnished with a candle, equal in size and both lighted at once—he whose candle outlasts the other being adjudged to have won his cause (Shway Yoe, *The*

Burman, ii. 254). In Borneo, the two parties are represented by two shell-fish on a plate, which are irritated by pouring on some lime-juice, and the one first moving settles the guilt or innocence (as has been before arranged) of its owner (St. John, *Forests of the Far East*, i. 89). The administration of ordeals has been much in the hands of priests, the intervention of a deity being invoked and assumed to take place even when the process is in its nature one of symbolic magic. The ordeal is related to divination (*q.v.*). *Coscinomancy* (the use of a sieve for divination) served anciently to discover a thief when, with prayer to the gods for direction, the names of the suspected persons were called over it (Potter, *Greek Antiquities*, i. 352). When a suspended hatchet was used in the same way to turn to the guilty, the process was called *axinomancy*. The sieve-ordeal is mentioned in Hudibras (ii. 3):

> . . . th' oracle of sieve and shears
> That turns as certain as the spheres.

In the modern Christian form of the key and bible, a psalter or bible is suspended by a key tied in at Psalm l. 18: "When thou sawest a thief, then thou consentedst with him"; the bow of the key being balanced on the fingers, and the names of those suspected being called over, he or she at whose name the book turns or falls is the culprit (*see* Brand, *Popular Antiquities*).

One form of divination passing into ordeals is the appeal to the corpse itself for discovery of its murderer. Thus the natives of Australia will ask the dead man carried on his bier of boughs, who bewitched him; if he has died by witchcraft he will make the bier move round, and if the sorcerer who killed him be present a bough will touch him (Eyre, *Australia*, ii. 344). Among the negroes of Ashanti, the corpse causes its bearers to dash against the guilty party (R. S. Rattray, *Religion and Art in Ashanti* [1927] p. 167, *see* also B. Malinowski, *Crime and Custom in Savage Society*, H. V. Russell, *Tribes and Castes of the Central Provinces*, [1916] iii. p. 90). The well-known ordeal of the bier in Europe in the middle ages seems founded on a different principle, the imagination that a sympathetic action of the blood causes it to flow at the touch or neighbourhood of the murderer. Apparently the liquefaction of the blood which in certain cases takes place after death may have furnished the ground for this belief. On Teutonic ground, this ordeal appears in the *Nibelungenlied*, where the murdered Siegfried is laid on his bier, and Hagen is called on to prove his innocence by going to the corpse, but at his approach the dead chief's wounds bleed afresh. In Shakespeare (*Rich. III.*, act 1, sc. 2):

> O gentlemen, see, see! dead Henry's wounds
> Open their congeal'd mouths, and bleed afresh!

Certain ordeals are closely related to oaths, so that the two shade into one another. Let the curse which is to fall on the oath-breaker take effect at once, it then becomes a sign condemning the swearer—in fact, an ordeal. Thus the drinking of water on which a curse or magical penalty has been laid is a mere oath so long as the time of fulfilment is unfixed (*see* OATH). But it becomes an ordeal when, as in Brahmanic India, the accused drinks three handfuls of water in which a sacred image has been dipped; if he is innocent nothing happens, but if he is guilty sickness or misfortune will fall on him within one to three weeks (for accounts of these and other Hindu ordeals *see* Ali Ibrahim Khan in *Asiatic Researches*, i. 389, and Stenzler's summary in *Z. D. M. G.*, vol. ix.). Numbers v. describes the mode of administering to a woman charged with unfaithfulness the bitter water mixed with the dust of the tabernacle floor, with the curse laid on it to cause her belly to swell and her thigh to fall if guilty. The term "bitter" is applied to the water before it has been cursed, which suggests that it already contained some drug, as in the poison-water ordeal still in constant use over a great part of Africa. The result of the ordeal depends partly on the patient's constitution, but more on the sorcerer who can prepare the proper dose to prove either guilt or innocence, and thereby acquires boundless influence. The poison-ordeal is also known to Brahmanic law, decoction of aconite root being one of the poisons given, and the accused if not sickening being declared free (Stenzler, *l.c.*). Theoretically connected with the ordeal by cursed drink is that by cursed food. The ordeal by bread and cheese, practised in Alexandria about the 2nd century, was practically the same as that known to English law five to ten centuries later as the *corsnaed* or "trial slice" of consecrated bread and cheese which was administered from the altar, with the curse that if the accused were guilty God would send the angel Gabriel to stop his throat, that he might not be able to swallow that bread and cheese. In fact, if guilty and not a hardened offender he was apt to fail, dry-mouthed and choking through terror, to get it down.

The passing through the fire is described in the Hindu codes of Yâjnavalkya and others, and in the *Râmâyana* the virtuous Sitâ thus proves her innocence to her jealous husband Râma (Stenzler, p. 669; Pictet, *Origines Indo-Européennes*, part ii. p. 457). In European law and chronicle, Richardis, wife of Charles the Fat, proves her innocence by going into a fire clothed in a waxed shift, and is unhurt by the fire (Grimm, *Deutsche Rechtsalterthümer*, p. 912). Yet more minutely prescribed in the Hindu ordeal-books is the rite of carrying the glowing hot iron seven steps, into the seven or nine circles traced on the ground, the examination of the hands to see if they show traces of burning, and the binding them up in leaves. In a Scandinavian law it is prescri[illegible] hot iron shall be carried nine steps (Grimm, *op. cit.*, p. 91[illegible] Anglo-Saxon laws the iron to be carried was at first only one pound weight, but Athelstan's law (in *Ancient Laws and Institutes of England*, iv. 6) increased it to three pounds. Another form well known in old Germany and England was the walking barefoot over glowing ploughshares, generally nine. The law-codes of the early middle ages show this as an ordinary criminal procedure (*see* the two works last referred to). Queen Emma, mother of Edward the Confessor, accused of familiarity with Alwyn bishop of Winchester, triumphantly purged herself and him by the help of St. Swithin—each of the two thus acquitted giving nine manors to the church of Winchester, in memory of the nine ploughshares, and the king being corrected with stripes (John Bromton, *see* Freeman's *Norm. Conq.*, vol. ii. App.). To dip the hand in boiling water or oil or melted lead and take out a stone or ring is another ordeal of this class. Some of these fiery trials are still in use, in regions of Africa or further Asia—the negro plunging his arm into the caldron of boiling oil, the Burman doing feats with melted lead, while the Bedouin will settle a conflict of evidence by the opposing witnesses licking a glowing hot iron spoon (Kennett, *Arabian justice*). This latter feat may be done with safety, provided the iron be clean and thoroughly white hot, while if only red-hot it would touch and burn the tongue. Probably the administerers of the ordeal know this, and the possibility of dipping the hand in melted metal; and there are stories of arts of protecting the skin (*see* the recipe in Albertus Magnus, *De Mirabilibus*), though it is not known what can be really done beyond making it horny like a smith's, which would serve as a defence in stepping on hot coals, but not in serious trials like that of carrying a heavy red-hot iron. The fire-ordeals are still performed by mountebanks. Fire walking is still practised by Hindus and was performed in Natal in the autumn of 1925. The Hindu code of Manu (viii. 115) avers that "He whom the flame does not burn, whom the water does not cast up, or whom no harm soon befalls, is to be taken as truthful in his oath." This water-ordeal is well known in Europe, where the accused is thrown bound into the water, which receives him if innocent, but rejects him if guilty. The directions given by Archbishop Hincmar in the 9th century provide that he who is let down into the water for trial is to be fastened by a rope, that he may not be in danger if the water receives him as innocent, but may be pulled out. In the later middle ages this ordeal by "swimming" or "fleeting" became the most approved means of trying a suspected witch: she was stripped naked and cross bound, the right thumb to the left toe, and the left thumb to the right toe. In this state she was cast into a pond or river, in which it was thought impossible for her to sink (Brand iii. 21). Cases of "ducking" witches which used to occur in England were remains of the ancient ordeal.

When in the warfare of Greeks and Trojans, of Jews and Philistines, of Vandals and Alamans, heroes come out from the two sides and their combat decides the victory, then we have the ordeal by battle. A passage from old German law shows the single

combat accepted as a regular legal procedure: "If there be dispute concerning fields, vineyards, or money, that they avoid perjury let two be chosen to fight, and decide the cause by duel" (Grimm, *Rechtsaltert.*, p. 928). In England, after the Conquest, trial by combat superseded other legal ordeals, which were abolished in the time of Henry III. A lord often sent his man in his stead to such combats, and priests and women were ordinarily represented by champions. The wager of battle died out so quietly in England without being legally abolished that in the court of king's bench in 1818 it was claimed by a person charged with murder, which led to its formal abolition (*Ashford* v. *Thornton* in Barnewall and Alderson 457; *see* details in H. C. Lea, *Superstition and Force*, ii.). A distinct connection may, however, be traced between the legal duel and the illegal private duel. (*See* DUEL.)

(E. B. T.; X.)

ORDER, a row or series, hence grade, class or rank, sequence or orderly arrangement (Lat. *ordo*, rank, arrangement). For its various meanings *see* MINISTRY, THE CHRISTIAN; MONASTICISM; KNIGHTHOOD AND CHIVALRY; ORDER IN COUNCIL; BILL OF EXCHANGE.

For technical mathematical uses of "order" *see* NUMBER; CURVE; SURFACE; DIFFERENTIAL EQUATION.

ORDER, (1.) in classic architecture, a column or pilaster, with its base, shaft and capital, and the entablature (*q.v.*) above it (sometimes called epistyle), consisting of architrave, frieze and cornice, considered as a single architectural feature; the "orders" are systematized classifications of five different types, Tuscan, Doric, Ionic, Corinthian and Composite. (2.) In mediaeval architecture, in an arched door or other opening, where the opening is larger on the outer face of a thick wall than on the inner face, one of the breaks in the steps in the thickness of the wall, consisting of an arch above and a pier on each side, by which the transition from larger exterior to smaller interior opening is effected.

Classic Orders.—Greek architecture had developed three easily recognizable classes of order which had been adopted by the Romans, with modifications, by the middle of the 1st century, B.C. It was natural, therefore, that Vitruvius, in his remarkable treatise on architecture (last quarter of 1st century, B.C.) should have attempted to give rules for the construction of these three orders. Moreover, as the Etruscan architects had developed a simple order of their own, using a wooden entablature, he added a section dealing with that. With the republication of Vitruvius in the second half of the 15th century, he was at once hailed as the authority on all things architectural, and architectural writers of the later Italian Renaissance attempted to imitate him by giving ideal rules for the orders, which should be efforts to reconcile the standards of Vitruvius with the many varying examples of Roman work that they knew. They added as a fifth order the Composite type of capital. The two most famous of these Renaissance compilations, those of Vignola (Giacomo Barocchio, or Barozzi), published in 1563, and Palladio (1570), exerted a tremendous influence over 17th and 18th century architecture throughout Europe, and gave rise to the idea that these compilations were not merely statements of average usage, but rules to be absolutely followed, an idea contradicted by the architectural work of the two authors themselves. Lacking knowledge of Greek remains, and of the structural systems and details of Etruscan temples, the Tuscan order, which they described, is merely a simplified Roman Doric. Their passion for regularization showed also in the fact that they specify a definite pedestal and even a definite baluster as a part of each order. Various 18th century and modern architectural writers have attempted to simplify the order descriptions of Vignola and Palladio, and have thus perpetuated the Renaissance myth of the immutability of the orders. In general, Vignola's work was followed in France and Palladio's in England. The orders, as thus systematized, are as follows:—

Tuscan.—This is the simplest of the orders. It is characterized by a column seven diameters high, the capital and base each occupying one-half the diameter in height. The base consists of a plain, square plinth (*q.v.*) with a large torus (*see* BEAD-MOULDING) and a fillet above. The capital has an astragal (*q.v.*) at the top of the shaft, a necking (*q.v.*), which is merely a short continuation of the line of the column, and above that an echinus (*q.v.*) consisting of a simple ovolo (*q.v.*) or quarter round with a fillet below it, and carrying a simple, square abacus (*q.v.*). The entablature, as in all the orders, is supposed to be one-quarter of the height of the column, and consists of a plain architrave (*q.v.*), or lower member, with a simple square projection or taenia (*q.v.*) at the top, a plain frieze, or central member, and a cornice with a single moulding as a bed-mould (*q.v.*), an undecorated corona (*q.v.*) or projecting rectangular portion, and a cymatium (*q.v.*) or crowning moulding that is an ovolo.

Doric.—The column is eight diameters high, and carries 20 flutes, separated by arrises or sharp edges. The base has two toruses, the lower one larger than the upper, and the capital is given a projecting moulding at the top of the echinus and additional fillets or an astragal below the ovolo. The necking is ornamented with eight rosettes. The achitrave in the entablature is sometimes given two faces, the upper one projecting slightly, being wider than the lower. The taenia is decorated with a moulding and beneath each triglyph of the frieze, a small block called a regula (*q.v.*), with six guttae, or small conical forms on its under side. The frieze is ornamented by triglyphs, or vertical projections decorated with a series of vertical grooves. Between each two triglyphs is a square metope (*q.v.*), a plain surface carrying sculpture; a triglyph is arranged over the centre of each column. Two forms of cornice are described; the denticular, in which the chief feature of the bed-mould is a row of dentils or little projecting blocks, and the mutular, in which the under side of the corona is decorated with projecting blocks, one over each triglyph. In both cases guttae are used on the soffit or under side of the cornice. In the denticular cornice they ornament square panels over each triglyph; in the mutular, the under side of the projecting blocks or mutules. The cymatium consists either of a cavetto or a cyma recta, a moulding of double curvature, the convex portion below and concave portion above.

Ionic.—The column is nine diameters high. The base is of the type known as an Attic base with a plinth carrying two toruses, separated by a scotia or hollow moulding. The capital is characterized by the volutes (*q.v.*) or spiral scrolls that are the ends of a band (usually consisting of a hollow portion called a canalis, and a raised fillet) represented as passing horizontally across the top of the echinus, and winding up on either side in a volute or helix. The capital is thus rectangular, and the volutes of the two faces of the capital are connected by a generally cylindrical form known as a cushion. This sometimes takes the form of two vases, end to end, and is sometimes decorated with leaves. The echinus, of ovolo profile, is carved with the egg and dart (*q.v.*), and where, as it follows the curve of the column, it disappears behind the rolls of the volutes, a little half anthemion (*q.v.*) or radiating petalled form hides the intersection. The entablature has an architrave decorated with either two or three bands, each wider and projecting farther than the one below it, and a taenia ornamented with mouldings. The frieze is plain, and the cornice has a bed-mould of three parts—a dentil band separating two mouldings, the lower one a cyma reversa, the upper one an ovolo. The cymatium is a cyma recta with a smaller cyma reversa below it.

Corinthian.—The column is ten diameters in height, and the base resembles the Attic base of the Ionic order, with the exception that in the centre of the scotia there is a third, small torus, with fillets above and below. The capital is much deeper than in the Doric and Ionic orders, and consists of a generally bell-shaped core, carrying a moulded abacus whose sides are concave, so that the corners project. At the bottom of the bell of the capital is an astragal, and the surface of the bell is surrounded by a characteristic decoration of acanthus leaves and scrolls. The lower two-thirds has 16 acanthus leaves in two rows of eight each, the centres of the upper leaves being placed between the joints of the lower leaves. Between the leaves of the upper row are cup-shaped leaf ornaments known as cauliculi (*q.v.*), which grow on stalks, and out of each cauliculus grow two stalks, one large and one small, so arranged that the voluted ends of the two adjacent large scrolls meet under each projecting corner of the abacus.

while the two adjacent smaller stalks come together under the centre of each concave abacus space; above their juncture is a large rosette. The architrave of the entablature, like that of the Ionic, has three bands and a moulded taenia, but additional richness is given by tiny mouldings between the bands. The frieze is plain, though sometimes pulvinated, or given a profile of convex curve. The cornice resembles that of the Ionic order with the addition of the band of modillions (*q.v.*). These are small scrolled brackets under the soffit of the corona, and are usually decorated on the sides with S-scrolls and on the bottom and front face with acanthus leaves. They are crowned by a little cyma reversa moulding. The soffit of the corona is panelled between the modillions, and in each panel there is a rosette.

Composite.—This is, in reality, merely a varied form of the Corinthian order and, like it, the column is fluted and ten diameters high. A special base is given to it by doubling the small torus in the centre of the scotia between the two large toruses. The capital, its main distinguishing feature, consists of a bell surrounded with 16 acanthus leaves, in two rows, arranged similarly to those of the Corinthian capital.

But above them, instead of the scrolls and cauliculi, there are volutes, like those of the Ionic order, except that they are on the four sides of the capital and brought out at an angle at the corners. In the bed-mould of the cornice, large rectangular blocks take the place of the modillions, and in some codifications a part of the bed-mould as well.

Scamozzi Ionic.—In addition to the five orders listed above, certain authorities have given a variant of the Ionic order, known as the Scamozzi Ionic after the Italian architect (Vincenzo Scamozzi, 1552–1616), who first codified it. Its chief difference from the ordinary Ionic order is in the fact that its capital is four-sided, the volutes occurring on all four faces, and at the corners brought out in an angle, so that the abacus above is concave-sided, like the Corinthian.

Moreover, the bands forming the volutes are not connected on each face by a horizontal line, but curve over and down into the top of the echinus; in the empty space thus left in the centre of each face there is a rosette. At times garlands connect the centres of the volutes.

Purpose.—The object of each codification of the orders is to furnish exact proportionate dimensions for every small feature, so that given the diameter of the column, the entire order may be constructed mechanically. The rules of all these attempted codifications vary slightly.

Origins.—The origin of the earliest of the orders, the *Doric*, was, at least partially, in wooden construction and seems to be a purely Dorian, or at least Hellenic, development, as far as the entablature is concerned. The question of the column is, however, more complex. In the Aegean culture, columns were common and their capitals consisted of a square abacus with a convex echinus below. The resemblance of this type, shown not only in wall paintings, but also in certain remains of the stair hall of the palace at Cnossus (*c.* 1500 B.C.), the column on the Lion Gate and those of the tholos of Atreus, both at Mycenae (both *c.* 1200 B.C.) to primitive Greek Doric capitals, is too close to be mere coincidence. On the other hand, Aegean columns universally tapered downward, were principally of wood and sometimes extremely slender in proportion, those at the tholos of Atreus being almost 11 diameters high, while those of the primitive Doric have an extreme taper upward and are short and stumpy. Moreover, the Aegean entablature, as shown in wall paintings, is entirely different from the Greek Doric, its chief features being round, projecting beam ends, close together, supported on a simple girder. The Greek Doric entablature has forms which seem to indicate a wooden origin, but one based on a different system of construction from that employed by the Aegean peoples. The architrave represents the original wooden beam running from post to post; the taenia, a board above this, to give a perfect bearing for the cross beams. The triglyphs are the ends of these cross beams, held in place by pegs through the taenia board, represented by the guttae. The metopes are merely closing boards between the beams. The mutules, or sloping blocks on the under side of the projecting cornice corona, represent the under sides of slanting roof rafters, supported on a timber or plate, above the cross beams, and perhaps decorated on the under side by flat boards or wooden pegs whose heads become the guttae in the stone version.

It is known that the primitive temple of Hera, at Olympia, had, originally, wooden posts, which were replaced from time to time during historic times, as they rotted, by stone columns. Nevertheless, the extreme taper and squat proportions of early Doric columns seem to demand an origin of masonry, and especially a masonry made of small stones. The origin would thus appear to be triple; the shaft, from early rubble construction; the capital borrowed and adapted from Aegean sources; while the entablature is an interpretation in stone of traditional Dorian wood construction. The earliest example known of the Greek Doric order is that of the temple at Corinth, probably dedicated to Apollo, which must be as early as the 6th century, and may go back to the 7th. Other early examples exist at Segesta, Selinus, Girgenti and Paestum, which are all of uncertain date, but undoubtedly prior to the Persian wars. Two of those at Selinus may go back to the 7th century B.C. The latest ancient example is that of the Agora gate at Athens (12 B.C.–A.D. 2). During these 700 years the basic elements of the Doric order did not change; the development, which was great, was only in the gradual refinement of every feature, and a continual experimentation in the exact treatment of each form, to give the desired result. Columns became taller and more slender, and the entasis (*q.v.*), or curved taper, more and more delicate. The ovolo of the echinus changed from the obese projections of Corinth and Paestum to the extremely refined and subtle curves of the Periclean period. The entablature, which in early examples had been almost half the height of the column, was gradually reduced in size, till in the Parthenon it is approximately one-fifth. The Greek Doric order was probably, in all cases, richly decorated in colour, so that its present appearance of austerity and over-restraint is illusory.

The *Roman Doric* order has plainly a double origin. The differences between it and the Greek Doric are not due entirely to Roman inability to appreciate the subtleties of Greek work, but merely to the fact that the Etruscans, and perhaps the north Italians, generally, had, at a very early period, developed a column and entablature of their own, with a long, slender, wooden column, having an ovolo echinus similar to the Aegean, and an entablature of wood, sometimes decorated with terra-cotta appliqués. It is this Etruscan column and entablature which Vitruvius endeavoured to describe, and which was misunderstood by the Renaissance, so that the name Tuscan came to be applied to a simplified Doric. It was also the origin of the unfluted, Roman Doric column, with its simple, quarter round echinus. To this the Romans applied an entablature embodying certain Greek features. In Roman architecture, the use of the Doric was reserved for small scale columns, as in many of the house courtyards at Pompeii (the forum colonnade at Pompeii was originally Greek), and to engaged or attached columns between arches. When used on a larger scale it was frequently much modified. Thus, in the temple of Hercules at Cori (attributed to Sulla, *c.* 80 B.C.), a base has been added, consisting of a single torus, but without a plinth. The entablature is extremely delicate in proportion, and the capital profile approximates that of the Greek Doric. A triglyph occurs on the corner, as in Greek work. In the theatre of Marcellus, at Rome (completed 13 B.C.), there is no base, and in the Colosseum (A.D. 80) there are no triglyphs. The Renaissance codifiers, however, took these two as the most typical, and their order is a sort of average between them. Another Doric order, coming originally from Albano, has no base except a fillet with apophyge, and the mouldings of the capital are richly carved. Other Roman Doric orders of extreme richness, in which the echinus of the capital is formed by a cyma recta instead of an ovolo are those from a temple on the Aventine, probably of the 2nd century A.D., and one from the baths of Diocletian (A.D. 305).

The *Ionic* order had manifestly an Asiatic origin. Its capital is a development from stele (*q.v.*) capitals of Phoenicia and the eastern end of the Mediterranean, which were themselves based

originally on the tri-lobed lotus. A famous example of the primitive type was found at Neiandreia, and another in Messa, in Lesbos. Excavations on the Acropolis at Athens, and elsewhere, have revealed many examples of the intermediate stages between the flaring volutes and awkward proportions of the early type and the refined perfection of the developed Ionic of the temple of Nike Apteros (probably between 440 and 410 B.C.), or the Erechtheum (407 B.C.). The characteristic features of the Greek Ionic order as found in Greece itself are the bold size and exquisite curvature of the volutes, the remarkable perfection of carved ornament that decorates the whole, and the variety of the types of base found.

The treatment of the order at the corners of a portico was difficult. The corner capital was formed with volutes on two adjacent, rather than two opposite, faces; where they met, the volutes were curved out at an angle together under the corner of the entablature. This created a new difficulty on the opposite corner, inside the colonnade, as it brought two half volutes together in an awkward way. It was this difficulty that led to a development of a variation of the Ionic capital with four faces the same and angle volutes. The most beautiful Greek example is that of the temple of Apollo at Bassae, designed by Ictinus, the architect of the Parthenon (probably *c.* 425 B.C.). In this the columns of the interior of the cella are connected by short walls to the exterior wall, and evidently, in order to have them present the same decorative face toward the entrance as toward the narrow nave between them, Ictinus adopted a four-sided Ionic capital.

A much more virile Ionic at enormous scale was developed in the great Hellenistic temples of the Asia Minor coast, such as those at Miletus and Priene. The archaic temple at Ephesus had set the style as early as the 6th century B.C., and its rebuilding, shortly after 350 B.C., by Dinocrates, while keeping certain of the more archaic features, such as the sculptured drums of the lower portions of the columns, was in the complete new Hellenistic Ionic style. The characteristics of this are: (1) a capital with volutes relatively smaller than in Athenian examples; (2) a cornice whose most striking feature was the very large dentils of the bed-mould, so large and so widely spaced, in fact, that in appearance they became almost separate brackets.

The *Roman Ionic* was based more on the Asia Minor than on the Attic types. Its details, throughout, were heavier than the usual Greek type. This heaviness appears even in the temple of Fortuna Virilis, which is not only the earliest purely Roman Ionic order, but also probably the earliest building in Rome in a good state of preservation to-day. It is variously attributed to the beginning of the 2nd and the beginning of the 1st century B.C. In general, the three chief differences between the Greek and Roman Ionic orders are: (1) the band connecting the volutes is perfectly horizontal, both at top and bottom, in Roman examples, and without the central dip of most Greek capitals; (2) the relative height and importance of the bed-mould of the cornice is much greater in the usual Roman examples. This is true, even in the most delicate and the most Greek of the monumental Roman orders—that of the theatre of Marcellus; (3) the base of the Roman order has, almost always, a square plinth as its lowest member. An exceptional type of Roman Ionic order is that of the temple of Saturn, on the Roman forum, the ancient treasury of Rome, whose ugly heaviness is characteristic of its date, after the great fire of A.D. 283.

Whatever the date of the original invention of the *Corinthian* order, it did not come into general use until the middle of the 4th century B.C. The capital perhaps owes its bell shape to Greek travellers' memories of the campaniform capitals of Egypt. But the Greek expression of this form is characteristically gracious. (For the charming Greek myth of its creation, *see* Vitruvius, Bk. IV.) Certainly the simplest form of the capital, in which a bell, decorated with flat and delicately pointed leaves, close together, has its lower portion surrounded by eight boldly curving acanthus leaves, suggests a basket around the bottom of which an acanthus plant has grown, as the myth states. The most famous example of this simple type decorated the "Tower of the Winds," at Athens, originally built in the 1st century B.C. to contain a water clock. The more complicated type, which is well represented by the exquisite capital of the tholos at Epidorus (middle 4th century B.C.), had two rows of leaves below and corner and central scrolls above. An even simpler form of the same type of capital, found alone in the ruins of the temple at Bassae, may be as early as the temple itself. The most popularly known example of the Greek Corinthian order, is that of the little choragic monument of Lysicrates, at Athens (335 B.C.).

The extremely lavish capital is, however, exceptional in many ways, and its silhouette unpleasantly broken. The existing columns and capitals of the great temple of Zeus at Athens were originally considered to be duplicates of the capital that Sulla took to Rome, and which served as a model for early Roman Corinthian. It is now known that the present remains are of the time of Hadrian. The order is, therefore, Roman, and not Greek. The Greeks never developed a separate entablature for the Corinthian order, using, instead, one of purely Ionic type; that of the tholos at Epidaurus owes its peculiar flat cornice to the fact that it was an interior order, rather than to any attempt to develop special entablature forms to crown the Corinthian capital.

Roman tradition found the origin of the *Roman Corinthian* order in a capital of the Athenian temple of Zeus, which Sulla brought with him to Rome. Long before that date, however, the Etruscans had been using forms Corinthianesque in type, and Pompeii also shows capitals which approach the Corinthian. In any case, the use of the Corinthian order on a monumental scale, as the Roman order *par excellence,* was well established by the time of Augustus, and the temple of Mars Ultor, dedicated in 2 B.C. as part of the forum of Augustus, and the portico of Octavia, of approximately the same date, both have completely developed magnificent Corinthian orders. It is noteworthy that in these the modillion (*q.v.*) had already reached a complete form. New light on the origin of this new feature which transformed the Ionic entablature into the Corinthian and which is the great Roman contribution to the development of the orders, is furnished by fragments of the order of the basilica Aemilia (dedicated 29 B.C.). These fragments are of the typically pure Augustan type, and therefore, probably due to this date and not to any of the succeeding rebuildings, and indicate a cornice with modillions which are deeper at the outer end than at the inner; that is, they slope down like the Doric mutules. Their outer ends are, however, scrolled.

The Roman Corinthian order is found in infinite variations. In certain small examples in tombs, gateways and the like, its proportions are thick and stumpy. as in the triumphal gateway at Saintes, of the time of Tiberius. In other cases it is extremely slender, as in the arch of Augustus at Susa. At times there are no modillions in the cornice, as in the temple of Antoninus and Faustina, at Rome (A.D. 141), and in the great temple of Venus, at Rome (A.D. 135), rebuilt by Maxentius (after 307). The modillions are replaced by the square, projecting blocks adopted by the Renaissance for the Composite order. Moreover, many types of capital exist. In some the two rows of leaves are at approximately equal height and kept tight to the bell, so that the effect is very vertical. In others, the lower row of leaves is made tall, so that the projecting leaf ends of both rows are close together and project markedly, giving almost the effect of a wreath around the capital. In other smaller examples, such as many at Pompeii, the ornament is hardly more than a frosting of the stucco surface of the bell. In the colonnade of the temple of Apollo, at Pompeii (rebuilt *c.* A.D. 63), a Doric entablature is supported by Corinthianesque columns. In some examples, rampant animals take the place of the corner volutes, as in the order of the temple of Concord, at Rome (A.D. 10) and in the capitals of the Roman gateway at Eleusis, in Greece (1st century A.D.). Another type, common in pilasters, substitutes for the cauliculi, with their double scrolls, an S-scroll at each side, turned in to the centre below and out to the corners above. This type gave rise to many 15th century early Renaissance capitals.

The most characteristic examples of the best type of the Roman Corinthian order are those of the round temple of Vesta.

at Tivoli (probably Augustan); the portico of the Pantheon, perhaps from the original building by Agrippa (27 B.C.); the interior of the Pantheon (A.D. 115–125); the portico of Octavia; the temple of Castor and Pollux on the forum (either of the rebuilding under Tiberius A.D. 6, or of the time of Hadrian), which is remarkable for the decoration of the middle band of the architrave and for the large, interlacing, central volutes of the capital; and that of the temple of Jupiter at Baalbek in Syria (time of Hadrian). An interesting order in brick and terra-cotta, evidently never stuccoed, is a doorway from an ancient Roman police station in Rome (early 3rd century); a more elaborate type of cut brick Corinthian with octagonal columns recessed into the wall is in the tomb of Annia Regilla (late 2nd century).

The *Roman Composite* order was actually only one of many variations of the Corinthian, and its erection into another order is a purely Renaissance idea. Vitruvius makes no mention of it and the earliest example known is one from a small garden pavilion in a house court recently (1928) excavated in Pompeii; an early monumental type is that of the arch of Titus, at Rome (completed A.D. 81), in which the exquisite composite capitals carry a normal Corinthian entablature. The bold richness of this type of capital was particularly popular during the later empire and the most magnificent example, remarkably delicate in execution for its late date, is one in the baths of Caracalla (211–216).

Renaissance.—During the middle and late 15th century in Italy and the early 16th century in France, the early Renaissance architects developed modified Corinthianesque orders of the most exquisite delicacy, in connection with doors, tombs and the like. The most characteristic feature of these orders is the general use of S-scrolls instead of volutes and cauliculi, and the use frequently of only small leaves beneath them at the corners of pilaster capitals. In the working out of the details of capitals of this type, the personalities of such sensitive designers as the Della Robbias, Desiderio da Settignano (1428–64) and Mino da Fiesole (1431–84) achieved some of their most characteristic and delicate expression. At times dolphins, birds and even cherubs' heads replaced the scrolls under the cornice of the capital. The entablatures of these orders are almost always without modillions, but characterized by a jewel-like delicacy in the carving of the ornamented mouldings. In the arrangement of this there is the greatest variety. During the high and late Renaissance the orders tend to become more normal, but little strict archaeology is found and much individuality of design is still present. The work of B. Peruzzi (1481–1537), of D. Bramante (1444–1514), of Vignola and of Palladio is particularly noteworthy. Typically Renaissance variations are rusticated orders like those in the gates of Verona by San Michele (1530) and the banded columns developed by Philibert Delorme for the Tuileries in Paris (1564), and followed in the Grande Gallerie (1578) and twisted columns like those of Bernini's baldacchino in S. Peter's at Rome (1633).

During the Baroque period, especially in Spain, all kinds of forms were used which approximate the orders, but are so broken up and contorted, and so varied in detail, that they can be assigned to no definite classification.

The 20th century has seen a reaction against the archaeological correctness of orders of the revival period. Orders, where occurring, are treated with the utmost freedom, and those styles seem most popular in which a like freedom prevailed, such as the late Georgian style of the Adam brothers, and American colonial, with its slimness and attenuation. In so-called modernist work, the order tends to pass from use as a superfluous ornament. In exceptional cases, however, especially in Scandinavia, extremely free and modified orders are still used, as in the concert hall at Stockholm, by Ivar Tengbom, and in America in portions of the interior of the Nebraska State capitol by B. G. Goodhue and the Goodhue associates.

(*See* also GREEK ARCHITECTURE; RENAISSANCE ARCHITECTURE; ROMAN ARCHITECTURE.)

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(T. F. H.)

ORDERIC VITALIS (1075–*c.* 1142), the chronicler, was the son of a French priest, Odeler of Orleans, who had entered the service of Roger Montgomery, earl of Shrewsbury, and had received from his patron a chapel in that city. Orderic was sent at the age of five to learn his letters from an English priest, Siward by name, who kept a school in the church of SS. Peter and Paul at Shrewsbury. When eleven years old he was entered as a novice in the Norman monastery of St. Evroul en Ouche. Orderic did not know a word of French when he reached Normandy; his book, though written many years later, shows that he never lost his English cast of mind or his love of England. His superiors rechristened him Vitalis, after a member of the legendary Theban legion. But in the title of his Ecclesiastical History he prefixes the old to the new name and proudly adds the epithet *Angligena*. He became a deacon in 1093, a priest in 1107. He left his cloister on several occasions, and speaks of having visited Croyland, Worcester, Cambrai (1105) and Cluny (1132). For many years he appears to have spent his summers in the scriptorium. His superiors (at some time between 1099 and 1122) ordered him to write the history of St. Evroul. The work grew under his hands until it became a general history of his own age. St. Evroul was a house of wealth and distinction. War-worn knights chose it as a resting-place of their last years. It entertained visitors from southern Italy, where it had planted colonies of monks, and from England, where it had extensive possessions.

Thus Orderic, though he witnessed no great events, was often well informed about them. His narrative gives us much invaluable information for which we should search the more methodical chroniclers in vain. He throws a flood of light upon the manners and ideas of his own age; he sometimes comments with surprising shrewdness upon the broader aspects and tendencies of history. His narrative breaks off in the middle of 1141, though he added some finishing touches in 1142.

The *Historia ecclesiastica* falls into three sections. (1) Bks. i., ii., which are historically valueless, give the history of Christianity from the birth of Christ. After 855 this becomes a bare catalogue of popes, ending with the name of Innocent I. These books were added, as an afterthought, to the original scheme; they were composed in the years 1136–1141. (2) Bks. iii.–vi. form a history of St. Evroul, the original nucleus of the work. Planned before 1122, they were mainly composed in the years 1123–1131. The fourth and fifth books contain long digressions on the deeds of William the Conqueror in Normandy and England. Before 1067 these are of little value, being chiefly derived from two extant sources, William of Jumièges' *Historia Normannorum* and William of Poitiers' *Gesta Guilelmi*. For the years 1067–1071 Orderic follows the last portion of the *Gesta Guilelmi*; hence this is of the first importance. From 1071 he begins to be an independent authority. But his notices of political events in this part of his work are far less copious than in (3) Bks. vii.–xiii., where ecclesiastical affairs are relegated to the background. In this section, after sketching the history of France under the Carolingians and early Capets, Orderic takes up the events of his own times, starting from about 1082. He has much to say concerning the empire, the papacy, the Normans in Italy and Apulia, the First Crusade (for which he follows Fulcher of Chartres and Baudri of Bourgueil). But his chief interest is in the histories of Duke Robert of Normandy, William Rufus and Henry I. He continues his work, in the form of annals, up to the defeat of Stephen at Lincoln in 1141.

The *Historica ecclesiastica* was edited by Duchesne in his *Historiae Normannorum scriptores* (Paris, 1619). This is the edition cited by Freeman and in many standard works. It is, however, inferior to that of A. le Prévost in five vols. (*Soc. de l'histoire de France*, Paris, 1838–55). The fifth volume contains excellent critical studies by M. Leopold Delisle, and is admirably indexed. Migne's edition (*Patrologia latina*, clxxxviii.) is merely a reprint of Duchesne. There is a French translation (by L. Dubois) in Guizot's *Collection des mémoires relatifs à l'histoire de France* (Paris, 1825–1827); and one in English by T. Forester in Bohn's Antiquarian Library (4 vols., 1853–56). In addition to the *Historia* there exists, in the library at Rouen, a manuscript edition of William of Jumièges' *Historia*

Normannorum which Leopold Delisle assigns to Orderic. (*See* this critic's *Lettre à M. Jules Lair* [1873].) (H. W. C. D.; X.)

ORDER IN COUNCIL, in Great Britain, an order issued by the sovereign on the advice of the privy council, or more usually on the advice of a few selected members thereof. It is the modern equivalent of the mediaeval ordinance and of the proclamation so frequently used by the Tudor and Stuart sovereigns. In practice it is only issued on the advice of ministers of the Crown, who are, of course, responsible to parliament for their action in the matter. Orders in council were first issued during the 18th century, and their legality has sometimes been called in question. Consequently in several cases parliament has subsequently passed acts of indemnity to protect the persons responsible for issuing them, and incidentally to assert its own authority. At the present time the principle seems generally accepted that orders in council may be issued on the strength of the royal prerogative, but they must not seriously alter the law of the land.

The most celebrated instance of the use of orders in council was in 1807 when Great Britain was at war with France. Orders in council are used to regulate the matters which need immediate attention on the death of one sovereign and the accession of another.

In addition to these and other orders issued by the sovereign by virtue of his prerogative, there is another class of orders in council, viz., those issued by the authority of an Act of parliament, many of which provide thus for carrying out their provisions. At the present day orders in council are extensively used by the various administrative departments of the government, who act on the strength of powers conferred upon them by some Act of parliament. They are largely used for regulating the details of local government and matters concerning the navy and the army, while a new bishopric is sometimes founded by an order in council. They are also employed to regulate the affairs of the crown colonies, and the lord-lieutenant of Ireland, the viceroy of India, the governor-general of Canada, and other representatives of the sovereign may issue orders in council under certain conditions.

In times of emergency the use of orders in council is indispensable to the executive. The Regulation of the Forces Act 1871 empowers the government in a time of emergency to take possession of the railway system by the issue of such an order; and during the World War the use of orders in council was frequent.

ORDERS OF KNIGHTHOOD: *see* KNIGHTHOOD AND CHIVALRY.

ORDINANCE, in mediaeval England, a form of legislation. The ordinance differed from the statute because it did not require the sanction of parliament, but was issued by the sovereign by virtue of the royal prerogative, although, especially during the reign of Edward I., the king often obtained the assent of his council to his ordinances. Legislation by ordinance was common during the reigns of Henry III. and Edward I. when laws were issued by the king in council or enacted in parliament indifferently. Both were regarded as equally binding. In 1389 the Commons presented a petition to King Richard II. asking that no ordinance should be made contrary to the common law, or the ancient customs of the land, or the statutes ordained by parliament. For this and other reasons this form of legislation fell gradually into disuse, becoming obsolete in the 15th century. The modern equivalent of the ordinance is the order in council (*q.v.*), but in the crown colonies legislation is both by orders in council and by local ordinance issued by the governor with the assent of his council.

In the 17th century the use of the word ordinance was revived, and was applied to some of the measures passed by the Long Parliament, among them the famous Self-denying Ordinance of 1645.

ORDINANCE or **ORDONNANCE,** in architecture, a composition of some particular order or style; not restricted to columnar composition, the term applies to any kind of design which is subjected to conventional rules for its arrangement.

ORDINARY, in canon law, the name commonly employed to designate a superior ecclesiastic exercising "ordinary" jurisdiction (*iurisdictionem ordinariam*), *i.e.,* in accordance with the normal organization of the Church. It is usually applied to the bishop of a diocese and to those who exercise jurisdiction in the name of the bishop or by delegation of his functions. In English law, however, the term ordinary is now confined to the bishop and the chancellor of his court. The pope is the *ordinarius* of the whole Roman Catholic Church, and is sometimes described as *ordinarius ordinariorum.* Similarly in the Church of England the king is legally the supreme ordinary, as the source of jurisdiction.

In England the only instance of the term ordinary being employed in its civil application was that of the office of judge ordinary created by the Divorce Act of 1857, a title which was, however, only in existence for about 18 years owing to the incorporation of the divorce court with the high court of justice by the Judicature Act, 1875. But in Scotland the ordinary judges of the inner and outer houses are called lords ordinary, the junior lord ordinary of the outer house acts as lord ordinary of the bills, the second junior as lord ordinary on teinds, the third junior as lord ordinary on exchequer causes. In the United States the ordinary possesses, in the States where such an officer exists, powers vested in him by the constitution and acts of the legislature identical with those usually vested in the courts of probate. In South Carolina he was a judicial officer, but the office no longer exists, as South Carolina has now a probate court.

ORDINATE: *see* CO-ORDINATES.

ORDNANCE. One definition approaching obsolescence would limit "ordnance" to great guns, naval or military, as distinct from small arms and other lesser types of war matériel. However, according to later usage the term embraces almost all varieties of weapons, projectiles, agents and devices, together with the apparatus necessary to activate or discharge these, which one people employs in an attempt to enforce its will upon another. (Excepted are certain atomic and chemical and all of the available bacteriological instrumentalities.) To satisfy both interpretations, the limited definition will be followed rather closely in the historical material covering the first four periods of ordnance development as described below, while the more comprehensive definition will be invoked for the last period (1940 and later).

The evolution of ordnance may conveniently be divided into a sequence of periods or epochs, as follows:

1. Appearance of gunpowder in mid-13th century to the first solid-cast cannon in the early 18th century—about 1713.
2. Early 18th century to end of smooth-bore era in mid-19th century—about 1845.
3. Mid-19th century to end of black powder era in early 1880s.
4. Early 1880s to about 1940—the smokeless powder era.
5. Post-1940—the atomic-electronic era.

FIRST PERIOD (c. 1248–c. 1713)

This period marks the appearance of gunpowder and artillery in the western world and the manufacture of cannon of increasing size and bore, both breech- and muzzle-loading, first from small, hollow bronze castings, then from welded rods of wrought iron by a "built-up" process, and still later from hollow castings, some of tremendous size. The era ended with the introduction of methods of producing solid gun castings and boring these to the required internal diameters.

Obviously, the development of an engine which could hurl missiles to distances beyond those achieved by the "artillery" (*i.e.,* bows and arrows) of the ancients had to await the appearance of some new and powerful agent capable of the sudden release of a vastly greater amount of energy than that stored in the bowstrings, twisted ropes, stressed timbers and elastic metal strips which, operating on principles of tension and torsion, had for centuries motivated man's projectile weapons of war. That agent proved to be gunpowder. For generations authorities have argued as to when and where this mixture of carbon, sulphur and saltpetre (potassium nitrate) appeared upon the world scene. Claims of its very early use in the orient, prior indeed to the Christian era (*see* below), are numerous but unsubstantiated. As to artillery (cannon), author after author repeats the erroneous translation from a Persian version of the ancient Gentoo (Hindu) laws which was prepared in 1776 by N. B. Halhead of the Bengal civil service. His text reads: "The magistrate shall not make war with . . . cannon and guns, or with any other kind of firearms." Actually the original Hindu text says: "The king shall not slay his enemies in battle

with deceitful or barbed or poisonous weapons, nor with any having a blade made red-hot by fire or tipped with burning materials."

In like manner, many an unwary student has claimed for both gunpowder and cannon a false antiquity because of failure to recognize that over the years the same word often designates different (but commonly related) objects.

Thus we read (*see* C. H. Owen, *Elementary Lectures on Artillery*) that: "For some time after cannon were first employed, we constantly find 'artillery' signifying not only cannon but all sorts of engines of war . . . ." As an example of the semantic confusion that long existed, Roger Ascham, writing in 1571, says: "Artillerie nowadays is taken for two things, gunnes and bowes."

Lieut. Col. H. W. L. Hime in his *History of the Royal Artillery Regiment* writes that Jean Froissart, French chronicler and historian (1338–1410), in his original account of the battle of Crécy (1346) speaks of crossbows and their bolts (quarrels) as "artillery," but designates as "kanons" the guns which the British brought upon the field. Thus these relatively feeble new contrivances had evidently not yet attained at that time a stature warranting the application to them of the generic name for projectile weapons.

It is fruitless to speculate upon the exact date of the introduction of gunpowder into Europe, or of the first cannon which presumably were developed not too long afterward. Despite many and oft-repeated statements to the contrary, the best available information indicates that both of these appeared first in the western world and travelled thence eastward. None of the extensive works of Arab and Greek alchemists dating prior to the 13th century even mention saltpetre, gunpowder's basic ingredient. This leaves as the first authentic account of the composition of gunpowder a document written about 1248 by Friar Roger Bacon, the outstanding British scientist of his day. Obviously, however, the existence of gunpowder must have been known to a limited few somewhat earlier. That it was already widely known as an explosive agent within 20 years after Bacon first wrote of it is indicated by a passage in his *Opus Tertium* (1265–68) in which he refers to it as in use "... *in mundi partibus diversis*" (in divers parts of the world).

H. B. C. Pollard stated that the city of Ghent (Belgium) acquired a cannon in 1313. This claim is quite substantial. Hime offers in evidence of its validity a passage from a yearbook commenced by the municipality of Ghent in 1300 and maintained for more than 100 years. One entry for 1313 reads: "Item, in this year the use of *bussen* (guns) was first discovered in Germany by a monk." In another record maintained by the same city appear for 1314 various notes recording the shipment to England of "*bussen mit kruyt*" (guns and powder).

With respect to the first two of these manuscripts, the cleric referred to could hardly have been other than Berthold Anklitzen, better known as Berthold Schwarz, of Mainz, Ger., who was also a sometime resident of Freiburg. He is credited with having been the first to recognize and harness the propellent force of gunpowder.

About as debatable as the name of the inventor of artillery (for there are many who discount the above tale) is the date and place of its first use in battle. At any rate, we do not commence to come upon soundly documented records until after 1300. We have referred to the city of Ghent and its possession of a cannon in 1313. According to R. Schmidt, a prolific writer on arms and ammunition during the third quarter of the 19th century, artillery appeared in Europe according to the following time schedule: Belgium, 1313; Germany, 1324; Italy, 1326; England, 1327; Spain, 1331; France, 1338; Switzerland, 1371; Russia, 1389; and Sweden, 1400.

It seems evident that somewhere between 1300 and 1325 cannon were first employed in Europe upon the field of battle and that no authentic instance of their prior use anywhere has been established. In the British Isles they appear during Edward III's invasion of Scotland (1327) as recorded by Archdeacon John Barbour of Aberdeen (1316?–95). The first acceptable account of their employment by a British war vessel is given by H. Brackenbury as 1338.

Examining the nature of the artillery which figured in the first historically substantial instances of its use, what were its characteristics? One way to approach this problem is through a study of the projectiles which these crude pieces discharged. Obviously it would be but a simple step if the first of these missiles had developed directly from their immediate predecessors, the darts or quarrels of the crossbow. As a matter of fact, that is exactly what happened. The oldest surviving illustration of a cannon, from a manuscript dated 1327 belonging to Christ Church, Oxford, Eng., depicts a vaselike contrivance on a wooden stand with an arrow-shaped missile emerging from its muzzle (*see* fig. 1). Furthermore, one of the earliest French documents bearing on artillery, which dates from 1338, mentions this type of projectile, the overall weight of which has been estimated at about seven to eight ounces. From this we deduce the fact that the piece discharging it must have been truly minuscule, light enough to have been held and fired by the individual soldier. Indeed, authorities tell us that the difference in size between contemporary "field artillery" pieces on wheelless mounts and the hand guns carried and discharged by the early 14th-century soldier was negligible. Thus we find on an inventory of stores in the fortress of Artois in 1381 "seven stout cannon, four of these large, and three transportable by hand."

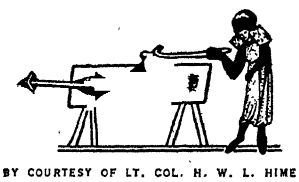

BY COURTESY OF LT. COL. H. W. L. HIME

FIG. 1.—EARLY TYPE OF CANNON

The outlines of the piece shown in the Christ Church manuscript explain why early cannon were commonly described as *vasi* or *pots-de-fer* ("iron pots"), since its contours are identical with those of a modern vase; viz., bulbous base, narrow curving neck and flaring mouth. They likewise indicate its characteristics with respect to size, shape, manner of mounting and firing, better than words could accomplish. And despite the obvious unsuitability of an arrow-type projectile for discharge from a firearm (an unsuitability belied in some measure by the successful development more than 400 years later of harpoon guns for whale fishing), this unhandy combination continued in use for well over two centuries.

As to method of manufacture, the first artillery pieces seem to have been constructed of cast bronze or brass and were very small. Soon after, guns of wrought iron appeared, but not of cast iron since the technique of producing successful casts with ferrous metals did not develop until the 15th century. It reached England relatively late. Research by the British Iron and Steel institute fixes 1509 as the approximate date of the first iron cannon to be cast in that country. Wrought iron, because of its slag inclusions, was far from a perfect medium in which to work, but it was long employed for lack of something better, and with it guns of very substantial dimensions were produced. The usual practice was to arrange one or more layers of hand-wrought iron bars or rods side by side in a circle, then weld their abutting surfaces together like the staves of a barrel (whence the name "gun barrel"). To fill the interstices which remained, molten lead was often employed. Then, to give added strength and solidity, wrought-iron rings were driven onto the sheaf of welded bars so closely together from breech to muzzle as to cover entirely that which lay beneath. Since it was difficult to attach an integral breech piece to this open-ended affair, many cannon so constructed were made breech-loading (*see* below), though in some instances a hollow bronze cylinder, open at one end and closed at the other, was driven into the breech end of the welded barrel to serve as a powder chamber. Thus the enclosed end of the cylinder became the breech of a completed, muzzle-loading cannon. For the breechloaders, powder chambers were supplied by welding to the open breech of the barrel tube, a skeletonized cylinder of a diameter somewhat greater than that of the bore, cut away at the top and open at the forward end where it joined the barrel to become a rearward extension thereof. Into the cutaway top of this barrel extension, a movable, ready-loaded chamber (powder container) could be dropped. This was simply a hollow vessel closed at one end, with a handle attached for easy manipulation. The rear (closed) end of this cylinder abutted against the closed (breech) end of the welded-on barrel extension. The forward end lined up with the breech end of the barrel tube.

The ball was pushed into the open rear end of the barrel, then the movable powder chamber dropped into position behind.

Early nomenclature for firearms of all kinds was, as we have indicated, confused. The English words "cannon" and "gun" (the latter can be traced back to about 1350, the former at least to Froissart) derive respectively from the Latin *canna* (a tube) and *mangonel,* a powerful pregunpowder stone-hurling engine of war. Mortar has always been applied to a short, stubby cannon because of its resemblance, in its earliest forms, to the conventional vessel of the chemist and apothecary. "Bombard" was also used to describe early guns, large and small. Thus *bombardes à main* (hand bombards) are mentioned as in use at the siege of Bonifacio in 1420, while the diminutive form *bombardelle* appears in an earlier Italian manuscript of 1381. However, after the art of casting great guns was mastered during the last decades of the 14th century, "bombard" came gradually to apply only to large pieces of artillery now long obsolete. Today we still use it in its verb form —to bombard.

Corresponding early German designations for both hand guns and field artillery were first *bussen* and later *Büchsen.* Over the years the latter, like bombard, became associated solely with larger pieces (cannon) only to experience a final reversal of meaning so that for modern generations it came to mean (rifled) shoulder weapons alone. The French *coulevrine* (English, culverin) underwent a similar evolution (from indicating guns small and large, to large only). The latter meaning still obtains, though the particular type of cannon to which it was applied has been forgotten for centuries. In some Latin-speaking countries, the word for gun took such variant forms as *scopitus, schioppi, schiopetto, escopette,* etc. The last of these persists in the modern *escopeta,* the Spanish word for shotgun.

The illustration of the cannon which appears in the Christ Church manuscript would certainly seem to depict a cast rather than a built-up piece. And the material used was presumably brass or bronze rather than iron, because of the pre-existing experience of bell-founders in the use of the two former. This is confirmed by a Florentine record of 1326 which relates to the manufacture of darts, iron balls and *cannones de metallo.* Had iron been meant, *cannones de fer* would have been the designation. However, iron pieces (presumably of wrought-iron construction) were soon to appear, since only 13 years later (1339) a Florentine manuscript records the presence at Cambrai of five iron cannon and five of metal (*i.e.,* nonferrous types).

Based upon various studies to which we have referred, it seems reasonable to believe that early portable firearms were originally produced as muzzle-loading brass or bronze (gun metal) castings, and that heavier pieces for field or fortress use were likewise similarly fashioned. (Brass is a mixture of copper and zinc, bronze an alloy of copper and tin. Gun metal is a bronze containing usually nine parts copper and one of tin.) But before many decades had passed, the discovery of a method to produce built-up iron guns resulted in the wrought-iron pieces already described, both muzzle- and breech-loading. Again, by 1370 the art of working in bronze had progressed so far that the casting of guns with bore diameters which even today appears staggering was undertaken (*e.g.,* the famous "Dulle Griete" of 1382 with a bore of 25 in.; *see* fig. 2).

Some of these monstrous pieces were muzzle-loading, some breech-loading. Both varieties were used without carriages, being simply laid upon the ground with breech embedded (the earth absorbing the recoil) and muzzle elevated by wedges. So placed they were of course tactically immobile and, while suitable for the battering of a city wall or other structure, and perhaps the interdiction of a narrow defile, useless against a hostile line of battle in case the enemy commander chose to move his force out of their line of fire. Napoleon executed this simple manoeuvre at the battle of the pyramids (1798) when facing guns so emplaced by the Turks opposing him.

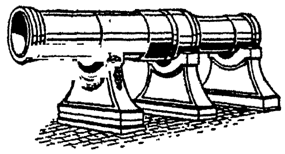
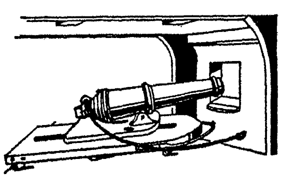


FIG. 2.—DULLE GRIETE, GHENT

The performance of early cannon varied directly with certain factors; *e.g.,* their own inherent strength and the character of the powder and projectile employed. As to strength, cast guns were from the beginning subject to invisible flaws which could result in their bursting upon the 1st discharge—or the 1001st—and though great improvements in methods of construction were effected over the years, the low tensile strength of cast iron (15,000 lb. per square inch), brass (24,000 lb.) and gun metal (29,000–32,000 lb.), compared with the high tensile strength of wrought iron (48,000 lb.), cast steel (70,000 lb.) and the exceedingly high tensile strength of many carbon and alloy steels, indicates why the trend was constantly toward metals of superior tensile qualities. At the same time, the cheapness of cast iron as against all other metals available caused it to be universally adopted as soon as satisfactory and economical means of working it were developed and likewise to be retained in general use until well past the middle of the 19th century.



FROM H. GARBETT, "NAVAL GUNNERY"

FIG. 3.—32-POUNDER CARRONADE, A SHORT-RANGE NAVAL CANNON, LATE 18TH CENTURY

Two accidental bursts occurring during the reign of Henry V of England were considered important enough to be recorded in the *Proceedings* of the privy council for 1415. Another, in 1460, took the life of James II of Scotland. According to an account by Robert Lindsay in the *Chronicles of Scotland,* "This prince . . . did stand nearby quhair [where] the Artylliare were discharged, his thigh bone was dung [done] in two by ane piece of ane misformed gun that brake in the shuting: by the quhilk [by which] he was stricken to the ground and died hastilie thereafter." Another accident of note occurred in 1716 when Mathew Bagley, a gun founder to the British crown, undertook to cast two brass 24-pounders in London. As the metal for one of these was poured into the (doubtless insufficiently dried) mould, an explosion occurred which killed him and 20 others.

Fortunately for the gunners, the quality of gunpowder was so indifferent during the first century of the use of artillery that most cannon, feeble though they were, could handle large charges with safety. The powder employed was mixed on the field from its three basic ingredients, since if transported ready mixed, these were inclined to settle out into layers according to their respective specific gravities. Further, once blended, the resulting compound tended to give off a very fine but highly explosive dust, some of which managed to escape from containers no matter how tightly sealed. And since ignition of the first guns, large and small, was effected by applying to their touchholes torches, fiery embers, red-hot wires or the glowing ends of smouldering bits of cord, a real danger of explosion was ever present. By keeping the ingredients separated until ready for use, this hazard was avoided.

Methods of powder making advanced slowly. As late as 1360–62, we find records of mortars and pestles being used for compounding gunpowder in the Tower of London. One of the first forward steps involved increasing the percentage of saltpetre in the mixture, at the expense of the other two components. This gradually rose from about 41% (Bacon, 1248) to around 75%, becoming stabilized at that figure during the 18th century, with charcoal contributing 15% of the final 25% and sulphur the remainder.

This first variety of low-order explosive (as against high explosives developed during the 19th century) was known as "mealed" or "serpentine" powder. Being very finely divided as a result of careful trituration, serpentine tended to pack closely when rammed into a chamber and hence to burn slowly because of lack of interstices between its almost microscopic grains. On the other hand, if packed too loosely, much of the charge was likely to be expelled from the muzzle unburned. As a result, skilled loaders who knew how to pack it just right (*i.e.,* not too compactly and not too loosely) were soon much in demand and acquired the title of "master gunner."

If powder improved slowly this was also true of the guns that fired it. Indeed, they were structurally unequal to handling the

corned variety (*i.e.*, powder produced with ingredients intimately and permanently commingled in grains of substantial size—no longer an impalpable mixture). This had appeared prior to 1430, but, although gradually adapted to hand grenades and small arms, was not generally employed in cannon for another century. Fabricated in grains of various sizes, each size intended for a different type of weapon, it burned so quickly and completely because of easy propagation of flame across the large interstices between grains that two pounds of corned powder would do the work of three of serpentine. Thus, from the original formula which called for a propellent charge of serpentine equal in weight to that of the projectile, a gradual reduction from this 1:1 proportion to one of 2:3 took place upon the introduction of the corned type, while by 1740 it had still further decreased to 1:2. By 1860 it was down to 1:4, and it was held that "a charge of $\frac{1}{4}$ the weight of the projectile and a bore of 18 calibres [*i.e.*, a gun barrel 18 times as long as its inside diameter] is the most favourable combination that can be made in cannon, to obtain the greatest range with least strain to the carriage." (Calibre used in describing a cannon means diameter of bore. In its plural form, when applied to a single piece, it indicates barrel length, as above.)

After the art of casting cannon had become well established and guns so made had practically displaced those of the wrought iron, built-up type, the *modus operandi* for producing a big gun became fairly well standardized. Described in the simplest terms, this involved the fashioning (around a reinforcing iron bar) of a long cylinder of clay in the size and shape of the bore of the finished weapon. This in turn was inserted into another larger concentric and roughly cylindrical clay mould the inner surface of which, after clever reverse modelling around a dummy form which was broken up and removed upon serving its purpose, exhibited all the external contours of the piece to be completed. The space between, when filled with molten metal (which was sometimes cast upon the spot), became, once the clay forms were removed, the barrel of the gun. During its preparation, the outer cylinder was reinforced with all manner of materials; *e.g.*, iron, timber, earth and stone.

With the technique of casting guns of substantial size once mastered, no radical changes in methods of fabrication were recorded throughout this era, though constant improvements in details of construction naturally took place. (*See* table for catalogue of principal cannon of the 16th century.) Cast iron steadily increased in popularity but never fully displaced the nonferrous types despite the fact that as early as 1646 William Eldred, master gunner at Dover (England) had expressed the prevalent opinion that ". . . Iron Ordnance is better and more serviceable than brass."

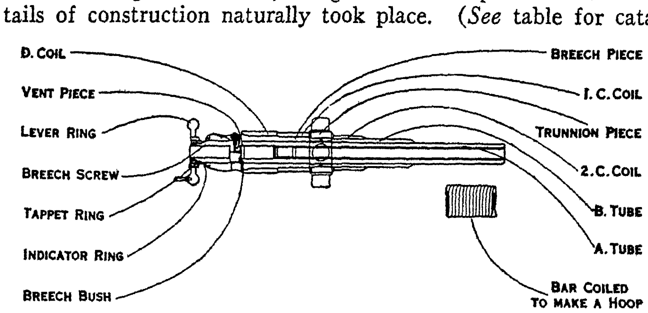


FIG. 4.—WROUGHT-IRON 40-POUNDER 35-CWT. GUN, MARK I (ARMSTRONG DESIGN)

Salient advances over this period included: (1) Wheeled carriages to replace crude sledges. (2) Substitution of the horse for the ox as a draught animal. (3) The pivoting of cannon on trunnions, thus permitting their ready adjustment to different elevations. This device served also to transmit the shock of recoil to the whole gun carriage instead of permitting it to work directly upon the heavy baulk which theretofore had constituted the rear element of a wooden framework in which the piece was supported —and transported. (4) Reversal of travelling position for field artillery from muzzle-foremost to breech-foremost. (5) Reduction in numbers of calibres and types of guns and carriages and general efforts toward simplification and standardization. (6) Locating the trunnions in the same plane as the axis of the bore instead of below this, as was the earlier practice. (7) Rifling the bores of artillery pieces was attempted, apparently without much success, as early as the mid-15th century; *i.e.*, soon after the practice had been adopted for certain types of shoulder weapons. Serious efforts to develop it are said to have been made by the Swiss Jean Maritz during the early 1700s, but manufacturing difficulties held it in abeyance for another 100 years and more. (8) Portable firearms and artillery had hardly become identified as separate types when a differentiation of the latter into three distinct varieties—mortar, howitzer and gun (or cannon)—commenced. These distinctions were still observed in the second half of the 20th century. The mortar is a short piece designed for high-angle fire at restricted ranges—to lob projectiles over hilltops onto an unseen enemy beyond; the howitzer with its longer barrel and less curving flight of projectile is employed for medium-range targets; and the gun, with longest barrel and flattest trajectory, seeks out targets as remote as may be attained by gunfire.

*Principal Guns of the 16th Century Compiled From What Appear to Be the Most Trustworthy Ancient Authorities**

Name of piece	Calibre	Length†	Weight of gun	Weight of shot	Charge of powder	Later designation
	In.	Ft. In	Lb.	Lb.	Lb	
Cannon royal	8.54	12 0	8,000	74	30	..
Cannon	8.0	9 10	6,000	60	27	..
Cannon serpentine	7.0	..	5,500	42	25	..
Bastard cannon	7 0	9 6	4,500	42	20	42 pounder
Demicannon	6.4	11 0	4,000	32	18	32 "
Cannon pedro, or petro‡	6.0	.	3,800	26	14	24 "
Culverin§	5.2	10 11	4,840	18	12	18 "
Basilisk	5.0	..	4,000	14	9	12 "
Demiculverin	4.0	..	3,400	8	6	9 "
Culverin bastard	4.56	8 6	3,000	11	5.7	..
Saker‖	3.65	6 11	1,400	6	4	6 pounder
Minion	3.5	6 6	1,050	5.2	3	..
Falcon	2.5	6 0	680	2	1.2	..
Falconet¶	2.0	3 9	500	1	.4	..
Serpentine	1.5	..	400	.5	.3	..
Rabinet or robinet	1.0	5 6	300	.3	.18	..

**See* Sir W. Monson's "Tracts" in Churchill's *Voyages*, iii; "*Archaeologia*," vi, 189; xi, 170; xiii, 27; etc. Tartaglia's "*Three Books of Colloquies*," translated by Lucar (London, 1588); and S.P.Dom. Eliz. ccxlii, 64. Hardly any two of these agree.

†Monson puts the length of the guns mentioned by him at 8 ft. 6 in.; but specimens still extant, dating from about his time, indicate that this was not always correct.

‡"Cannon pedro" was the English form of *canon pierrier*, and means a gun primarily intended for throwing stone shot.

§I.e., couleuvrine—serpent. Compare basilisk.

‖Named after the saker hawk. Compare falcon.

¶In the grounds of the Seigneurie, Sark, is a well-preserved brass gun, apparently a falconet, 57 in. in length and 1⅞ in in calibre, bearing the following inscription: "*Don de sa Majesté la Royne Elizabeth au Seigneur de Sarcq*, A.D. *1572*."

Source: Laird Clowes, *The Royal Navy, A History*, vol. i, p. 410 (London, 1897–1903).

Propellants of the First Period.—As already indicated, two major improvements in gunpowder took place during the first era, both contributing mightily to its increased effectiveness as a propellant. The first of these, the development of a method to produce powders in grains of varying sizes adapted to various purposes (in general, the larger the gun, the larger the grain it used) came toward the end of the first quarter of the 15th century; the second, which involved a gradual change in the proportion of gunpowder's three ingredients, was a continuing process, commencing soon after its introduction and not ending until during the 18th century.

First Period Projectiles.—The first cannon fired projectiles which were no more nor less than crossbow darts. These proved none too satisfactory, and search for improvements soon commenced. One material almost universally available was stone, so it was only to be expected that spherical stone projectiles would appear early upon the scene. They are mentioned as remotely as 1346. Despite their low specific gravity and resultant short range, their cheapness ensured continued use for centuries. Bronze shot are mentioned by Petrarch in one of his works written during or before 1344. According to Napoleon III the French used lead shot in 1345. Cast-iron balls did not appear until the 15th century, though crude wrought-iron specimens were in use before the 14th century ended. The introduction of cast-iron spheres did not result in the immediate abandonment of earlier types. Thus when certain guns were salved centuries later from the wreck of the British warship "Mary Rose," sunk in 1545, they were found to

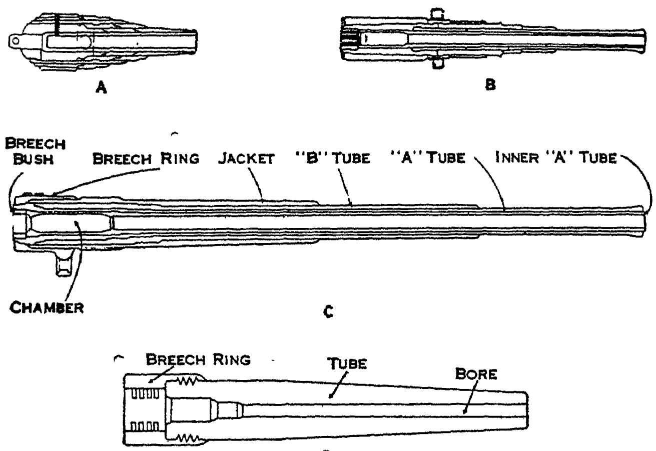


FIG. 5.—(A) MUZZLE-LOADING 12-IN. GUN OF 1864. (B) BREECH-LOADING 9.2-IN. GUN OF 1887 (SHRUNK HOOPS-STEEL). (C) 6-IN. STEEL GUN SHOWING CONSTRUCTION. (D) MONOBLOC TUBE

be loaded indiscriminately with balls of stone, wrought iron and cast iron. As late as 1578 the Tower of London housed 47,000 cannon balls of iron and 45,000 of stone. Given the same initial velocity, lead balls were the farthest ranging, followed by bronze, iron and stone, in that order.

Case Shot (Canister).—Early attempts to fire a volley of small shot from a single gun consisted of storing a number of projectiles (commonly flint pebbles) in a metal case (canister) and loading this into a gun of large calibre. Such a charge, reputedly developed as remotely as the early 15th century, could be murderously effective at a short distance. As the period advanced, canister loads of lead or iron balls of musket calibre and upward were developed for point-blank firing into massed troops. Longer ranging were grape shot, iron spheres from about 2 in. to 3½ in. in diameter and weighing from one to six pounds. Unlike case loads, which to all intents consisted simply of a tin can full of loose balls which started to fly helter-skelter almost upon leaving the muzzle, grape were packed in layers within a skeleton metal frame and held together for some distance before commencing to separate. Explosive shell are said to date to the late 14th century, although Hime states that the first record of their use "in large numbers and with good effect" was at the siege of Bergen-op-Zoom in 1588. They consisted originally of hollow spheres of hard-fired clay with very thick walls, each pierced with a fuze hole and filled with gunpowder. Unable to withstand much pressure, these were soon supplanted by hollow balls of iron. Into the fuze hole of each was driven a conical fuze, first of reed, then of wood, centrally bored to receive a train of compressed powder. In the beginning, the sole purpose of a fuze was ignition. But later, by a rough system of trial and error, it was, before insertion, cut long or short according to the estimated range at which the shell was desired to explode, then hammered into the cavity made to receive it. Shell containing a bursting charge and a number of small balls to be dispersed when the charge exploded (and thus to increase materially the number of flying missiles so produced) were developed as early as 1573. About 200 years later a new and much more efficient shell of this general type was developed by Sir Henry Shrapnel (*see* below).

Other artillery projectiles appearing during this era included carcasses (spheres filled with incendiary material to ignite flammable targets). To the same end were employed red-hot shot, heated in special furnaces and loaded very gingerly over wet clay wads, and incendiary rockets, though the latter saw no wide use during this period. For cutting the rigging of vessels, still other specialized projectiles—bar shot and chain shot—were developed.

SECOND PERIOD (c. 1713–1845)

This period marked the cessation for 100 years or more of the practice of casting cannon around a solid core to be withdrawn after the piece had cooled, and the adoption of a system whereby the tube was bored from a solid casting. (Core casting reappeared, with quite different techniques, as the period ended.) The newer practice is ascribed to Maritz, the Swiss previously mentioned,

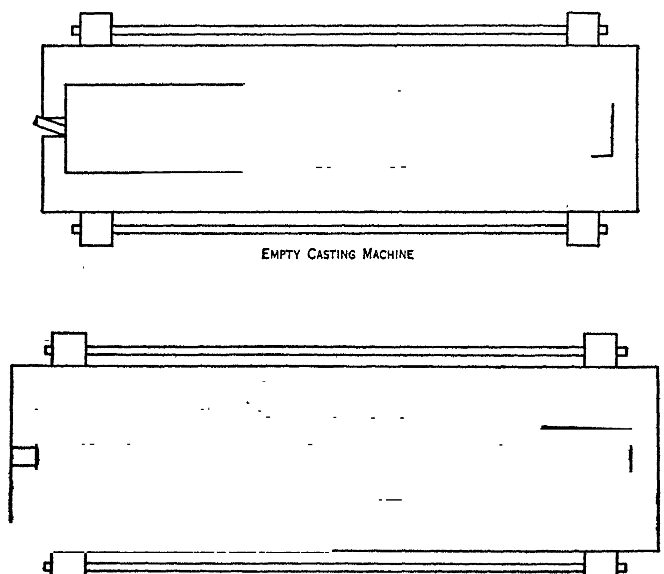


FIG. 7.—CENTRIFUGAL CASTING

who is said to have perfected it in 1713. Its outstanding advantage lay in the fact that by careful boring of the interior and turning of the exterior it was possible to produce a piece with walls of uniform thickness, a requirement not to be met under the earlier method because of the ever-present tendency of the interior clay core to move with respect to the outer one which enveloped it. So material was this improvement that the privy council of the Netherlands, by which Maritz was then employed, decreed in 1747 that his method would thereafter be followed exclusively. Furthermore, the process was declared secret, and all persons engaged in applying it were sworn to secrecy. However, it was obviously impossible long to prevent its disclosure, and by 1775 the British board of ordnance had followed the example of the Netherlands and was refusing to accept any gun not bored from a solid casting.

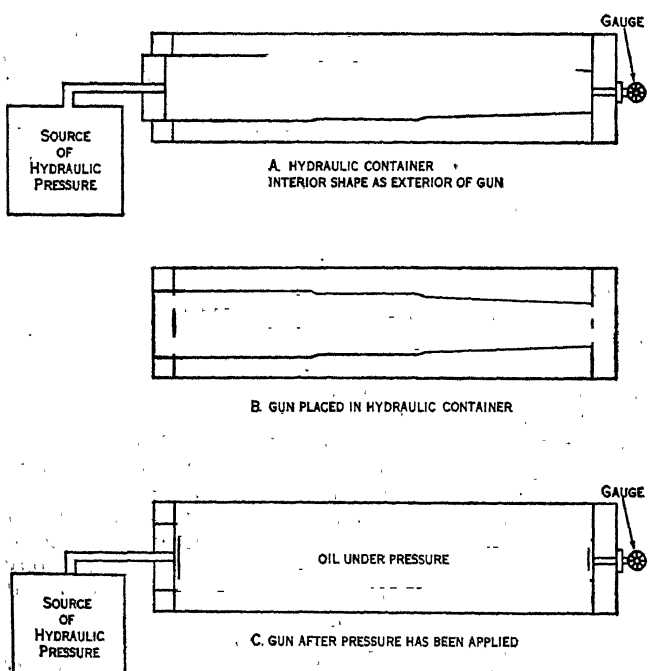


FIG. 6.—COLD WORKED PROCESS

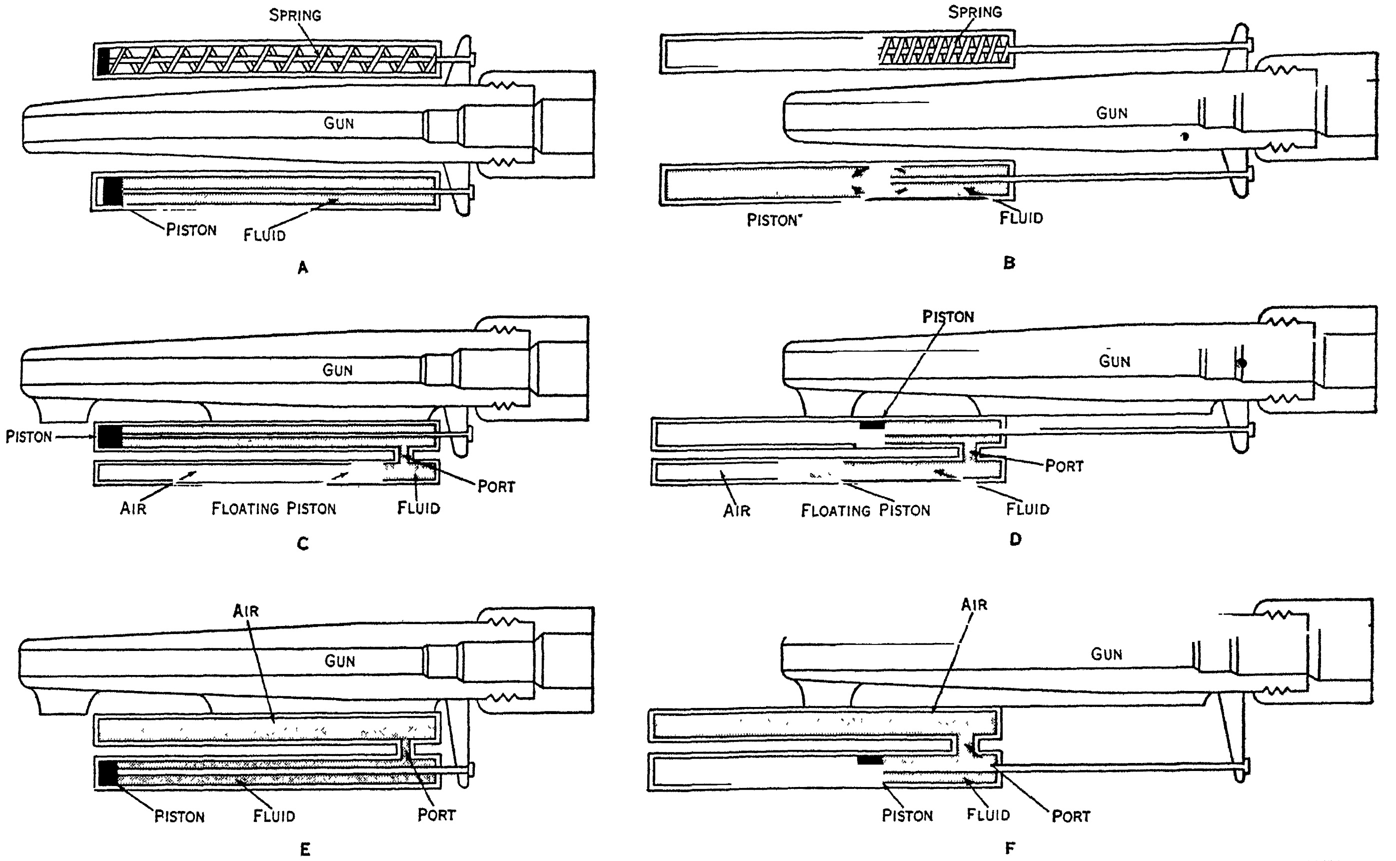


FIG. 8.—(A-B) HYDRO-SPRING RECOIL SYSTEM SHOWING IN-BATTERY OR FIRING POSITION (A) AND END OF RECOIL (B). (C-D) HYDROPNEUMATIC RECOIL SYSTEM WITH FLOATING PISTON SHOWING IN-BATTERY OR FIRING POSITION (C) AND END OF RECOIL (D). (E-F) HYDROPNEUMATIC RECOIL SYSTEM WITH FLUID IN DIRECT CONTACT WITH THE AIR, SHOWING IN-BATTERY OR FIRING POSITION (E) AND END OF RECOIL (F)

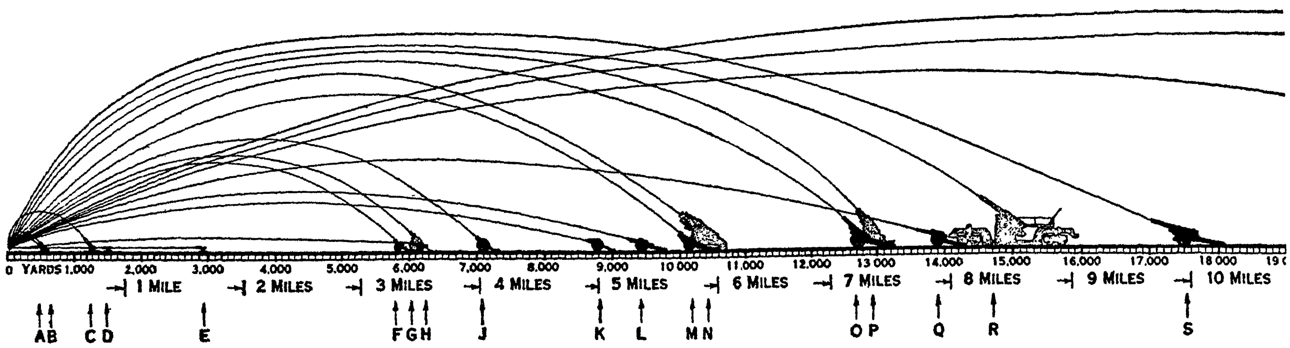
Further improvements in artillery during this period included new efforts toward: (1) reduction in the almost countless varieties of cannon and their attendant equipment; (2) standardization of types and of methods of manufacture; (3) reduction in windage (clearance between the projectile and the bore down which it travelled) and the introduction of a short, powerful naval gun of small windage—the carronade (*see* fig. 3); (4) interchangeability of parts; (5) greater use of cartridges (*i.e.*, charge and ball assembled into a single package and so loaded into the piece, instead of loose powder and shot, separately introduced); (6) the development of a horse artillery sufficiently mobile to manoeuvre with cavalry; (7) classification of land ordnance according to its special purpose, as for field, siege and coast defense; and (8) a truly scientific approach toward the study of the forces acting on a projectile while (*a*) within the gun bore (interior ballistics) and (*b*) while travelling from muzzle to target (exterior ballistics). For this last, Benjamin Robins, British mathematician, was responsible. Robins also strongly advocated the practice of rifling great guns, but another 100 years elapsed before his advice was followed.

Propellants of the Second Period.—During this period little change took place in the proportions of the ingredients of gunpowder. As early as 1670 these were recorded by Sir James Turner as follows: saltpetre, five parts; sulphur and charcoal, of each, one part (*i.e.*, 71.4%, 14.3% and 14.3%). By 1742 the figures had become six, one and one (75%, 12½% and 12½%), while by 1781 they were 75%, 15% and 10%, a ratio still practically unchanged at mid-20th century. Methods of manufacture, however, underwent tremendous improvement, and the cost of the finished product steadily declined.

Projectiles of the Second Period.—During this era the use of explosive shell in howitzers and cannon (they had theretofore seen service almost exclusively as short-range projectiles discharged from mortars) began to receive serious study. Some of the earliest trials of this expedient took place at the siege of Gibraltar in 1779, the conventional 5.5-in. mortar shell being fired from the standard British 24-pounder gun of the same bore. However, the fuzes performed erratically and the regulation heavy bursting charge shattered the casing into an average of eight fragments only, with little damage to the enemy. Shell containing a bursting charge and a parcel of balls to be dispersed upon explosion had long been in use (see *Projectiles of the First Period*, above). But they had never proved successful for reasons soon to be disclosed. Clearly there was need for a new type of projectile effective against troops in open order and beyond the range of case.

The problem was answered by the development of an improved shell which was originally known as spherical case but which, when adapted to elongated projectiles a half century later, became identified with the name of its inventor, Sir Henry Shrapnel. Conceived by him about 1784, it did not receive serious trial until 1803. Thereafter it underwent steady improvement but never achieved maximum efficiency until the appearance of a truly effective time fuze (1854) shortly after the period ended. Externally resembling the older spherical shell of the special type which housed an explosive plus a complement of small balls, it differed in that its reduced powder charge when exploding merely cracked open the outer casing and allowed the contained balls so released to continue their forward travel (with the velocity imparted by the original container) and to disperse gradually. By contrast, in the earlier type a much heavier disruptive charge scattered the balls in all directions at the instant of explosion. If that moment were not timed to occur exactly as the projectile passed over enemy ranks—impossible with the crude fuzes then existing—the shell was wasted. Shrapnel's device however developed a danger zone of considerable depth, with high antipersonnel effect when variations in fuze performance were not excessive.

Another noteworthy projectile appearing during this period was Sir William Congreve's rocket. Developed as a sort of auxiliary artillery, it bore the form of the conventional stick-guided sky-



BY COURTESY OF THE IMPERIAL WAR MUSEUM

FIG. 9.—DIAGRAM ILLUSTRATING THE RELATIVE EXTREME RANGES OF (A) 3-in. Stokes mortar, (B) 2-in. trench mortar, (C) 9.45-in. trench mortar, (D) machine gun (effective range), (E) machine gun (distant range), (F) 3.7-in. mountain howitzer, (G) 6-in. 30-cwt. howitzer, (H) 2.75-in. mountain gun, (J) 4.5-in. howitzer, (K) 13-pounder, (L) 18-pounder

rocket employed in pyrotechnic displays, but carried an explosive or incendiary head and was adaptable to use both by land and sea.

Coming into use shortly after 1800, and fired (on land) from light folding metal fixtures, easily portable, this rocket figured in a number of decisive battles between that date and the American Civil War (*e.g.*, Copenhagen 1807, Leipzig 1813, Bladensburg and Baltimore, 1814). During the 1840s a much more efficient type (stickless and self-rotating) was developed by William Hale of England, but the tremendous improvements in conventional forms of artillery which commenced almost immediately thereafter soon resulted in its almost complete eclipse, although it was still an article of issue in the British army as late as 1908. Thereafter it remained neglected until suddenly, in the early 1940s, it underwent an explosive reincarnation and became one of the most effective missiles of World War II.

In addition to the contributions of Shrapnel and Congreve to the improvement and diversification of projectiles for land use, the explosive shell, for centuries neglected by the maritime services, commenced early in the 19th century to receive increasing attention from naval authorities, chiefly through the efforts of the French Gen. Henri Joseph Paixhans. By the time the period ended, it was already threatening the dominance of the solid shot which had theretofore reigned supreme upon the seas.

THIRD PERIOD (1845–EARLY 1880s)

More progress in ordnance took place during this period than during the six centuries preceding. Outstanding were: (1) the perfection and general adoption of various systems of rifling for artillery (*see* fig. 10); and (2) as a corollary, the replacement of spherical projectiles by elongated types, cylindroogival in form and spin-stabilized by passage through rifled bores; (3) perfection and general adoption of various systems of breechloading (Great Britain, an exception, adopted then discarded breechloaders and did not resume their use until 1880); (4) the invention (independently) by two military men, the Belgian Capt. Paul Émil le Boulengé and the U.S. Capt., later Gen., Thomas J. Rodman (1860s), of the first really accurate devices for (*a*) measuring the velocities of missiles (the chronograph) and (*b*) estimating the pressures within gun tubes (the crusher gauge) which together helped to eliminate much of the guesswork previously involved in the design of guns and appropriate projectiles; (5) construction, commencing in the 1830s, of guns on the "built-up" principle as developed by the Frenchman M. Thiery (1834) and the Americans Benjamin Chambers (1849), Daniel Treadwell (1855), *et al.* These embodied tubes of cast or wrought iron (later of steel) surrounded by one or several reinforcing jackets (hoops) of wrought iron or steel, shrunken or screwed on. Thenceforward this was to represent the standard method of fabrication (*see* fig. 5, A). There followed a gradual displacement (beginning about 1856) of guns formerly produced as solid iron castings, by others exhibiting various combinations of forged iron, cast iron and finally steel, with or without jackets. By 1880 the all-steel gun was fast replacing all preexisting types.

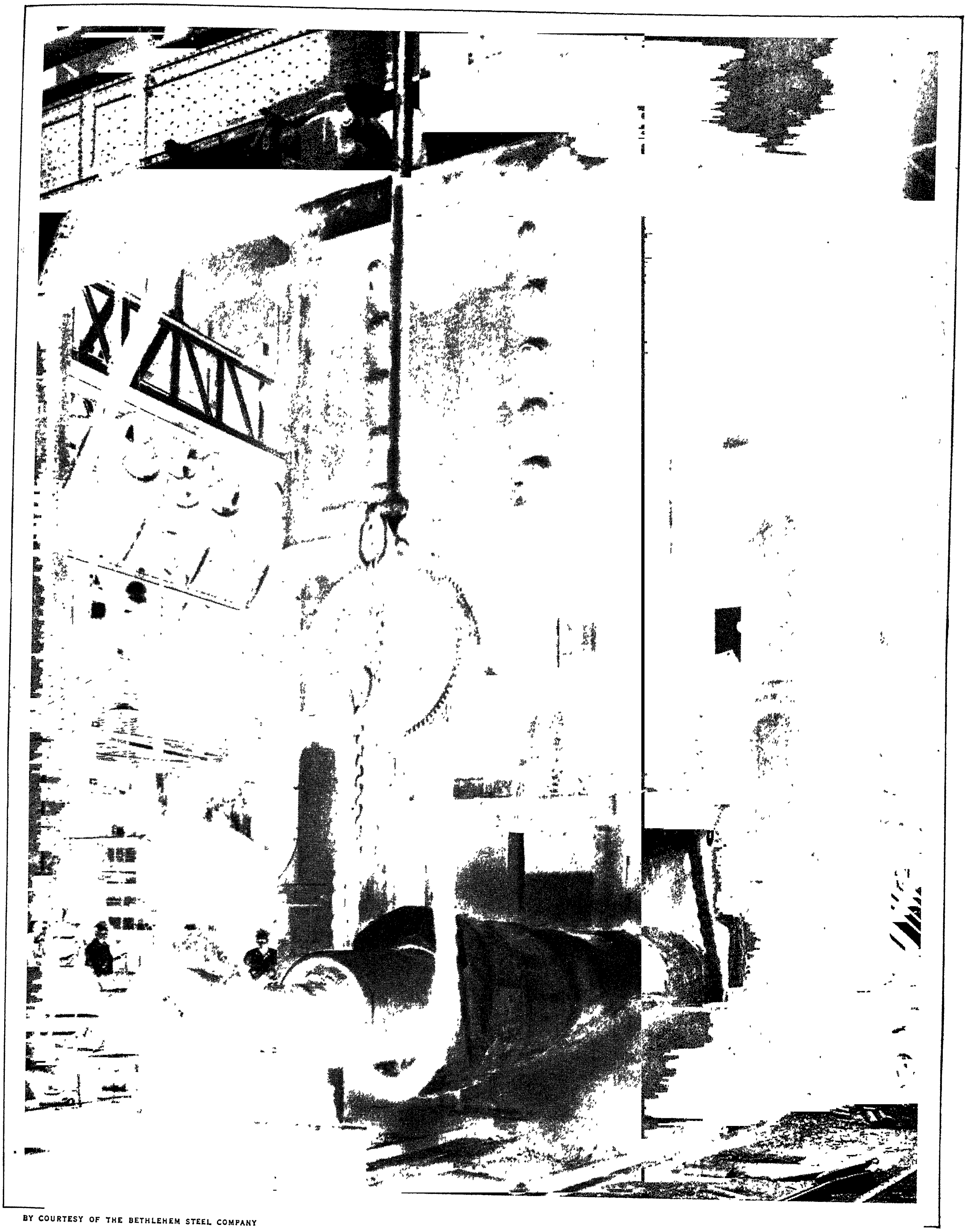
An interesting throwback to the method of casting a gun barrel around a central core was developed soon after this period commenced by Captain Rodman. He employed a hollow core through which a stream of water was passed. By keeping the exterior of the completed casting warmed and so controlling its rate of cooling, he succeeded in causing the outer layers of the metal to shrink and thus compress the core (*i.e.*, the bore), securing by a different approach the same results as were attained by shrinking on hoops according to the built-up method. His system was ingenious and effective but came too late to see wide employment before metallurgical advances rendered it obsolete. (Compression of the bore of a cannon exerted upon it by outer layers of encircling metal helps it to resist internal pressures developed when a charge is fired, hence the various means devised to effect this.)

Alfred Krupp (Germany) was the first to produce a successful all-steel gun. Drilled out of a single block of cast metal, it was the marvel of its day. The first specimen to be shown at a world exposition, a modest six-pounder displayed at London in 1851, attracted universal attention. Within ten years Krupp was producing guns of 8-in. bore and larger, all from solid blocks of cast steel. However, after other makers had demonstrated the possibilities of all-steel guns on the built-up (hooped) system, he gradually adopted that method of fabrication also. (*See* fig. 5, B.)

The names of Sir William Armstrong and Sir Joseph Whitworth are closely associated with the development (1850s) of the wrought-iron, built-up, rifled cannon (*see* fig. 4), especially of the light field type, in both muzzle- and breech-loading varieties. Whitworth's was noteworthy in possessing a hexagonal bore. (*See* fig. 10.) The American Civil War of 1861–65 offered the first opportunity for a mass trial of rifled guns and, to a limited degree, of breechloaders as well. Even so, the vast majority of cannon figuring in the conflict were smooth-bore cast-iron (plus some brass) muzzle-loaders, although steps to modernize these by reaming out the original bore and driving into it a rifled tube of wrought iron or steel were commenced during this period and continued for a number of years thereafter. Wire-wound guns in which countless turns of fine wire coiled under tension replaced shrunken-on hoops as reinforcement for a relatively thin central tube had already been under development since about 1855 but were yet to receive the recognition later accorded them.

During this period another epochal change took place with the introduction and general adoption of iron and, later, steel plating as defensive armament on ships of war and in the gun emplacements of permanent land fortifications. The battle between U.S.S. "Monitor" and C.S.S. "Merrimac" ("Virginia") in Hampton Roads (March 1862) marked for all practical purposes the end of the unprotected wooden vessel. At the same time, increase in size and power of naval artillery necessitated gradual abandonment of the centuries-old method of controlling recoil by rope breechings only, or by breechings plus friction planes (*see* fig. 3), and the substitution of a carriage fitted with vertical iron friction plates moving between other plates attached to a slide positioned between carriage and deck, and automatically compressed as required to develop the amount of friction necessary to absorb recoil.

Even this material improvement soon proved inadequate and

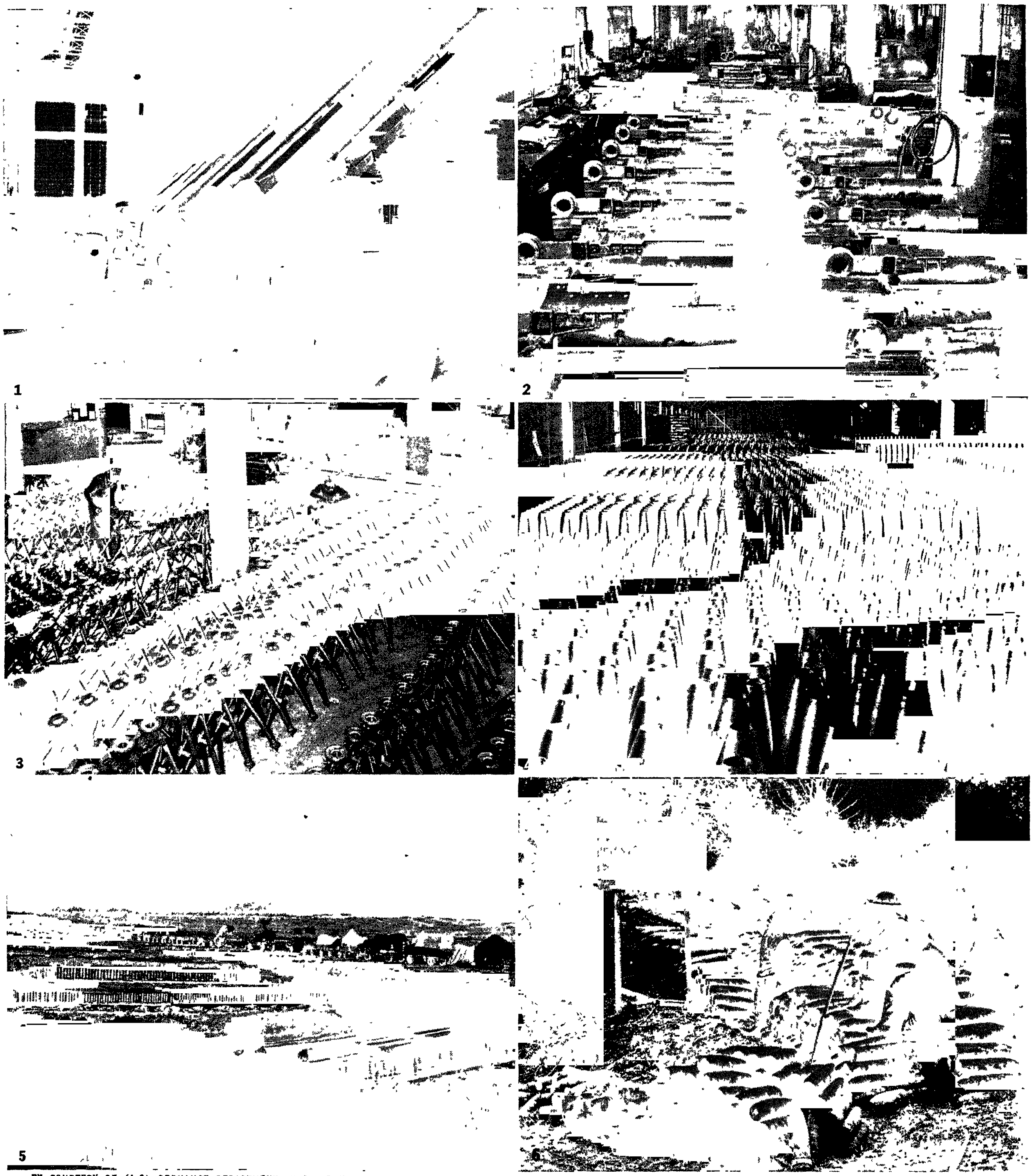


BY COURTESY OF THE BETHLEHEM STEEL COMPANY

GUN FORGING

Forging a large pressure vessel in a 14,000-ton hydraulic forging press. Under great pressure, the hot plastic metal is pressed into the required shape, following which it is machined and heat-treated to obtain the desired physical properties

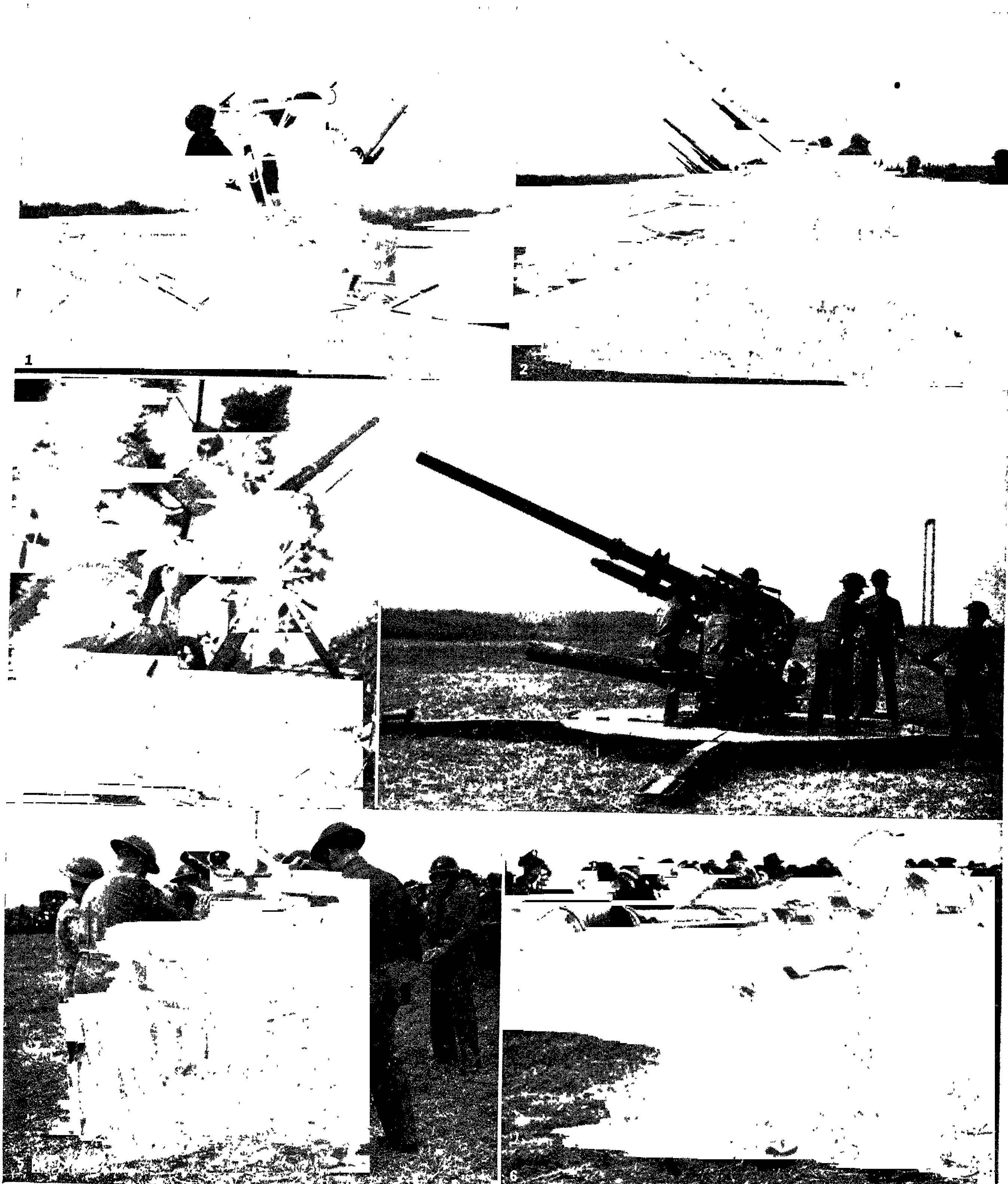
ORDNANCE



BY COURTESY OF (1-3) ORDNANCE DEPARTMENT, U S ARMY, (4-6) U S. WAR DEPARTMENT

MANUFACTURE AND STORING OF ORDNANCE AND AMMUNITION

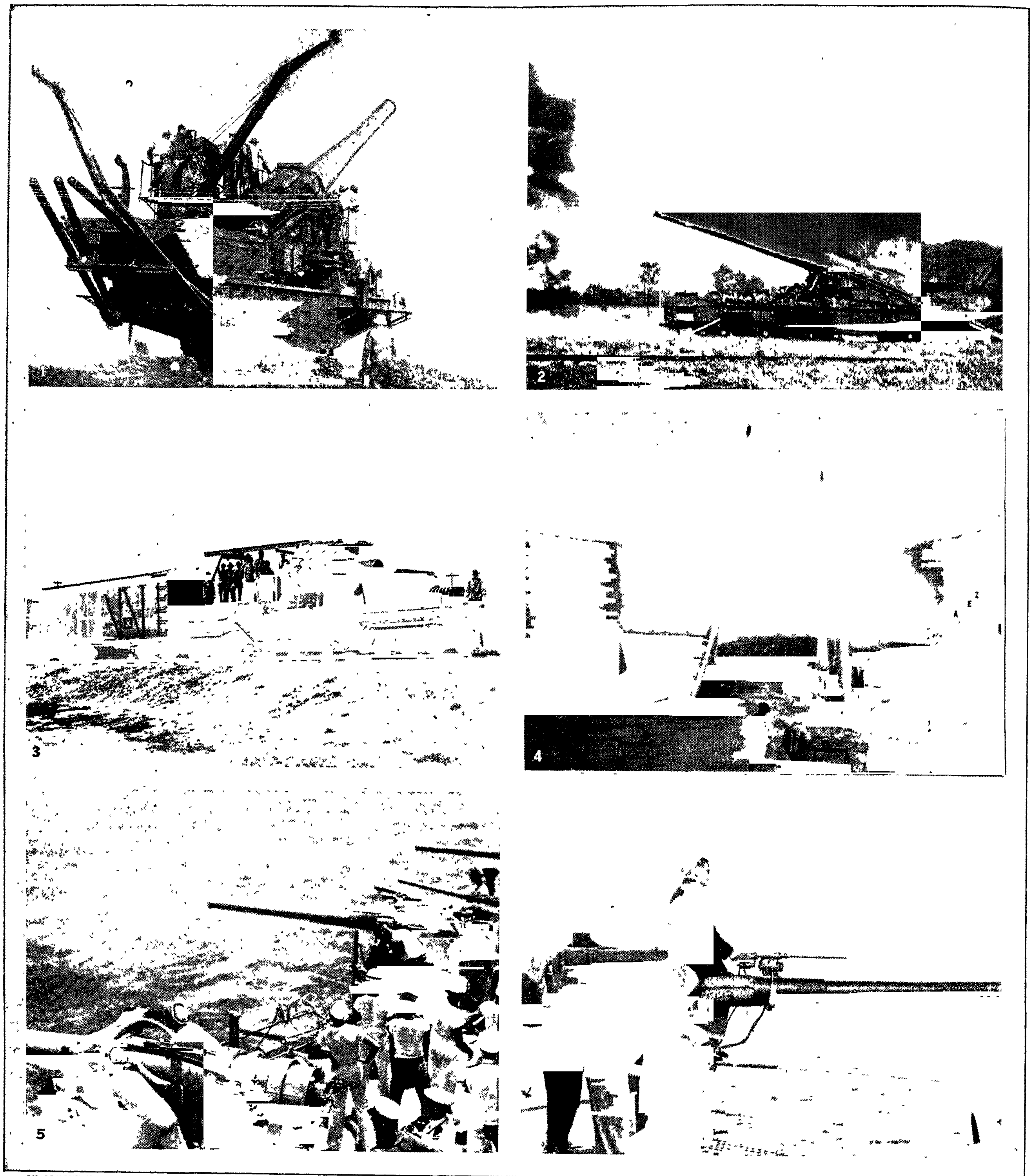
1. New 75-mm. field guns being completed at Rock Island arsenal, U.S.A.
2. Sub-assembly for 3" anti-aircraft carriages
3. Assembling tripods for .30 calibre machine guns
4. Finished shell in storage without fuses
5. Ammunition dump behind a theatre of operation, World War (1914–18)
6. Ammunition dump for brigade near line of action during World War (1914–18)



BY COURTESY OF THE U.S ARMY SIGNAL CORPS

AMERICAN ANTI-AIRCRAFT GUNS AND EQUIPMENT

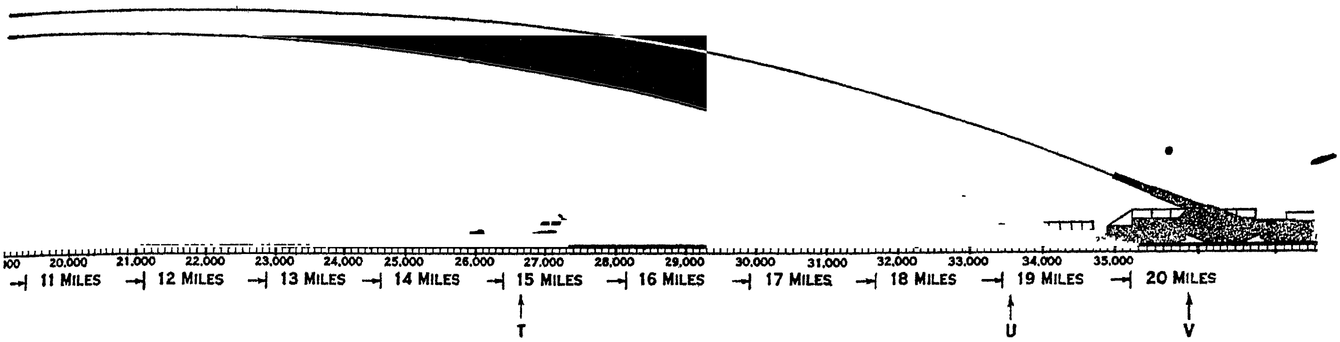
1. 37-mm. mobile anti-aircraft gun in action at Aberdeen proving grounds, Maryland
2. Battery of 3" anti-aircraft guns
3. .50 calibre anti-aircraft gun
4. 90-mm. anti-aircraft gun on platform mount
5. Anti-aircraft director being demonstrated at Aberdeen proving grounds
6. Aircraft height finder



BY COURTESY OF (3, 4) THE U S ARMY SIGNAL CORPS, PHOTOGRAPHS, (1, 2, 6) UNDERWOOD AND UNDERWOOD, (5) EWING GALLOWAY

UNITED STATES COAST DEFENCE ORDNANCE

1. A 14-in. mobile coast defence rifle mounted on a railway carriage. The big gun has an effective range of 27 miles
2. A 14-in. rifle on railway mount having an effective range of more than 27 miles
3. A 12-in. railway mortar going into firing position at Fort Monroe, Virginia
4. Firing 12-in. mortars at Fort Monroe, Virginia
5. Midshipmen of the U.S.S. "Nevada" at the 5-in. guns used for torpedo boat defence
6. Coast Guardsmen operating a 3-in. gun on the U.S. Coast Guard cruising cutter "Modoc"



THE BRITISH PIECES OF ORDNANCE USED IN WORLD WAR I
(Mark IV), (M) 6-in. 26-cwt. howitzer, (N) 15-in. howitzer, (O) 8-in. (Mark VII) howitzer, (P) 9.2-in. (Mark II) howitzer, (Q) 60-pounder (Mark I), (R) 12-in. (Mark V) howitzer, (S) 6-in. (Mark XIX) gun, (T) 9.2-in. (Mark X) gun, (U) 12-in. gun (Mark IX), (V) 14-in. gun (Mark III)

was supplanted both on sea and land by systems in which cylinders attached to the carriage contained air, liquid, spiral springs or combinations of these to be compressed during recoil by a piston attached to the gun (*see* fig. 8). Anyone was capable of neutralizing the full energy of recoil and, when this was dissipated, of returning the piece to battery (firing position). Such systems continued in use to and through World War II.

Propellants of the Third Period.—Black gunpowder remained king despite a brief threat from guncotton as developed by Austria in the 1850s, both as a propellant and as an explosive charge for shell. It proved dangerously unstable, however, and after a series of disastrous explosions at manufacturing plants was discarded. As a result of the efforts of Rodman and others, who developed grains in new sizes and shapes, some perforated, and so learned how to control in large measure its rate of burning, black gunpowder became much more versatile than ever before.

Projectiles of the Third Period.—With the general adoption of rifling, the advantages of elongated projectiles (which fly farther and straighter when discharged from a rifled tube than do spheres of equal weight) could now be exploited, and these were produced in myriad types. The long-used spherical case gave way to the elongated form thereafter called shrapnel for its inventor, and employed in increasing quantities to and through World War I, after which it became obsolete, being entirely replaced by high-explosive shell. Nevertheless, as much later as the Korean war of the 1950s, injuries from shell fragments were still erroneously being designated as shrapnel wounds.

As the period progressed, solid shot gave way entirely, except for target purposes, to armour-piercing shell and common shell, the former with a small, the latter with a large, cavity for the explosive charge. As the period ended these, with shrapnel and canister, armed with one of the many newly developed and greatly improved types of fuzes, time or instantaneous, base-detonating or point-detonating, had become pretty well standardized.

The use of fixed ammunition with projectile and propellant combined in a single brass case became the general practice for field artillery of light and medium calibres, supplanting the old method of loading powder in cartridge bags behind a separate projectile. In moderately heavy calibres the projectile was loaded first, followed by the case containing the powder. This was known as separate loading. For the heaviest guns, bag loading, with the naked projectile followed by a number of cylindrical powder-filled bags, continued to be accepted procedure.

FOURTH PERIOD (1880–1940)

This was the era of the all-steel gun (*see* fig. 5, C), smokeless powder and mechanically controlled recoil. Great changes were witnessed but they were relatively less epochal than those recorded during the period just ended. There were comparatively few innovations; in general, ordnance matériel merely became "bigger and better." Cast steel was generally replaced by forgings for gun tubes and reinforcing hoops, though some "monobloc" guns (of a steel tube forged or cast in one piece plus a screwed-on breech jacket) were being produced (*see* fig. 5, D). The addition of small amounts of other metals (nickel, molybdenum, etc.) to batches of steel while still in the crucible, combined with improved methods of casting, forging and heat treating, produced alloys with highly improved physical characteristics and permitted the construction of guns which would withstand more powerful charges and achieve correspondingly greater ranges than had their predecessors. By World War I, the conventional field gun of about 3-in. bore was reaching out to around 9,700 yd., the 6-in. piece to about 17,700 yd. (By the time of World War II, figures for comparable pieces were 14,000 and 25,000 yd., respectively.) Following World War I a new procedure was introduced for producing gun tubes by a process of centrifugal casting (*see* fig. 7), then bore-hardening them by "autofrettage" (compression within a closed container by the action of water introduced under terrific pressure; *see* fig. 6). These methods were increasing in popularity as World War II approached. Smokeless powder as a propellant for both small arms and cannon projectiles appeared in 1886 and was in general use for military purposes by 1900. Lengths of gun barrels increased from the optimum of 18 calibres suggested by the U.S. ordnance manual of 1861, to 50 calibres and more. Muzzle velocities up to 3,000 ft. were attained, though in general these did not exceed 2,500 foot seconds. An exception was afforded by the German guns bombarding Paris in 1918. With a bore of 8.26 in., and a barrel more than 100 ft. long, these launched their projectiles to distances up to 75 mi. with muzzle velocities of 5,500 foot seconds and breech pressures ranging to 70,000 lb. per square inch, 30,000 to 40,000 lb. above standard practice. Another ordnance achievement of that war was the German "Big Bertha" 42-cm. (16½ in.) mortar-howitzer, specimens of which destroyed the forts at Liège and Namur, the explosion of a single shell producing destructive effects previously unimagined. For their part, the Allies perfected and employed with much success on the western front railway artillery in calibres up to 16 in., while, by reason of the long period of stabilized warfare on that front, both sides developed and used extensively trench mortars in calibres of 3 in. to 240 mm. (9.45 in.).

In the years that followed, the rapid expansion of air power caused marked changes in the ordnance picture. It became necessary to invent and produce devices to detect oncoming planes at considerable distances, to track them when once located and to compute automatically and feed electrically to gun batteries the necessary firing data, including height, speed and slant range of the target. To reach out for the constantly higher and faster flying planes of the enemy, quick-firing anti-aircraft guns of calibres from 37 mm. to 120 mm. (1½ in. to 4.7 in.) with vertical ranges up to 56,000 ft. were designed and fabricated. The rapid evolution of the tank, which during World War I had been little more than a mechanical curiosity, called for special cannon for installation on these vehicles and on motor gun carriages, also of others for anti-tank use, not to speak of protective armour for the behemoths that were already under development. Aircraft bombs of increasing size and power were produced, and by the same token the usefulness of heavy guns in fixed installations such as coastal defenses decreased to the vanishing point.

Propellants of the Fourth Period.—Black gunpowder ceased to be used as a propellant, though small quantities were employed

as igniters in the now standard smokeless loadings and to expel the contained balls from shrapnel shell. Coating of individual grains with deterrent compositions (to retard the rate of burning), and the production of grains in the sizes and shapes found by experiment to be most efficient for a gun of a given type, permitted a considerable degree of control over speed of burning and, as a consequence, over chamber pressure and muzzle velocity.

Projectiles of the Fourth Period.—During the first few years of the period explosive charges for projectiles consisted chiefly of picric acid under various names (lyddite, melinite, shimose, etc.) and during the latter years of trinitrotoluene (T.N.T.), but by World War I dozens of satisfactory explosives were available, and of course even more as World War II approached, although methods for mass producing more than a few of these at reasonable cost were yet to be developed. Time fuzes which had originally incorporated a powder train to burn for a predetermined number of seconds were giving way to others mechanically actuated and more efficient in performance. New, speedier and cheaper methods of producing ammunition components were evolving as the 1930s ended, and substitutes for metals difficult of procurement in time of war were being exploited. Appropriations by major powers for ordnance matériel, fallen to near-zero in the period following World War I, were being voted in amounts considered fantastic, but which, by comparison with those of the war years to follow, were little more than niggardly.

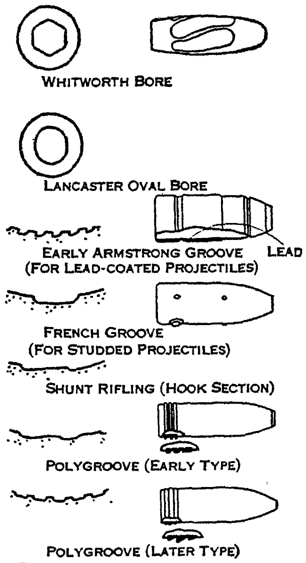


FIG. 10.—FORMS OF RIFLING

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(C. GD.)

FIFTH PERIOD: THE ATOMIC-ELECTRONIC ERA

The period after 1940 saw most of the nations of the world engulfed in World War II (1939–45), followed by the so-called "cold war," the fighting in Korea in the early 1950s and a prolonged struggle in Indochina. During the decade of the 1940s the supply of weapons to military forces became for a time the primary business of mankind. Standard types of small arms and artillery pieces were produced in great quantities, and a host of new and improved devices was brought forth. Rockets, guided missiles, recoilless weapons, fire bombs, giant tanks—in all these fields there were striking new developments. Most awe-inspiring of all was the development of the atomic bomb, followed by the vastly more potent hydrogen bomb in the early 1950s.

Research and Development.—During the Napoleonic era it was often said that victory in war belonged to the side with the big battalions. By the time of World War I (1914–18), when huge quantities of guns and ammunition were needed, this maxim was revised to say that victory belonged to the side with the big factories. During World War II (1939–45), when the full force of scientific knowledge was applied to the development of weapons, it was commonly said that victory belonged to the side with the big laboratories. As the 20th century passed its mid-point, intensive application of science to war purposes had resulted in the development of such a host of weapon types that a mere listing of the new devices would fill a large volume.

All major powers in World War II attempted with greater or less success to mobilize their scientific resources for the development of new and improved ordnance. The term "research and development" rose to a position of prominence equal to the older military terms such as "supply," "strategy" and "intelligence." Exchange of scientific information regarding new weapons among allied nations became as important as that concerning the strength and disposition of forces in the field. In Germany, Hitler dramatized the work of his military research scientists and attempted to raise the morale of his people and strike terror in the hearts of his enemies by repeatedly promising that new secret weapons would soon appear in the hands of German forces to turn the tide of battle.

Research and development on new military weapons are usually long and arduous. Ideas seldom if ever spring full-blown from the mind of an imaginative inventor. Like their counterparts in civilian life, they are usually the products of years of patient study and experiment in laboratories and proving grounds. Often the motivating force that starts the train of research is the appearance of a new enemy weapon which must be countered. More often new devices appear as the result of years of effort to achieve greater fire power, increased mobility or better protection against weapons long known to be in possession of the enemy. Ordnance research includes both basic research—the discovery of new scientific knowledge—and applied or technical research, which is concerned with the application of existing knowledge to a specific use. It requires laboratories and firing ranges equipped with a bewildering array of ingenious weighing and measuring instruments, high-speed cameras, wind tunnels and electronic calculating machines. Once a working model of a new weapon is designed it must be improved or developed as its deficiencies become apparent through severe proving-ground tests. For long-range weapons such tests are conducted on tracts of uninhabited land, some of which cover thousands of square miles. Finally, ordnance research must extend also into the realm of production, for a weapon that cannot readily be produced in quantity with available raw materials has limited military value.

Economy in Manufacture.—In the manufacture of military arms and equipment every major power is forced to practise economy in the use of materials, machine tools and manpower. Efforts are made to devise the most efficient manufacturing techniques, for the demands of the military forces are so great that no nation can afford to waste its productive power. This is particularly true in time of war, when the nation may be suddenly cut off from its normal overseas sources of supply and when a large proportion of its manpower must serve in the armed forces.

Among the major powers engaged in World War II, perhaps the most critical metal shortage, as far as arms manufacture was concerned, was in copper. For many years the standard material for cartridge cases around the world had been brass (an alloy of copper and zinc), for it not only possessed the required elasticity and ability to resist corrosion but also was adaptable to mass production. The Germans succeeded in making steel cartridge cases, but in the United States the development of steel cases was less successful. In the late 1940s the U.S. army continued to study the matter and gave close attention to the shaping of steel by the

cold extrusion method used by the Germans rather than by the traditional practice of punch and draw. Another step to conserve copper was the substitution of copper-clad steel for gilding metal (90% copper, 10% zinc) in small arms bullet jackets.

To conserve aluminum, for which there was great demand by the aircraft industry, many changes were made in ordnance matériel. Ammunition chests were constructed of steel instead of aluminum; handles of inspection gauges and other items were converted to plastic or wood; plastic took the place of aluminum in mortar fuzes. Application of the die-casting process to manufacture of aluminum parts yielded substantial savings of aluminum, for it made possible the use of secondary scrap metal and saved both labour and machine time. The design of weapons to speed production, reduce cost and save labour and machine time is strikingly illustrated by the U.S. army's submachine gun M3, made largely of steel stampings instead of finely machined parts and costing only one-third as much as the pre-1940 model.

One of the most significant developments of the period following World War II was the steady growth in the use of powder metallurgy. In this process the metal is reduced to powder (sintered) and is then pressed into the desired shape. Both the United States and Germany used sintered-iron rotating bands for artillery shell during the war and produced millions of small arms ammunition components from iron and steel powders and from tungsten carbide.

Small Arms.—The basic infantry weapon of the U.S. army in World War II and in Korea (1950–53) was the calibre .30 rifle M–1, popularly known as the Garand rifle after its inventor, John C. Garand, an engineer at Springfield (Mass.) armoury. It is a rugged, comparatively light-weight, semiautomatic, gas-operated weapon. The British army used the calibre .303 bolt-action Enfield rifle in World War II, the Germans a 7.92-mm. (.312-in.) bolt-action Mauser rifle and several models of 7.92-mm. semiautomatic rifles. In 1951 the U.S. army announced that it had developed a calibre .30 rifle weighing less than the Garand, capable of semiautomatic or full automatic fire and using a new lightweight cartridge. For any such weapon, it should be noted, only brief bursts of automatic fire are possible because of the small magazine. The British army meanwhile had developed a calibre .280 rifle that rivalled in effectiveness the new U.S. weapon. The standard shoulder arm of the Soviet army was the 7.62-mm. (calibre .30) bolt-action carbine that would be classed as a rifle in the United States. For service and rear-area troops the U.S. army adopted the semiautomatic calibre .30 carbine during World War II to replace the pistol, and later introduced a modified version capable of automatic fire. For the same purpose the German army used a 9-mm. machine pistol and a 7.92-mm. carbine. The U.S. Browning automatic rifle (B.A.R.) is a fully automatic calibre .30 weapon that weighs, with magazine and bipod, less than 20 lb. Its German counterpart was the 7.92-mm. automatic rifle.

Both rifles and carbines may be equipped with bayonets for hand-to-hand combat and with grenade launchers to give the foot soldier added striking power. Anti-tank and antipersonnel rifle grenades were used by all major powers in World War II. For use against tanks, a shaped charge grenade (*see* below) is effective at close range. White phosphorous rifle grenades may be used for setting up a smoke screen or for their physiological effect, and smoke grenades of various colours are employed for signalling.

The flame thrower is a fearsome weapon that employs compressed gas to project a stream of burning fuel into caves or pillboxes to burn, blind or suffocate the enemy. The portable unit is carried and fired by one man, usually under protection by other soldiers who cover the enemy with small-arms fire. The flame thrower is fired in short bursts of two or three seconds each to a range of about 100 ft. As early as 1942 the British mounted heavy flame throwers with longer range and greater fuel capacity on Churchill tanks.

In World War II the famous calibre .45 submachine gun known as the Tommy gun was supplanted by a cheap, mass-production gun (M3) commonly called the grease gun because of its similarity in appearance to the tool used to lubricate automobiles. The U.S. counterpart of the British Sten and German Schmeisser, it weighs only eight pounds and can fire at a rate of about 400 rounds per minute. Its barrel and bolt assembly can readily be replaced to permit firing the 9-mm. pistol cartridge common in Europe. The British army uses the Bren calibre .303 light machine gun as well as other types such as the Lewis, Vickers and Hotchkiss. The Soviet army is supplied with a 7.62-mm. submachine gun under the name of machine pistol. Machine guns of calibre .30 and .50 (both air-cooled and water-cooled) are used by ground troops to provide a heavy volume of fire at comparatively short range. The calibre .50 water-cooled gun of the U.S. army weighs about 100 lb., has a rapid rate of fire and is often used as an anti-aircraft weapon. The standard machine gun of the German army in World War II was the 7.92-mm. M.G.34 that could be used for anti-aircraft fire as well as against ground targets. The Soviet army employs three air-cooled machine guns, a light 7.62-mm. company machine gun, a medium 7.62-mm. Goryunov (named for its designer) and a heavy 12.7-mm. (calibre .50) that may be detached from its wheeled mount and set up for anti-aircraft fire.

Aircraft Armament.—This is a special field with distinctive requirements stemming from the fact that weight and space factors are of great importance in combat planes. The extremes of temperature encountered in high-altitude flight must also be considered in designing aircraft weapons. As the high speed at which planes travel means that the time gun sights are on the target is often only a fraction of a second, automatic weapons with high cyclic rates are used to increase the probability of scoring a hit. The weapon most used on British and U.S. planes is the air-cooled calibre .50 aircraft machine gun. Powerful enough to cripple an opposing plane if it strikes a vital spot, and effective against certain ground and naval targets as well, it has a cyclic rate of more than 1,200 rounds per minute. A bomber can carry more than a dozen such weapons plus a large supply of ammunition (including incendiary and tracer rounds) to give it all-round protection. Fixed aircraft guns are mounted in a fixed position, as in the wings or nose; they are aimed by manoeuvring the plane and fired by remote control. Flexible guns are mounted so they may be swung on a pivot to aim at their targets.

The 20-mm. automatic aircraft cannon used by the British and U.S. air forces in World War II and favoured by the U.S. navy in the postwar years weighs only a little more than 100 lb. and fires at a rate of 800 shots per minute. Both Germany and Japan made use of similar 20-mm. weapons. The 37-mm. aircraft gun weighs much more and has a correspondingly lower rate of fire. The largest gun used in aircraft during World War II was the 75-mm. aircraft cannon, but the U.S. army also developed a 105-mm. aircraft gun. Rocket launchers (*see* below) are mounted on planes for both air-to-air and air-to-ground attack.

In the Korean war the predominant weapon on planes of the United Nations was the calibre .50 aircraft gun. To meet the challenge of supersonic jet planes, aircraft guns firing at the rate of several thousand rounds per minute were reported to be under development. The Russian MIG–15 planes were armed with a variety of larger-calibre, slower-firing weapons ranging in size from the calibre .50 to the 37-mm., including a 23-mm. gun with a cyclic rate of 700–800 rounds per minute. Many factors, particularly rate of fire and weight of gun and ammunition, are considered in assessing the relative value of small and large aircraft weapons.

Artillery.—As noted earlier, artillery weapons are classified according to barrel lengths as guns, howitzers or mortars, although the lines between the three types are not sharply drawn. World War I witnessed the development of a variety of light mortars, and weapons of this type saw much service in World War II and in Korea. Most infantry mortars have smooth bores and fire fin-stabilized projectiles, but the 4.2-in. United States mortar has a rifled bore. Because of their high angle of fire, mortars are used to reach targets behind hills or to lob projectiles into trenches. Broadly speaking, both mortars and howitzers are lighter and more easily manoeuvred than are guns.

Large permanent gun installations such as those in the Maginot line or in coastal defense batteries became outmoded during World War II, for they could too easily be attacked by aeroplanes or by-passed by mobile ground forces. In a war of rapid move-

ment, mobility became a prime consideration, and the older wooden-wheeled, horse-drawn field artillery weapons were redesigned and fitted with rubber tires, to be towed by trucks or tractors. To cope with heavily armoured tanks mounting powerful guns, all major powers developed special anti-tank guns (ranging upward from the 37-mm.) and self-propelled artillery. As the German 88-mm. anti-aircraft gun had been used as an anti-tank weapon dealing punishing blows to U.S. and British tanks in North Africa, a 90-mm. high-velocity gun to match the dreaded 88-mm. was put into service by the U.S. army. British and U.S. troops in North Africa also used a 105-mm. howitzer motor carriage nicknamed the "Priest" from its pulpitlike appearance. Larger gun motor carriages mount 3-in. and 90-mm. guns.

The field artillery of the U.S. army includes the 75-mm. pack howitzer specially designed for easy transport by pack animals; this weapon can be dropped by parachute from aeroplanes either assembled or unassembled. The 105-mm. howitzer is so widely used that it earned the title of "work horse" of the U.S. army. Mounted on a two-wheeled carriage, it can be towed by a truck or tractor or dropped by parachute from an aeroplane. The 155-mm. howitzer and the 155-mm. gun ("Long Tom") are used on towed mounts or on motor carriages. In the heavy artillery class are guns and howitzers of 8-in. (203-mm.) and 240-mm. sizes. The 8-in. gun fires a somewhat lighter shell as far as 20 mi. The mortars used by the U.S. army in the 1950s were the 60-mm., 81-mm., 105-mm., 155-mm. and 4.2-in. During World War II a 914-mm. ($36\frac{1}{4}$-in.) mortar known as "Little David" was developed but not used in combat.

German artillery in World War II included a similar range of weapons, from the 75-mm. mountain howitzer to the 540-mm. mortar used against Stalingrad. The most famous was the 88-mm. triple-threat gun that could be used against aircraft, tanks or ground troops. To achieve high velocity in anti-tank guns the Germans developed several tapered-bore weapons such as the 28/20-mm., 42/28-mm. and 75/55-mm., but they were not notably successful. Modern Russian artillery ranges from the 76-mm. mountain howitzer and the 76-mm. self-propelled gun to two huge howitzers of 280-mm. and 305-mm. bore. In addition to light and medium mortars the Soviets also employ heavy mortars ranging from the 107-mm. mountain mortar up to the 160-mm. Russian artillery pieces lack the refinements found in British-U.S. weapons, but they are rugged, simply constructed and very effective. The artillery used by the Chinese Communist army in Korea was a mixture of weapons made in China or the Soviet Union and weapons captured from the Japanese, the Chinese Nationalists and United Nations forces.

A new type of weapon developed during World War II and extensively used in Korea was the recoilless rifle. Ordnance designers had long dreamed of creating a weapon that would have no "kick," or recoil, and would therefore need no heavy recoil-absorbing mechanism. The dream was realized by designing a weapon that permits some of the propellent gases to escape through exhaust ports in the breech, thus giving the weapon a forward thrust equal to the normal recoil. Germany developed 75-mm. and 105-mm. air-borne recoilless weapons, and the U.S. army adopted powerful light-weight recoilless rifles of three calibres, 57 mm., 75 mm. and 105 mm. The 57-mm. rifle, weighing less than 50 lb., can be handled by one man as a shoulder weapon and may be classified under small arms. The 105-mm. was developed after the war to be mounted on a Jeep or fired from the ground. Recoilless weapons are characterized by their simplicity, lightness, vented breechblocks, perforated cartridge cases and pre-engraved shells (*i.e.*, with rotating bands cut to fit rifling). One of the greatest drawbacks to their tactical use is the rearward blast that betrays their location and makes them unsuitable for use in bunkers or pillboxes.

The most dramatic new artillery piece revealed by the U.S. army in the post-World War II years was the 280-mm. gun capable of firing both conventional and atomic shells. The first firing of an atomic shell occurred on May 25, 1953, at the Atomic Energy commission's proving ground near Las Vegas, Nev. The atomic gun has a range of about 20 mi. and is fired by a nine-man crew. It is carried suspended between two cabs, front and rear, that can transport their load on highways at a speed of 35 m.p.h. The complete unit ready for travelling weighs 85 tons and has an over-all length of 84 ft., 2 in. The entire carriage is balanced on a turntable to permit traverse of 360°. The projectile and powder charge are loaded into the breech by means of a hydraulic power rammer, though loading may also be done by hand.

Anti-aircraft artillery achieved a position of great importance during the first half of the 20th century as the aeroplane came into its own as an engine of war. Although calibre .50 machine guns on multiple mounts were effective in downing planes or forcing them to keep at a safe distance, the trend of development was toward more powerful long-range weapons such as the 20-mm. automatic cannon, the 25-mm. Japanese anti-aircraft and anti-tank gun and the 40-mm. Bofors gun, all of which have been widely used, along with the 37-mm. anti-aircraft gun. The 40-mm. gun was designed in Sweden and adopted by many nations. The model used by the U.S. army for anti-aircraft defense is air-cooled, fires at the rate of 120 rounds per minute and is accurate up to about three miles. The U.S. navy employs a water-cooled version of the 40-mm.

Three larger guns, the 3-in., 90-mm. and the 120-mm. "Stratosphere," were adopted by United States forces for defense against high-flying bombers. Germany employed 105-mm. guns for this purpose; the Japanese used 100-mm. and 120-mm. types. The most baffling problem in the use of such weapons is fire control, for they must be used against planes flying at great speeds and at heights of 30,000 ft. or more. Height finders and complex instruments known as directors or computers make the intricate calculations needed to aim the gun properly. As it is virtually impossible to score a direct hit on a high-flying plane, artillery shells are set to explode when they reach the estimated altitude of the aeroplane.

The most significant advance in anti-aircraft ammunition during World War II was the development of the V.T. or proximity fuze that causes a shell to explode when it comes within a predetermined distance of its target. Proximity fuzes contain a miniature radio sending and receiving apparatus that explodes the shell when the radio signal is reflected from the target (or other solid object). Proximity fuzes played an important role in defending ships against air attacks, countering the German "buzz bomb" attacks on England in 1944 (*see* below), and later in ground warfare on the continent.

In 1953 the U.S. army released information on a new automatic anti-aircraft gun called the "Skysweeper." A 75-mm. weapon, it has a built-in radar for tracking hostile planes and a computer that automatically plots the range, speed and course of the target plane. It fires $11\frac{1}{2}$-lb. high-explosive shell equipped with proximity fuzes at a rate of 45 per minute. It can detect approaching planes 15 mi. away and attack targets as distant as 4 mi. The entire unit weighs ten tons and can be towed by tractor or transported by plane.

Artillery Ammunition.—The best-known types of artillery ammunition are described as high explosive (H.E.), armour-piercing (A.P.), high-explosive anti-tank (H.E.A.T.), canister, smoke, illuminating or chemical. Some artillery shells are made to be stuffed with propaganda leaflets. In World War I shrapnel ammunition consisting of a shell filled with steel or lead balls and an expelling charge was widely used but became obsolete as high-explosive shell fragments were found to be more effective. An improved canister shell that bursts its casing in flight and scatters small but lethal steel missiles by centrifugal force was used in Korea by United Nations troops to combat the "human wave" tactics of the Chinese Communists. Unlike the older shrapnel, canister contains no chemical expelling agent.

A round of high-explosive ammunition is composed of a steel shell filled with an explosive, a fuze to detonate the explosive at the proper moment and a brass or steel cartridge case containing the propellent powder. There are also many other small but essential elements such as detonators, primers, boosters, adapters and safety devices. The fuzes on artillery shells are delicate and complicated mechanisms designed to detonate the explosive charge

upon impact or after a short delay. Most fuzes are placed in the nose of the shell and are called point-detonating, but some, particularly those used in shells designed for penetrating armour or concrete, are in the base. The explosive train in the fuze of an artillery shell consists essentially of three elements: a small quantity of very sensitive explosive, known as the primer, actuated by a firing pin; a less sensitive detonator that amplifies the weak primer impulse; a still less sensitive booster that amplifies the primer-detonator flash sufficiently to cause full detonation of the comparatively insensitive high explosive. (An explosive train is also used in artillery cartridge cases to ignite the propellent powder.)

Another type of ammunition utilizing the "shaped charge" or "hollow charge" principle came into use during World War II for penetrating armour. The standard A.P. round depended for its effectiveness on high velocity and use of a core of very hard material, such as tungsten carbide. The shaped-charge projectile was based on the so-called Munroe effect noted by a U.S. chemist, Charles E. Munroe, in the 1880s. The explosive charge in this type of ammunition is designed with a cone-shaped cavity (base forward), lined with metal, that focuses the effect of the blast on a central point. A remarkable feature of this type of ammunition is that its penetrating power is not a function of its velocity. It is used with low-velocity weapons such as the bazooka, with bombs or even with hand grenades and demolition charges.

Hand grenades are among the simplest types of ammunition, consisting basically of a steel case filled with a high-explosive charge detonated by a short-delay fuze. The traditional "pineapple" type (so called for its shape and outer case markings) is of a convenient size for throwing by hand. Other types are of many different shapes and sizes including the widely used "potato masher" grenade. Hand grenades are cheap, expendable and easy to use. The Soviet army is known to place great emphasis on them. In Korea the Chinese Communists made liberal use of hand grenades as offensive, defensive and anti-tank weapons.

Land mines are a special type of ammunition designed to be buried a few inches below the surface of the ground and to explode when the enemy unwittingly applies pressure to the ground above them. Instead of being buried they may be hidden and equipped with trip wires or other ingenious actuating devices that give them the name "booby trap." Mines fall into two classes—small antipersonnel mines and more powerful anti-tank mines. Both types may be used in areas being evacuated to hinder the enemy from occupying the ground, or they may be hastily planted around a newly won position as protection against counterattacks. Mines are sometimes equipped with antidisturbance devices that cause them to explode if efforts are made to remove them. Controlled mines are detonated by concealed observers while automatic mines are set to explode after a predetermined interval. To foil electronic mine detectors that reveal the presence of buried metallic mines, all major powers use nonmetallic mines made of wood, plastic or pottery.

Underwater mines have been widely used for many years for the defense of harbours. They are employed against surface vessels or submarines and some are placed in the shallow water along beaches to destroy small landing craft. The controlled mines used for harbour defense consist essentially of a buoyant case filled with an explosive, a firing device connected to a shore station, and a cable reaching to an anchor resting on the bottom of the harbour. A new type of contact mine, the magnetic mine, was developed in Germany and first used against the British in the fall of 1939. These mines contained a firing mechanism that was activated by the magnetic field surrounding a steel ship and did not depend upon bumping by the ship. The effectiveness of the magnetic mine was eventually nullified by the development of means to reduce the magnetic fields of naval vessels, a process known as degaussing.

Two main types of torpedoes (nicknamed "tin fish") are used by naval forces to attack enemy surface vessels or submarines. The first is the straight-running torpedo that maintains the course on which it is launched until it reaches its target or completes its run. The other is the target-seeking torpedo equipped with an acoustic system that adjusts its course to assure hitting a hostile submarine or surface vessel, even though the target vessel takes evasive action. Both radio-controlled torpedoes and torpedoes guided by the magnetism of a ship's hull have been devised. Launched by surface vessels, submarines, aeroplanes, helicopters or lighter-than-air aircraft, torpedoes are large and complicated mechanisms that carry several hundred pounds of explosive, have a long range and travel at high speeds.

Bombs.—Conventional bombs (excluding atomic or hydrogen bombs) are generally classified under three headings—demolition, fragmentation and chemical—although other terms are also in use such as general purpose (G.P.), pyrotechnic, incendiary or semi-armour-piercing (S.A.P.). Demolition bombs are designed to destroy the target by the blast effect of their high-explosive charge. They are the largest bombs, for they must carry as much explosive as possible, and have light cases. U.S. forces in World War II used demolition bombs ranging in size up to 4,000 lb., while the British used a 12,000-lb. "Tall Boy" bomb and developed a 22,000-lb. "Grand Slam" bomb. Depth bombs are a special type of high-explosive bomb used for attacking submarines or other targets under water, the damage being caused by the hydrostatic pressure created by the blast of the bomb. The depth bomb is larger than the depth charge, popularly called "ash can," hurled from surface vessels. The British developed a multiple mortar device nicknamed "Hedgehog" for launching depth bombs from destroyers, and the United States adopted a rocket launcher for this purpose with the name of "Mousetrap."

Fragmentation bombs are made with relatively thick cases that break into pieces when their small explosive charge is detonated and thus fill the air with flying steel fragments. They are most effective against such targets as enemy troops or parked planes when detonated a short distance above the ground. To achieve this effect and to permit low-flying launching planes to escape damage, they are sometimes equipped with parachutes that check their rate of fall. The so-called "butterfly" bomb is equipped with metal wings that unfold after the bomb is released, retard its fall and arm its fuze mechanically. In 1945 bombs with proximity fuzes (*see* above) were used by the Allies in the Pacific and in Europe to provide highly destructive air bursts.

Chemical bombs may be filled with chemical agents such as a smoke-producing substance, an incendiary material or an irritating or poisonous gas. They contain a bursting charge that disperses the chemical agent on impact. The increased use of incendiary bombs was one of the outstanding new developments in aerial warfare during World War II. Filled with thermit (aluminum and iron oxide) or magnesium, these bombs were rained down upon London during the blitz of 1940 and caused untold damage. In the war against Japan the United States used a new type of incendiary bomb filled with a gasoline jelly known as napalm. In its gelatinous state the gasoline burns for a long time and readily adheres to the walls of buildings. The napalm bomb is considered by many to be the single most devastating weapon used against the Japanese.

On a lonely desert area in New Mexico, in the semidarkness of early morning, July 16, 1945, the first atomic bomb exploded with a blinding flash and deafening roar. (*See* ATOMIC ENERGY.) The energy released was estimated to equal that of 20,000 tons of T.N.T. The new bomb was the product of nearly five years of intensive work by research scientists and engineers enlisted in one of the biggest military gambles in modern history. Starting in 1940 with little more than a scientific theory, British and U.S. scientists, significantly aided by refugee scientists from various European countries, telescoped a generation of research into a few short years and provided the Allied nations with a new weapon of awe-inspiring power. The official government press release described it as "a revolutionary weapon destined to change war as we know it, or which may even be the instrumentality to end all wars."

Only two atomic bombs were dropped in combat during World War II. The first descended on the Japanese city of Hiroshima on Aug. 6, 1945, and the second on the city of Nagasaki on Aug. 9. The effect in both instances was devastating and was credited with

speeding the Japanese decision to surrender before Allied ground troops had set foot on the Japanese home islands.

No sooner had the bombs been dropped than discussion was begun of means to outlaw their use in the future. The matter was taken up by the United Nations, but differences in viewpoint between the Soviet Union on the one hand and the United States and Great Britain on the other forestalled any progress. In 1946 the United States conducted extensive tests at the Bikini atoll in the Pacific to determine the effect of the bomb on naval vessels. In 1950 the U.S. announced that evidence was at hand to show that an atomic explosion had occurred in the Soviet Union. None of the belligerents used atomic bombs during the Korean war (1950–53).

Immediately after the atomic bomb became a reality scientists began speculating on the possibility of producing a vastly more powerful hydrogen bomb with explosive force equal to millions of tons of T.N.T. In Aug. 1953 the Soviet government announced that it had developed and tested a hydrogen bomb, and a few days later the United States government stated that it had learned through its long-range detection system that a hydrogen bomb had in fact been tested in the U.S.S.R. on Aug. 12. At the same time the United States government revealed that it had tested hydrogen bombs in 1951 and 1952.

Explosives and Propellants.—During World War II, as during preceding years, the most widely used explosive for ammunition was T.N.T., which could be employed by itself or in combination with other explosives. Its production was greatly increased by discovery of the reverse nitration process that doubled the capacity of existing T.N.T. plants, and its blast effect was enhanced by mixing T.N.T. with aluminum powder and other materials. The British used minol, a mixture of aluminum and amatol, and tritonal, a mixture of aluminum and T.N.T., in 4,000-lb. bombs and found they produced an area of devastation nearly twice that of bombs filled with T.N.T. alone. For certain applications T.N.T. was superseded by other explosive compounds such as cyclonite or R.D.X. (British abbreviation for research department explosive), haleite, ednatol and pentolite. Known long before 1940 but not employed as an explosive filling for shells because it was too sensitive, R.D.X. assumed a position of major importance as a military explosive only after a method for combining it with desensitizing agents was devised and a new mass-production process worked out. During World War II R.D.X. compositions were produced—composition A for shell loading, composition B for loading of bombs and composition C for demolition charges. Because its under-water blast effect is nearly double that of T.N.T., R.D.X. composition B mixed with powdered aluminum was widely used by British and U.S. naval forces under the name of torpex. Haleite (named for G. C. Hale of Picatinny arsenal), also known as E.D.N.A. (ethylene dinitramine), was used increasingly during the 1940s as improved processes for its manufacture were developed. For shaped charges (*see* above) a combination of T.N.T. and E.D.N.A. known as ednatol was adopted, and some use was also made of pentolite, a mixture of T.N.T. and PETN (pentaerythritol tetranitrate). As pentolite has more brisance (shattering power) than T.N.T., is readily detonated and can be easily loaded, many nations use it as a standard charge for bombs, land mines, rockets and high-explosive antitank shells.

As distinguished from high explosives, a propellant is a substance with a lower rate of combustion used to propel projectiles from weapons. The ideal propellant is one that gives high velocity, causes little barrel erosion, produces neither flash nor smoke, is easy to manufacture and is nonhygroscopic; *i.e.*, does not readily absorb moisture from the air. The United States uses single-base propellent powders, composed primarily of nitrocellulose, while most other nations use double-base powders containing nitroglycerine as well as nitrocellulose. The standard British propellant is cordite, a double-base powder. British forces also made some use of nitroguanidine in World War II, and the United States forces took an interest in it also in spite of the noxious ammonial fumes that had earlier caused it to be discarded. An improved manufacturing process for producing nitroguanidine was developed using less hydroelectric power than the process used in Canada during World War II.

Rockets.—As the early part of this article makes clear, war rockets are not modern inventions but weapons of ancient lineage which, after being neglected during the late 19th and early 20th century, reappeared in great numbers and in diverse forms during World War II. The Russians pioneered in firing anti-tank rockets from planes and in bombarding ground targets with massed rocket weapons. The British employed rockets for anti-aircraft and antisubmarine defense as early as 1940. Germany developed a multiple-tube rocket launcher to bombard enemy troops and in 1944 launched one of its most spectacular secret weapons, the long-range V-2 rocket (*see* below), against England. Later than other nations, the United States developed a wide range of ground and air rocket weapons.

Perhaps the most publicized weapon carried by Allied ground troops during World War II was the 2.36-in. bazooka, a rocket launcher firing a shaped-charge round with which an infantryman could knock out a tank if he hit a vital spot at close range. It consisted essentially of a six-foot tube, open at both ends, and a rocket projectile, and took its name from its resemblance to the musical instrument played by the comedian Bob Burns. To escape the backblast the operator did not hold the bazooka as he would a rifle but rested the middle of the tube on his shoulder. In the Korean war the 3.5-in. so-called superbazooka appeared for use against heavily armoured tanks.

The German counterparts of bazooka-type weapons were the light 88-mm. rocket launcher known as *Panzerschreck* (Tank Terror) or *Ofenrohr* (Stovepipe) and a heavy 88-mm. mounted on a two-wheel carriage. Among the many other rocket weapons employed by the Germans were the six-tube 105-mm. launcher mounted on a two-wheel carriage, a ten-tube 150-mm. launcher mounted on a half-track armoured vehicle, a five-tube 210-mm. launcher and a *Propagandawerfer* for firing leaflets. The German *Panzerfaust* weapons were recoilless grenade launchers but they did not fire rockets. For ground fighting where volume of fire was more important than accuracy, the Russians used rockets more than any other nation. Their two standard rocket launchers are the 16-tube 132-mm. and the 12-tube 300-mm. weapons mounted on trucks. Both England and the United States experimentally mounted banks of launching tubes on tanks.

As early as 1942 the Soviet air force used rockets to attack ground targets, particularly tanks, and in 1943 the Germans attacked Allied bomber formations with plane-to-plane rockets. Meanwhile the U.S. army adopted a 4.5-in. aircraft rocket launcher firing a rocket stabilized by fins that unfolded after the projectile left the tube. The U.S. navy developed a 5-in. high-velocity aircraft rocket (H.V.A.R.) nicknamed "Holy Moses" that saw combat use in 1944. The largest U.S. aircraft rocket to see service in World War II was the 11.75-in. "Tiny Tim" that carried an explosive charge of 150 lb. of T.N.T.

Beach barrage rockets fired from landing craft were significant innovations first used by the British in the invasion of Sicily. Continuously fed and automatically fired, each launcher could fire up to 30 rockets per minute, and some rocket ships mounted ten launchers. These small craft had, for brief periods, the striking power of destroyers and were able to saturate beach areas with close-in fire just before assault troops went ashore.

For antisubmarine attacks by aircraft two types of rockets were employed—forward-firing and backward-firing. The former had a long, shallow under-water trajectory suitable for attacking submarines. The latter was a scientific oddity that enabled a fast-flying plane to drop its bomb directly above a submarine instead of taking a long lead to allow for the forward motion imparted to the bomb by the plane. When the retrobomb was shot backward at the same speed as the plane was moving forward it dropped straight down on its target.

With these examples to illustrate the wide range of rocket applications we may consider briefly some of the basic features of modern rocket ordnance. All rockets fall into two classes—the liquid-fuel type such as the German V-2 and the solid-fuel rockets typified by aircraft and artillery rockets. The liquid-fuel type

carries a fuel, such as alcohol, and oxygen in tanks from which fuel lines lead to the combustion chamber. Solid-fuel rockets are powered by the burning of large sticks or grains of smokeless powder.

Rockets also fall naturally into two categories in terms of their means of stabilization in flight. As conventional artillery shell maintain stability in flight by rotation, one class of rockets operating on the same principle is known as spin-stabilized. The spin is imparted by the gases escaping through a ring of nozzles set at an angle to the rocket's longitudinal axis. The other type does not rotate but maintains its stability in flight by means of fins (comparable to the feathers used on an arrow) and is called fin-stabilized. The absence of spin is sometimes an important consideration because shaped-charge ammunition functions best when it does not rotate, but spin-stabilized rockets are easier to handle in the field and are usually more accurate than the fin-stabilized type.

Like other ammunition, rockets require propelling charges, and the development and manufacture of the various types of propellent powders must go hand in hand with the design and production of rockets and launchers. The two broad categories into which powders fall in terms of production methods are solvent and solventless. Both are double-base powders consisting of nitrocellulose and nitroglycerine. In the solvent type, a mixture of volatile solvents (alcohol and acetone) is used to assist in colloiding the nitrocellulose-nitroglycerine mass. After the powder is granulated, the solvents are removed by evaporation. For production of rocket powder in large grains or sticks the solvent method has two drawbacks—the long time required for drying, and the distortion of the grains during the drying period. In the solventless method the powder is colloided by means of heat, pressure and mechanical working and may be extruded by heavy presses into sticks that hold their size and shape. To get the desired burning qualities, sticks of rocket powder are often perforated and formed into unusual shapes—cylindrical, hexagonal, cruciform or star.

When used in weapons of the bazooka type, rockets lack the accuracy of conventional artillery, have much shorter range and far less velocity and do not function properly at extremely high or low temperatures. Their chief advantage is the absence of recoil that permits use of light launchers which are quite mobile and easy to manufacture. The 4.5-in. rocket and launcher, for example, weighs only 55 lb. as compared to 4,000 lb. for a 105-mm. (4-in.) howitzer. For aircraft armament, rockets provide a most useful intermediate weapon with fire power between the small-calibre machine gun and the bomb.

Guided Missiles.—The term "guided missile" covers such a wide range of weapons that only a cursory examination of their basic characteristics is possible in this brief space. Simply stated, a guided missile is a flying bomb or other projectile equipped with a device for directing its flight. The guiding device may be carried within the missile and may be of the preset type that will land the projectile after it has travelled a certain distance over a prescribed course, or of the target-seeking type that will cause it to "home" on a target by heat, radar, light or other form of energy. The controlling agent may be external, permitting guidance by radio from a ground station, an aeroplane or a naval vessel. To achieve guidance, elaborate mechanisms are sometimes used consisting of gyroscopes, servomotors, electronic devices, compasses, altimeters and many others.

Guided missiles are generally classified according to their tactical use as ground-to-air, air-to-ground, air-to-air or ground-to-ground. (Many other terms are sometimes used, as ship-to-shore or sea-to-air.) They may be propelled by conventional aeroplane engines, jet engines, rockets or, as with glide bombs, by force of gravity. They may be launched from the ground, from ships at sea (including surfaced submarines) or from aeroplanes. Long-range guided missiles travelling miles above the earth at supersonic speeds and carrying atomic warheads from continent to continent were regarded by many after the Korean war as the "weapons of the future." Consideration of their potentialities gave rise to much speculation about an era of "push-button warfare" that would render obsolete the piloted aircraft and the ground armies of the past.

Exaggerated claims must, of course, be discounted, but during the decade of 1940–50 guided missiles definitely moved out of the realm of science fiction and became grim military realities.

A simple type of guided missile is the pilotless radio-controlled "drone" aeroplane used for gunnery training, test flights or photo reconnaissance. During World War II old bombers equipped with automatic pilots (gyroscopes and motors that keep a plane on course) were loaded with high explosives and sent crashing against German submarine pens. Glide bombs, nicknamed "glombs," were fitted with wings that caused them to glide earthward and were subject to control by the launching plane. One U.S. type, named "Roc" after the giant mythological bird that dropped boulders on Sinbad's ship, had a television "eye" while another, named "Bat," emitted radar signals that were reflected from its target much as the sounds emitted by bats are reflected to enable these blind creatures to "see." The azon bomb was another type that could be guided to the right or left (*i.e.*, in azimuth only; hence the name "azon") by the launching plane. The razon bomb that could be guided in both range and azimuth and other U.S. missiles propelled by rocket or jet engines came very late in the war.

By far the most outstanding new developments with guided missiles during World War II came out of Germany. In mid-June 1944, just one week after the start of the cross-channel invasion, Germany launched the first V-1 (abbreviation for *Vergeltungswaffe Eins* or Revenge Weapon One) against London. It was a small aeroplanelike missile with a wing spread of 17½ ft., powered by a jet engine (not a rocket) and carrying about one ton of high explosive. As this "buzz bomb" travelled less than 400 m.p.h. at an altitude of 2,000–3,000 ft., and had a range of only 150 mi., British defense forces, using radar, anti-aircraft directors and fighter planes, were able to shoot down the V-1s with increasing success. Early in Sept. 1944 the Germans launched their first V-2 against England. This was a true rocket bomb, larger than the V-1, that travelled so high and fast that interception was impossible. Carrying its own fuel (alcohol) and its own oxygen, it rose to an altitude of 70 mi. above the earth and travelled so fast (more than 3,000 m.p.h.) on its downward plunge through the stratosphere that it reached its target before the sound of its coming was heard. Assembled in an underground factory, the V-2s emerged to trace a flaming path through the European skies and then crash to earth with terrifying explosive effect. German scientists also drew up plans late in the war for a so-called "American rocket" with range sufficient to cross the Atlantic ocean.

After the war's end the United States, Great Britain and presumably the Soviet Union made intensive efforts to build upon the foundation laid by Germany and to develop improved missiles. As early as 1945 the United States established in New Mexico the White Sands proving ground, a desert area more than 100 mi. long and 40 mi. wide, for study and test of captured German missiles and new U.S.-made devices. One of the outstanding events was the test firing at White Sands on Feb. 24, 1949, of a step-rocket—a German V-2 carrying in its nose a smaller 700-lb. rocket known as the Wac Corporal. After riding the V-2 to a height of 20 mi. or more the Wac Corporal automatically broke loose and, powered by its own rocket engine, reached an altitude of 250 mi. Searchers did not pick up any of the pieces of the Wac Corporal from the New Mexico sands for a full year. Many other tests of high-altitude, long-range missiles have been made, including the firing of a V-2 from the deck of an aircraft carrier, the launching from submarines of flying bombs similar to the V-1 and the ascension of a Viking (closest U.S. approach to the V-2) from the deck of a vessel in mid-Pacific to a height of more than 100 mi. on May 10, 1950. In 1953 the U.S. army released information on a new ground-to-air missile named Nike (for the Greek goddess of victory), said to be highly effective against high-flying planes. Launched from the ground by a booster that drops off after the missile attains enough speed, the Nike is steered by ground crews who track the target plane by radar.

Tanks.—The word "tank," originally used as a cover name by the British in 1916, became a part of accepted military terminology to denote a track-laying vehicle usually mounting one powerful

gun and several small-calibre machine guns, and providing all-round armour protection for its crew (*see* TANKS). Tanks are often classified as light, medium or heavy, depending on their over-all weight, or as light-gun, medium-gun or heavy-gun, according to the calibres of their primary weapons. Tanks are distinguished from gun (or howitzer) motor carriages by their fully enclosed and heavily armoured crew compartments.

In 1939–40 the German army startled the world with its blitzkrieg tactics wherein tanks and aeroplanes spearheaded the rapid advance of the infantry. Of the four German tanks used in 1940 (*Panzer* I, II, III and IV) only the Panzer IV carried a 75-mm. gun. They proved to be no match for the heavy Soviet tanks encountered during the invasion of the U.S.S.R. (1941). The Tiger tank used by the Germans in North Africa proved superior to the American Grant and British Churchill tanks. When the U.S. General Sherman appeared it served well until the heavier German Panther came on the scene.

At the time of the attack on Pearl Harbor the United States had a 65-ton heavy tank (M6) in production, but its manufacture was cancelled in favour of medium tanks of the General Grant and General Sherman types. The latter, weighing about 35 tons and in later models mounting a 76-mm. high-velocity gun, was more manoeuvrable than the proposed heavy tank. The 45-ton General Pershing tank with a 90-mm. gun appeared late in the war. Both the Sherman and the Pershing, as well as the light tank, General Chaffee, and the General Patton (M46), a modified General Pershing, saw service with the U.S. army in Korea. The British used the Centurion 50-ton heavy tank mounting a 20-pounder gun. One of the newer U.S. tanks was the Patton 48, a 45 to 50-ton vehicle with a 90-mm. gun, publicly announced in 1952. Another was a heavy tank carrying a 120-mm. high-velocity gun. The third member of the U.S. army's new tank family was a light 26-ton tank mounting a 76-mm. high-velocity gun and nicknamed the Walker Bulldog. The standard tanks of the Soviet army at the time of the Korean war were the T-34, a 35-ton medium tank carrying an 85-mm. high-velocity gun, and 50-ton heavy tanks (JS-1, JS-2 and JS-3) mounting 122-mm. guns. (*See* also AMMUNITION; ARTILLERY; GUNNERY, NAVAL; SMALL ARMS, DEVELOPMENT OF; also articles on individual weapons such as GUN, MACHINE; ROCKETS; etc.)

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ORDOS: *see* SHENSI.

ORDOVICIAN SYSTEM, in geology a term introduced by Charles Lapworth in 1879 to include those rocks—well developed in the Welsh region formerly inhabited by the Ordovices—which had been classed by Sir Roderick Murchison as Lower Silurian and by Adam Sedgwick as Upper Cambrian (*see* SILURIAN). The Ordovician system is of rocks formed in the Ordovician period of time, a span of about 60,000,000 years that ended about 400,000,000 years ago, the duration and age being based on interpretations of the depositional record and on the present state of disintegration of radioactive minerals in associated rocks. The Ordovician period in current classification of geologic time followed the Cambrian period and preceded the restricted Silurian or Gotlandian period.

In the early part of the 19th century all the rocks which lie beneath the Carboniferous limestone were grouped together under the general name of Transition series, and it was not till 1831 that Sedgwick and Murchison made the first serious attempt to reduce them to order. Sedgwick started to work in the Snowdon district, and Murchison began upon the Welsh borders. By 1835 they had advanced so that Murchison gave the name Silurian system to the sequence of rocks with which he was dealing, while Sedgwick called his the Cambrian series. At the time it was supposed that the Cambrian lay entirely below the Silurian. Subsequently it was shown that the upper part of Sedgwick's Cambrian is the same as the lower part of Murchison's Silurian. A prolonged controversy followed which left its effects in some confusion of nomenclature even to the second half of the 20th century. Believing that the Cambrian and Silurian of Sedgwick and Murchison included three natural divisions, Lapworth in 1879 proposed that these be called Cambrian, Ordovician and Silurian. Murchison's terminology was still used to some extent at mid-20th century especially in Germany, the three divisions being called the Cambrian, the Lower Silurian and the Upper Silurian.

The three systems are universally recognized but there are some differences of usage with regard to their precise limits. Most British geologists adhere to a classification, based largely on original definition and structural considerations, in which the base is drawn above the Tremadoc, which includes the zone of *Dictyonema flabelliforme,* whereas in extra-British areas there is general adherence to the Scandinavian practice of placing the base below that zone. There is also some divergence of opinion as to the horizon at which the upper limit should be placed, particularly inasmuch as correlations among the several continents are not conclusive.

The strata composing the system can be classified in several contemporary lithologic facies deposited under differing physical conditions, and inasmuch as these evidence differing environments, each of the lithologies has an associated distinctive fossil assemblage. The lithologies vary continuously, geographically and temporally. Their textures and depositional structures can be related to the velocities of the currents that transported and sorted them and to the depths in which they were laid; their compositions reflect the materials that were carried into their places of deposition and the minerals that were precipitated locally by inorganic or organic processes. (1) Rocks of nonmarine origin include consolidated gravels (conglomerates), sands and clays having particles of sizes streams were incompetent to carry farther, as well as the original fluviatile structures. (2) Marine rocks ordinarily contain some significant organisms that substantiate recognition of origin from interpretation of their textures and structures. They are broadly separable into (*a*) those laid in shallow water, of depth of scores of feet or less, and (*b*) those laid in deeper water where currents and agitation were insufficient to prevent settling of fine particles. Each may be dominantly of inorganic detritus transported from lands, of minerals formed locally by precipitation, or from the accumulation of organisms and organic detritus. Those of shallow-water origin include shelly limestones (coquinas) and calcite sandstones (calcarenites), grading into quartz sandstones, graywackes (quartz-sandy argillites) and shaly and silty argillites deposited in seas receiving detritus eroded from lands; and from areas having limited circulation, dense limestones (calcilutites) and dolomites, and evaporites such as gypsum and salt deposits. Rocks of deeper-water origin pass through dense and nodular, somewhat cherty and argillaceous limestones into dark laminated argillites (black shales) and dense argillaceous limestone interbeds, prevalent in deeply sinking regions in which deposition failed to keep pace with subsidence. (3) There are additional and significant lavas and volcanic fragmental rocks.

Thicknesses are a measure of the subsidence of the earth's surface, fluctuations of sea level and the rate of deposition. The Ordovician rocks of the several facies are distributed in systematic but changing patterns that reflect the structural development within the areas of deposition, as well as the uplift and erosion

of adjoining lands.

The earth had several large, rather stable areas of continental proportions and varying relative elevation (cratons) separated by linear geosynclinal belts of greater mobility. The central parts of the geosynclinal belts had thick sequences of sediments, and volcanic rocks accumulated in rapidly sinking geosynclines (eugeosynclines) that gained detritus from near-by rising narrow islands; the typical Ordovician of Wales is of this facies. Adjoining are belts of nonvolcanic rocks of relatively great thickness (miogeosynclines), commonly decreasing rather rapidly at the margins of the cratons. The thicker rocks of the cratons are principally of shallow-water origin, increasing and diminishing in response to warping movements within their area; deeply sinking local regions occasionally gained deposits of geosynclinal proportions (autogeosynclines). This pattern is disturbed or destroyed as orogenies deform and raise the rocks of the linear geosynclinal belts, streams distributing the detritus into subsiding areas in the borders of the cratons (exogeosynclines).

Life.—The changing distribution and elevations of lands and the depths of the seas not only influenced the lithologies, but controlled physical and organic environments and restricted migration. Thus, Ordovician faunas exhibit changes with time, but also the effects of ecological factors and the isolation of geographic provinces.

The life of the system has several distinctive features; the changes from the older Cambrian and into the younger Silurian are not abrupt but are apparent to those familiar with the refinements of biological classification. Similar contrasts developed within the system not only in successive strata but among varying environments represented in differing present rocks. Few classes of organisms are common to faunas both of quartz and calcite sandstones and calcareous shales deposited in relatively turbid shallow water, and of black shales and dense argillaceous limestones laid in deep water; and such as are represented in each have distinctive families and genera. Trilobites that dominate Cambrian sediments of many lithologies continue in abundance, but become subordinate in numbers to other groups that had been absent or uncommon. Brachiopods, gastropods and cephalopods and later bryozoans, ostracodes, cystids, tetracorals and pelecypods became locally common in the limy and sandy lithologies, the shelly facies. The genera in each class are numbered in scores and hundreds, having smaller or greater temporal (stratigraphic) and geographic ranges; those of abundance in limited stratigraphic range are most useful in classifying and correlating the containing rocks in time. Graptolites, free-floating colonial marine organisms having individuals living in small cups (thecae) along raylike threads or branches (stipes) which when compressed seem like miniature deeply cut saw blades, are present in Cambrian rocks, but abound in some laminated Ordovician black shales; their fragile structures were not destroyed in the quiet and rather sterile environment of the clay deposition. Being free-floating (planktonic), they are more cosmopolitan, having many of the same genera and similar or identical species over the whole earth. The appearance of these forms is in fairly consistent order whether in Britain, North America or Australia, permitting rather confident general intercontinental correlation. They are the preponderant fossils in the black-shale facies and will serve as an example of changing life forms, such as might be repeated for any of many other biologic groups, though not with such world-wide prevalence.

Dictyonema, fan-shaped with connecting bars between the rays, is particularly prevalent in the basal Ordovician of the Scandinavian classification in beds classified as uppermost Cambrian in Britain. *Dichograptus,* with eight rays radiating from a central sac, *Tetragraptus,* two rays spreading from each end of a short bar, *Phyllograptus,* leaf-shaped when compressed but originally having an X-shaped cross section as of two interlocking leaves, and *Didymograptus,* tuning-fork shaped with the cups toward the centre, have wide distribution in the earlier Ordovician. *Nemagraptus,* having many long branches radiating from an S-shaped central rod, appears for a limited time near the middle of the system, with *Climacograptus,* like a single narrow leaf with cups on both sides, *Diplograptus,* similar with the cups more at an angle

to the stem, *Dicellograptus,* two branches diverging very broadly to form a very obtuse inverted V with exterior cups, and *Dicranograptus,* similar but an inverted V with cups toward the inside, having much longer range, some continuing to or into the Silurian. Graptolites abound with changing forms in dark shales of the Silurian system but are rare in younger rocks.

DISTRIBUTION

The rocks of the system are widely distributed but best known where they have been studied most intensely, in northern Europe and North America. Southern Europe has comparatively limited exposure of rocks as old as the Ordovician. In North America the system has been extensively preserved and penetrated by wells in broad areas where the rocks are concealed deeply. Knowledge in other continents is restricted by such factors as sparse surface distribution and severe deformation of the rocks and by the limited study that they have received over broad regions of the earth.

Europe.—The system was originally described from Wales, where it is of thousands of feet of graywacke and shale having thick lava flows and volcanic fragmental rocks, and is rather widely distributed in northern Europe. The northern European shield or craton has relatively thin sections, principally of carbonates, exposed in southeastern Norway, Sweden, Bornholm (Denmark), Estonia and east to Lake Ladoga in the U.S.S.R., and in southern Poland. Geosynclines having greater thicknesses of argillites, graywackes and volcanic rocks are represented in the Caledonide rocks of the northwest Norwegian coast, Scotland and Wales, in a belt from Cornwall and Brittany to western Bohemia and probably along the east side of the Ural mountains. Northwest of the Caledonides are isolated small areas with limestone sections; beyond the geosynclinal belt south of the craton are scattered areas, principally of argillites on the Mediterranean coasts and in the southern Alps.

The section in Britain has been divided into several series having zones with graptolite assemblages named for a distinctive species; authors differ in their delimiting of series, but the geological survey in Great Britain prefers the following classification:

Ashgill:	15.	*Dicellograptus anceps*
	14.	*Dicellograptus complanatus*
Caradoc:	13.	*Pleurograptus linearis*
	12.	*Dicranograptus clingani*
	11.	*Climacograptus wilsoni*
	10.	*Climacograptus peltifer*
	9.	*Nemagraptus gracilis*
Llandeilo:	8.	*Glyptograptus teretiusculus*
Llanvirn:	7.	*Didymograptus murchisoni*
	6.	*Didymograptus bifidus*
Arenig:	5.	*Didymograptus hirundo*
	4.	*Didymograptus extensus*
	3.	*Dichograptus octobrachiatus*
Tremadoc:	2.	*Bryograptus cambriensis*
	1.	*Dictyonema socialis*

The Tremadoc is usually placed in the Cambrian in Britain, conforming to the original definition; authors commonly do not add -ian or -an suffixes to names of series. Many prefer placing zone 6 in the Arenigian and zones 7 to 9 in the Llandeilian.

The Ordovician rocks of Britain were laid in a rapidly sinking volcanic geosyncline that passed from southern Ireland and western Cornwall through central Wales and the Lake district of Northwest England into southern Scotland. Islands on the northwest furnished the principal detritus, for the Arenigian laps over Cambrian and Pre-Cambrian in Anglesey, northwest Wales; and more than 2,000 ft. of Llandeilian and Caradocian in the Girvan district, southwest Scotland, overlaps Arenigian and has coarse sediment, whereas equivalent rocks near the English border to the east are the black shales (Glenkiln and Hartfell) with "condensed section" from the lower Caradocian through the Ashgillian totalling less than 200 ft. There are hundreds of feet of Arenigian lavas and

Ordovician System

British classifications		Southwest Scotland: Girvan	Southwest Scotland: Moffat	Northwest England: Lake district	Northwest Wales	West England: Shropshire	Norway: Oslo district	Sweden: Vastergotland and Oland	Sweden: Skane	Estonia	Czechoslovakia: Bohemia
ASHGILLIAN		Ardmillian: Drummock shale; Shalloch shale; Whitehouse shale, limestone	Hartfell slate	Ashgill shale; Keisley limestone	Conway Castle sandstone; Deganwy shale; Bodeidda shale	*absent*	Upper Chasmops limestone; Isotelus limestones, shales; Trinucleus shale, limestone	Staurocephalus shale; Trinucleus shale	Dicellograptus shale	Saarmoisa limestone; Rakvere limestone	Zdice: ? Kosev quartzite; Kal ur dvur shale, sandstone
CARADOCIAN	CARADOCIAN	Ardmillian: Ardwell shale, sandstone	Hartfell slate	Sleddale: Applethwaite beds; Stockdale lavas; Stile End beds	Cadnant shales; Snowdon lavas; Gwastadnant sandstone; Conway lavas	Chirbury: Whittery shale, volcanics; Hagley shale, volcanics; Aldress shale; Spy Wood sandstones	Chasmops shales and limestones; Ampyx limestone	Chasmops limestone: Macrourus limestone; Echinosphaerites limestone	Dicellograptus shale	Voiselemma limestone; Keila limestone; Johvi limestone; Kukruse shale; Uhaku shale	Zahorany: Bohdalec shale; Lodenice shale; Chrustenice shale
CARADOCIAN	LLANDEILIAN	Barr: Balclatchie sandstone, limestone; Benan conglomerate; Stinchar limestone	Glenkiln slate	Roman Fell beds	Glanrafon	Middleton: Rorrington shale	Ogygia shale	Orthoceras limestone: Lituites: Ancistroceras; Centaurus	Dicellograptus shale	Talinna limestone	Drabov quartzite
LLANDEILIAN	LLANDEILIAN	Barr: Kirkland conglomerate	Glenkiln slate	Borrowdale volcanics	slates, lavas	Middleton: Meadowtown beds; Betton shale; Weston shale, sandstone	Ogygia shale	Orthoceras limestone: Lituites: Platyurus	Dicellograptus shale	Talinna limestone	Drabov quartzite
LLANVIRNIAN	ARENIGIAN	*probably absent*	*Uncertain*	Borrowdale volcanics	Maesgwym slates, lavas	Shelve: Stapeley ash; Hope shale	Upper Didymograptus shale; Orthoceras limestone	Orthoceras limestone: Vaginatum: Gigas	Didymograptus shale	Aseri limestone; Kunda limestone	Kvan: Sv. Dubrotiva shale, lavas; Sarka shale and lavas
ARENIGIAN	ARENIGIAN	chert, slate; Ballantrae volcanics	*Uncertain*	Skiddaw slates	volcanics and slates; Garth sandstones; Rhobell Fawr volcanics	Shelve: Stiperstone quartzite	Expansus limestone; Megalaspis limestone; Lower Didymograptus shale	Orthoceras limestone: Expansus; Limbata; Planilimbata; Tetragraptus shale	Didymograptus shale	Paldiski limestone	Komarov shale, lava
TREMADOCIAN		*unknown*	*Uncertain*	*uncertain*	slates	Shineton slates	Ceratopyge limestone, shale; Dictyonema shale	Ceratopyge limestone, shale; Obolus conglomerate	Dictyograptus shale	Pakerordi shale and sandstone	Krusna: d'Olesna shale; Milina shale, sandstone; Trenice cgl.
Approximate thickness		*a mile*	*few hundred feet*	*a few miles*	*a few miles*	*two miles*	*1,000 ft.*	*a few hundred feet*		*1,000 ft.*	*a mile*

North American classifications	Central Newfoundland	Vermont-New York: Taconic Mts.	Vermont-New York: Lake Champlain-Hudson river	New York-Ontario: Eastern Lake Ontario	Pennsylvania-Virginia: Appalachian valley	Pennsylvania-Virginia: Appalachian mountains	Mississippi valley	Mississippi valley	Oklahoma: Arbuckle mountains	Oklahoma: Ouachita Mts.	Manitoba: Lake Winnipeg	Australia: South Victoria	British classifications
CINCINNATIAN	*Present*	*absent*	*absent* Frankfort shale	Queenston red shale Oneida sandstone Lorraine: Pulaski shale, sandstone Whetstone Gulf shale	*absent*	Juniata red sandstone Oneida ss. Reedsville shale	(*Ohio*) Richmond shale Maysville shale Eden shale	Maquoketa shale *absent*	Sylvan shale *absent*	Polk creek shale *absent*	Stony mountain limestone *absent*	Bolindian slate, sandstone, and volcanics	ASHGILLIAN
MOHAWKIAN: TRENTONIAN	*Possibly absent* Bay of Exploits slates, sandstones, conglomerates, lavas	*absent* Normanskill shale, sandstone	Utica shale Canajoharie shale Glens Falls ls. Isle la Motte ls.	Trenton: Holland Patent shale Cobourg limestone Denmark limestone Shoreham limestone Kirkfield ls. Rockland ls.	Martinsburg shale, sandstone Orandals Mercersburg ls.	Antes shale Coburn limestone Salona limestone Nealmont ls.	Galena ls. Kimmswick ls.	(*Iowa*) Dubuque dolomite, limestone Stewartville dolomite, limestone Prosser limestone Decorah shale, limestone	Viola limestone	Big fork chert	Red river limestone (*possibly younger*) Winnipeg sandstone	Eastonian slate	CARADOCIAN
MOHAWKIAN: BOLARIAN	Bay of Exploits slates, sandstones, conglomerates, lavas	Normanskill shale, sandstone	*principally absent*	Black river: Chaumont limestone Lowville limestone Pamelia limestone	*absent* Shippensburg ls. Edinburg ls. "Athens" shale	Curtin ls. Benner ls. Benbolt-Ward Cove ls.	(*Missouri*) Plattin limestone Joachim limestone Dutchtown limestone	(*Minnesota*) Platteville limestone Glenwood shale, sandstone *absent*	Simpson: Bromide limestone, shale Tulip Creek limestone McLish limestone, sandstone	Womble shale, sandstone	*absent*	Gisbornian slate	CARADOCIAN LLANDEILIAN
CHAZYAN	Bay of Exploits slates, sandstones, conglomerates, lavas	Deepkill shale	Valcour limestone Crown Point limestone Day Point limestone, sandstone	*absent*	Lincolnshire limestone New Market limestone Whistle Creek limestone	Lincolnshire limestone Five Oaks limestone Blackford limestone, dolomite	St. Peter sandstone	St. Peter sandstone	Simpson: Oil Creek limestone, sandstone Joins ls.	Womble shale, sandstone		Darriwilian slate	LLANDEILIAN LLANVIRNIAN
CANADIAN OR BEEKMANTOWNIAN	slates, cherts, lavas	Deepkill shale Schaghticoke shale	Beekmantown dolomite: Bridport dolomite Bascom limestone Cutting dolomite Shelburne limestone	*absent*	Bellefonte dolomite Axeman limestone Nittany dolomite Stonehenge and Chepultepec limestone and dolomite	Bellefonte dolomite Axeman limestone Nittany dolomite Stonehenge and Chepultepec limestone and dolomite	Black Rock Smithville ls. Powell dol. Cotter dol. Theodosia dol. Rich Fountain dol., ss. Roubidoux dol., ss. Gasconade dol. Van Buren ss., dol.	*absent* Prairie du Chien dol.: Shakopee dol. New Richmond ss. *absent* Oneota dol.	Arbuckle limestone: West Spring Creek Kindblade Cool Creek Strange McKenzie Hill	Blakeley shale, ss. Mazarn shale		Castlemainian slate Bendigonian slate Lancefieldian slate	ARENIGIAN TREMADOCIAN
Approximate thickness	*five miles*	*a mile*	*more than a mile*	*a half mile*	*more than a mile*	*more than a mile*	*a half mile*	*1,000 ft.*	*more than a mile*	*a mile*	*a few hundred feet*	*a few miles*	

volcanic fragmental rocks in the Girvan district. The principal flows in the Lake district, the Borrowdale volcanics, thousands of feet of andesite and rhyolite, are Llanvirnian or Llandeilian. The typical Ordovician of North Wales has similar thickness in rocks ranging from Arenigian to Caradocian; the latter, the Snowdon volcanics, resistant to erosion, form the scenic highest elevations such as Mt. Snowdon. Volcanism continued locally to the end of the Ordovician, there being volcanic tuffs and flows of felsite in the Ashgillian of southwest Scotland. The rocks thin rapidly as they enter England, and in southern Shropshire, Caradocian lies locally on pre-Ordovician. These sediments are principally shallow-water types with shelly faunas, deposited on the margin of the gently sinking platform of the Midlands and southeastward.

England was along the southeastern border of a great volcanic belt that extended from Wales through the Caledonides of the Highlands of Scotland and the northwest coast of Norway, where areas such as Trondheim have thick sections of sediments and lavas. Northwest of this geosyncline, limestones that occupy a small area at Durness in the extreme north of Scotland and islands such as Smolen northwest of Norway are so dissimilar in lithology and faunas to those in the geosynclinal belt to the southeast that they are more readily compared with those in North America; Bear Island and Spitsbergen also have limestone sections. The Ordovician of the geosynclinal belt was severely deformed, and thrust faulted northwestward in Scotland, southeastward in Norway, in the Caledonian revolution after the Silurian; there are some areas having granites intruded within the Ordovician period.

Southeast of this geosyncline was a large area of relatively greater stability and thinner sections, the early Palaeozoic craton of Europe, occupying much of the region from the Caledonides and the Barents sea to the Urals and southward toward the Alps. The rocks have become exposed in scattered areas in southern Norway and Sweden, Bornholm, south of the Gulf of Finland, from Oland through Estonia to Lake Ladoga, and in south-central Poland. The Tremadocian lies on a slightly eroded surface of Cambrian, commonly with glauconitic sandstone at the base. Succeeding Ordovician rocks are rather constant in thickness and lithology over considerable areas and are principally limestones with abundant shell facies faunas, Estonia having particularly fine representation. The older series pass into graptolitic shales in Skane, south Sweden, and in the Oslo district, Norway, so that the temporal relations of facies and the correlations with Wales are generally known. The Silurian lies on varying Ashgillian horizons in Scandinavia and on Caradocian in Poland. Throughout the region there were no highlands, nor did uplifts in the adjoining geosynclinal belts contribute significant thicknesses of coarse detritus to the craton.

The Baltic belt of outcrop is rather isolated by the thick younger sediments of the Low Countries and the German and Polish plains from areas of exposure from western France through eastern Belgium, Bavaria and Thuringia to Bohemia. Inasmuch as wells have not penetrated the system in this great region, the character can only be induced. In Bohemia is the classic section of nearly a mile of Ordovician studied by Joachim Barrande. The older Tremadocian to Llanvirnian, mostly of graptolitic shales like those in the region along the margin of the Welsh geosyncline, has basic lavas and volcanics above the Tremadocian; coarsening graywackes and sandstones of the Caradocian and Ashgillian seem to have come from rising lands to the south. Similar sections are in southern Thuringia and Bavaria and westward through the Ardennes of Belgium into Normandy, where the Arenigian is the widely distributed, Armorican sandstone lapping over pre-Ordovician rocks. To the east, Ordovician calcareous and argillaceous rocks are present sparingly in the southern Urals; the eastern Urals have younger slates, cherts and volcanic sequences thrust westward, and similar rocks may have filled a geosyncline in the Ordovician. Thus the north European craton of the early Palaeozoic was margined on northwest, south and east by more rapidly subsiding geosynclines that were filled predominantly by argillites and graywackes derived from more distant lands or islands, and volcanic rocks of varying kinds, ages and thicknesses.

The Ordovician of southern Europe is exposed widely only in the Iberian peninsula, which in northwestern Spain and northern Portugal has overlapping Arenigian sandstone like the Armorican of France under graptolite-bearing shales and graywackes. Elsewhere north of the Mediterranean, outcrops have been so displaced by later structures that a comprehensive portrayal is not possible. Diminishing areas of land are considered to have extended in a belt from Brittany to western Bohemia; but Ordovician is present within the region, and the outline and distribution of the islands is not established. Similarly, the Iberian peninsula had land areas between a geosynclinal belt trending from the Pyrenees to the southern Alps and one through the western Mediterranean region. Shales and sandstones are prevalent in all these sequences.

North America.—The central part of North America in the Ordovician was a great shield or craton. Low-lying land of Pre-Cambrian crystalline rocks persisted in the northern half until late in the period; earlier sediments, principally carbonates, with some quartz sandstones thinned irregularly northward in the southern half. Belts of thicker carbonates (miogeosynclines) surrounded this relatively stable shield, the broadest belt being on the west. The peripheral parts of the present continent had deeply sinking geosynclines of dominantly argillaceous rocks, with interbedded lava flows and other volcanic rocks and thick graywackes and conglomerates that must have come from associated islands; these are the eugeosynclinal belts. These general relations were disturbed in the east in the middle of the period as uplifts in the peripheral areas were eroded, spreading detritus progressively over earlier carbonates, first in the miogeosynclinal belt, subsequently until they extended far into the craton, forming an exogeosyncline. Finally, the Taconian revolution severely folded and thrust-faulted the eastern geosynclines and thrust them toward the craton. The tradition has been that the early Palaeozoic North American shield had persisting geosynclines along its borders, Appalachian on the east, Ouachitan, Cordilleran and Franklinian on south, west and north, with great crystalline borderlands, Appalachia, Llanoria, Cascadia and Pearya, respectively, beyond. The margining geosynclines were of changing form, position and character, however, and the areas of the "borderlands" are known to have very thick sections of metamorphosed Palaeozoic sediments; sediments that have been attributed to the borderlands seem to have come initially from within the continent and subsequently also from lands raised in the geosynclinal belts.

The Ordovician, the most widely distributed system in North America, is usually divided into four series, having several groups:

Cincinnatian:	Gamache Richmond Maysville Eden
Mohawkian:	Trenton Black river
Chazyan:	Valcour Crown Point Day Point
Canadian or Beekmantownian:	Bridport Bascom Cutting Shelburne (possibly Upper Cambrian)

The Canadian is considered Lower, the Chazyan and Mohawkian Middle, and the Cincinnatian Upper Ordovician. The listed divisions of the Canadian are the formations in the type region of New York and Vermont, but reference is made more often to the sequence in the Ozark region in Missouri and Arkansas. Some would divide the Mohawkian into two series, Bolarian and Trentonian, the Black river group being within the former.

The classification is based principally on shell-facies faunas, but argillitic facies are well known and their relative positions established. The Canadian has Tremadocian to early Llanvirnian faunas from the zone of *Dictyonema flabelliforme* (Schaghticoke) to that of *Didymograptus bifidus* (upper Levis-Deepkill), though the latter may be somewhat older than the European *bifidus* zone. The Chazyan seems essentially Llanvirnian and Llandeilian, for

the basal Caradocian *Nemagraptus gracilis* zone (lower Normanskill) is about the base of the Mohawkian. Mohawkian and Cincinnatian faunas resemble Caradocian and Ashgillian though precise correlations have not been established, and the Upper Ashgillian may be included in rocks classified as lower Silurian.

The Canadian is of two principal lithologies, carbonates in the southern part of the craton, and in geosynclines along its margins; and in areas bordering the present continent, argillites and coarser sediments gained from adjoining islands, as well as volcanic rocks on the Atlantic and Pacific coast. The limestones and dolomites are in a narrow belt east of the craton from western Newfoundland to Alabama, a great area in the southern half of the craton where they thin northward, in a broad belt along the west from eastern Yukon and British Columbia through eastern Idaho, western Utah and eastern Nevada, southeastern California and western Sonora, and north as in northwestern Greenland. Sections along Lake Champlain in New York, Vermont and Quebec, and in the Ozark mountains of Missouri and Arkansas, are representative of this facies and have many genera of cephalopods, gastropods, brachiopods and trilobites. The graptolite sequence in the argillitic shales is known from many regions all around the continent, as scattered as central Newfoundland, eastern New York, Oklahoma, Nevada, southeastern Alaska and northern Greenland. Large boulders of carbonate facies of Cambrian and Canadian are found in the graptolite-bearing argillites south of the St. Lawrence river below Quebec city, and similar "exotic boulder" conglomerates are known in younger Ordovician in western Newfoundland. Some of the blocks being tens of feet long, their transportation has been attributed to submarine slumping in muds of rocks raised and dislodged, possibly by faulting, from the carbonate facies to the northwest. In central Nevada, Canadian and younger graptolitic slates and lavas form a sheet thrust more than 15 mi. on a section of folded sediments including contrasting Canadian carbonates; similar thrusts are known or suggested in many regions where the two facies are in proximity, making the determination of their original relations obscure.

The Middle Ordovician Chazyan and Mohawkian series are typically exposed on the east and west sides of the Adirondack mountains, northeastern New York. The former is limited in distribution or recognition on the continent. A remarkably pure wind-transported, water-laid quartz sand, the St. Peter sandstone, formed in a sinking embayment from central Michigan through Illinois toward the lower Mississippi river, probably in the Chazyan. The first phase of orogeny in the east was about the end of the epoch. Rising land in the Carolina region produced sands and clays that accumulated to a few thousand feet in a geosyncline in southwestern Virginia and eastern Tennessee; the argillites (Athens) having *Nemagraptus* grade into carbonates that thin rapidly westward. The succeeding lower Mohawkian Black river limestones are principally within the craton. Uplift east of New York in late Mohawkian (medial Trentonian) produced graywackes (Upper Normanskill-Schenectady) grading westward into black shales (Canajoharie and Utica) that thin rapidly along a northeast-trending axis passing through the present Adirondack mountains into shallow-laid limestones farther northwest. This narrow zone of gradation is recognized from Quebec to Virginia. Mohawkian carbonates of the interior are generally less than 1,000 ft., thinning irregularly northward so that Trentonian in central Canada lies directly on Pre-Cambrian, blanketing nearly all of the crystalline rocks so extensively exposed from the beginning of the Palaeozoic.

The Cincinnatian series has typical development in calcareous and argillaceous shales in Ohio, Indiana and Kentucky; the Edenian and Maysvillian are found only in the eastern states and southeastern Canada. The earlier Cincinnatian is detrital graywacke and shale (Lorraine) laid in a geosyncline, arcuate toward and extending into the continental interior, an exogeosyncline. The late Cincinnatian (Richmondian) seas retreated before the advancing deltas of fluviatile sands and gravels (Juniata) and red silts and clays (Queenston) from rising lands to the east. In the rest of the continental interior Richmondian carbonates and shales formed in the most widespread sea in North American history unless it be that of the latest Trentonian, over which the rocks commonly lie, the Edenian and Maysvillian being of restricted extent. The section of the Cincinnatian on Anticosti Island, Quebec, in the Gulf of St. Lawrence, is remarkable in its having a relatively continuous succession of latest Ordovician (Gamachian) and earliest Silurian fossiliferous shales and limestones. The Taconian revolution at the close of the period folded rocks from eastern Pennsylvania to Newfoundland and may have involved thrust faults of great displacement that brought the argillaceous facies upon the carbonate facies in the east.

Australia and New Zealand.—The Ordovician is well developed in a belt in Australia extending from eastern Queensland through New South Wales and Victoria into Tasmania, but is absent or sparsely known in the western half of the continent. Nearly three miles of slate and graywacke in southern Victoria form one of the finest sequences of graptolite-bearing shales in the world; the order of appearances of the genera is quite like that in Britain and America, and most of the forms are found in all continents. Lavas and pyroclastics are interbedded in the argillaceous rocks in a number of places, as in eastern New South Wales, southern Victoria and Tasmania, and the Upper Ordovician has phosphatic beds and cherts. Intrusions of granite are thought to have invaded the geosynclinal sediments in eastern Queensland at the close of the period. Shallow-water laid carbonates and sandstones are exposed at intervals in western Queensland, central and southern Australia, and reach thicknesses of a few thousand feet. In New Zealand, graptolitic argillites are present in the New Zealand alps of the South Island.

Other Continents.—Ordovician sediments are widely distributed in Asia and have been studied considerably, particularly in China and Manchuria, where the preponderant sediments are limestones. Argillites with graptolites are known in several areas, and are associated with volcanics in a belt in western Yunnan, along the Burma frontier. The Ordovician of South America is best known in a rather continuous belt along the west of the Brazilian shield from the Mendoza region, northwestern Argentina, through Bolivia and Peru to Cordillera Oriental of eastern Colombia and southern Venezuela; there are argillites, and limy beds having faunas more similar to those of the Ordovician of Britain and Sweden than those in North America. Ordovician rocks are of limited distribution in Africa, found principally in the north; in Morocco and northwestern Algiers are thick argillitic sequences. (M. Ky.)

ORDU (anc. *Cotyora*, where the "Ten Thousand" embarked for home), the chief town of a Turkish vilayet, on the north coast of Asia Minor, connected with Zara, and so with Sivas, by road, and with Istanbul and Trebizond by steamer. Filberts are exported. Pop. of vilayet (1950) 372,492; town 11,913.

ORDYN-NASHCHOKIN (or Ordin-), **AFANASY LAVRENTIEVICH** (d. 1680), Russian statesman under the tsar Alexis, was closely associated with the policy of westernizing Muscovite administration and economy while safeguarding the traditions of Muscovite life. The establishment of a postal service between Muscovy, Courland and Poland and the building of Russian merchant ships on the Western Dvina and the Volga were due to him. He negotiated the treaty of Andrusovo with Poland (1667) and hoped to secure for Russia an outlet to the Baltic by wresting Livonia from Sweden. But the tsar's growing opposition caused Ordyn-Nashchokin to retire to a monastery near his native Pskov, where he took vows (1672). His relatively humble origin, his knowledge of European affairs and his diplomatic integrity distinguished him from most of his colleagues; and his policy anticipated that of Peter the Great.

See E. Likhach, article in *Russky Biografichesky Slovar*, vol. xii (St. Petersburg, 1905); V. O. Klyuchevsky, *A History of Russia*, trans. by C. J. Hogarth, vol. iii (London, 1913).

ÖREBRO, a town of Sweden, capital of the district (*län*) of Örebro, lying on both banks of the Svartå a mile above its entrance into Lake Hjelmar, 135 mi. W. of Stockholm by rail. Pop. (1950), 63,521. Örebro was in existence in the 11th century. Its castle was erected by Birger Jarl in the 13th century, and 20 diets or important assemblies were held either in the castle or in the

town. Such were the Örebro *concilium* of 1537, the diet of 1540 in which the crown was declared hereditary, and that of 1810 when Bernadotte was elected crown prince. In great part rebuilt since a fire in 1854, Örebro has a modern appearance. An ancient castle, however, with four round towers, still remains, and is used as a museum. There may be mentioned also the church of St. Nicholas, of the 13th century; and the King's House (*Kungsstuga*), an old and picturesque timber building. The patriot Engelbrecht (d. 1436) was born there. The Swedish reformers of the 16th century, Olaus and Laurentius Petri, are commemorated by an obelisk. Örebro is the centre of the Swedish shoe industry; trade is carried on, by way of the Örebro canal and lakes Hjelmar and Mälar, with Stockholm.

ORE DEPOSITS. Minerals are naturally occurring substances of fairly constant chemical composition and physical properties. They make up ore deposits and rocks. In ore deposits, the minerals that give value to the deposit are the ore minerals, and the valueless minerals are the gangue minerals; the rock in which the ore is found is the country rock. The ore and gangue minerals are mined together—*i.e.*, taken out of the country rock in a mass—manually or mechanically. Thereafter the ore must generally be milled, the ore mineral being separated from the gangue mineral, usually mechanically. Next, the desired metal is extracted from the ore mineral by a chemical or metallurgical process; commonly this is a smelting operation. After this, the metal may be still further purified or alloyed with other metals, as in a copper refinery or a steel mill. Exploration, mining, milling and refining are thus successive steps in the utilization of an ore deposit to yield a metal.

By general agreement, ore deposits should contain metal-yielding minerals, should be of natural origin and should be economically workable. In a given instance, however, any of the three conditions included in this definition may be violated, provided the other two still hold. Thus, "ore deposits" is commonly applied to certain occurrences worked primarily for their nonmetallic elements, like the deposits of pyrite (FeS_2) mined in many industrialized countries as sources of sulphur gases and sulphuric acid. The accumulated waste, once useless, remaining after milling some ores may subsequently become a source of metals that can be extracted with profit; hence, it is at times, though rarely, called an ore deposit. Finally, the disseminated, lean deposits of copper minerals in granitelike rocks, occurring notably in parts of the western U.S., northwestern Mexico and Chile, were called ore deposits even before technologic progress made it possible to work them to economic advantage.

To be economically recovered the metals must be present as elements or compounds in concentrations far higher than normal in limited volumes in the earth's crust. The degree of concentration is shown by Table I, compiled from data by J. F. Kemp and F. H. Hatch; this contrasts the amount of a given metal necessary for profitable mining with the percentage of the metal in the rocks composing the earth's crust, as determined by F. W. Clarke (1924).

TABLE I.—*Metal Concentrations*

Element	Average percentage in earth's crust	Approximate percentage needed for profitable working
Aluminum	8.06	30
Iron	5.06	35-60
Manganese	.091	25-45
Chromium	.036	15-30
Nickel	.019	1.5-5
Vanadium	.016	3-8
Copper	.010	0.7-10.0
Zinc	.004	3-8
Lead	.002	2-4

For gold and silver the ratios of natural concentration to make a workable deposit in ordinary rocks are much more than those of the base metals. The figures in the third column require material qualification if by-products are obtainable, as is commonly the case.

As almost every rock contains at least a small quantity of almost every ion, the detection of desired metals is limited virtually by the sensitivity of the analytical method available, extending even to the small quantities of copper, lead and manganese in plant ashes. The widespread occurrence, but rare concentration, of the metalliferous minerals has affected the theories for the genesis of ore deposits and the methods of searching for them.

Classification and Genesis.—Before the 20th century, a favourite classification for ore deposits stressed their composition—iron deposits, gold deposits and so on. This method lacked any genetic significance, for iron-ore deposits can originate in several different ways. Furthermore, it ignored the fact that many ore deposits have two or more metals in abundance; the tin veins of Cornwall in Britain also yielded copper, the zinc deposits of Silesia carried noteworthy quantities of lead, and Cerro de Pasco in Peru had become by the middle of the 20th century an important source of zinc, though previously known for its copper production. In fact, the practical miner finds it necessary to apply such terms as "argentiferous lead deposits" to mixed ores like the silver-lead deposits in Murcia in southern Spain, or "dry gold ores" to the gold-quartz ores free from base metals.

A second basis for classification, as illustrated by the comprehensive system of Bernhard von Cotta (1808–79) and others, stressed the geometrical form of the ore body. Thus, Albrecht von Groddeck, a follower of Cotta, in 1879 distinguished bedded deposits, massive deposits and clastic deposits (including placers). Classification by form serves well in the search for an extension of a known ore body or for other similar bodies in localities where deposits have been found previously. Understandably, the application of this classification led almost insensibly to a genetic grouping through the schemes presented in 1881 by A. W. Stelzner, in 1903 by Kemp and in 1909 by Richard Beck.

The most scientific mode of classification is genetic. It may be attributed to the great controversy between the "Neptunist" A. G. Werner (1750–1817) on the one hand and the "Plutonists" James Hutton (1726–97) and John Playfair (1748–1819) on the other. This controversy turned on whether most mineral deposits were to be regarded as laid down in the sea, as suggested by Werner, or as injections or fissure fillings essentially from melts or hot solutions, as the "Plutonists" maintained. Despite widely held views to the contrary, both concepts held much truth. Later scientific followers continued this discussion on more quantitative grounds, but the front shifted somewhat; F. von Sandberger (1826–98), Groddeck and others stressed the derivation of the ore ions (*e.g.*, zinc in deposits of the zinc sulphide mineral sphalerite) from the country rock and their deposition in openings of that rock, a concept usually called lateral secretion. The transportation in such a process has been variously assigned to cool surface waters, later laterally moving (as by C. E. Siebenthal for the zinc and lead ores of the Tristate, Missouri-Oklahoma-Kansas district, U.S.) or to waters of the same origin which, though originally cool, had been heated by contact with hot rocks at depth and had subsequently risen, depositing their dissolved matter as they rose and cooled, as urged by C. R. Van Hise. Since it was at first believed that all waters, even the hot ones, were merely reheated surface waters and were, in fact, notably lacking near volcanoes, where molten rock comes to the surface and can be observed, it was generally contended that few or no solutions could have come up from deep inside the earth, carrying valuable metallic or other ions. But between 1910 and 1920 came confirmation of the large quantities of water and other adequate solvents of metals (such as ions of chlorine and fluorine) in the gases given off by certain carefully observed volcanoes, notably those of Hawaii (A. L. Day and E. S. Shepherd, 1913) and Katmai, Alaska (C. N. Fenner, 1920; E. G. Zies, 1924). Thereupon the viewpoint had to be abridged that excluded completely the role of solutions and ions of deep origin, probably related to deeply buried molten lavas; *i.e.*, "magmatic." The volcanic data combined with physicochemical inferences strongly supported the "hydrothermal" school of economic geologists represented by Waldemar Lindgren, J. H. L. Vogt, W. H. Emmons, J. E. Spurr, Paul Niggli and Hans Schneiderhoehn, who derived both ores and their transporting solutions in large part from magmatic sources.

By 1950, however, there was discernible a swing of the pendulum toward a modified lateral secretion idea, advanced in England by the writings of H. H. Read (1939), in the U.S. by those of G. E.

Goodspeed (1952), in Australia by those of C. J. Sullivan (1948) and in France by those of R. Perrin and M. Roubault (1939), all of whom suggested or hypothesized that some of the granitic rocks of the earth's crust may be remelted or recrystallized sediments. These or their followers inferred that during granitization, ore minerals may be generated or transferred. Even Niggli thus explained some of the "alpine" mineral deposits. This concept sought to derive the metalliferous minerals for the most part from deeper crustal or subcrustal sources, rather than from local masses of molten rock, and to attribute mainly to heat gradients and ionic diffusion the movements of the metal ions essentially to their present sites. If this process is effective, the ionic radii of the metallic elements concerned may well be a modifying factor.

Certain ore deposits were regarded by Vogt, A. P. Coleman and others as magmatic segregations. The minerals composing these were attributed to separation from the molten rock as a result of partial or complete immiscibility with the other rock constituents. Such ore minerals are generally sulphides or oxides of base metals (such as iron, chromium, copper and nickel) but they include native (elemental) metals of the platinum group and possibly also metallic iron. Many of the great nickel deposits (*e.g.*, Sudbury in Ontario, Petsamo in Finland), most of the known chromite deposits (Selukwe in Southern Rhodesia, the Stillwater deposits in Montana), probably many of the iron deposits made up of the mineral magnetite (Fe_3O_4) whether with or without titanium (as at Kiruna in Sweden, at Tahawus in New York and elsewhere) are generally regarded as of this origin. The original concentration of the platinum in the rocks of the Ural mountains of the U.S.S.R. is best explained in this manner. For some deposits of this general type the origin appears to be a separation in place of the ore from the gangue minerals, such as the feldspars (*q.v.*), quartz (*q.v.*), olivine (*q.v.*), the micas biotite (*q.v.*) and muscovite (*q.v.*) or the amphiboles (*q.v.*) or pyroxenes (*q.v.*)—the major constituents of the once molten (igneous) rocks that contain the ores. For others (*e.g.*, Kiruna) studies at mid-20th century seemed to show that a melt, unusually rich in ore minerals, was separated at depth and subsequently emplaced as a melt, injected into the containing rock after the latter had itself undergone injection and solidification.

Some ore deposits are closely related to intrusions of apparently molten rocks in the sense that they occur in or near such rocks, as a more or less continuous halo around the now solid mass. Such a melt has lost some of its more volatile constituents in the crystallization process (a theory developed by Niggli, Fenner and others), and the volatile matter moved into the adjacent, unmolten rock, usually a limestone or at least generally a rock carrying appreciable quantities of carbonates such as dolomite (*q.v.*) or calcite (*q.v.*). The volatiles reacted with the rock surrounding the igneous intrusion, giving a halo, made of "skarn" or tactite in which the ore minerals may be concentrated. Once interpreted as the effect of mere recrystallization of the materials present in the surrounding limestone or other sediment (W. L. Uglow, 1913) but later recognized as the result of a reaction between intruding and intruded rock, such deposits have been called "contact metamorphic deposits" (the pyrometasomatic deposits of Lindgren). The importance of the process in ore deposition was still being debated at mid-20th century (Harrison Schmitt, 1948).

None of the concepts outlined above is contrary to the nonmagmatic origin of certain clearly sedimentary ore deposits, such as the iron ores of eastern Britain, those of Belgium, Lorraine and eastern France (minette ores), those of the Clinton type in the eastern U.S., and of the Wabana district in Newfoundland. The widespread banded iron ores existing in the older (Pre-Cambrian) rocks of the Crimean region (Krivoi Rog) in the U.S.S.R., and other similar ores of India, the Lake Superior region in North America, the Labrador and Ungava regions in Canada and the Pre-Cambrian terrains of Venezuela and Brazil are likewise clearly sedimentary, as are the great bedded manganese deposits of Nikopol and Chiatouri in the Ukraine and Georgia, U.S.S.R. Sedimentary ores are formed by decay of surface rocks, which contribute the necessary ions to the lakes or the sea, where they may be precipitated by evaporation, chemically or biochemically (by action of bacteria, algae or the like). Evaporation has contributed important salt and potash beds in various regions but seems to have had little part in the formation of ore deposits. Streambed or marine deposition may also take place mechanically, yielding placer deposits if the minerals concerned are sufficiently resistant to the chemical attack of the atmosphere and to impact when carried as particles by streams. Placers of world importance are the titanium-bearing beach sands of Travancore, India; the gold-bearing stream gravels of the Sierra Nevada and Western Australia; the platinum gravels near Sverdlovsk on the eastern slope of the Ural mountains and those of Colombia; and possibly the gold-bearing conglomerate beds of the Witwatersrand, Union of South Africa.

Despite much discussion as to the derivation of the metallic ions in ore deposits (whether from country rock or magma) and their mode of transfer (whether in solution or by diffusion), the general grouping of the resulting deposits is fairly clearly defined and agreed upon, as a result of collective efforts through more than a century by many mineralogists, petrologists and economic geologists. The classes now generally recognized were perhaps best defined by Lindgren (1913), who separated all ore deposits into magmatic segregates, contact metamorphic deposits, pegmatites, veins and veinlike deposits of differing degrees of intensity in temperature and pressure (hypothermal, mesothermal, epithermal) and sedimentary deposits. For completeness these classes were modified, in part by subdivisions, and additional kinds of origin were recognized. Lindgren and those previously listed as sharing his views, as well as many later investigators, regarded the magma as containing the metallic ions of the ore minerals while deep down in the crust; the mass, while crystallizing there, loses its volatile constituents; these pass off, chiefly upward, depositing the ore minerals in pre-existing openings, or "fluxing" their way upward by dissolving the superincumbent rocks and finding room for ore deposition by a replacement or metasomatic process. Highly concentrated solutions of volatiles, localized in the igneous rocks from which they separated, give, according to this school, the pegmatite veins or dikes that are of much importance as sources of nonmetallic minerals (mica, gems, etc.) and at times of elements useful in the metal industry (*e.g.*, beryllium).

A fundamental basis for the classification given above is the temperature of formation of the ores. By observing the behaviour of the inclusions in the ore minerals as the temperature is raised (W. H. Newhouse, 1933); by recording the temperatures at which certain minerals in the ore deposits break down when heated (the "decrepitation temperature," F. G. Smith, 1947); by a comparison of textures suggesting the unmixing of solutions at known temperatures; and by means of basic data on inversion temperatures of the minerals present, attempts have been made to set exact limits governing the origin of these deposits. Such evidence, though useful, is admittedly still inconclusive and, like the theories for the genesis of individual deposits, is constantly undergoing revision.

A very striking feature of the primary mineralization of ores is the fact that the contents of a given ore deposit may change upward or laterally. In the tin deposition of southwestern Britain (Cornwall) an ore body which at depth yields chiefly tin-ore minerals, may pass upward into a predominantly cupriferous ore, and at the surface become essentially a zinc or lead deposit (W. R. Jones, 1925). The central, copper-rich part of the Butte, Mont.. mining district passes laterally into silver-bearing zinc ores and these give way to silver-bearing manganese veins and even into galena-bearing ore bodies (W. H. Weed, 1897; R. H. Sales, 1908). In fact, L. de Launay (1900), Spurr (1907) and W. H. Emmons (1924) developed in detail the sequence of mineralization from deep to shallow deposits which can be traced through the following ions: tin, tungsten, arsenic, copper, zinc, silver, lead, antimony, mercury; the position of iron and gold, among the common metallic ions, is varied and anomalous. A somewhat similar effect, extending also to certain gangue minerals, is noted with contact metamorphic deposits (V. M. Goldschmidt, 1911; Spurr, Fenner, G. H. Garrey, 1908, 1912). Such compositional changes are called zoning.

Secondary Changes in Primary Ores.—The processes described above yield the ore minerals as freshly deposited (pri-

mary), before being acted upon by atmosphere or cold surface waters, circulating downward. Examples of the more common primary ore minerals are given below:

Iron		Copper		Silver	
Fe_3O_4	magnetite	Cu	native copper	Ag	native silver
Fe_2O_3	haematite	$CuFeS_2$	chalcopyrite	Ag_2S	argentite
$Fe_2O_3.nH_2O$	limonite	Cu_5FeS_4	bornite	Ag_9SbS_6	polybasite
$FeCO_3$	siderite	Cu_2S	chalcocite	Ag_3AsS_3	proustite
FeS_2	pyrite	$Cu_8Sb_2S_7$	tetrahedrite	Ag_2Te	hessite
iron silicates		Cu_3AsS_4	enargite		
Aluminum		Zinc		Gold	
aluminum silicates		ZnS	sphalerite	Au, Ag	electrum
alkali alum silicates				Au	native gold
		Lead		$AuAgTe_4$	sylvanite
Tin		PbS	galena	Au_2Te	petzite
SnO_2	cassiterite	Nickel		Mercury	
Cu_2FeSnS_4	stannite	$FeNiS_2$	pentlandite	HgS	cinnabar

Most common primary ore minerals are sulphides or oxides; some are tellurides, native metals, carbonates, silicates or sulpho salts (double salts of the metal sulphides and sulphides of arsenic or antimony). Some of the minerals carry only one metal (*e.g.*, pyrite, FeS_2); others carry two or more metals (*e.g.*, stannite, Cu_2FeSnS_4).

After such primary ores are formed, the surface is slowly lowered by processes of weathering and erosion. At and near the surface, these processes act upon the ore minerals as upon other rock materials; in fact, even at some depth these minerals are attacked by waters, which, moving downward from contact with the air, transport oxygen, carbon dioxide and other materials in solution. Under these conditions the oxides and native metals are generally stable. The other minerals, however, tend to be converted to relatively soluble compounds. This applies especially to the sulphides, which, for the most part, become highly soluble sulphates. Copper sulphides become soluble copper sulphate which generally travels farther down with the descending ground water. Below the level of saturation, however, the oxygen supply to this water is cut off, reducing conditions prevail (especially in the presence of more sulphides of the primary ore, together with the sulphuric acid in the water), and eventually the copper tends to precipitate out as sulphides, such as chalcocite and covellite (CuS). This is characteristic of the zone of secondary sulphide enrichment. As this precipitation is greatest where the descending copper-bearing solutions first come into the zone of reduction, the effects of such reprecipitation of copper taper off downward. If, however, the downward moving, acid waters, while still above the zone of saturation and reduction, encounter a reagent (*e.g.*, the calcium carbonate of a bed of limestone) that neutralizes the acid, a reaction takes place which throws down the copper (generally by replacement) as a copper carbonate, the calcium ions travelling on in sulphate solution; in siliceous rock, the copper may similarly be precipitated as a silicate; or, in the presence of a strong oxidizing agent, the copper may precipitate as copper oxides or native copper. These minerals characterize copper deposits in the near-surface zone of oxidation.

If gold or its compounds occur in the primary ore, the relatively unstable telluride compounds are broken down into metallic gold, and the insoluble gold is concentrated in the oxide zone except in the presence of manganese dioxide and chloride compounds, which together yield the strong solvent, Cl^-.

Iron sulphides on oxidation yield sulphuric acid and the unstable ferrous sulphate. The latter is oxidized to ferric sulphate which then hydrolizes to ferric hydroxide, and eventually a precipitate of limonite or a related mineral is formed. In general, zinc sulphide behaves like copper but primary sulphides are more soluble. Lead sulphide, however, oxidizes rather easily to the poorly soluble sulphate (cerussite). Silver minerals behave like copper minerals but may be stabilized in the zone of oxidation if there are halogens present. Manganese resembles iron in reactions.

A special kind of change in primary ores is summarily described as residual concentration. In this, the effect of solution (leaching) by surface waters in the zone of oxidation is to dissolve and remove the gangue minerals, and in cases to stabilize the desired metallic ions still further. Thus relatively small quantities of iron carbonate in a limestone (composed of $CaCO_3$) may be converted to limonite; meantime the limestone is dissolved, if the surface water is rich in atmospheric carbon dioxide, approximately thus:

$$CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2.$$

If the iron content of the limestone was originally only 5%, the removal of all the limestone by solution would yield natural iron ore bearing about 48% iron. Such a process is facilitated by moisture, the presence of vegetation (yielding the solvents humic acids and carbon dioxide), a warm climate (to accelerate the reaction and to permit plant growth), good drainage (at least, periodically, as in a climate with dry and wet seasons alternating) and a topography high enough to promote drainage but not so high that most of the rainwater will run off instead of penetrating to do its important chemical work at the surface and just below it. Examples of such concentration are the secondary manganese ores of the Gold Coast; the bauxitic aluminum ores of the Guianas; the residual iron ores of Moa and Mayari, Cuba; and the gold ores of the southern Appalachians. Inimical to such a process is everything that strips the soil rapidly, such as glaciation or rapid erosion. As applied to the marked enrichment in gold, this process is called eluviation; when applied to iron, manganese and aluminum ores, it is lateritization and the resulting ore is called laterite.

A table, illustrative rather than complete, is included to show the changes in the composition of ore deposits after oxidation and secondary sulphide enrichment.

TABLE II.—*Depth Zone Below Surface*

Metal	Zone of oxidation	Secondary enrichment zone	Primary ore
Iron . .	$Fe_2O_3.nH_2O$ (limonite) Fe_2O_3 (haematite)		$FeCO_3$ (siderite) FeS_2 (pyrite) Fe_3O_4 (magnetite) Fe_2O_3 (haematite) Iron silicates
Aluminum .	$Al_2O_3.H_2O$ (diaspore) $Al_2O_3.2H_2O$ (bauxite) $Al_2O_3.3H_2O$ (gibbsite)		Rock-forming minerals such as clay minerals, feldspars, etc.
Manganese .	MnO_2 (pyrolusite) Mn_2O_3 nH_2O (psilomelane) etc.		$MnCO_3$ (rhodochrosite) Manganese silicates
Copper . .	Cu (native copper) Copper oxides Copper carbonates Copper silicates	Copper sulphides, especially Cu_2S (chalcocite), CuS (covellite)	$CuFeS_2$ (chalcopyrite) Cu_5FeS_4 (bornite) Copper sulpho salts
Zinc . .	$ZnCO_3$ (smithsonite) $ZnSiO_3.Zn(OH)_2$ (hemimorphite)	ZnS? (wurtzite?)	ZnS (sphalerite)
Lead . .	Residual galena $PbCO_3$ (cerussite) $PbSO_4$ (anglesite)		PbS (galena)
Silver . .	AgCl (cerargyrite) and other halides Ag (native silver)	Ag_2S (argentite)	Ag (native silver) Ag_2S (argentite) Silver sulpho salts Silver tellurides
Gold . .	Residual native gold		Ag, Au (electrum) Au (native gold) Gold tellurides

This sequence of alteration may greatly complicate the richness of the ore at changing depth. Many of the disseminated copper ores (*e.g.*, Bisbee, Ariz., and Chuquicamata, Chile) are of moderate richness at the surface, where the once-exposed primary ores have had some of their copper and other, valueless, components removed; at depth, however, in the zone of secondary sulphide enrichment, they become richer, the tenor (grade) rising to perhaps twice the figure for the surface zone. At still greater depths the ore values decline to perhaps half those of the oxidized zone and the metal content may decline from a useable ore to a protore, unprofitable today but perhaps workable in the future after natural enrichment takes place or cheaper working methods are developed or copper prices rise. Abrupt differences in the vertical level of these three zones may result horizontally from movement along fault planes or differences in surface conditions affecting ingress of surface waters, drainage or the like.

Forms, Structures and Textures of Ore Deposits.—In the past, ore deposits were also classified on the basis of form, or other large-scale features, collectively spoken of as structure, but it

appeared later that this was not a feature fundamental to genesis and such classifications were abandoned. None the less, the form of a given ore body is of great practical importance in the search for ore extensions or for analogous bodies in near-by localities under similar geologic conditions. Thus, in the early half of the 20th century, stress came to be placed upon the geologic structures (faults and folds in the rocks or dikes [*q.v.*], sills [*q.v.*] and larger intrusions of igneous rocks) that might be the cause for localizing the ore or have exercised structural control on ore deposition. This school of investigators, among whom Canadians such as M. E. Wilson and E. L. Bruce, South Africans such as Ben Lightfoot and Americans such as B. S. Butler and G. M. Fowler merit mention as leaders, stressed the geologic structure rather than the mineralogy of the ore or the country rock—a natural outgrowth of the more intensive search for ore prevailing in a period of very abrupt rise in consumption rate.

The simplest types of ores from the structural viewpoint are the bedded or stratiform ores. In the strictest sense these consist of ore minerals deposited like any other sediment. If not too greatly deformed they may exhibit intertonguing, channelling, fading out, gradation of grain, ripple marks, fossils and other features of sedimentary rocks. They may be intensely folded, as shown by the Pre-Cambrian iron ores, or suffer thrust or normal faulting, like the minette iron ores of western Europe or those of the Clinton belt in the U.S. Among special types of sediments are the placer deposits already mentioned. The forms and other features of placers particularly resemble those that go with coarser clastic sediments, such as cross bedding and channel deposits. Concentration of the desired mineral may be in the inside of the meanders, the slipoff slope of bars or the lowest part of the bed, yielding accumulations that are locally especially rich (the "pay streak"). If deposition of ore minerals is by replacement of soluble minerals or by filling of pore space in a given stratum, the appearance of the ore may suggest a sedimentary deposit, even though ore deposition was much later than sedimentation. A special case is penecontemporaneous replacement, by which, apparently while falling to the sea bottom or shortly thereafter (during the solidification of a given sediment), such rocks as the limestones may have some or all of their constituents replaced by iron compounds.

Many ore deposits are apparently simple fissure fillings (fissure veins), transverse to pre-existing rock structures (*e.g.*, bedding) or parallel to them, as in bedded veins. If the former, they may indicate planes of shear or of tension, depending on their relation to the tectonic history of the region, which thus becomes of special interest. In closely studied districts (*e.g.*, the Erzgebirge, Saxony; the Mother Lode and Grass valley, California; and Braden, Chile), both the opening and the mineralization have proved to be repeated. This may well account, at least locally, for the wide veins of certain mining districts; other explanations for such veins include (1) a dense, essentially viscous and meltlike mineralizing solution (Spurr's "ore magma"); (2) an opening standing several feet wide, gradually filled with ore that crystallized from dilute solutions; (3) replacement (*e.g.*, solution of the country rock, with simultaneous deposition of the ore minerals) rather than open-cavity filling. Fissure fillings include such distinct types as ladder veins, small fissures between two or more bordering fractures; gash veins, several small fissure veins frequently overlapping; sheeted zones, many smaller subparallel veins making up a compound vein that is large but not simply one fracture; saddle reefs, veins in openings where beds separate at the crests and troughs of folds; zigzag veins, the direction or inclination changing as differing rock types are crossed; thinned or thickened veins, the changes taking place in a vein where it crosses from one rock type to another; breccia veins, with numerous fragments of the country rock in the plane of the vein and partially embedded in the vein material; an ore "pipe" or "chimney," a body of ore saturating and cementing a shattered rock mass and having one long dimension and two lesser dimensions. Larger fissures commonly break up into many smaller ones at their ends—upward, downward or laterally. Much attention has been given to the causes for the various forms of fissure veins.

Irregular forms include ore bodies apparently resulting from the filling of irregular caverns (though such cases are probably few); from the segregation of ore within an igneous mass in place; or from replacement, the simultaneous solution of country rock and deposition of ore, especially where ore solutions react with the country rock, as where a granitic rock is irregularly replaced by copper-iron sulphides (*e.g.*, the main ore body disseminated through the granitelike mass at Bingham, Utah) or where a limestone or dolomitic (magnesian) limestone is replaced by irregular masses of zinc and lead sulphides, with diameters ranging from microscopic to tens or even hundreds of feet. Several genetically different classes are thus included among the ore deposits of irregular form. There is not uncommonly a gradation from a fissure vein to an irregular body as a fissure vein enters a rock readily attacked by the ore solution.

The textures of ore bodies are their more minute characteristics. Thus, sedimentary ores are commonly oölitic, with particles like the *Bohnenerz* (bean ore) of many sedimentary iron ores; their texture consists of small spheres, frequently concentrically banded, up to half an inch but generally much less in diameter. A similar feature, though on a larger scale, is common in oxidized ores as in the beautiful concentric (botryoidal, mammillary) banding of head-sized masses of the bright green basic copper carbonate malachite. Such features, especially if characterized by syneresis (dehydration cracks), are regarded by many as evidence of colloidal deposition, hence called colloform textures.

A mineral in a replacement ore may have the crystal form of the preceding (host) mineral and is then known as a pseudomorph of the later. Fillings in open spaces are likely to show a sequence of mineral deposition, the first minerals formed being nearest the wall rock; the centre may remain unfilled. Studies of these and other textural relations yield an idea of the sequence of mineral formation or paragenesis. From 1920 onward, the reflecting (metallurgical) microscope (*q.v.*) proved a valuable tool not only to identify opaque ore minerals but also to study and interpret their microscopic textures in terms of their paragenesis and their origin.

In addition to picturing the larger or smaller features of an ore, the attitude and position of an ore body must generally be described, to aid the mining engineer or miner in extracting it. In the case of irregularly shaped ore bodies, this is generally a matter of citing detailed measurements in many places. Alternatively, a series of sections across the ore body may be presented or a three-dimensional model may be prepared by mapping successively deeper levels on glass planes supported in a frame, or by making a plastic or wooden model.

For tabular ore bodies, such as bedded ores or simple fissure veins of some size, the nomenclature of description is like that applied to a stratum by the geologist. By definition, the strike of a tabular vein or ore bed is the direction in azimuth of the line marking its intersection with a horizontal plane; the dip of the plane of the vein or bed is its angle of inclination measured from the horizontal down the slope of the plane and normal to the strike. A fissure vein may thus be said to strike N. 20° E., with dip 50° S.E., its attitude being thus defined.

Within an otherwise barren fissure vein there may be a richer part, the shoot. If large, the ore shoot is a bonanza, if small, a pocket. If dimensions are given for such shoots, the longest measurement in the horizontal plane is the stope length ("stope" being the cavity ultimately left when the ore body has been mined out), the longest dimension directly down dip is the stope depth and the smallest in the horizontal plane is the stope width or thickness. If the ore body is chimneylike, cylindrical or relatively long for its width, the miner may refer to the dimension down dip along its longest axis as the pitch length.

Exploration for Ore Deposits.—Ore deposits are sought by means of three related methods—geological, geophysical and geochemical. Geological exploration is dependent upon a knowledge of the basic geology of the terrain in which the ore is being sought. This may be carried to varying levels of detail. For example, if exploration were contemplated in Mexico, general geologic facts and previous experience indicate that search for copper might

be pursued with best hope for success in the northwestern part of the country, especially in Sonora; search for lead and zinc in the Mesa Central or the Sierra Madre Oriental; and for precious metals in the andesitic lavas of the canyon region, designated by some the Sierra Occidental. Thus are defined certain metallogenic provinces, characterized by ores rich in a specific group of metals, as though the deeper, molten part of the earth in each province had distinctive components. The ancient rocks of the Pre-Cambrian shield of eastern Canada bear little zinc or lead but have produced much gold, nickel and copper, suggesting, by this linkage of their age with certain metals, that specific ore types characterize certain periods of the earth's history, distinguishable as metallogenic periods; this concept can be applied also to sedimentary ores such as the siliceous banded iron ores which are virtually confined to the Pre-Cambrian.

The problem may, instead, be one of greater detail. When reason to expect ore in a small area or a mine exists, where shall search be especially pressed? Placer gold may be followed upstream till it stops; the outcrop of the vein from which it was derived should be on the stream bank or in the drainage basin near at hand. Principles of structural control may be used; given ore-bearing fissures, the richest and largest shoots are generally near intersections of two fissures. If present along a vein, ore is commonly found where strike or dip changes abruptly. Ore is common in smaller folds above dome-shaped intrusions. It is generally richest where a mineralized vein passes from shale to limestone, especially under capping beds of shale or other impervious or insoluble rock.

With progressive exhaustion of ore bodies that crop out, methods are continually sought by which subtler criteria can be used to find buried ore. The surface residue, especially the limonitic outcrop (gossan, "iron hat"), has been studied (Augustus Locke, Roland Blanchard, P. F. Boswell, 1926 *et seq.*) in an attempt to establish colours, textures and the like characteristic of the deeper, primary ore; also gossan is analyzed for traces of deeper elements. Alteration halos marking changes produced by solutions accompanying ore deposition have been recognized for some time as clues; these halos are distinguished by their predominant minerals—tourmalinization, albitization, epidotization, sericitization, kaolinization, sideritization and dolomitization. Special types are greisenization (bleaching and sericite development in an alkali-rich igneous rock), propylitization (the development of certain greenish minerals in intermediate to basic igneous rocks) and the widely distributed development of claylike minerals (argillization, T. S. Lovering, G. M. Schwartz and P. F. Kerr *c.* 1944) and of silica (silicification) which received particular attention after 1940.

Geophysics (*q.v.*) affords methods also increasingly useful. Many iron ores and some others are magnetic; the compass and dip needle (a vertically suspended magnetic needle) have been used for over a century in search of such ores. Lately modified forms of such instruments (the "flying magnetometer") have been flown over promising terrain. Electric methods depend largely on the electric potential developed as ore bodies oxidize. Conductivity of ore minerals, generally higher than that of gangue, is studied with the aid of sensitive current measurements. Gravity anomalies may be a guide to ore. Uranium-rich ores give counts with a Geiger counter, and many ores, especially those of tungsten, fluoresce with characteristic colour and may thus be sought in the dark.

Tools developed by mid-20th century were geochemical ones. Careful analyses give evidences of ore by traces of the ore elements, whether the traces are in the rock outcrop, the residual soil or in growing plants rooted in that soil, or in water draining across it.

These methods have as object narrowing down the area to be explored. Once thus narrowed, the area may be explored at depth by drilling with auger, churn drill or diamond drill, by pit-hole sinking, tunnelling or shaft sinking. Diamond drilling furnishes a solid cylindrical core (if recovery is good), which can be geologically studied and provides a sample for chemical analysis as well.

Evaluation of Ore Deposits.—Geologists and mining engineers are required at times to evaluate an ore body, quite aside from the equipment that may be on the ground. For this purpose the deposit must be sampled, usually by making a cut into a clean face of typical ore and analyzing (assaying) the material thus obtained. Systematic, large-scale sampling repeats the process at regularly spaced intervals and seeks a weighted average to obtain the grade of the ore. The total volume of the ore is then computed using measured or inferred dimensions. The specific gravity of the ore is obtained, the weight per unit volume determined from this and the total tonnage derived by multiplication. The case is simple if the ore body is a tabular one, such as a simple vein of fairly constant thickness, or a replacement body in a stratum, or a sedimentary ore bed. For such cases E. F. Burchard recommended the formula:

$$\text{Total tonnage} = \frac{\frac{1}{2}(T+t) \times L \times D \times R}{\text{cu.ft. per ton}}$$

in which T is average thickness of ore bed (or vein) at outcrop, t is minimum workable thickness, L is length of outcrop, D is distance from outcrop at which thickness of ore becomes t and R is the percentage of recoverable ore. In complex ore bodies changing in richness and volume from place to place, the body is divided, for the purpose of computation, into geometrical units small enough to be essentially constant in width, thickness and composition; the tonnage and grade of each such unit is then separately determined to give a total for the deposit as a whole. The most comprehensive estimates require consideration of such diverse factors as future metal prices, rates of exhaustion (depletion), probable tax assessments, mining, milling and transportation costs, and even such matters as labour sources, pertinent tariff policies and political and economic stability of the country where the mining is to be carried out.

Special attention in the 20th century has been given to the role of mineral deposits in international affairs and in the economics of development, and much literature dealt with this broad subject, especially after World War I.

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(C. H. BE.)

ORE DRESSING is the art of treating crude ores and mineral products by mechanical means to separate the valuable minerals from the worthless constituents in the crude material. The term "ore dressing" at one time referred only to processes employed in treating ores containing valuable metals such as gold and silver, but as these processes were applied more and more to the recovery of nonmetallic minerals it was also used to describe the methods for treating such materials as graphite, sulphur, mica, feldspar, asbestos and fluorspar. The term "mineral dressing" is becoming widely used instead of "ore dressing" because of its broader meaning. Usually the two terms are considered to be synonymous, but sometimes mineral dressing is intended to include other branches of metallurgy and coal preparation whereas ore dressing always refers to methods of separation of solid inorganic minerals from each other without effecting substantial chemical changes.

The need for ore dressing to produce enriched products or concentrates from low-grade ores arises from the fact that most metals and valuable minerals do not occur in nature in such a form as to be usable directly. The common base metals copper, lead and zinc seldom comprise more than a few per cent of the total rock from which they must be extracted and usually occur combined chemically with other elements. These metal-bearing com-

pounds must eventually be subjected to a chemical treatment to break up the chemical union and liberate the metallic elements. The processes employed to accomplish the chemical separations are expensive as a rule, and the cost depends largely on the bulk of material treated. Thus it would cost as much to smelt a ton of copper ore containing 1% copper as to smelt a ton of concentrated copper ore with 30% copper, and the amount of copper produced in the first case would be only one-thirtieth as much as in the second. It is economically impossible to smelt a copper ore of 1% but, by using relatively cheap ore-dressing processes to make 30% copper concentrates for smelting, the 1% ore can be utilized economically.

Ore dressing is the first process which most ores undergo after they are dug from the ground. It may consist of very simple operations such as washing with water and hand sorting to select the richer ore pieces, or it may involve much more complicated processes using elaborate equipment to effect the separations desired. The primary operations in ore dressing are comminution, or crushing, and concentration, but there are many other important operations involved in modern ore-dressing plants, such as sizing and classification, settling and filtering, drying and heat treating, and agglomerating or pelletizing.

Comminution.—Some ores occur in nature as mixtures of separate mineral particles that are not attached to each other and require no crushing or breaking apart. Examples of this type of ore are the placer deposits found in stream and gravel beds where the ore mineral is native gold or perhaps precious stones such as diamonds or emeralds, or perhaps it is simply gravel to be utilized in concrete highways. These materials are mined and the valuable constituent concentrated directly without crushing, but important as the minerals found in such condition may be they represent only a small portion of the ores treated throughout the world for their mineral content. By far the greater part of the ores mined consist of hard and tough rock masses that must be crushed to free the valuable minerals. This operation is called comminution and sometimes includes the breaking down of the ore from huge boulders to fine powders depending upon the fineness of dissemination of the mineral particles.

Comminution of ores is customarily done in three steps: primary or coarse crushing, secondary or fine crushing and grinding. Primary crushing is usually accomplished with jaw or gyratory crushers. Jaw crushers consist of two steel "jaw plates" one of which is stationary and the other movable. Rock fed between the plates is mashed by the action of the movable jaw and reduced to a size small enough to be taken by the following or secondary crusher. Gyratory crushers are essentially a fixed crushing surface, in the form of an outer steel shell, and an inner spindle that is made to gyrate or to rotate, thus alternately receding from and approaching all the points on the outer shell. These machines in their largest form are capable of taking rock masses up to six feet in their longest dimension and reducing them to as small as one inch in size.

Secondary crushers are numerous, the more commonly used ones being rolls, cone crushers and rod mills. These machines customarily receive rock one to three inches in size and reduce it to about one-fourth or one-eighth inch. Rolls crushers consist of a heavy steel frame on which are mounted two cylindrical steel rolls. These rolls are driven so that they rotate toward each other in the same manner as the rollers on a clothes wringer operate. Rock or ore fed between the moving rolls from above is nipped, crushed and discharged below the rolls. Cone crushers consist of an inverted bowl-shaped steel crushing surface within which is gyrated a conical crushing head. The conical crushing head is mounted on a shaft and is gyrated by means of a long eccentric which is driven by a gear and motor assembly similar to those used on the larger gyratory crushers. Rod mills formerly were used only for relatively fine grinding but became popular as secondary crushers because of their high capacity and low maintenance costs. They are cylindrical-shaped steel shells loaded with steel rods and rotated about their horizontal axis. Ore and water are fed into one end of the shell, and the ore is crushed by the tumbling heavy rods within the shell. Rod mills are always made of a length greater than their diameter in order that the rods will not become tangled inside the mill.

There is little difference between grinding and crushing except that crushing usually refers to breaking coarse material, and grinding applies to relatively fine material. Originally grinding referred to that method of comminution which involved a heavy object being dragged or rolled over the material being ground. Mortar and pestle grinding is an example of this type of grinding, and there are still some of the early-type commercial machines in use that employ this principle. The arrastra or drag-stone mill grinds the ore by dragging flat stones around a circular stone floor; roller mills employ heavy rollers revolving about a central shaft on a circular ring; buhrstone mills consist of two flat circular stones, either one of which may rotate or they may both rotate in opposite directions with grinding taking place between the stones. However, modern ore-dressing plants almost always employ rotating cylindrical mills for fine grinding. A mill containing iron or steel balls for the grinding medium is called a ball mill; if it contains rods it is called a rod mill, and if it contains lumps of rock, ore or flint pebbles it is a pebble mill. These mills may be operated either wet or dry depending on the character of the ore or subsequent ore-dressing processes to which the ore is to be subjected.

Concentration.—The act of separating the valuable minerals of an ore from the worthless matter (gangue) into one or more enriched or concentrated products is called concentration. In ore dressing this is possible because of the difference of certain properties of the mineral particles. The simplest form of concentration is hand picking, which is used occasionally in modern plants to remove either rich material or waste material by hand from a moving table or conveyor belt. This operation employs the difference in colour or lustre of the lumps of rock so that the picker may distinguish the wanted from the unwanted material. Differences in the density of minerals permit separation by various methods of gravity concentration; magnetic properties are the basis for separation by magnetic methods; electric properties govern the electrostatic separation of minerals, and surface properties are used to effect the almost magic separations accomplished by flotation.

The feed to a concentration process consists of ore crushed and ground to a suitable size and is called the heads. The enriched product derived from the process is known as concentrates, and the waste or unwanted material is called tailings. A third product of the concentration treatment may be produced which requires further treatment before it can be resolved into concentrates and tailings. This product is called a middlings and, theoretically at least, consists of valuable and gangue minerals which are still locked together. When such a fraction is produced it is returned to the grinding equipment for further comminution and retreatment.

In addition to the simple process of hand picking there are other seemingly crude but effective methods of concentration which are widely used throughout the mining industry. For example, many ores such as those containing nodular manganese and iron minerals occur in a matrix of clay. Often the manganese and iron nodules require only washing with water and vigorous agitation to separate them from the soft clay. This results in greatly enriched concentrates which may be utilized by the iron and steel industry. Another simple concentrating device is an ordinary screen which may be used on many ores where the valuable mineral is either finer or coarser than the size of the openings in the screen. The hardness of minerals is sometimes utilized to effect separations by screening. This may be accomplished by first grinding the ore in a ball mill so that the softer minerals are differentially ground, and the harder minerals almost retain their original size. Simple screening of the differentially ground material results in the production of concentrates of the harder mineral on the screen while the softer material goes through the screen.

Gravity concentration processes have been practised by ore dressers to obtain mineral concentrates from the earth throughout the history of mankind. Probably the first gold ever seen by man was obtained from some ancient stream bed by some form of pan-

ning that was not much different from that used by prospectors in modern times. The miner's gold pan is simply a device to concentrate heavy minerals in the bottom of the pan while the lighter, worthless minerals are washed off the top. The mechanical jig is a development of the gold pan that utilizes the faster settling rate of heavy minerals through a semistationary bed of crushed ore in water. Essentially a jig is an open box with a perforated bottom through which pulsating water currents are forced. Crushed ore fed into the top of the box is stratified by the action of the water currents, with the heavier minerals settling to the bottom. If the heavy minerals are fine enough, they pass through the perforated bottom and are discharged intermittently through a spigot. If they are too coarse to pass through the perforations, they are removed continuously through a cup or pocket on top of the perforations.

Shaking tables are gravity concentration devices used to treat material too fine for jigging. They consist of a tablelike surface inclined slightly from the horizontal and are operated with a reciprocating action that shakes the table in the direction of the long axis. Fine ore and water are fed to the upper corner of the table and flow across the deck which has shallow riffles running the full length of the table. The reciprocating action of the table causes the heavy minerals to move to the end of the table, while the lighter minerals are washed by the water over the side of the deck. Shaking tables are called sand tables or slime tables, depending upon the size of the material that they treat.

Heavy-medium or sink-float separation processes are concentration methods that depend on the buoyant power of suspensions of fine heavy solids in water. Separating vessels are usually in the shape of a stationary cone, a revolving drum or a stationary tank with a revolving screw conveyor to remove the concentrates. The vessel is filled with a mixture of finely divided particles of some heavy material such as ferrosilicon, magnetite or galena and water. The mixture acts as a fluid with an apparent specific gravity lower than that of the mineral to be concentrated but higher than that of the gangue minerals. Crushed ore fed into the liquid-solid mixture separates into a sink or heavy product and a float or light fraction. The sink product is removed continuously from cone separators by pumps and from drum and screw separators by means of suitable conveyors. The float product overflows the top of the vessel in which the separation is made and both products are separated from the heavy medium by screening and washing with water. The treatment is applicable only to ores coarser than about one-eighth inch because of the relatively high viscosity of the heavy medium. The settling rate of fine particles in a viscous liquid or suspensoid medium is too slow to permit rapid separation, and other gravity concentration methods must be used for the finer portion of an ore.

Gravity concentration processes for treating fine sands include spiral separation which employs a spiral trough with a curved bottom. When fed with a water-sand mixture, the dilute pulp flows by gravity from the top of the spiral to the bottom. The lighter minerals, usually quartz and feldspar, are more easily suspended by the water and are washed to the outside of the spiral, while the heavier particles tend to cling to the bottom and inside of the trough. Ports or outlets are spaced along the bottom of the spiral for removal of heavy concentrates while the lighter tailings are discharged at the lower end of the spiral. Shaking tables accomplish the same separations that spirals do, but require more floor space and have more moving parts. Hydrocyclones, also known as Dreissen cones or Dutch State Mines cyclones, may be used in conjunction with a heavy-medium suspension to effect separations of heavy minerals in fine sizes. The hydrocyclone consists of a cone-shaped vessel in which a separation is made based on the principle of the vortex. A dilute ore pulp is pumped tangentially into the cone near the top with a heavy medium and the heavier ore particles find their way to the bottom of the cone while the lighter gangue minerals are removed at the top.

The foregoing processes involve concentration of ores with water, but there are equivalent processes employing air as the separating medium. Pneumatic jigs and tables operate on the same principles of gravity separation as wet jigs and tables but find use in desert regions where water is scarce and on ores that are best treated dry, such as asbestos, which depends upon the light, fluffy nature of the mineral for efficient concentration.

Magnetic separation is an efficient means for concentrating many minerals which contain iron. The mineral magnetite is both heavy and strongly attracted by a magnetic field and may be separated from its gangue minerals by either gravity concentration or magnetic methods, but magnetic separation of magnetite is so highly efficient that it is almost invariably used to concentrate the mineral rather than other, perhaps less complicated, processes. Originally dry magnetic pulleys were the only separators used for concentrating magnetite, but wet separators were found to produce much richer concentrates.

Minerals such as garnet, ilmenite, wolframite and haematite are not as strongly magnetic as magnetite but are sufficiently attracted by a powerful magnetic field to permit separation from completely nonmagnetic minerals such as quartz, feldspar, rutile and zircon. A number of specially designed magnetic separators were found suitable for concentrating these weakly magnetic minerals. Among them are the induced-roll separator and the crossed-belt separator, both of which are highly efficient and widely used. They differ from each other largely in the manner of conveying the ore particles through the magnetic field. The induced-roll machine utilizes a revolving roll to carry the ore stream through the field, the magnetic particles adhering to the roll while the nonmagnetic particles are thrown by centrifugal force away from the roll. The crossed-belt separator, as the name implies, consists of a conveyor belt which carries the ore through the field and a second belt crossing under a magnet above the first belt and at right angles to it; magnetic particles are attracted upward toward the magnet and are removed to the side by the travelling belt, while the nonmagnetic particles remain on the first belt and are discharged at the end of the machine.

Electrostatic separation is a concentration method that utilizes the force of an electric field to effect separations between minerals with different electrical properties. It is based on the phenomenon of attraction between unlike electrical charges and repulsion between like charges. It is particularly applicable to the separation of some nonmetallic minerals although it may be applied to metallic minerals with equal success. It is the only process that proved successful for separating zircon from rutile, these being commonly found associated in beach sand deposits.

Flotation is perhaps the most important concentration process in the mineral industry in that more ore is treated by this method than by any other. As applied to ore dressing, the process dates back to ancient times when the Greeks reportedly used feathers dipped in pitch to recover gold from the mud of a lake, but large-scale modern use of flotation did not come about until after 1924 when the use of xanthate, to collect metal sulphides in a froth, was patented.

The flotation process depends upon the ability of the ore dresser to wet selectively some mineral particles while other minerals remain unwetted and adhere to air bubbles which float to the surface and are removed as a concentrate in the froth. Certain minerals, such as graphite, talc and sulphur, are called self-floating because of their natural tendency to resist wetting by water, but most minerals require coating with a water repellent to render them floatable. Coating the finely ground mineral particles is accomplished by agitating the mixture of ore, water and suitable chemicals in a conditioner for a short time, during which the chemicals react with the elements at the surface of the particles to form a new surface which is more water repellent than the original surface. Minerals that naturally tend to resist wetting may be treated so that their surfaces will be wetted and they will sink in the water and not be floated with the concentrates. Flotation is most commonly used to concentrate copper, lead and zinc minerals from their ores because of the ease with which they are floated or not floated as the case may be. These minerals often occur together and the ore dresser is called upon to separate them from each other as well as from the gangue minerals. By using suitable chemicals it is possible to float copper, lead and zinc minerals selectively from each other by preventing the flotation of

all minerals, except those containing lead, then floating only the copper minerals and finally only the zinc minerals. This ability of the ore dresser to modify the floatability of minerals at will made possible many seemingly magical separations that are common practice in modern mills. In fact it can be said that any two minerals may be separated by flotation if one contains a substantial amount of one element that is absent in the other.

Sizing and Classification.—All ore-dressing concentration processes require that the ore be sized to a certain degree. Often it is the size to which the ore must be ground before the valuable minerals are unlocked that governs the process that will be used to concentrate those minerals. Machines, used to assure grinding to at least unlocking sizes, are called sizers or classifiers. Screens are perhaps the simplest devices used to size ores, and they are widely used in a variety of forms. Fixed screens, for coarse sizing, consist of parallel bars, punched plates or coarsely woven wire. Trommel screens are cylindrical screens revolving slowly about their horizontal axes; vibrating screens are plane surfaces of woven wire cloth which are rapidly vibrated by mechanical or electrical means; and shaking screens are slightly inclined plane surfaces of wire cloth shaken endwise or sidewise. All screens may be used with or without water and some modern screens are heated either by electric current or hot air. Heated screens are less inclined to become blinded by sticky material and thus have greater capacity than unheated ones. Classifiers are made in numerous forms and may be operated either wet or dry. Hydraulic classification depends upon the different settling rates in water of grains of mixed sizes. The water in a classifier may be either in motion or substantially at rest. Air classification is equivalent to the wet operation except that air is used as the medium instead of water. Centrifugal classifiers, wet or dry, are devices that utilize centrifugal force to effect separations between coarse and fine particles.

Settling and Filtering.—Settling or thickening is a term applied by the ore dresser to the process of removing water from a dilute mixture of fine ore and water so that a relatively thick pulp results. Most ore-dressing processes require large amounts of water and the resulting concentrates and particularly the tailings are extremely dilute. The first operation in separating the solids from the water is usually carried out in thickeners. These are large tanks in which the fine solids are allowed to settle. Chemicals are sometimes added to increase the settling rate of the solids. Feed to thickeners usually contains from 5% to 20% solids, and the discharge, which is pumped from the bottom of the thickener, varies from about 40% to 80% solids. Thickened pulps may be further dewatered by filtering. Filters for ore-dressing plants are usually rotating cylinders covered with a porous fabric through which the water is drawn by means of a vacuum under the cloth. Such machines are called vacuum filters, and there are numerous other forms and types of filtering devices.

Drying and Heat Treating.—Dryers for ores and concentrates consist of some form of container and a means to apply heat to the wet material within the container. Most commonly used dryers are rotary kilns which are slightly inclined rotating cylinders with a burner at one end or the other. Wet ore is fed continuously to the upper end of the cylinder while the dry material is discharged at the lower end. Infra-red lamps are sometimes used to dry small quantities of concentrates, and many kinds of dryers have found use on special types of ores. Roasting is sometimes used in ore-dressing plants to change the form of some mineral in the ore so that it may be more easily concentrated. Roasting of pyrite, for example, to drive off sulphur and render the mineral magnetic is carried out in roasters of various types. Roasting sometimes causes a mineral to expand or decrepitate, as in the case of vermiculite which expands and spodumene which breaks into small particles, thus making it more readily separable from unaltered minerals.

Agglomeration.—Some ores, particularly those of iron, chromium and manganese, which are smelted in blast furnaces cannot be utilized as fine particles. They must be agglomerated in some manner so as to form large, tough lumps of material suitable for smelting. This process, variously called sintering, agglomerating, nodulizing, pelletizing and briquetting, may be carried out by fusing the material at high temperature, as is done in sintering and nodulizing, or by mixing a binder such as starch, molasses or bentonite with the fine ore and heating or applying pressure to the mixture. (*See* also AMALGAMATION; CYANIDE PROCESS.)

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OREGON, popularly known as the "Beaver state," is one of the northwestern states of the United States of America. Its capital is Salem. It lies on the Pacific slope between approximately 42° and 46° 18′ N. and 116° 33′ and 124° 32′ W. It is bounded on the north by Washington from which it is separated in part by the Columbia river and in part by the 46th parallel; on the east by Idaho, from which it is separated in part by the Snake river; on the south by Nevada and California; and on the west by the Pacific ocean, upon which it has a tidal shore line, omitting islands, of 429 mi. It has an extreme length east and west of 375 mi., an extreme width north and south of 290 mi., and a total area of 96,981 sq.mi., of which 666 sq.mi. are inland water surface. The origin of the name "Oregon" is unknown. The first known use of the word was by Maj. Robert Rogers in 1765 in his plans for an exploring expedition to the northwest coast. He applied it to a river flowing into the Pacific ocean of which he had heard. Such a river was discovered in 1792 and named "Columbia," but the name "Oregon" was given to the entire territory drained by this river. Several states were created out of this territory and only the present area retains the name.

Of the total area of approximately 62,000,000 ac. the federal government at mid-20th century held title to about 32,600,000 ac., consisting largely of public domain used for grazing, national forests, revested forest lands and Indian reservations.

Physical Features.—The coast of the state extends in a general north and south direction for about 30 mi. and consists of long stretches of sandy beach broken occasionally by lateral spurs of the Coast range and by bays into which coastal streams empty. Parallel with the coast and with its main axis about 20 mi. inland is an irregular chain of mountains known as the Coast range. The range is irregular, with a maximum elevation of 4,097 ft. (Mary's Peak). Several rivers, among them the Nehalem, Umpqua and Rogue, cut their way through the Coast range to reach the ocean. For the northern two-thirds of its length in Oregon the Coast range is bordered on the east by the Willamette valley, which is about 150 mi. long and 30 mi. wide, and is the most thickly populated portion of the state. In the south the Coast range merges into the complex group designated as the Klamath mountains, lying partly in Oregon and partly in California, and extending from the northern extremity of the Sierra Nevada to the sea. A number of ridges in the group bear local names, such as the Rogue river, Umpqua and Siskiyou mountains. The Cascade mountains, which cross the state from north to south about 100 mi. inland, form the predominant physical feature of the state. They are the product of succeeding periods of vulcanism and folding. Some of the peaks are cones of extinct volcanoes, with glaciers on their slopes. Highest point in the state is Mt. Hood (11,245 ft.); other peaks in the Cascades are Mt. Jefferson (10,495 ft.), Three Sisters and Diamond peak.

The Cascade mountains divide the state topographically into two sharply contrasted parts. West of this range the country exhibits a great variety of surface structure and is humid and densely wooded; east of the range it consists of a broken tableland, arid or semiarid, with a general elevation reaching 5,000 ft. This eastern tableland, though really very rugged and mountainous, has few striking topographic features when compared with the more broken area to the west. In the northeastern part of this eastern plateau lie the Blue mountains, which have an average elevation of 6,000 ft. and decline gradually toward the north. A southwestern spur,

about 100 mi. in length, and the principal ridge together enclose on several sides a wide valley drained by the tributaries of the John Day river. Draining the eastern slopes of the Cascade range for the northern two-thirds of its length and flowing into the Columbia a few miles west of the mouth of the John Day river is the Deschutes river, flowing through a valley less arid than the plateau region to the southeastward. Southeast of the Deschutes river and south of the Blue mountains lies the great basin region. In Oregon this area extends from the Nevada boundary northward for about 150 mi. and embraces an area of about 18,500 sq.mi. All of its streams lose their water by seepage or evaporation. Many of the mountains within the basin region consist of great faulted crust blocks, with a general north and south trend. One face of these mountains is usually in the form of a steep palisade, while the other has a very gradual slope. Between these ridges lie level valleys whose floors consist partly of lava, partly of volcanic fragmental material, partly of detritus from the bordering mountains.

Some large permanent lakes occupy troughs between faulted blocks in southern Oregon, among them Malheur and Harney lakes in Harney county and Lake Abert, Warner and Summer lakes in Lake county. All of these are salt and shallow, shrinking to small proportions in the dry season. East of the Steens mountains, besides a number of small alkaline lakes, is a playa or mud flat, known as the Alvord desert, which in the spring is covered with 50 to 60 sq.mi. of rain water only a foot or two deep.

In the northwestern quarter of the basin occupying an area 100 mi. long and 60 mi. wide is a part of Oregon's high desert. Its surface consists of pumiceous soil and earth blown from the semiarid depressions once occupied by lakes that formed in troughs between fault-block mountains. From this plateau surface arise ridges and mountains created by earth faulting, and weathered buttes that are remnants of volcanic cones. There are no surface streams in the area except a few that are seasonal. Semiartesian water is pumped from wells in the Fort Rock valley, and shallow excavations in the northern part of the area provide water for livestock. A heavy growth of sagebrush covers most of the region and western junipers are abundant.

Southwest of the basin and draining the southern third of the eastern Cascade slopes is the Klamath valley, containing Upper Klamath lake, drained by Klamath river. Near the northwestern boundary of Klamath county is Crater lake, whose surface is 6,160 ft. above the sea. This lake lies in a great pit or caldera created by the wrecking in prehistoric times of the volcano Mt. Mazama, which according to geologists once had an altitude of about 14,000 ft. above the sea and 8,000 ft. above the surrounding tableland. The upper portion of the mountain was blown off or fell inward, possibly because of the withdrawal of interior lava; and a craterlike rim or caldera was left, rising 2,000 ft. above the surrounding country. The lake is 4 mi. wide and 6 mi. long, has a depth in some places of nearly 2,000 ft. and is surrounded by walls of rock from 500 to 2,000 ft. high. In spite of its great elevation the lake has never been known to freeze, and though it has no visible outlet its waters are fresh.

East of the great basin and the Blue mountains is the region tributary to the Snake river. The southern half, drained by the Owyhee river, is much like the great basin, being arid and plainlike in character. North of the Owyhee the chief tributaries of the Snake are the Malheur, Burnt, Powder and Grande Ronde rivers flowing through small but beautiful and fertile valleys.

In the northeastern corner of the state are the Wallowa mountains, an upthrust of granite and marble, very scenic, with sharp peaks rising to the height of 10,000 ft., and numerous lakes. Here at the border of the state the Snake river goes through a mile-deep canyon (Hell's canyon), with near-vertical walls, one of the deepest gashes on the surface of the earth.

Climate.—Along the coast and in the western valleys the climate is mild, uniform and relatively humid except during the warmer summer months. Air masses moving across the higher Cascades lose, by precipitation, a considerable part of their moisture causing the eastern two-thirds of the state to be dry with much greater temperature extremes. Along the coast the normal annual precipitation is near 75 in., increasing to as much as 130 in. at some of the higher elevations in the Coast range. In the western valleys it ranges from about 18 in. in the Medford area to as much as 50 in. in the northern Willamette valley. This increases to between 75 and 90 in. on the upper west slopes of the Cascades, then declines sharply moving down the east slopes. On the eastern valley floors yearly normals vary from less than 8 in. to slightly more than 25 in., with those for 80% of the area lying between 9 and 14 in.

Temperatures along the coast never go as low as 0° F. and only rarely reach 100°. In the Willamette valley a few degrees may be added to each extreme, but even here temperatures of zero or lower have been recorded only a few times, and those above 90° occur on an average of only six to eight times a year. There is only a range of 15° (45°–60°) between the coast average mean January and July temperatures. In the Willamette valley this ranges from 38° in January to near 66° in July. In the Rogue river valley of southwest Oregon the July mean is about 5° higher and the occurrence of temperatures above 90° is about seven times as great as in the Willamette. East of the Cascades temperatures have been recorded as low as −54° and as high as 119°. These, however, are the extreme conditions. The normal mean January temperature is 25°–28° in valleys of the southeast and 29°–33° in those of the northeast. Average July means in central Oregon range between 65° and 70° while those of the extreme eastern area are between 70° and 78°.

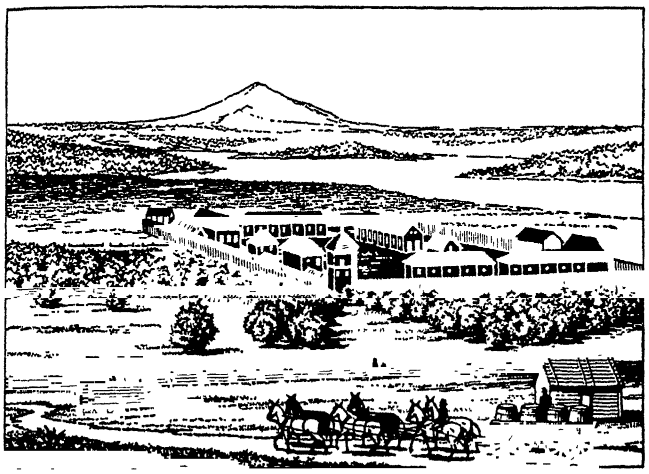
Snowfall at many coastal stations averages only about an inch a year; in the Rogue river valley the average is near 20 in.; in the Willamette valley from 6 to 13 in.; while at elevations of 6,000 ft. on Mt. Hood a short-time record indicated an average annual fall of approximately 465 in. Except at higher elevations eastern stations have between 16 and 20 in. of snow each winter.

Winter relative humidities average between 80% and 90% in western Oregon and near 70% east of the Cascades. Average July humidities range between 55% and 65% in the west and near 40% in the east, though in both areas humidities in the low 20s are common during periods of highest temperatures.

History.—The Spanish pilot, Bartolomé Ferrelo, who in 1543 made the farthest northward voyage along the Pacific coast recorded in the first half of the 16th century, may have sighted the shores of Oregon. So also the famous English captain, Sir Francis Drake, who in 1579 coasted these shores seeking a route home by a northwest passage is supposed to have reached a point near 43° lat. before giving up the search and turning westward across the Pacific. In 1603 the Spaniards Sebastián Vizcaíno and Martin d'Aguilar also passed 42° lat., D'Aguilar claiming to have reached a point of land near 43° which he called Cape Blanco. The Spanish, however, were too much interested in the profitable trade between their colonies and the far east to give much attention to northwest exploration, and it was not until 160 years later that fear of Russian and English encroachment caused them to send out further expeditions. In 1774 Juan Pérez was sent out with orders to proceed to 60° lat. He turned back at 54° but was the first to sail along the entire coast line of the Oregon country. The following year Bruno Heceta commanded another expedition which near Point Grenville made the first landing in the region. They erected a cross and in formal ceremony took possession for Spain.

The Spaniards made no effort to colonize northwestern America or to develop its trade with the Indians, but toward the end of the 18th century the traders of the great British fur companies of the north were gradually pushing overland to the Pacific. Upon the sea, too, the English were not idle. Capt. James Cook in March 1778 sighted the coast of Oregon in lat. 44°, and examined it between 47° and 48° in the hope of finding the Straits of Juan de Fuca described in the Spanish accounts. Soon after the close of the Revolutionary War U.S. merchants began to buy furs along the northwest coast and to ship them to China to be exchanged there for the products of the east. It was in the prosecution of his trade that Capt. Robert Gray (1755–1806), an American in the service of Boston merchants, discovered in 1792 the long-sought river of the west, which he named the Columbia, after his ship. By the discovery of this river Gray gave to the United States a claim to the whole territory drained by its waters.

Land exploration soon followed these discoveries along the coast. Alexander Mackenzie, in the service of the North West company, in 1793 had explored through Canada to the Pacific coast in about lat. 52° 20′ N., and Meriwether Lewis and William Clark, U.S. explorers acting under the orders of Pres. Thomas Jefferson, in 1805–06 had passed west of the Rocky mountains and down the Columbia river to the Pacific ocean. Both British and U.S. adventurers



BY COURTESY OF THE UNION PACIFIC SYSTEM
FORT VANCOUVER OF THE HUDSON'S BAY CO. ESTABLISHED IN 1815, AFTER A SKETCH MADE BY STANLEY IN 1854

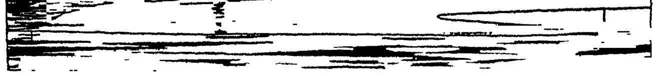
were attracted to the region by the profitable fur trade. In 1808 the North West company had several posts on the Fraser river, and in 1809–11 they built others south of the 49th parallel. In 1811, also, the Pacific Fur company, under the guidance of John Jacob Astor of New York, founded a trading post at the mouth of the Columbia which was called Astoria, and set up a number of minor posts on the Willamette, Spokane and Okanogan rivers. On hearing of the war between England and the United States, Astor's associates, deeming Astoria untenable, sold the property in 1813 to the North West company. The British took formal possession and renamed the post Fort George.

Soon after the restoration of peace between England and the United States there arose the so-called "northwestern boundary dispute" or "Oregon question" which agitated both countries for a generation and almost led to another war. The United States was willing at the time to extend the northwestern boundary along the 49th parallel from Lake of the Woods to the Pacific, but to this the British government would not consent, so in 1818 both nations agreed to a "joint occupation" for ten years of the country "on the north-west coast of America, westward of the Stony (Rocky) mountains." By treaty the following year Spain waived its claim to the territory north of 42° in favour of the United States, and in 1824 Russia likewise agreed to make no settlements south of 54° 40′. In 1827 the agreement of 1818 for joint occupation by Great Britain and the United States was renewed for an indefinite term, with the proviso that it might be terminated by either party on 12 months' notice. For the next three decades the history of Oregon was concerned mainly with British fur traders and U.S. immigrants. The Hudson's Bay company absorbed its rival, the North West company, in 1821 and thus secured a practical monopoly of the trade of the Oregon region. Its policy was to discourage colonization, in order to maintain the territory in which it operated as a vast preserve. The company sent to the Columbia river as its governor west of the Rocky mountains John McLoughlin, who ruled the vast empire firmly and wisely for 22 years and became known affectionately as the "Father of Oregon." His capital was at Fort Vancouver which he built on the north bank of the Columbia opposite the mouth of the Willamette river. In 1829 he also built an establishment at the falls of the Willamette which determined the site of Oregon City. Though it was against the company's interests he generously aided the U.S. colonists who later came to the region and later in life, after U.S. government was extended over the country, himself became a citizen of the United States.

The elderly employees of the company were urged by McLoughlin, when they wished to retire from active service, to settle with their families in the Willamette valley. There were a number of these settlers, mostly French Canadians, there by 1835. In 1834 Jason and Daniel Lee arrived from the United States and founded Methodist missions in the Willamette valley. In 1837, 20 more missionaries arrived and a branch mission was opened at The Dalles. In 1838 Jason Lee started overland for the states, and his lecturing and preaching not only raised money for the mission but aroused great interest in Oregon, with the result that the U.S. element was increased in 1840 by 50 more arrivals by sea. In 1842 the first immigrant train over the Oregon trail, headed by Elijah White and piloted for part of its way by Thomas Fitzpatrick, arrived. The following was the year of the "Great Migration" when nearly 900 men, women and children likewise followed the trail and settled in the Willamette valley. After this the flow of immigrants over the Oregon trail steadily increased, about 1,400 arriving in 1844 and 3,000 in 1845. The U.S. settlers started a movement for the immediate and permanent settlement of the Oregon dispute. In 1843 they had established for themselves a provisional government, but settlement and business undertakings were held back until their future rulers and the nature of their permanent government were settled. The western states rallied to their support with the result that the Democratic national convention in 1844 declared the title of the United States to "the whole of the Territory of Oregon" to be "clear and unquestionable," and the party made "Fifty-four forty or fight" a campaign slogan. Upon the success of the party, negotiations were entered into which resulted in a compromise treaty (1846) fixing the boundary between Oregon and British possessions at its present position, and giving the United States complete title to all land to the southward.

Territorial status and a territorial government were delayed until 1848 because of opposition from the slavery element in congress. As then constituted the territory included the present states of Oregon, Washington, Idaho and parts of Montana and Wyoming. Its area was reduced in 1853 by the creation of the territory of Washington. The discovery of gold in California drew many Oregon settlers to that country in 1848–50, but this exodus was soon offset as a result of the enactment by congress in 1850 of the Donation Land act by which settlers in Oregon were able to obtain large tracts of land free of cost. The number of claims registered under this act was more than 8,000.

In 1857 the people voted for statehood; in the same year a constitutional convention drafted a constitution which they adopted in November, and on Feb. 14, 1859, Oregon was admitted into the union with its present boundaries. Gold had been discovered in paying quantities at Jacksonville in southern Oregon in 1851 and in 1861 in eastern Oregon along the John Day and Powder rivers. Each of these discoveries resulted in a stampede which



FROM GRAY, "A HISTORY OF OREGON"
THE SETTLEMENT OF ASTORIA, OREGON, IN 1811, FOUNDED BY JOHN JACOB ASTOR AT THE HEAD OF THE COLUMBIA RIVER

settled a region which otherwise would have been settled very slowly. The increase of mining population in Oregon and Idaho encouraged agricultural development in that it provided markets.

Permanent settlements were made in all the important valleys of eastern Oregon in the 1860s. By 1870 the population of the state was 91,000. In the next 20 years it nearly doubled. This increase was due largely to the opening of railroad connections with the outside world. Two lines, one on each side of the Willamette river, to connect with a line in California, were begun in 1868, but progress was so slow that the connection was not made until 1887. Meanwhile a line had been built along the Columbia river to meet the transcontinental lines being built west through Idaho, and this junction was effected in 1883. Many local lines were also built.

Starting in the 1930s a vast program of public works was launched in the Columbia basin for the generation of electric power, improvement of navigation, irrigation and prevention of floods. Bonneville and Grand Coulee on the Columbia river (the latter in central Washington) were two large dams completed during this period.

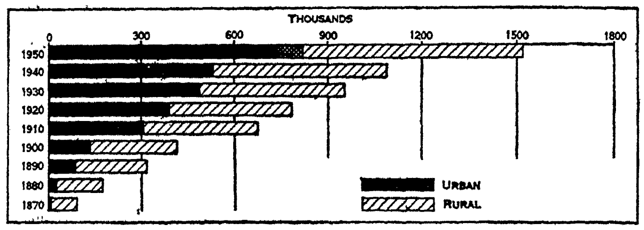
Politically the state at first was Democratic; in later years Republican. Of its 25 governors to 1950, 15 were Republican, 9 Democrat, 1 independent. Only six times had the state cast its vote for a Democratic candidate for president. It voted for F. D. Roosevelt four times and for T. E. Dewey in 1948.

Government.—Oregon is governed under its original constitution adopted in 1857, amended in a number of important respects. The legislative power is vested in a legislative assembly of two houses, but limited by direct action of the people through the initiative and referendum. The senate has a membership of 30 elected for four-year terms, and the house numbers 60 elected for two-year terms. The regular session begins in January of odd-numbered years. The governor has the single-item veto as well as the general veto. A two-thirds vote in each house is required to repass a bill over a veto.

Through a series of constitutional amendments and laws beginning in 1902, the people of Oregon adopted a number of reforms widely known as the "Oregon system." Its distinctive features were: (1) the initiative for legislative bills and constitutional amendments; (2) the referendum; (3) the direct primary; (4) a corrupt practices act; (5) presidential preference primary; (6) the recall; (7) a voters' pamphlet. Under the initiative proposed laws or amendments must be submitted to the voters at the next general election on the filing of petitions signed by 8% of the number voting for justice of the supreme court at the last general election. A total of 5% of the voters signing petitions procure a referendum on any law passed by the legislature, and the legislature itself may refer any law it has approved to the people for their approval. All elected public officials are subject to the recall, but it is rarely invoked. The voters' pamphlet (campaign textbook) contains the text of measures to be voted on and arguments for and against, also informational material inserted by candidates. The pamphlets are distributed to all registered voters.

The executive power in Oregon is vested in a governor elected for a four-year term. There is no lieutenant governor. The elected administrative officials are the secretary of state, treasurer, attorney general, superintendent of public instruction and labour commissioner, all elected for four-year terms. There are a number of boards and commissions, some ex officio such as the board of control and state land board, others appointive such as the board of forestry, board of health, board of higher education, parole board, library board, public employees' retirement board, highway commission, tax commission, industrial accident and unemployment compensation commissions, public welfare commission, civil service commission, fish and game commissions and liquor control commission. Appointive heads of departments include the adjutant general, director of agriculture, budget director, insurance commissioner, public utilities commissioner and corporation commissioner. In most instances the appointing power rests with the governor. The administration of justice is entrusted to a supreme court, circuit courts, district courts, county judges and justices of the peace. There are municipal courts in cities. The supreme court has seven members elected for six-year terms. Sessions of the court are held in Salem and Pendleton. The state is divided into 21 judicial districts for the circuit court, and some of the districts have several judges. In civil cases three-fourths of a jury may render a verdict. The county court is an administrative body consisting of the county judge and two commissioners. The county judge, except in certain counties, also handles probate and juvenile court matters.

Population.—The population of Oregon in 1850 was 13,294; in 1880 it was 174,768; in 1910, 672,765; in 1940, 1,089,684; and in 1950, 1,521,341. This last figure represented an increase of 39.6% over the population in 1940. The population per square mile in 1950 was 15.8, as compared with 11.3 in 1940, and with 50.7 for the U.S. in 1950.



BY COURTESY OF THE U.S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF OREGON: 1870 TO 1950

The crosshatched part of the 1950 bar represents the population of the additional areas counted as urban under the new 1950 definition

Of the 1950 population, 732,247 or 48.1% lived in incorporated places of 2,500 or more, as compared with 48.8% in 1940, when these places constituted the urban area. The entire urban population, under a new definition set up for 1950 which included also the thickly settled suburban area, or "urban fringe," adjacent to the city of Portland, and two unincorporated places of 2,500 or more outside this fringe, amounted to 819,318, or 53.9% of the state total.

Area	Population			Per cent of increase	
	1950	1940	1930	1940–50	1930–40
The state	1,521,341	1,089,684	953,786	39.6	14.2
Urban	819,318*	531,675	489,746	54.1	8.6
Rural	702,023*	558,009	464,040	25.8	20.3
Per cent urban	53.9*	48.8	51.3	..	..
Principal cities:					
Portland	373,628	305,394	301,815	22.3	1.2
Salem	43,140	30,908	26,266	39.6	17.7
Eugene	35,879	20,838	18,901	72.2	10.2

*Final figures for 1950 based on *new* definition. *See* comment in text.

The number of occupied dwelling units (or households) in 1950 was approximately 480,000, as compared with 338,000 in 1940. The average population per household was 3.2, both in 1940 and in 1950.

The population of the state was distributed by colour and nativity in 1950 as follows: 92.9% native white, 5.5% foreign-born white and 1.6% nonwhite, mainly Indians. Of the foreign-born white, 22.5% were born in Canada, 9.5% in Germany and 8.3% in Sweden. There were 102.2 males per 100 females in the native white population and 117.2 in the foreign-born; 8.7% of the population was 65 years old or over; and 54.5% of the population 14 years old and over was in the labour force. Of the total number of employed males, 14.4% were engaged in agriculture, 9.8% in construction, 27.3% in manufacturing, 9.8% in transportation and 17.7% in wholesale and retail trade.

Finance.—The assessed valuation of taxable property was $1,607,876,262 in 1950 and $896,787,005 in 1940. Total receipts of the state treasury for the fiscal year 1949–50 were $288,392,748 and total disbursements $296,777,971. Cash balances in all funds on June 30, 1950, were $162,681,344. The principal fund is the state general fund which is derived chiefly from personal income and corporate excise taxes, inheritance taxes and profits of state liquor stores. No direct property tax for state purposes was levied after 1940. Total property taxes levied for 1950–51 for local units of government were $96,476,733.

Oregon initiated the tax on gasoline as a means of financing highway construction and maintenance.

Total bonded indebtedness of the state in 1950 was $29,427,820, of which the chief items were $21,000,000 for veterans' loan fund, $5,075,000 for veterans' World War I state aid and $2,237,500 for

highway bonds. Provisions were made for retirement of all bonds at maturity. County bonded debt in 1950 was $5,000,000 for roads. Bonded debt of school districts was $47,260,000; of cities $47,335,000. On June 30, 1950, there were 21 national banks with 86 branches and 52 state banks with 12 branches in Oregon. Aggregate deposits on Oct. 4, 1950, were $1,478,647,190.

Education.—Public schools of Oregon are operated by school districts. There is a state board of education with limited powers and a state department of education headed by an elective superintendent of public instruction. Total school enrolment in 1949–50 was 281,309 and in 1939–40, 205,928; high school enrolment 1949–50 was 69,020, in 1939–40, 63,057; parochial school enrolment in 1948–49 was 16,416, in 1939–40, 10,967. Total cost of public-school education in 1948–49 was $58,161,000 and in 1939–40, $18,126,538. In 1948–49 there were 10,568 teachers employed in public schools at an average salary of $3,130. Oregon Technical institute is maintained at Klamath Falls under the state board of education; in 1949–50 its enrolment was 708.

The state board of higher education operates seven institutions of higher learning: University of Oregon at Eugene; University of Oregon medical and dental school at Portland; Oregon State college, a land-grant college, at Corvallis; three colleges of education at Monmouth, Ashland and La Grande; and Vanport Extension centre under the extension division at Portland. Enrolment in the seven institutions in 1949–50 was 19,269 and in addition 16,716 were enrolled in extension classes. The state college operates an agricultural experiment station at Corvallis and nine branch stations over the state and conducts the agricultural extension service in co-operation with the federal department of agriculture. Besides the state institutions of higher learning there were 12 independent colleges and normal schools in Oregon in 1950.

Penal and Charitable Institutions.—In 1951 the state operated 11 penal and charitable institutions under the state board of control. Inmate population on June 30, 1950, was 4,375 in the two mental hospitals at Salem and Pendleton; 1,452 in the penitentiary at Salem; 1,242 in Fairview home for feeble-minded at Salem; 419 in three tuberculosis hospitals in Salem, The Dalles and Portland. Other institutions were schools for the deaf and blind and Hillcrest girls' training school at Salem, boys' training school at Woodburn.

Public welfare expenditures for old-age and general assistance, aid to dependent children and the blind for 1949–50 amounted to $25,687,637. Payments for unemployment compensation for that year were $25,893,895.

Agriculture and Livestock.—Agriculture is a major source of income in Oregon. Of the land area of 61,664,000 ac. in 1945 19,754,257 ac. or 32% were in farmland. The number of farms increased from 61,829 in 1940 to 63,125 in 1945. The average size of farms was 290.9 ac. in 1940 and 312.9 in 1945. The value of farmlands and buildings was $476,817,354 in 1940 and $697,775,183 in 1945. The value of implements and machinery was $44,607,932 in 1940 and $66,656,778 in 1945. The number of farm tenants decreased from 11,277 in 1940 to 6,823 in 1945.

Wheat, the chief grain crop, is produced mainly in the drier portion east of the Cascade mountains. In 1950 the wheat acreage was 940,000 and production was 24,215,000 bu.; average production for 1939–48 was 21,906,000 bu. Acreage and production of other important field crops in 1950 were as follows, with average production for 1939–48 in parentheses: oats 308,000 ac., 9,856,000 bu. (9,655,000 bu.); barley 415,000 ac., 14,525,000 bu. (8,774,000 bu.); potatoes 39,000 ac., 12,870,000 bu. (10,164,000 bu.); all hay 1,113,000 ac., 1,909,000 tons (1,942,000 tons).

Oregon is an important fruit-raising state and many of its valleys are noted for high quality fruits; *e.g.*, Rogue river for pears and Hood river for apples. Fruits, berries and nuts are grown extensively in the Willamette valley. Apple production was 2,788,000 bu. in 1950 (1939–48 average 2,783,000 bu.); pears 5,574,000 bu. in 1950 (1939–48 average 4,592,000 bu.). Cherry production was 19,700 tons in 1950 and prunes 20,700 tons.

Oregon produces a variety of specialty crops including hops, peppermint oil, vegetables, English walnuts, filberts, nursery stock and many seed crops.

Irrigation is employed extensively. In eastern Oregon it is necessary for crop production except where precipitation is sufficient for dry-land farming; it is also used in western Oregon to obtain maximum production for pasture and crops. In eastern Oregon irrigation districts, often in conjunction with the U.S. bureau of reclamation, manage the storage and distribution of water to lands; in western Oregon irrigating is usually an individual enterprise, water being drawn from wells or surface streams and distributed to lands through pipe and overhead sprinklers. Major irrigation developments are Owyhee, Deschutes, Umatilla, Klamath and Rogue river. The area under irrigation in 1950 was estimated at 1,130,000 ac., of which 465,812 ac. were in the 54 active irrigation districts on July 1, 1950.

The aggregate value of livestock on Oregon farms on Jan. 1, 1950, was $149,389,000, an increase of 50% from the average for 1939–48. Great numbers of beef cattle are raised on the farms and ranges of eastern Oregon while the Willamette valley and coast districts are devoted more to dairying. The number of all cattle and calves on Jan. 1, 1950, was 1,107,000, valued at $121,770,000. Of these, 383,000 were milch cows and heifers and heifer calves, valued at $36,240,000. Total milk production in 1949 was 1,305,000,000 lb. Numbers of sheep and lambs had declined steadily and stood at 689,000 valued at $12,212,000 on Jan. 1, 1950; numbers in 1930 were 2,530,000. Wool production decreased from 14,016,000 lb. in 1940 to 5,366,000 lb. in 1950. Horses and mules decreased from 301,000 in 1930 to 74,000 on Jan. 1, 1950, with a value of $2,836,000. Hogs numbered 166,000 in 1950 with a value of $4,233,000. Poultry raising is an important industry. On Jan. 1, 1950, there were 3,584,000 chickens valued at $5,627,000 and 370,000 turkeys valued at $2,405,000.

Mining.—Between 1851 and 1880 the mining of gold was a major occupation in Oregon and was responsible for the settlement of many localities. This continued with varying degrees of activity until World War II, when mining of precious metals ceased. Gold production was 93,372 troy ounces in 1939, valued at $3,268,000; in 1949 it was 16,226 oz. with a value of $567,910. Value of all mineral production in 1939 was $8,636,440 and in 1949 $22,479,000, of which metallic production amounted to only $676,000. Chief mineral products in 1949 were clay and clay products $1,196,177; sand and gravel $7,682,272; stone $6,479,164. In 1950 three portland cement plants were operating in the state; also one coal mine in Coos county, two gold lode mines and 40 gold dredges seasonally. Several plants were supplying lightweight aggregates: pumice, perlite and expanded shale (haydite).

Fisheries.—Fisheries production for 1949–50 amounted to 39,173,00 lb. valued at $7,389,000. Fish and shellfish are caught in coastal streams and the ocean and marketed fresh or canned. Principal fish are salmon, tuna, shad and bottomfish, the last a grouping of several species of ocean fish.

Forests and Lumbering.—Oregon contains the largest body of standing timber in the U.S., and its annual cut of lumber is the largest of all the states. The volume of standing timber in 1950 was 355,000,000,000 bd.ft. The area of timberland in the state was 29,755,000 ac. There were 13 national forests in Oregon, located principally in the mountain ranges, embracing 14,820,000 ac. with 157,000,000,000 bd.ft. of saw timber. Lands in state forests amounted to 687,400 ac. The amount of timber cut in 1949 was 6,874,953,000 bd.ft., and the plywood production was 709,149,000 sq.ft., ⅜-in. basis. Value of timber cut in 1949 was $309,000,000, green rough basis. The comparative figure for 1940 was $130,000,000.

The forests are largely of softwood. In western Oregon are some of the finest stands in the world of Douglas fir, western hemlock, spruce and western cedar. The chief commercial species east of the Cascades is ponderosa pine.

Oregon enacted advanced legislation for forest conservation and reforestation of cutover and burned-over lands. Many private owners of timberland became engaged in a "tree farms" program for continued cropping of lands in forests.

Manufactures.—Manufacturing showed rapid expansion in the state as indicated in comparative figures reported by the census bureau for 1947 and 1937, the figures for the latter year

in parentheses: number of establishments 3,075 (2,107); number of employees, average for year 105,591 (73,033); salaries and wages $317,827,000 ($94,162,000); value added by manufacture $675,017,000 ($169,057,000). The chief manufacturing industry is lumbering, with 1,390 establishments in 1947 which employed 51,550 persons, paid wages of $164,203,000 and gave added value of $363,561,000. Second was food and kindred products: 545 establishments with 17,761 employees, wages $46,063,000, value added by manufacture $107,767,000. Values added by manufacture in other important industries were: paper and allied products $34,653,000; printing and publishing $24,311,000; fabricated metal products $20,685,000; primary metal industries $19,782,000; furniture and fixtures $15,300,000. Canning and freezing of fruits, berries and vegetables are important.

Transportation and Commerce.—Total steam railway mileage of the state increased from 3,779 mi. in 1929 to 4,996 in 1939 and 5,054 in 1949. Electric railway mileage decreased from 364 mi. in 1929 to 105 in 1949. Main steam railway lines are those of the Southern Pacific, Union Pacific, Great Northern, Northern Pacific and Spokane, Portland and Seattle. The Southern Pacific operates a main line from Portland south across the state to California with numerous branch lines through western Oregon. The Union Pacific crosses the northeastern corner of the state to the Columbia river, which it follows to Portland. The Spokane, Portland and Seattle, jointly owned by the Great Northern and Northern Pacific, operates a line on the north bank of the Columbia river to Portland, thence on the south bank to Astoria and Seaside, as well as subsidiary lines in the Willamette valley and central Oregon. The Great Northern makes a connection from Bend through Klamath Falls to the Western Pacific in California. The state system of highways on Dec. 31, 1949, included 7,320 mi., of which 6,824 mi. were surfaced. There were 32,566 mi. of county roads, of which 16,889 were surfaced. In the fiscal year 1949–50 the state highway department (created in 1917) expended $34,974,459. Revenues were derived from fuels tax ($25,958,666 in 1949–50), motor vehicle registrations and drivers' licences ($9,709,880) and use fees from commercial vehicles ($5,545,387), also federal funds.

A deepwater channel in the Columbia and Willamette rivers makes Portland accessible for ocean-going vessels. Other principal ports are Astoria and Coos Bay. Tonnage figures on waterborne commerce at Portland for 1949 in domestic and foreign trade were, inbound 6,351,255 short tons, outbound 1,582,042 tons. Total cargo tonnage of merchandise exports for the Oregon customs district was 736,600 tons in 1949; imports 56,250 tons.

Air transportation in 1950 was provided by United Air Lines, Northwest Airlines, Western Air Lines, West Coast Airlines, Pan American World Airways, Southwestern Airways and Empire Air Lines.

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OREGON CITY, a city of Oregon, U.S., on the east bank of the Willamette river, 12 mi. S. by E. of Portland; the county seat of Clackamas county. It is on federal highway 99E, and is served by the Southern Pacific and electric railways, and by motor coach lines. Pop. (1950) 7,682; it was 6,124 in 1940 and 5,761 in 1930. The river there makes a plunge of 40 ft. over a basalt ridge, and then flows between steep walls of solid rock 20 to 50 ft. high. The residential section, on the plateau above the cliff, is served by North America's only "perpendicular street" —an elevator which carries passengers up- and downtown. Abundant water power makes Oregon City a centre for paper and pulp, woollen fabrics and other commodities. John McLoughlin, a chief agent of the Hudson's Bay company, established a claim to the falls and city site and erected a mill and residence.

In 1840 Oregon City was platted, but McLoughlin's claim was disputed by a Methodist misson. And in 1850 congress awarded a great part of the claim for a university. This was rectified in 1862 with restoration of the land to McLoughlin's heirs by the Oregon legislature. In 1924 a commission-manager form of government was adopted.

OREGON GRAPE (*Mahonia aquifolium*), a North American evergreen shrub of the family of Berberidaceae, closely allied to the barberry (*q.v.*), and found from British Columbia to Oregon. It grows from three to ten feet high and bears large pinnate leaves composed of five to nine thick, spiny-toothed, somewhat hollylike leaflets, bright yellow flowers in erect racemes, followed by showy clusters of small blue berries. The plant is the floral emblem or state flower of Oregon, and is widely grown as an ornamental.

OREGON MYRTLE (*Umbellularia californica*), a North American tree of the laurel family (Lauraceae, *q.v.*), called also California laurel, native to Oregon and California. It occasionally attains a height of 90 ft. and a trunk diameter of 5 ft., but is usually much smaller. The tree features lance-shaped, fragrant evergreen leaves, greenish-yellow flowers, in small clusters, and a somewhat olivelike, dark purple fruit (drupe). The wood is one of the most valuable cabinet timbers of the Pacific states.

OREGON PINE: *see* Douglas Fir.

OREGON TEA TREE (*Ceanothus sanguineus*), a name given to a large shrub of the buckthorn family (Rhamnaceae), called also buckbrush, native from northern California to British Columbia and eastward to Montana. It grows about ten feet high and bears reddish branchlets, thin, smooth, ovate, toothed leaves, and compound clusters, two to four inches long, of small white flowers. As in the case of the New Jersey tea (*q.v.*), its leaves have been used as tea. (*See* Ceanothus.)

OREGON TRAIL: *see* Old Oregon Trail.

O'REILLY, JOHN BOYLE (1844–1890), Irish-American politician and journalist, was born near Drogheda, Ire., June 28, 1844, the son of a schoolmaster. After some years of newspaper experience, during which he became an ardent revolutionist and joined the Fenian organization known as the Irish Republican Brotherhood, he enlisted in 1863 in a British cavalry regiment with the purpose of winning over the troops to the revolutionary cause. At this period wholesale corruption of the army, in which there was a very large percentage of Irishmen, was a strong feature in the Fenian program, and O'Reilly was successful in disseminating disaffection in his regiment. In 1866 the extent of the sedition in the regiments in Ireland was discovered. O'Reilly was tried by court-martial and sentenced to be shot, but the sentence was commuted to 20 years' penal servitude. After confinement in various English prisons, he was transported in 1867 to Bunbury, Western Australia. In 1869 he escaped to the United States and settled in Boston, where he became editor of *The Pilot,* a

Roman Catholic newspaper. He subsequently organized the expedition which rescued all the Irish military political prisoners from the Western Australia convict establishments (1876). He was the author of several volumes of poetry, and of a novel of convict life, *Moondyne* (1879).

He died in Hull, Mass., on Aug. 10, 1890.

See J. J. Roche, *Life of John Boyle O'Reilly* (1891).

OREL (now ORYOL), a region of the Russian S.F.S.R., surrounded by the regions of Tula, Smolensk, Mogilev, Gomel, Chernigov, Sumy, Kursk, Voronezh and Ryazan. Area 25,669 sq.mi. Pop. (1939) 3,482,388. Orel forms part of the Black Earth area (central), which was created in 1928. The region consists mainly of dissected plateau, drained by the Oka and its tributaries, flowing into the Volga, and the Sosna. On the water partings between the streams, the Kurgans or artificial mounds, some containing burials and some being remains of earthworks, stand out sharply. In the Bolkhov and Dmitrov districts, the soil is podzol (*see* RUSSIA: *Soils and Their Influence*), but the rest of the region is covered with black earth. The forests have almost disappeared and a scarcity of wood and fuel exists. For climate, the difficulties of agriculture and social conditions *see* VORONEZH. Average January temperature 14.8° F., average July 67°.

The chief crops are rye, oats, potatoes, millet and hemp. Very little wheat or sunflower seed is grown. Cattle, sheep and pigs are bred; in pre-World War I times Orel was noted for horse breeding, but their numbers diminished greatly because of war requisitions and they were slow to recover. Livensk and Maloarchangelsk have, however, recovered their former position in regard to horse breeding. Factory industries include the making of chemical manure from the phosphorites of the region, iron mining and smelting in the Zinoviev district, near Dmitrovsk, and at Elets, flour milling, distilling, leather and chalk. Koustar (peasant) industries include the making of plows, rope, makhorka tobacco, carpets and, in Elets, lace. The region suffered much during the civil war 1917–20, and Elets changed hands several times. The chief towns are Orel and Elets.

In the 9th century a Slav tribe, the Vyatichis, was established on the Oka river and paid tribute to the Khazars. They recognized the rule of Rurik from 884 and were later absorbed in the principality of Chernigov. Their wealthy towns and villages were devastated by the Mongols in 1239–42 and the region was reduced to poverty. The Russians erected forts and established colonies in the 16th century. In 1610 Orel then known as the Ukrayna or Ukraine (*i.e.*, "border region") was the scene of civil warfare under the false Demetrius. From 1917 to 1920 it was again the scene of civil struggles.

Orel (now Oryol), the chief town of the above region, situated at the confluence of the Orlik with the Oka river, and at the junction of roads and railways linking it with Moscow, Bryansk, Kharkov and the east, in 53° N., 36° 8′ E. Pop. (1939) 110,567.

O'RELL, MAX, the *nom-de-plume* of PAUL BLOUET (1848–1903), French author and journalist, who was born in Brittany in 1848. He is chiefly remembered for his once famous book, *John Bull et son Île*. He died in Paris, on May 25, 1903.

ORELLANA, FRANCISCO DE (*c.* 1490–*c.* 1546), Spanish soldier and first discoverer of the Amazon, was born at Truxillo about 1490. He sailed for Peru in 1535, and in 1540–41 accompanied Pizarro's expedition from Quito to Napo in the capacity of lieutenant. Early in 1541 he was sent ahead of the main party to obtain provisions, but he deserted his charge, either from necessity or choice, and continued his journey down the Rio Napo to the valley of the Amazon, whose course he explored from its source in the Andes to the Atlantic; he reached the coast in Aug. 1541. He is reported to have encountered a tribe of female warriors, of whom he had been told by the Indians, and from whom the name of the river is derived. On his return to Spain he was granted the right to conquer the newly discovered lands, but an expedition, undertaken in 1544 for this purpose, met with little success. Orellana died, probably in Venezuela, about 1546.

See "The Voyage of Francisco de Orellana down the River of the Amazons," trans. C. R. Markham, from A. de Herrera's *Historia general de las Indias occidentales,* Hakluyt Society *Publications,* vol. xxiv (1859).

ORELLI, JOHANN CASPAR VON (1787–1849), Swiss classical scholar, was born at Zürich on Feb. 13, 1787. His cousin, JOHANN CONRAD ORELLI (1770–1826), was the author of several works in the department of later Greek literature. From 1807 to 1814 Orelli worked as preacher in the reformed community of Bergamo and published *Contributions to the History of Italian Poetry* (1810) and a biography (1812) of Vittorino da Feltre, his ideal of a teacher. In 1814 he became teacher of modern languages and history at the cantonal school at Chur (Coire); in 1819, professor of eloquence and hermeneutics at the Carolinum in Zürich, and in 1833 professor at the new university, the foundation of which was largely due to his efforts. He had already published (1814) an edition, with critical notes and commentary, of the *Antidosis* of Isocrates. The three works upon which his reputation rests are the following. (1) A complete edition of Cicero in seven volumes (1826–38). (2) The works of Horace (1837–38; 4th ed., 1886–92). (3) *Inscriptionum Latinarum Selectarum Collectio* (1828; revised edition by W. Henzen, 1856). His editions of Plato (1839–41, including the old scholia, in collaboration with A. W. Winckelmann) and Tacitus (1846–48, new ed. by various scholars, 1875–94) also deserve mention. Orelli died at Zürich on Jan. 6, 1849.

See *Life* by his younger brother Conrad in *Neujahrsblatt der Stadtbibliothek Zurich* (1851); J. Adert, *Essai sur la Vie et les Travaux de Johann Caspar Orelli* (Geneva, 1849); H. Schweizer-Sidler, *Gedächtnisrede auf Johann Caspar Orelli* (Zürich, 1874); C. Bursian, *Geschichte der klassischen Philologie in Deutschland* (1883).

ORENBURG (now CHKALOV), region of the Russian S.F.S.R. consisting of the former Orenburg and Orsk districts of the larger pre-1914 province of the same name. Area 22,085 sq.mi. Pop. (1939) 1,677,013. It is a narrow strip between Bashkiria on the north and Kazakstan on the south, widening out to the east and west. The province is hilly, except for the valleys of the Ural river and its tributaries, the Sakmara and the Or. It belongs to the region of perennial drought and dry and desert steppe. The soils are chestnut-brown clays and sands with salt efflorescences, on which crops can be raised successfully if drought is not too severe and if careful attention is paid to manuring and to the type of cultivation. Some fertile black earth occurs in the valleys. The average January temperature is 3.4° F., July 70.9° F., average rainfall 15.2 in. Coal and rich layers of rock salt are found near Iletsk, in the south of the province and phosphorite exists. The peasants are specially skilled in the preparation of leather, and the women knit the famous Orenburg goats' wool shawls.

The district lies on the border region between the territory of the Bashkirs and that of the Kirghiz; the Bashkirs were brought under Russian rule in 1557, and the fort of Ufa was built to protect them from Kirghiz raids. The frequent risings of the Bashkirs and the raids of the Kirghiz led the Russian government in the 18th century to erect a line of forts and blockhouses on the Ural and Sakmara rivers, which were afterward extended southwestward toward the Caspian and eastward toward Omsk, and Chkalov became the central point of these military lines.

ORENBURG (now CHKALOV), the chief town of the region of the same name in the Russian S.F.S.R., on the Ural river in 51° 46′ N., 55° 7′ E. Pop. (1939) 172,925. The opening of the Orenburg-Tashkent railway in 1905 greatly increased its importance, and it has an important railway workshop for this line. Its industries include the making of metal goods and bricks, sawmilling and brewing. Trading caravans from the central Asiatic republics bring carpets, silk, cotton, lambskin, wool and dried fruits to Orenburg to exchange against textiles, metal goods and other products of European Russia. Cattle, horses and sheep from the steppe lands are brought to its market, and animal products including frozen meat, hides, sheepskins, tallow and bristles are sent by rail to Samara and the west. Its population is mixed and includes Russians, Tatars, Kirghiz and Bashkirs, among others. In 1735 a fort was erected at the confluence of the Or and Ural rivers as an outpost of Russia against the Bashkirs and Kirghiz, and was called Orenburg. In 1740–43, the fortress was moved 120 mi.

down the Ural river to its present position and the former Orenburg was renamed Orsk. Heavy fighting occurred here after the 1917 revolution, and in that year its population was swollen to 140,588 by refugees. During the famine of 1920–21, the town suffered severely and the population dropped proportionately.

ORENDEL, a Middle High German poem, of no great literary merit, dating from the close of the 12th century. The story is associated with the town of Treves (Trier), where the poem was probably written. The introduction narrates the story of the Holy Coat, which, after many adventures, is swallowed by a whale. Orendel, son of King Eivel of Treves, who had embarked with 22 ships in order to woo the lovely Brida, the mistress of the Holy Sepulchre, is wrecked, and falls into the hands of the fisherman Eise, in whose service he catches the whale and recovers the Holy Coat. The poem exists in a single manuscript of the 15th century, and in one printed version dated 1512. It has been edited by F. H. von der Hagen (1844), L. Ettmüller (1858) and A. E. Berger (1888); there is a modern German translation by K. Simrock (1845).

See H. Harkensee, *Untersuchungen über das Spielmannsgedicht Orendel* (1879); F. Vogt, in the *Zeitschrift für deutsche Philologie,* vol. xxii (1890); K. Müllenhoff, in *Deutsche Altertumskunde,* vol. i, 2nd ed. (1890), pp. 32 *seq.;* R. Heinzel, *Über das Gedicht von König Orendel* (1892).

ORENSE, an inland province of northwestern Spain, formed in 1833 of districts previously included in Galicia, and bounded on the north by Pontevedra and Lugo, east by Leon and Zamora, south by Portugal, and west by Portugal and Pontevedra. Pop. (1950) 466,302; area 2,695 sq.mi. The province is almost everywhere mountainous. Its western half is traversed in a southwesterly direction by the river Miño; the Sil, a left-hand tributary of the Miño, waters the northeastern districts; and the Limia rises in the central mountains and flows west-southwest, reaching the sea at the Portuguese port of Viana do Castello. The railway from Monforte to Vigo runs through the province. There are iron foundries. The chief towns are Orense (*q.v.*), Allariz (1,819), Carballino (2,469), Viana del Bollo (980) and Nogueira de Ramuín (7,791). The province fell to insurgent troops early in the civil war of 1936–39.

ORENSE, an episcopal see and the capital of the Spanish province of Orense, on the left bank of the river Miño, and on the Tuy-Monforte railway. Pop. (1950) 55,574. The river is there crossed by one of the most remarkable bridges in Spain. It was built by Bishop Lorenzo in 1230, but has frequently been repaired. The image of El Santo Cristo in the Gothic cathedral is celebrated throughout Galicia. The warm springs known as Las Burgas attract many summer visitors; the waters were well known to the Romans, as their ancient names, Aquae Originis, Aquae Urentes or perhaps Aquae Salientes, clearly indicate. They named Orense Aurium, probably from the alluvial gold found in the Miño valley. Chocolate and leather are manufactured, and there are sawmills, flour mills and iron foundries.

OREODONT, vernacular name for any member of the extinct family Merycoidodontidae. The oreodonts were piglike in general appearance and structure, but the teeth were like those of ruminants. They were related to both pigs and ruminants, but only distantly. Extremely abundant and varied throughout most of the age of mammals (late Eocene through Pliocene) in North America, oreodonts have not been found on other continents. (G. G. Si.)

ORESTES, in Greek legend, son of Agamemnon and Clytaemnestra. According to the Homeric story he was absent from Mycenae when his father returned from the Trojan War and was murdered by Aegisthus and Clytaemnestra. Eight years later he returned from Athens and revenged his father's death by slaying his mother and her paramour (*Odyssey,* iii. 306; xi. 542). For later forms of the legend of his return, *see* ELECTRA.

In post-Homeric writers, Orestes, after the deed, is pursued by the Erinyes (*q.v.*). He takes refuge in the temple at Delphi. Apollo sends him to Athens to plead his cause before the Areopagus. The Erinyes demand their victim; he pleads the orders of Apollo; the votes of the judges are equally divided, and Athena gives her casting vote for acquittal. The Erinyes are propitiated by a new ritual, in which they are worshipped as Eumenides (the Kindly), and Orestes dedicates an altar to Athena Areia. According to Euripides, some of the Erinyes were not satisfied, so Orestes was ordered by Apollo to go to Tauris, carry off the statue of Artemis which had fallen from heaven, and bring it to Athens. He repairs to Tauris with Pylades, the son of Strophius and the intimate friend of Orestes, and the pair are at once imprisoned by the people, among whom the custom is to sacrifice all strangers to Artemis. The priestess of Artemis, whose duty it is to perform the sacrifice, is his sister Iphigeneia (*q.v.*). A recognition is brought about, and all three escape together, carrying with them the image of Artemis. After his return to Greece, Orestes took possession of his father's kingdom of Mycenae, to which were added Argos and Laconia. To gain possession of Hermione, whom Neoptolemus had married, he murdered the latter at Delphi. He is said to have died of the bite of a snake. The development of the legend is the result (*a*) of the post-Homeric horror of bloodshed (Erinyes; to Homer, Orestes does nothing which is not entirely admirable); (*b*) of the growing interest in cases of conscience (conflict of the duty of revenge and the sacredness of his mother's person); (*c*) of the development of modern ideas of ethics and jurisprudence (the Areopagus consider motive and mitigating circumstances, instead of merely regarding the act); (*d*) of the replacement of blood-feud by state intervention and formal trial.

See Jebb, introduction to Sophocles, *Electra;* Höfer in Roschers *Lexikon,* art. "Orestes." (H. J. R.)

ORFE or GOLDEN ORFE, a variety, originating in Germany, of the ide (*Idus idus*), one of the Cyprinidae and allied fairly closely to the roach (*q.v.*).

ORFILA, MATHIEU JOSEPH BONAVENTURE (1787–1853), French toxicologist and chemist, was by birth a Spaniard, having been born at Mahon in Minorca on April 24, 1787. After studying medicine at the universities of Valencia and Barcelona, he settled in Paris to study under the chemist L. N. Vauquelin. In 1811 he graduated and immediately became a private lecturer on chemistry in the French capital. In 1819 he was appointed professor of medical jurisprudence, and four years later he succeeded Vauquelin as professor of chemistry in the faculty of medicine at Paris. In 1830 he was nominated dean of that faculty. He died in Paris on March 12, 1853. Orfila's fame rests on his *Traité des poisons,* or *Toxicologie générale* (1813).

ORFORD, ROBERT WALPOLE, 1st EARL OF (1676–1745), generally known as SIR ROBERT WALPOLE, prime minister of England from 1721 to 1742, third son of Robert Walpole, M.P., of Houghton in Norfolk, was born at Houghton on Aug. 26, 1676. He was an Eton colleger from 1690 to 1695 and was admitted at King's college, Cambridge, as scholar on April 22, 1696. At this time he was destined, as a younger son, for the church, but the death of two elder brothers made him heir to an estate producing about £2,000 a year, whereupon he resigned his scholarship and was withdrawn from the university.

Walpole sat in parliament at first for the family borough of Castle Rising (1701) and then for King's Lynn, which he represented until he was raised to the peerage. In June 1705 he was appointed one of the council to Prince George of Denmark, the inactive husband of Queen Anne, and then lord high admiral of England. On Feb. 25, 1708, he succeeded Henry St. John as secretary at war, and was thus brought into immediate contact with the duke of Marlborough and the queen. With this post he held for a short time (1710) the treasurership of the navy, and was admitted to the inmost councils of the ministry. He could not dissuade Godolphin from the impeachment of Henry Sacheverell, and when the committee was appointed in Dec. 1709 to draw up the impeachment Walpole was nominated one of the managers for the house of commons. Walpole shared in the general wreck of the Whig party, and in spite of the flattery, followed by the threats, of Sir Edward Harley he took his place with his friends in opposition. Both in debate and in the pamphlet press he vindicated Godolphin from the charge of peculation, and in revenge for his zeal his political opponents brought against him an accusation of personal corruption. On these charges he was in 1712 expelled from the house and spent a short time in the tower.

His prison cell became the rendezvous of the Whigs, while his praises were sung in popular ballads. In the last parliament of Queen Anne he defended Sir Richard Steele against the attacks of the Tories.

After the accession of George, the Whigs for nearly half a century retained the control of English politics. Walpole, who had supported the Hanoverian succession, obtained the lucrative post of paymaster-general of the forces in the administration which was formed under the nominal rule of Lord Halifax, but of which James Stanhope and Townshend were the guiding spirits. Walpole was chairman of the committee appointed to inquire into the acts of the late ministry, and especially into the Peace of Utrecht, with a view to the impeachment of Harley and St. John. Halifax died on May 19, 1715, and after a short interval Walpole became first lord of the treasury and chancellor of the exchequer (Oct. 11, 1715). Jealousies, however, prevailed among the Whigs, and the German favourites of the new monarch quickly showed their discontent with the heads of the ministry. Townshend was forced to resign his secretaryship of state for the viceroyalty of Ireland, but he never crossed the sea to Dublin, and the support which Sunderland and Stanhope, the new advisers of the king, received from him and from Walpole was so grudging that Townshend was dismissed from the lord-lieutenancy (April 9, 1717), and Walpole on the next morning withdrew from the ministry. They plunged into opposition with unflagging energy, and in resisting the measure by which it was proposed to limit the royal prerogative in the creation of peerages (March–December 1718) Walpole exerted all his powers. This display of ability brought about a partial reconciliation of the two sections of the Whigs. To Townshend was given the presidency of the council, and Walpole reassumed the paymastership of the forces (1720).

On the financial crash which followed the failure of the South Sea scheme, Walpole was regarded by the general public as the indispensable man. Stanhope and James Craggs, the two secretaries of state, died, John Aislabie, the chancellor of the exchequer, was committed to the tower, and Sunderland, though acquitted of corruption, was compelled to resign. Walpole, at first lord of the treasury and chancellor of the exchequer (April 1721), became with Townshend responsible for the government (though for some years they had to contend with the influence of Carteret), the danger arising from the panic in South Sea stock was averted by its amalgamation with Bank and East India stock, and during the rest of the reign of George I they remained at the head of the ministry. The hopes of the Jacobites, which revived with these financial troubles, were disappointed. Atterbury, their boldest leader, was exiled in 1723; Bolingbroke sued for pardon and was permitted to return to his own country. Peace was assured by a treaty between England, Prussia and France concluded at Hanover in 1725.

In 1727 George I died, but the confidence which the old king had reposed in Walpole was renewed by his successor, after a brief period of coldness, and in Queen Caroline the Whig minister found a faithful and lifelong friend. For three years he shared power with Townshend, but quarrelled with him in 1730, and Townshend retired into private life. Walpole's administration was based on two principles, sound finance at home and freedom from the intrigues and wars which raged abroad. On the continent congresses and treaties were matters of annual arrangement, and England enjoyed many years of peace. Walpole's influence received a serious blow in 1733. The enormous frauds on the excise duties forced themselves on his attention, and he proposed to check smuggling and avoid fraud by levying the full tax on tobacco and wine when they were removed from the warehouses for sale. His proposals met with violent opposition and had to be dropped. Several of his most active antagonists were dismissed from office or deprived of their regiments, but their spirits remained unquenched, as the incessant attacks in the *Craftsman* showed, and when Walpole met a new house of commons in 1734 his supporters were far less numerous. The Gin Act of 1736 led to disorders in the suburbs of London; and the imprisonment of two notorious smugglers in the Tolbooth at Edinburgh resulted in the Porteous riots described in the *Heart of Midlothian*. These events weakened Walpole's influence in the country, but his parliamentary supremacy remained unimpaired, and was illustrated in 1737 by his defeat of Sir John Barnard's plan for the reduction of the interest on the national debt, and by his passing of the Playhouse act, for the regulation of the London theatres.

That year, however, heralded his fall from power. His constant friend Queen Caroline died on Nov. 20, 1737, and Frederick, prince of Wales, whose request for an increase in his official allowance had been refused, became his active opponent. The prince controlled many boroughs within the duchy of Cornwall, and he attracted Pitt, the Grenvilles and others to his cause. The leading orators of England thundered against Walpole in the house of commons, and the press resounded with the taunts of the poets and pamphleteers, illustrious and obscure, who found abundant food for their invectives in the troubles with Spain over its exclusive pretensions to the continent of America and its claim to the right of searching English vessels. Walpole long resisted the pressure of the opposition for war, but at the close of 1739, as the king would not allow him to resign, he was forced into hostility with Spain. The Tory minority known as "the patriots" had seceded from parliament in March 1739, but at the commencement of the new session, in Nov. 1739, they returned to their places with redoubled energies. The successes of the troops brought little strength to Walpole's declining popularity, and in the new house of commons of 1741 political parties were almost evenly balanced. Their strength was tried immediately on the opening of parliament. Walpole was defeated. On Feb. 9, 1742 he was created earl of Orford, and two days later he ceased to be prime minister. A committee of inquiry into the conduct of his ministry for the previous ten years was ultimately granted, but its deliberations came to nothing. Walpole died at Arlington street, London, on March 18, 1745, and was buried at Houghton on March 25. With the permanent places, valued at £15,000 per annum, which he had secured for his family, and with his accumulations in office, he had rebuilt the mansion at great expense, and formed a gallery of pictures within its walls at a cost of £40,000, but the collection was sold by his grandson for a much larger sum in 1779 to the empress of Russia.

Walpole was twice married—in 1700 to Catherine Shorter (d. 1737) and in March 1738 to Maria Skerret.

Sir Robert Walpole's life has been written by Archdeacon William Coxe in 3 vol. (1798 and 1800), A. C. Ewald (1878) and John Viscount Morley (1889). *See* also Edward Jenks, *Walpole, a Study in Politics* (1894); *English Hist. Rev.* xv, 251, 479, 665, xvi, 67, 308, 439 (his foreign policy, by Basil Williams); Walter Sichel, *Bolingbroke*, 2 vol. (1901–02); the histories, letters and reminiscences by his son, Horace Walpole; and the other lives of the chief political personages of the period.

ORFORD, a small town on the River Alde, Suffolk, England, 20 mi. E.N.E. of Ipswich by road. Pop. (1931) 706. In the 12th century a thriving port, it had declined by the 16th century owing to the increase of the shingle spit known as Orford Ness which had pushed the mouth of the river farther down the coast. Of Orford castle the Norman keep remains, built of flint and Caen stone.

ORGAN. In music, organ is the name given to the familiar wind instrument played from keyboards (from Gr. ὄργανον; Lat. *organum,* instrument). It may be defined as a musical instrument gaining sound from pipes, these pipes being set on wind chests supplied with air under constant pressure. The flow of air to the pipes is controlled by intermediary mechanisms from one or more keyboards.

The name implies pipes; thus the designation "pipe organ" is redundant, as would be the term "string violin." A reed organ is more properly called a harmonium. Electronic devices devoid of pipes and reeds do not qualify for the name.

Early History: to 1500.—Music has been called the youngest of the arts, but among devices for the expression of music the organ is one of the oldest, and it was the first of the keyboard instruments. It is mentioned in the Old Testament, but the Greek word in Genesis translated "organ" is used in the same general sense that we use the term "instrument." Ancient fable ascribes the invention of the organ to Pan, the sylvan god, and relates that it was made from reeds that grew by the river. Considering the organ

superior to the lyre of Apollo, Pan challenged Apollo to a trial of skill, which Midas, the umpire, decided in favour of Pan's pipes.

In principle of musical speech, the beginnings of the organ may be seen in primitive flutes, fashioned from reeds or hollow sticks. These were grouped together into a syrinx, or pan pipe, a collection of hollow tubes of various lengths, bound side by side, raft fashion, and blown from the top. Some time later came the discovery that tone could be produced by blowing from the base of a tube and by deflecting the flow of air out of a slot cut in the side of the tube just above a partial obstruction. Possibly the next phase in the development of the organ resembled the modern bagpipes, when some inventive genius assisted human lung power by devising a wind reservoir out of a skin, leading to a handful of pipes, all of them stopped by the fingers except the one intended to speak.

This led to the first organ of which there is an actual record. Ctesibius, a Greek engineer of the 3rd century B.C., living in Alexandria, is credited with the evolution of the *hydraulis*, an instrument with the essential characteristics of the modern organs. It had a set of pipes, each of a different pitch and controlled in their speech by keys or levers, which admitted or shut off the wind as desired. The *hydraulis* gained its descriptive name from the method by which a supply of wind was provided. A reservoir of air under the necessary constant pressure was obtained by the immersion in water of a large cup or bell, on the principle of a diving bell, within a large container. The water compressed the air upward within the bell, and as the air was drawn off by the speech of the pipes it was replenished by bellows, connected to the bell. The blowing arrangement was ingenious in its simplicity for, if the bell was kept full so that a surplus of air constantly escaped from the bottom, the pulsation of air from the bellows was evened out by the constant weight and upward thrust of the water.

Hero in his *Pneumatica* (*c.* 3rd century B.C.) and Vitruvius in his *De Architectura* (*c.* 14 B.C.) describe the workings of this instrument. A clay model of a *hydraulis* was discovered in 1885 in the ruins of Carthage, and portions of an actual instrument were found in 1931 in Aquincum, near Budapest. Pictorial representations and writings of those centuries indicate that the *hydraulis* played a large part in the life of the period. Cicero relates that it was used at banquets and speaks of its sound as being as delectable to the ear as the most delicious fish to the palate. Other writings indicate that the *hydraulis* was used in the arena to accompany fights and circus performances. A notable performer on this early organ was the Roman emperor Nero (37–68 A.D.), and it is related that on an occasion of particular danger, from an insurrection of the Gauls under Vindex, Nero summoned his political advisers to a meeting, but after a brief conference spent most of the day showing them a new type of *hydraulis*.

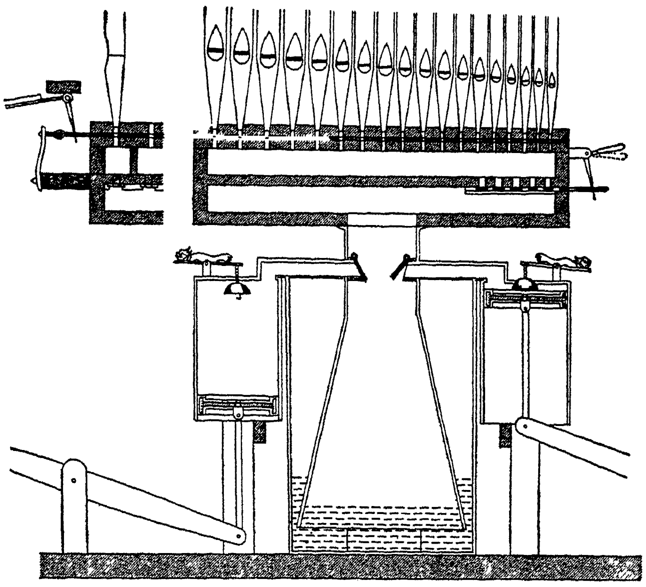

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FIG. 1.—HYDRAULUS BY AUDSLEY

Over the next few centuries the *hydraulis* evolved into the pneumatic organ, an instrument in which bellows supplanted the hydraulic mechanism as the source of wind supply. The first representation of such an organ dates from the 4th century A.D., on an obelisk at Constantinople, erected by the emperor Theodosius (died 395 A.D.). An earlier passage, even, in Pollux' *Onomasticon* from about the year 120 refers to "brazen pipes blown from below . . . by bellows." Descriptive references to the organ occur in an epigram by Julian the Apostate (331–363) and in the writings of St. Augustine (354–430). References to the organ occur frequently during the next few centuries, and the event of the year 757 for many writers was the arrival in Compiègne of an organ, a gift to King Pippin from the Byzantine emperor Constantine Copronymus. Around 950, a giant organ was constructed in England for the Old church in Winchester. It is vividly described by the monk Wulstan: "Twice six bellows are ranged in a row, and fourteen lie below . . . worked by seventy [seven?] strong men . . . the music of the pipes is heard throughout the town, and the flying fame thereof is gone out over the whole country. . . ."

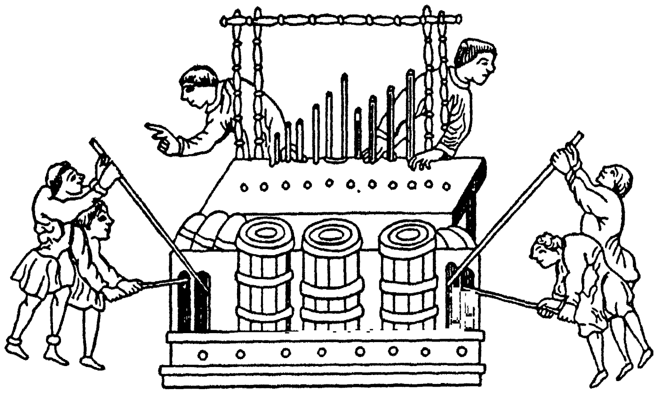

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FIG. 2.—ORGAN OF THE 11TH CENTURY

It would be interesting to know just what music was played on such instruments, but no manuscripts of organ music appear to have survived from these early centuries. No doubt music played on the rather sketchy keyboards was purely vocal in character and probably of just one melodic line, though the presence of two players in the illustration of the Utrecht Psalter of about 800 prompts the speculation that the melody was occasionally embellished with a second part.

Around 1100 the cathedral of Magdeburg acquired a notable organ, and in 1360 a large instrument was built by the priest Nikolaus Faber for the Halberstadt cathedral. Michael Praetorius notes that it had three keyboards and pedals, and it was the first organ to have a complete scale of semitones. Most of the organs to that time had been constructed by priests or monks, but one Albert van Os, who lived during the 12th century, has the distinction of being the first professional organ builder on record.

The Organ from 1500.—By 1500 organs had evolved in size and in refinement of tone. Principles of voicing and ensemble became generally understood. Certain reeds, flutes and other solo stops were added, expanding the tonal spectrum of the organ, and these new timbres were developed into complete tonal families, grouped on different manuals. The pedal organ was gradually evolved, its compass was extended, and its musical possibilities began to be realized. The mechanism of keyboards and pedals and of stop control became more readily workable. Progress to this point is summarized in Arnolt Schlick's *Spiegel der Orgelmacher und Organisten* (1511). At the same time smaller instruments known as *Positivs* and *Portativs* came into general use. They were instruments of varying degrees of sonority; the *Positivs* were

made small enough to be moved as occasion required, and the *Portativs* were occasionally used, as the accompanying illustrations show, in processions. Both types played a large part in music of the home, and much keyboard music of this period is interchangeable between the harpsichord and these small organs. Writing in 1676, Thomas Mace of Trinity college, Cambridge, describes and illustrates a small "table organ" that he built himself for his home. It included seven stops: diapason, principal, 12th, 15th, and "two-and-twentieth," regal and a "hooboy stop."

The expanding skill of the organ builder was matched by the growing imagination of the composer. From the 14th century on, a new style of writing developed at a great pace, exploiting the possibilities of the organ, and it was on organ manuals that keyboard music graduated from the imitatively vocal to the purely instrumental. The Reformation lent enormous impetus to organ composition, for the inspired and compelling chorales provided a musical treasure which composers later elaborated into countless chorale preludes and fantasies. Forms of composition took shape, the toccata, the various types of fugal writing; and the flowering of musical composition that took place over a period of almost four centuries centred largely around the organ. Not only was the organ an expressive medium, but for musicians of those days it was also the grandiose in music. Since most composers were also organists, they understood the nature of the instrument and set down some of their finest musical thoughts for the organ.

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FIG. 3.—MEDIAEVAL PORTATIVE

The progress of these centuries was described in its instrumental aspect by Praetorius in his *Syntagma musicum* of 1618; the musical side was typified by the towering organ compositions of Johann Sebastian Bach (1685–1750). After 1750 the position of the organ in musical activity began to be challenged by the developing orchestra and by the newly invented pianoforte. The trend of musical composition was away from contrapuntal writing and toward a percussive and chordal type of texture not suited to organ performance. Though some organ builders valued and preserved the classic traditions of the instrument, others attempted innovations of questionable merit. Wind pressures were raised in order to obtain greater volume of sound from pipes with the unfortunate result that mixture and mutation stops, which become shrill on high wind pressure, were gradually omitted in organ specifications. A variety of soloistic stops designed to imitate orchestral instruments were substituted for stops of the basic ensemble. In quest of "expression" it became the habit to enclose practically all of the pipes in swell boxes, with shutters which could blanket the tone in varying degree. With some notable exceptions, organ builders of the 19th century pursued the goal of a "romantic expressiveness," but frequently succeeded only in producing instruments of thickened sonorities, embellished with imitative orchestral stops, yet lacking in authentic organ ensemble.

During these years players tended to forget their unequalled heritage of music and spent much effort in attempting to imitate the orchestra and to play the orchestral repertoire on the organ. In the 20th century, the motion picture theatre organ made its entrance and its exit. Perhaps this sort of instrument, at its best only with the poorer types of music, may represent the culmination of this less fortunate phase of organ building, which bears little relation to the centuries-old tradition of the instrument.

On the other hand, the 20th century also saw a reawakening on the part of musicians and organ builders to the fundamentals of their art. In many modern organs practices of classic design and voicing became re-established, and this progressive trend restored the musical prestige of the instrument. Principles of ensemble—the blending of stops of different pitches into a homogeneous sonority—were carried out with increasing success. Low wind pressures were again recognized as essential, and many progressive organ builders left the mouths of most pipes unnicked, thus preserving a slight and agreeable accent in the speech. Moreover, it was realized anew that an organ ideally must be placed completely in the open, for undue enclosure will restrain and damage the tone. A pipe in the open is worth two in a box, for a soft sound, unenclosed, has presence and beauty, but a louder tone blanketed in a swell box, or even in the recess of an organ chamber, loses presence and is by no means a satisfactory substitute. Through modern ingenuity a good organ touch has the responsive character of the keys of a grand piano, with the particular difference that the speech of a pipe is unaffected by the degree of force with which a key is depressed. A more readily playable pedal board of radiating and concave design came into general use, replacing the previous flat and parallel pattern of keys.

The organ remains an instrument best suited to the horizontal rather than the vertical type of music—that is, to flowing contrapuntal lines rather than chordal structures—and an instrument of individual colours and a variety of ensembles not imitative of any of its musical relatives, but of a musically architectural character strictly its own. This return to the authentic tonal texture of the organ was paralleled by a new awareness of the instrument on the part of contemporary composers, and it is notable that the best of modern composition is closely allied to classic models, though harmony and idiom may be modern.

GENERAL DESCRIPTION

The sounds of an organ are produced by pipes of various lengths and shapes, set into musical speech by the flow of air under pressure. The sounding of these pipes is determined by the use of the keys, some of which are played by the hands, some by the feet. In appearance, the keys of an organ resemble those of a piano, but whereas a piano has one keyboard an organ may have several, each governing a division of pipes, in addition to a keyboard of pedals, played by the feet. The criterion of musical excellence inevitably resides in the voicing of the pipes, rather than in the size of the organ, and an instrument even of two manuals, with pedals, provides an adequate medium for by far the greater part of the organ repertoire, though instruments of three and four manuals offer advantages, and organs of as many as seven manuals have been built.

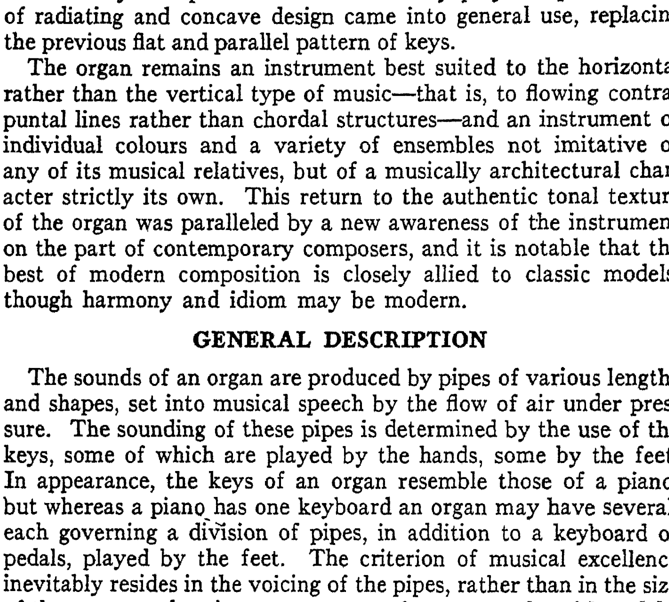

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FIG. 4.—POSITIVE ORGAN OF THE 16TH CENTURY

Stops.—Organ pipes differ in two essentials from other wind instruments. A flute player, for example, obtains different notes by altering with his fingers the speaking length of his instrument and by blowing at different pressures. An organ pipe speaks one

note only and is voiced for an unvarying wind pressure. Even were it mechanically possible to alter the effective speaking length at will, and to vary the pressure of the wind supply, no musical advantage would be gained, for it would be impossible to play more than one note at a time.

An organ stop, set, register or rank, of pipes necessarily comprises one pipe (or more: see *Mixtures,* below) for each note of the keyboard. Each stop is a member of a section or division, controlled from one of the keyboards, and each manual division is in turn a part of the complete organ. To an organ builder a stop implies a set of pipes, though the same name is also given to the knob or tablet at the console which actuates the valve or slider, admitting or shutting off wind to the rank of pipes. Each stop has a separate knob or tablet, just as each note has a separate key, and unless one or more of the stops be drawn no sound will result when the keys are played. The pipes of a given stop all produce sounds of similar quantity, but naturally of different pitches. No two stops are exactly alike in musical timbre; on the contrary, they are designed to differ. Some have a thin, some a full quality of tone, and, moreover, some stops are of high pitch, some of low.

Divisions, Compass.—From the grouping of pipes into a stop, we pass next to the grouping of several stops into a section or division. Each of these "organs" is played from its own keyboard or manual and has its own characteristic timbre and utility. Briefly, these divisions are: The great organ, the positive or choir organ, the swell organ, the solo, orchestral, or bombarde organ, and the echo or antiphonal organ. Moreover, on all but the smallest instruments, there is a pedal organ. The assignment on different manuals of these various divisions varies among builders and among different countries; but certain basic principles have become established. A one-manual organ will have the character of the great. A two-manual is best designed as a great and positive, or choir, though a two-manual will often be made up of a great and swell. A three-manual will almost invariably consist of a great, positive or choir, and swell, while the remaining divisions will be controlled from a fourth or from additional manuals.

The usual compass of organ manuals is 61 notes, five octaves, from C in the bass to C'''' in the treble. The customary pedal compass is 32 notes, just over $2\frac{1}{2}$ octaves, from CC in the bass (lowest C on the pianoforte) to the G above middle C. Thus a manual stop ordinarily comprises 61 pipes and a pedal stop 32 pipes, offering between the pedals and manuals a tonal compass of six octaves. However, the total compass of the organ is often larger by three or more octaves than the six octaves mentioned, for in addition to the normal 8-ft. stops (see *Pitches of Stops* below) there may be others speaking one or two octaves higher or lower than implied by the controlling note on the keyboard. Thus a 32-ft. pedal stop carries down the pitch an octave lower, low C having a frequency of 16 vibrations a second, while a 2-ft. manual stop will extend the upward pitch two octaves higher, giving high C a frequency of more than 8,000 vibrations a second.

Pipes.—Organ pipes fall chiefly into the two categories of flues and reeds. The flue pipe in principle is similar to a tin whistle, except that a flue pipe is designed to sound one note only. In reed pipes, the wind vibrates a curved brass tongue held over the cut and flattened side of a brass tube called a shallot, so that the oscillations of the tongue cause the speech of the pipe. Associated with the reed is a cylindrical cone or pipe which acts as a resonator, giving security of pitch and adding quality to the tone. Such an organ stop is known as a beating reed and differs considerably in sound from the free reed employed without a resonator in the harmonium.

The pitch of a flue pipe is set by its length and, generally speaking, the width of the pipe determines the volume and quality of the tone, a wider diameter giving a fuller tone and a narrower diameter producing a keener sound. This relation of width to length is referred to as the scale of the pipe. On the other hand, the pitch of a reed pipe depends on the length of tongue set into vibration and is also affected by the thickness and tension of the tongue and the length, shape and scale of the resonator.

Flue pipes may be open, with the top of the pipe open to the air; or they may be closed or stopped with a stopper or cap covering the pipe at the top. The diapasons and principals are all open pipes; gedeckts and bourdons are stopped. A stopped pipe will sound a note an octave lower than an open pipe of the same length; and the even-numbered harmonics of the tone become minimized, giving a light and rather transparent quality to the sound.

Another type of flue pipe is made of double length, open at the top, pierced about midway with a small hole. Known as harmonic pipes and having a very bright tone, these give a sound an octave higher than open pipes of the same length.

Stops of the same name vary considerably in character and strength among different organs and in work of different builders. Names of organ stops, therefore, denote a general character rather than a specific quality and volume of sound. In the case of stops bearing the names of orchestral instruments the resemblance is only approximate.

Flue Stops.—Flue stops fall into three general categories: flutes, principals and viols. Flutes themselves divide into open and closed pipes. There are the half-length and stopped pipes (gedeckts, bourdons—also occasionally called stopped diapasons); the normal length and open (melodia, claribel, concert flutes) or double length (the harmonic flute).

Another class of flutes (the Koppel flute, Ger. *Rohrflöte,* Fr.

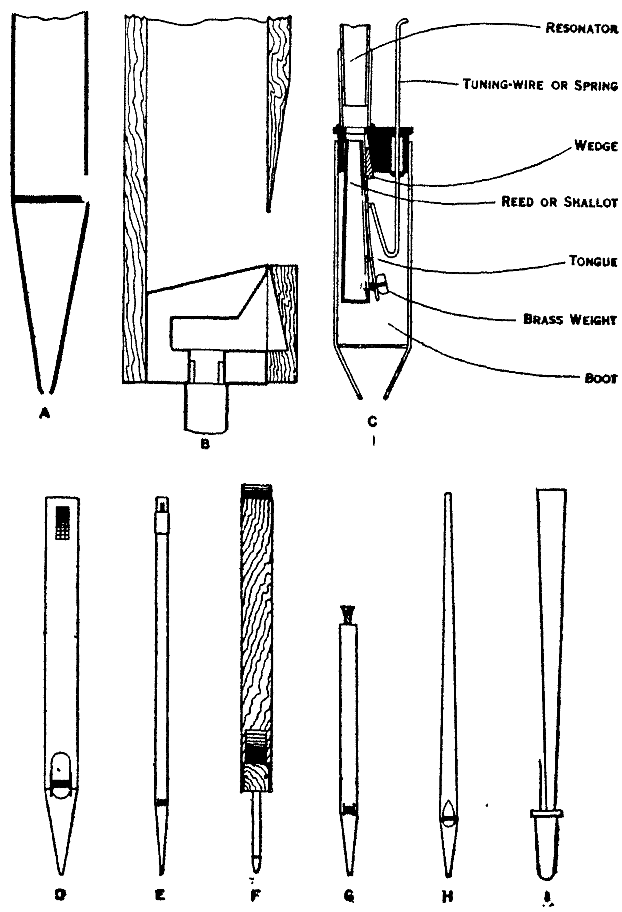

FIG. 5.—VARIOUS TYPES OF ORGAN PIPES

(A) Section of metal flue pipe; (B) section of wooden flue pipe; (C) section of reed pipe (trumpet) and its component parts; (D) open diapason; (E) Viola da gamba; (F) clarabella, or *Hohlflöte;* (G) Gedeckt; (H) Gemshorn or *Spitzflöte;* (I) trumpet or cornopean (reed). (Not to scale)

flûte à cheminée) is given a high harmonic development by being half stopped, with a small chimney of some form incorporated into the stopper.

Principals (Eng. diapason or Fr. *montre*) have the sound typically associated with the organ and are open pipes of medium scale. The principal-type stops of different pitches which furnish the ensemble of the organ are identified merely by their pitch;

octave, 12th, 15th, etc. Mixture stops are usually of principal character.

Viols, or string-toned stops such as the salicional, gamba, dulciana, etc., are made of pipes similar to the principals except that the scale is much reduced (*i.e.,* they are of smaller diameter in relation to length), and they are usually somewhat lighter in construction.

A tempered or muted tone, in various degrees of compromise, may be obtained by making the pipe in the shape of a long inverted cone. Thus the *Spitzflöte* and the gemshorn present a mixture of the species and have certain useful tonal characteristics.

Reed Stops.—Reed stops, which in all organs are far outnumbered by the flues, fall into three general divisions.

First there are the natural organ reeds, nonimitative in character, which have descended from the classic period of organ building. The krummhorn (or cromorne), regal, schalmei, and rankett are in this class. They have an authentic organ sonority, appropriate to organ music and are invaluable as solo stops or in ensemble. Resonators of these reeds are often made of fractional length, being half, a quarter or even one-sixteenth of the length implied by the note sounded.

Next are the reeds of the trumpet family (trumpet, trompette, trombone, clarion, cornopean, etc.) often known as chorus reeds. If not voiced too broadly, they serve a useful function in the chorus or ensemble, particularly on the pedals, and they are distinctive as solo stops.

The third group of reeds comprises the modern and frankly imitative stops—such as the clarinet (which is not unlike the older krummhorn), the oboe, orchestral oboe, the bassoon, English horn and French horn. Many of the imitative reeds require considerably higher wind pressures than the authentic organ reeds and flues.

Tuning.—Flue pipes are tuned by lengthening or shortening the effective speaking length, and this is accomplished by various methods according to the type of pipe in question. Some are tuned by moving up or down a metal slide or extension which fits over the top of the pipe. Others, particularly the smaller "upperwork" pipes, have to be coned in (closed) or expanded slightly at the top, according to whether it is desired to flatten or sharpen the pitch. Wooden pipes of some types are tuned by pressing in or pulling out a metal shade affixed in or near the top of the pipe. In the case of stopped pipes the caps or stoppers afford a ready means of altering the pitch.

Reeds are tuned by altering the position of a tuning wire or spring, which can be made to increase or diminish the length of reed allowed to vibrate. The length of the resonator must also be brought into sympathetic adjustment.

Pitches of Stops.—Organ pipes that speak at the pitch implied by the particular manual key played are called 8-ft. or unison stops, because an open pipe sounding the lowest note of the keyboard (that is, CC) is about 8 ft. in length. Gedeckts and reeds of half this length and harmonic pipes of double length, sounding the indicated pitch, are still referred to as 8-ft. stops.

On the manuals, then, a 16-ft. stop will sound notes one octave below normal pitch. Of stops sounding higher than 8-ft. pitch, 4-ft. stops give the octave, $2\frac{2}{3}$-ft. stops the 12th, 2-ft. stops the superoctave or 15th, $1\frac{3}{5}$-ft. stops the tierce or 17th, $1\frac{1}{3}$-ft. stops the larigot or nineteenth, 1-ft. stops the 22nd and so—in theory at least—ad infinitum, according to the natural law known as the harmonic series. Practical considerations, however, set arbitrary limits, and in this case they rule: (1) ranks above the 15th are too small and acute to be carried through the whole compass of the keyboard in an unbroken form; (2) no rank more dissonant than a minor seventh—or at most a major third—is tolerable in the tonal economy of the organ; (3) for most ordinary purposes, ranks sounding octaves, thirds and fifths sufficiently represent the harmonic series. As a matter of practice, all stops above the 15th form a part of what are called the mixtures, and except for special purposes are employed collectively as upper work. Manual stops of 16-ft., 8-ft. and 4-ft. pitches are termed foundation work (Fr. *fonds*). The 12th and 15th are usually independent ranks but are sometimes part of the mixtures. Thus foundation work and upper work complement each other into a complete tonal texture or ensemble.

Mixtures.—The mixture stops (*fourniture, plein-jeu, Zimbel,* etc.), also known as compound stops, are a grouping together of two, three or more ranks of pipes (usually but not necessarily of the principal type, though never of reeds) speaking a selection of the harmonics of the fundamental note. The essential and important difference between a mixture and a harmonic stop is that the latter (for example, as 12th or 15th) continues in unbroken note sequence right to the top of the keyboard, while a mixture will "break back" in the composition of its harmonics at frequent intervals. Thus the partials of a mixture, which on low C of the keyboard may be spread over a band beginning two octaves higher than 8-ft. pitch, will be gradually changed as the scale ascends, the higher partials being replaced by lower ones. The result is a brightening of the lower and tenor registers, a broadening of the middle and treble registers and—if the mixture is well voiced—a smoothing out of the upper registers. In the design and voicing of mixture stops lies the most difficult part of the organ builder's art, and experience proves that mixtures cannot be given satisfactory musical speech save on the lowest of wind pressures.

MANUALS

Great.—The great organ (Ger. *Hauptwerk,* Fr. *grand orgue*), as its name implies, represents a grouping of the most important stops of the organ. The typical great division of a large instrument will contain a principal chorus, the 8-ft. principal providing the basis. The double open principal 16 ft., the octave or principal 4 ft., the 12th $2\frac{2}{3}$ ft., the 15th 2 ft. and the mixture or mixtures are equally essential and may be likened to the root, branches and twigs of the principal trunk. The gedeckts (bourdon 16 ft., stopped diapason 8 ft., flute couverte 4 ft.) will be present, and in addition to their own solo usefulness will combine well with some of the upper principal stops. Open flute stops of several pitches may be included in the scheme under a diversity of shapes and names (clarabella, wald flute, melodia, etc.). Viols blend less readily with other stops, and thus may be little represented. Reeds are sometimes included; trumpets at 16-, 8- and 4-ft. pitches.

It may be remarked that the tonal individuality of an organ is set very largely by the character of the great ensemble, which musically—though illogically—might therefore be compared to the string section of a modern orchestra. National characteristics in organ design vary on this point. The German great is often designed on lines minimizing the proportion of the 8-ft. principal stops.

The French great tends to a thicker and more flutey tone for its 8-ft. basis, while the Spanish great sometimes appears to depend on a foundation of 8-ft. flute and viol tone.

Positive.—The division of the positive (Ger. *Oberwerk, Positiv* or *Brustwerk;* Fr. *positif*) comes next in musical importance. It may be placed above the great as an *Oberwerk,* below the great as a *Brustwerk* or as a *Rückpositiv* projecting from the gallery, quite apart from the main organ. Ideally it is a miniature great, of considerably smaller scale, with a gedeckt possibly replacing the 8-ft. diapason as the ensemble basis, and containing a reed such as the krummhorn. The positive should be totally unenclosed and placed well to the front (as stated above) where its tone will be distinguished from that of the great. The use of the positive is called for in practically all organ compositions, in episodic contrast to the great.

Swell.—The swell organ (Ger. *Schwellwerk,* Fr. *recit*), as implied by the name, is a grouping together of stops all enclosed within a large box. This box is faced on one or more sides with a set of shutters, not unlike the louvers of a venetian blind. By means of a swell pedal, connected to the shutters by mechanical or electrical means, the player may vary the volume of sound allowed to issue from the box. A typical swell division will contain a series of principal stops somewhat lighter than the great, flutes, salicionals and other viol-type stops, and some hybrids. A distinctive feature of the swell is the inclusion of a full representation of reed stops of the chorus type; an oboe, and a trumpet (trompette) or cornopean at 16-, 8- and 4-ft. pitches. The swell mixtures are

frequently designed to blend with these reeds.

Choir.—The choir organ is often included in place of the positive, though this is not a desirable substitution. In its general form it will have a collection, which ideally should be a complete ensemble, of mild flutes and viols, with the addition of a clarinet and perhaps other imitative reeds, the whole division being enclosed in a box on the same principle as the swell. Occasionally, large choir divisions will contain a complete flue and reed chorus.

Solo.—Whereas all divisions so far have been designed with the aim of building up a harmonious whole, the solo organ is frequently considered to be successful only in so far as it contains stops foreign to the rest of the instrument. On the solo manual are grouped imitative stops of all types, often representing extremes of scaling and voicing useful mainly in a solo capacity. On this manual, too, will be found the bombarde organ, a family of large scale reeds reinforced perhaps by mixtures. Here also will be placed the echo organ, or the antiphonal organ, gaining contrast by the placement of the pipes at a distance.

Pedal.—Included in the pedal organ should be stops continuing downward all types of tone included on the manuals, so that a suitable bass may be found for any stop, or combination of stops, piano to fortissimo. The pedal stops are pitched an octave lower than those of the same name on the manuals. Thus the characteristic pitch is 16 ft., rather than 8 ft., and the length of low C on the pedal open principal will be 16 ft. A well-equipped pedal organ will include stops of various pitches from perhaps 32 ft. to 4 ft., 2 ft. or even 1 ft. and some mixture stops. In general, the pedal organ should hold its own against the full manual divisions without having to be coupled to them, and it should be able to carry a melodic line at any of several pitches independently of the manuals. Reed stops are particularly effective on the pedal and may be present at unison pitches from 32 ft. to 2 ft. They may often be played with fine effect against the full flue ensembles of the manuals.

Wind Chests, Blowing Apparatus.—In addition to supporting the pipes, a wind chest contains the mechanism for distributing wind to each pipe. The usual chest is a large wooden box divided into as many longitudinal compartments as there are stops to be accommodated. Over its top surface are the upper boards on which the pipes rest, the foot of each pipe fitting exactly into a hole through which wind from the chest may pass, as permitted by a pallet or valve. Above the upper boards are the rack boards, which support the pipes at a point several inches higher and thus maintain their vertical position.

The supply of air to the wind chest is delivered by a rotary blower, spun at high speed by an electric motor. Air under pressure may also be provided by the operation of large bellows, by hand or by mechanical means. From one of these originating sources, the wind passes to a reservoir—a shallow box which can expand upward, concertina fashion, but contained by springs or by weights on the top. The reservoir smoothes out the supply of air from the primary source and passes it along to the wind chest under an even and predetermined pressure.

An organ is said to have a certain number of inches of wind pressure. The figure is determined by applying the wind supply, from a pipe hole of the wind chest, to one side of two even columns of water in an anemometer, or open U-shaped glass tube. If the two columns are displaced to the extent of say, $2\frac{1}{2}$ in., the pipes are said to be speaking on $2\frac{1}{2}$ in. of wind pressure.

The interior mechanism of the wind chest consists in principle of a valve, or pallet, at the foot of each pipe; with which the player, through connecting mechanisms between the keyboards and the wind chest, may by the playing of the key admit or shut off air to that pipe. There have been four general types of such organ action. All older organs depended on a mechanical or tracker action, consisting of a series of rods and levers by which the actual physical motion of the finger and the key was transmitted, pulling down the pallet under the pipe. Certain musical advantages are claimed for this method as well as a basic simplicity, and it still has a certain vogue. The 19th century saw the invention of the Barker lever, a small pneumatic bellows which by expansion assisted the player in the chain of effort and movement. Electropneumatic action, coupled with the Pitman chest is by far the most widely used method among organ builders of the 20th century, though other electropneumatic actions have been evolved, and some all-electric actions have been devised.

As the name implies, the electropneumatic action depends for its motive power both on electricity and wind pressure. If we may regard all intermediate mechanisms which join the fingers of the organist with the sounding of the pipes as links in a chain, the first such link will be the completion of an electric circuit by the depression of a key at the console. This actuates an electric magnet which in turn opens a small valve. This allows pneumatic pressure to pull down the pallet underneath the pipe, allowing pressure wind in the chest to pass up through the foot of the pipe and to cause the pipe to speak.

The method of the stop action, by which any one rank of pipes, or any combinations of ranks, may be played at will, is readily understood by considering the method employed in the older slider chests. Underneath each row of pipes on these chests is a strip of wood (or slider) bored with a row of holes corresponding to the foot holes of the pipe. In this position, the stop is "on," but by levers extending from the stop knobs at the console the board may be pulled slightly to one side, so that the holes do not coincide and the passage of air from the wind chest past the pallets to the pipes will be blocked.

In the Pitman chest, sliders are not employed, and the same end is achieved by the provision of an individual valve for each pipe, these valves being controlled by electric or electropneumatic means from the stop knobs or stop tablets at the console.

Console.—At the console the player may have before him several manuals, each controlling one or more divisions of the organ. From the lower to the upper manuals the sequence is usually: positive and/or choir; great; swell; solo (bombarde, orchestral, echo, antiphonal). Beneath his feet is the pedal board, with keys similar to those of the manuals but of larger size, to be played by the feet. To the right and left on the stop jambs, and possibly in front above the top manual, are the stops (knobs or tablets) ranged according to their groupings on the manuals. With a knob pulled out, or a tablet tilted down, a stop is said to be on (*i.e.*, at the ready). Certain stops are called couplers. These are not connected to pipes, but provide for the coupling of almost any one manual to another, either at unison or at sub- or superoctave pitch. Moreover, some manuals may be duplicated on themselves at sub- or superoctave pitches, though this is a device sometimes expedient but rarely desirable and should not be necessary in the ensemble of a well-voiced instrument. Buttons under or above the manuals, which may be preset or adjustable in their action, enable the player to pull out or push in stops and couplers en masse or in various groupings. These buttons are frequently duplicated by toe studs placed just above the pedal board. Above and to the centre of the pedal board will also be found balanced "expression" pedals, controlling the opening and closing of the shutters of enclosed divisions. The crescendo pedal, usually to the right of any "expression" pedals, is a rough and ready means of bringing on the stops in sequence by electrical means, without actuating the stop knobs. German organs have a roller device (*Rollschweller*) which achieves the same end. Mechanical connections in a tracker action necessitate placing the console as near to the wind chests as possible, but with modern action it is an advantage to be able to place the console at a convenient distance from the organ, where the player may better judge the balance of sound, connection between console and wind chest being made by electric cable.

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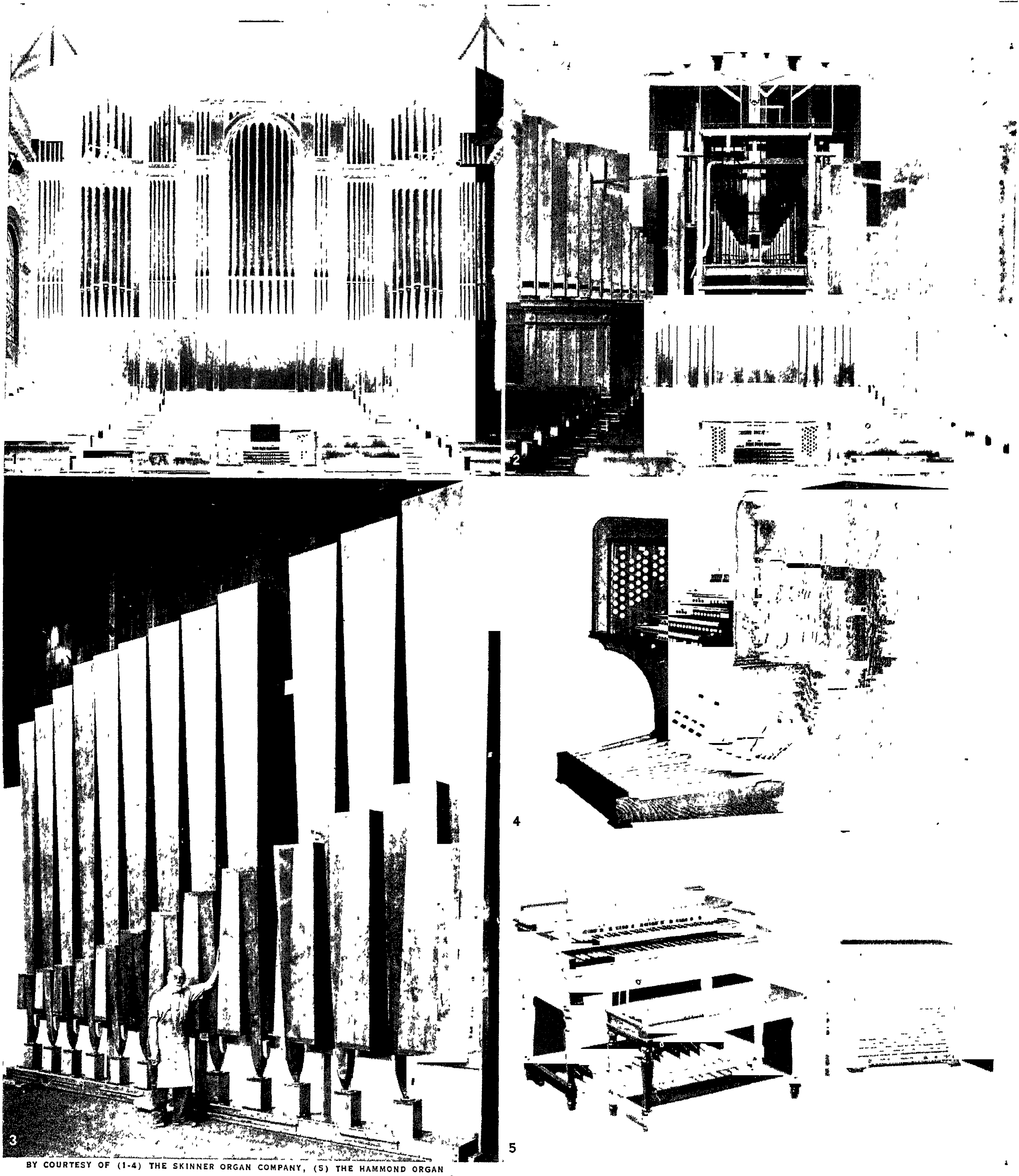


BY COURTESY OF (1-4) THE SKINNER ORGAN COMPANY, (5) THE HAMMOND ORGAN

PARTS OF A MODERN ORGAN

1. Large organ at Finney Chapel, Oberlin College, Oberlin, Ohio, showing casework and display pipes. The console is in the foreground
2. Same organ shown in fig. 1, with casework and display pipes removed, showing interior, with manual and pedal pipes and swell boxes
3. Giant pipes known as Bombardes, set up in the factory for voicing and tuning
4. View of a standard four manual console, similar to the instrument shown in fig 1
5. A modern electric organ, the two units of which shown are the entire instrument. The organ can be played the moment it is plugged into the ordinary household electric circuit. Its tones are created by electrical impulses instead of by air pressure. When a playing key is depressed an electrical wave, of the same shape as the sound wave for that key, is generated within the console and passed to the tone cabinet where it is amplified into audible sound. This modern electrical instrument is said to achieve the quality and rich variety of the great organs.

ORGANIC SENSATIONS, a term for all the bodily sensations except those derived from the skin. In addition to the four special senses, sight, hearing, taste and smell, there is the common sensibility or somaesthesia, which includes cutaneous sensations and also organic sensations. Organic sensations may be subdivided into kinaesthetic sensations, vestibular, or static, sensations and visceral sensations. The deep sensibility that comes from the tissues immediately beneath the skin may also be included under this class term.

Kinaesthetic sensation, so named because it mediates the perception of bodily movement as well as the perceptions of weight, resistance and posture, arises in the muscles, tendons and joints, all of which are supplied with sense organs. Its nervous mechanism has also been called the proprioceptive system, whose function it is to furnish the sensory clues necessary for the control of precise movement.

The vestibular, or static, sense has to do with the maintenance of balance and of bodily position and with the perception of rotation. It arises in the vestibule and the semicircular canals of the inner ear.

The otolith organs in the vestibule mediate the perception of linear acceleration, up and down, forward and backward, and also function in the maintenance of bodily posture. The canals mediate the perception of rotation and dizziness.

The visceral sensations constitute the basis for such experiences as hunger, nausea, appetite and sexual urge.

The experience of gnawing hunger depends on certain slow contractions of the stomach which stimulate sense organs in the gastric tissues.

(*See* also SENSATION; SKIN, SENSORY FUNCTIONS OF.)

(E. G. BOR.)

ORGANOMETALLIC COMPOUNDS are chemical substances containing a metal or metalloid in direct association with one or more hydrocarbon radicals. These compounds never arise by natural processes in the vegetable and animal kingdoms, being produced synthetically by the art of the chemist. They have played an important part in the development of modern chemistry, and among them are several substances of great practical utility.

Lead tetraethyl (*see* below), a most effective antidetonant in motor gasoline, or petrol, and salvarsan, a specific remedy in syphilis, are two outstanding examples of organometallic compounds of proven worth.

Included in this group of carbon compounds are the organic derivatives of magnesium known after their discoverer as Grignard reagents (*q.v.*).

The application of these reagents in chemical synthesis has proved to be without doubt one of the most fruitful and far-reaching advances in practical organic chemistry since the end of the 19th century.

Brief references to organometallic compounds have been given under the headings of certain of the metals and metalloids, and the present article affords a general survey of the whole group of compounds.

The arrangement adopted below follows the natural sequence of the elements according to the periodic law (*q.v.*).

Group I.—Although organosodium compounds were prepared as early as 1858 (J. Wanklyn), the existence and properties of these substances remained doubtful until early in the 20th century (W. Schlenk and co-workers, 1913–17). Lithium ethyl, $Li.C_2H_5$, is prepared by the action of metallic lithium on mercury diethyl; it crystallizes from benzene or high-boiling petroleum in colourless, six-sided plates melting at 95° C. Lithium methyl, $Li.CH_3$, and lithium phenyl, $Li.C_6H_5$, are crystalline powders obtained by double decomposition between lithium ethyl and mercury dimethyl and diphenyl respectively (Schlenk and J. Holtz, 1917). More recently, lithium alkyls and aryls have been prepared from lithium metal and alkyl and aryl halides (K. Ziegler, 1930; H. Gilman, 1932). Sodium triphenylmethyl, $Na.C(C_6H_5)_3$, is obtained by the action of 1% sodium amalgam on triphenylchloromethane, $(C_6H_5)_3CCl$, dissolved in dry ether in an atmosphere of oxygen-free nitrogen. The product is a brownish-red solid. The simpler sodium alkyls are prepared by the action of sodium metal on a mercury alkyl (Schlenk) or zinc alkyl (A. v. Grosse, 1926). Sodium methyl, $Na.CH_3$, is a white powder which burns in air with explosive rapidity. Sodium ethyl, $Na.C_2H_5$, sodium *n*-propyl, $Na.C_3H_7$, and sodium phenyl, $Na.C_6H_5$, are colourless solids having similar properties. Cuprous phenyl, $Cu.C_6H_5$, obtained by the interaction of cuprous iodide and magnesium phenyl bromide in ethereal solution, is a white powder decomposing at 80° C. into copper and diphenyl. Silver phenyl, $Ag.C_6H_5$, an even more unstable substance obtained from phenyl magnesium bromide and silver bromide, is a yellow solid, exploding on rubbing, on gentle warming or on treatment with acids. An ethereal solution of auric bromide and magnesium ethyl bromide yields on evaporation colourless crystalline diethylauric bromide, $(C_2H_5)_2AuBr$, melting at 58° C. and exploding at 70° C. Bromine in chloroform converts this monobromide into the ruby-red ethylauric dibromide, $C_2H_5.AuBr_2$ (W. J. Pope and C. S. Gibson, 1907).

Group II.—The organic derivatives of beryllium are referred to under this metal and the organomagnesium compounds are described in a special article. (*See* GRIGNARD REAGENTS.) The organozinc compounds were discovered by E. Frankland in 1849, and from his study of similar compounds he was led to the conception of chemical valency. In conjunction with B. F. Duppa (1863) he applied them in many organic syntheses which were extended by G. A. Freund (1861), A. Butlerow (1867) and others. Zinc dimethyl (b.p. 46° C.) and zinc diethyl (b.p. 118° C.) are colourless malodorous liquids, spontaneously inflammable in air. They are prepared by distilling the products of the interaction of methyl and ethyl iodides with a zinc copper couple. More recently zinc phenyl bromide, as a crystalline dietherate (E. Blaise, 1911), and zinc diphenyl (A. Job and R. Reich, 1923) have been obtained by the interaction of magnesium phenyl bromide and anhydrous zinc chloride. The cadmium dialkyls (dimethyl, diethyl, dipropyl, dibutyl, etc.) are procurable in good yields from anhydrous cadmium bromide and the appropriate magnesium alkyl bromide. Cadmium dimethyl, $Cd(CH_3)_2$ is a colourless liquid boiling at 105° C. (E. Krause, 1917). Mercury possesses a remarkable capacity for combination with the carbon of hydrocarbon groups and of organic radicals in general. Sodium amalgam acts directly on ethyl iodide and bromobenzene, giving respectively mercury diethyl, $Hg(C_2H_5)_2$ (b.p. 159° C.), and mercury diphenyl, $Hg(C_6H_5)_2$ (m.p. 120° C.). With certain reactive substances such as aromatic bases or phenols, mercury derivatives are obtained merely by boiling with mercuric acetate; aniline yields *o*- and *p*-amino-phenylmercuriacetates, whereas *m*-toluidine takes up two and even three mercuriacetate residues. Phenol gives rise to *o*- and *p*-hydroxyphenylmercuriacetates and hydroxyphenyl-2:4-dimercuriacetate. In addition to the foregoing processes, organomercury compounds are conveniently prepared through the agency of Grignard reagents. Mercury dimethyl, a colourless liquid boiling at 89–92° C., is obtained from magnesium methyl iodide and mercuric chloride, and the homologous mercury dialkyls are prepared similarly.

Group III.—Aluminum trialkyls and triaryls have been recorded, and the production of these substances is facilitated by the use of Grignard reagents. Magnesium ethyl bromide and anhydrous aluminum chloride interact in dry ether to produce aluminum triethyl etherate, $4Al(C_2H_5)_3,3(C_2H_5)_2O$, as a colourless mobile liquid boiling at 112° C./16mm. It fumes in air, takes fire spontaneously, and is decomposed explosively by cold water (E. Krause and B. Wendt, 1923). Aluminum diethyl iodide (b.p. 118–120° C./4 mm.) and aluminum ethyl diiodide (m.p. 35–37° C.; b.p. 158–160° C./4 mm.) were obtained by V. Grignard and R. L. Jenkins (1925) from the liquid product of the interaction of aluminum and ethyl iodide.

Organic derivatives of indium and thallium are obtainable through the Grignard reagents. Thallic bromide, but not thallous bromide, yields both dialkyl and diaryl compounds. Thallic dimethyl bromide, $(CH_3)_2TlBr$, forms silvery-white leaflets (R. J. Meyer and A. Bertheim, 1904), whereas thallic diphenyl bromide, $(C_6H_5)_2TlBr$, is obtained in colourless transparent microscopic needles (D. Goddard and A. E. Goddard, 1922).

Group IV.—Organic derivatives are known of silicon (*q.v.*), germanium (*q.v.*), tin and lead. The most common and stable organolead compounds are the lead tetraalkyls and tetraaryls, which are obtained by interaction of lead chloride or lead bromide with the appropriate Grignard reagent,

$$4\ RMgBr + 2\ PbBr_2 = PbR_4 + Pb + 4\ MgBr_2.$$

Lead tetramethyl, $Pb(CH_3)_4$, lead tetraethyl, $Pb(C_2H_5)_4$, and other lead tetraalkyls have been prepared in this manner, as have the tetraaryls such as lead tetraphenyl, $Pb(C_6H_5)_4$. Treatment of these compounds with acids or halogens converts them to alkyl lead salts, such as $(C_2H_5)_3PbCl$ and $(C_6H_5)_2Pb(NO_3)_2$. Lead tetraalkyls containing different alkyl groups are prepared by reaction of alkyl lead halides with a Grignard reagent containing a different alkyl group (G. Grüttner and E. Krause, 1917), or by interaction of two different lead tetraalkyls in the presence of aluminum chloride (G. Calingaert and co-workers, 1939). The lower lead tetraalkyls are relatively stable, colourless, volatile liquids, while the lead tetraaryls are colourless solids. Organolead compounds such as dilead hexamethyl, $(CH_3)_3Pb.Pb(CH_3)_3$, dilead hexaphenyl, $(C_6H_5)_3Pb.Pb(C_6H_5)_3$, and lead diphenyl, $Pb(C_6H_5)_2$ have also been prepared; on being heated these decompose to the corresponding PbR_4 compounds and metallic lead.

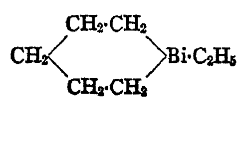
The commercially important lead tetraethyl is now manufactured (in the U.S.A. and other countries) by the action of ethyl chloride under pressure on a powdered alloy of lead and sodium contained in an autoclave. The lead tetraethyl is steam distilled from the reaction mass, leaving sodium chloride and metallic lead as the by-products. It is a colourless liquid, stable in air, soluble in gasoline, and quite volatile, although it decomposes at temperatures below its boiling point. For use as an antidetonant, it is added to gasoline in quantities not exceeding 3.0 cc. per gallon; a small quantity of ethylene dibromide, and sometimes ethylene dichloride, is added to prevent the formation of lead deposits in the engine.

The preparation and properties of organotin compounds are very much like those of organolead compounds. Stannous chloride and magnesium ethyl bromide give tin diethyl, $Sn(C_2H_5)_2$, as an oxidizable oil insoluble in water (P. Pfeiffer, 1911), whereas tin diphenyl, $Sn(C_6H_5)_2$, a bright yellow powder melting at 130° C. to a dark red liquid, is obtained from stannous chloride and magnesium phenyl bromide. When excess of Grignard reagent is used, this diaryl compound loses part of its tin and passes into ditin hexaphenyl, $3Sn(C_6H_5)_2 = Sn + (C_6H_5)_3Sn.Sn(C_6H_5)_3$, obtained in colourless plates melting at 237° C. (E. Krause and R. Becker, 1920). Tin tetramethyl, $Sn(CH_3)_4$, and tin tetraethyl $Sn(C_2H_5)_4$, boiling at 78° C. and 175° C. respectively, are prepared in good yields from stannic chloride and the appropriate Grignard reagents; in the latter case triethylstannic chloride, $(C_2H_5)_3SnCl$, is obtained as a by-product.

Magnesium benzyl chloride and stannic chloride give tribenzylstannic chloride, $(C_7H_7)_3SnCl$, (m.p. 143–145° C.) and tin tetrabenzyl (tetrabenzylstannane), $Sn(C_7H_7)_4$, (colourless needles, m.p. 42–43° C.). The former compound when acted on by chlorine furnishes dibenzylstannic chloride $(C_7H_7)_2SnCl_2$ in colourless crystals melting at 163–4° C. (T. Smith and F. S. Kipping, 1912).

Group V.—Certain more outstanding examples of organic derivatives of arsenic and antimony are described in the articles on these metalloids. Both trialkyl- and triaryl-bismuthines have long been known and were formerly prepared by the interaction of alkyl or aryl halides and sodium or potassium bismuthides.

The use of Grignard reagents has considerably enlarged the bismuth series of organic compounds. Diphenyl-α-naphthylbismuthine and tri-α-naphthylbismuthine (melting points 118–119° C. and 235° C.) have been prepared in this way (F. Challenger, 1914), and a cyclic bismuth compound, ethyl*cyclo*bismuthopentane has been prepared by the successive action on bismuth tribromide of magnesium ethyl bromide and the dimagnesium compound of 1:5–dibromopentane (G. Grüttner and M. Wiernik, 1915); it is a yellow viscous oil boiling at 108–112° C./18–20 mm. with an unpleasant odour and oxidizing rapidly in air.



Group VI.—Organic derivatives of selenium (*q.v.*) and tellurium (*q.v.*) are mentioned under these headings. A remarkable series of organic chromium compounds has been described by F. Hein (1919–24), who by the action of magnesium phenyl bromide either on chromyl chloride or on anhydrous chromic chloride obtained chromium pentaphenyl bromide, $Cr(C_6H_5)_5Br$, an orange-brown amorphous substance converted by alcoholic potash into chromium pentaphenyl hydroxide, $Cr(C_6H_5)_5OH,4H_2O$, crystallizing in golden-yellow leaflets. This basic hydroxide on treatment with acids loses a phenyl group giving rise to salts of the general type $[Cr(C_6H_5)_4]X$ (where X is the acid radical). Moreover, the mother-liquors from chromium pentaphenyl hydroxide contain chromium triphenyl hydroxide, which gives the corresponding salts $[Cr(C_6H_5)_3]X$. These organic derivatives indicate that chromium has valencies of 6, 5 and 4.

Group VIII.—Very few organometallic compounds of the metals of this group are known. Apart from some organoiron compounds, the only organometallic compounds isolated have been some platinum compounds. Ethyl iron chloride, C_2H_5FeCl, has been prepared by interaction of ethyl zinc iodide and ferrous chloride (A. Job and R. Reich, 1922). Phenyl iron iodide, $(C_6H_5)FeI$, has also been prepared from ferrous iodide and phenyl zinc iodide (G. Champetier, 1930). Trimethyl platinum iodide, $(CH_3)_3PtI$, has been obtained by interaction of platinum chloride and magnesium methyl iodide. The product, a yellow crystalline solid, is converted by silver oxide to trimethyl platinum hydroxide, $(CH_3)_3PtOH$. Solution of the latter in nitric acid gives the nitrate, $(CH_3)_3PtNO_3$. The corresponding chloride, $(CH_3)_3PtCl$, crystallizes from chloroform in colourless rhombic dodecahedra (W. J. Pope and S. J. Peachy, 1909). Platinum tetramethyl, $Pt(CH_3)_4$, has been prepared from trimethyl platinum iodide and sodium methyl, and diplatinum hexamethyl, $(CH_3)_3Pt.Pt(CH_3)_3$, has been obtained by heating trimethyl platinum iodide with powdered potassium in dry benzene (H. Gilman and M. Lichtenwalter, 1936).

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(G. T. M.; G. Ct.)

ORGANON, the name given to Aristotle's logical treatises (Gr. ὄργανον, instrument). They are so called because logic is itself neither a speculative science nor a practical art in the ordinary sense, but an aid or instrument to all scientific thought. Francis Bacon gave to his own treatise the name *Novum Organum* in the belief that he had discovered a new inductive logic.

ORGY, a term originally denoting the secret rites or ceremonies connected with the worship of certain deities. The word is derived from Lat. *Orgia*, Gr. ὄργια, a post-Homeric word used of the secret rites of Demeter (*q.v.*), at Eleusis, of the Cabeiri, Orpheus and Eumolpus (*qq.v.*), but most commonly of the rites of Dionysus-Bacchus, with their dedications and purifications. The word has been connected with *ἔργω = ἔρδω, ῥέζω, in the sense of performing sacred rites; Lat. *operari*, to perform sacrifice.

The Dionysiac orgies, which were restricted to women, were celebrated in the winter among the Thracian hills or in spots remote from city life. The women met, generally at night, clad in fawn skins, with hair dishevelled, swinging the thyrsus and beating the cymbal; they danced and worked themselves up to a state of mad excitement. A bull, the representative of the god, was torn in pieces by them as Dionysus-Zagreus had been torn. The women tore the bull with their teeth, and the eating of the raw flesh was a necessary part of the ritual. The most famous festival of the kind was the τριετηρίς, the triennial festival, celebrated on Parnassus by the women of Attica and Phocis. The

celebrants were called Maenads or Bacchae. The wild dances and other "orgiastic" ceremonies have given rise to the use of the word "orgy" for any wild revel or festivity. (*See* DIONYSUS and MYSTERY.)

ORIBI or **OUREBI**, a small South African antelope (*Ourebia ourebi*), standing about 24 in. at the shoulder, and characterized by a bare glandular spot below the ear, the upright horns of the bucks, which are ringed for a short distance above the face, and the tufted bushy tail. The name is extended to include the other members of the same genus.

ORIEL, in architecture, a projecting bay window carried by corbels or mouldings. It is usually polygonal or semicircular in plan, but at Oxford, in some of the colleges, there are examples which are rectangular and rise through two or three storeys. In Germany it forms a favourite feature, and is sometimes placed at the angle of a building, carried up through two or three floors and covered with a lofty roof. The oriel is also said to have been provided as a recess for an altar in an oratory or small chapel. In the 15th century oriels came into general use, and are frequently found over entrance gateways.

The earliest meaning of the word seems to be a gallery, portico or corridor, and the application of the term to a particular form of window apparently arose from such a window being in an "oriel." In Cornwall "orrel" is still used of a balcony or porch at the head of an outside staircase leading to an upper storey in a fisherman's cottage. The name of Oriel college, Oxford, comes from a tenement known as Seneschal Hall or La Oriole, granted to the college in 1327. (*See* BAY; WINDOW.)

ORIENTAL COOKERY is characterized by the use of many condiments, often making the food very "hot," and by the use of very sweet dishes. In general, the Orient prefers main dishes in which many food materials have been combined into one appetizing whole, and this means cutting into small pieces. Confucius refused to eat food that was not "chopped up properly," and also ruled that there must never be more flesh food than vegetables in the mixture. A Japanese rule calls for the five tastes of sweet, salt, sour, bitter and acrid in each meal, and another for something in each from both sea and mountain. The most widely used meat is lamb or mutton. In China pork is common. The *kebob* of Turkey and India is meat, fish or poultry cut small and strung on a skewer, often with alternating slices of vegetable. It is usually broiled. *Pilaf* or *pilau*, the national dish of Turkey and much eaten in India, is a dish of rice (usually browned in fat before cooking in stock), to which flesh foods or vegetables or both are added, either cooked with the rice or served on it, and the mixture highly seasoned. The Armenian *herissa* and the Arabian *couscous* are similar dishes made with cracked wheat instead of rice. The Turkish *dolma* is a vegetable stuffed with rice and minced meat or olive oil. Vine leaves are also used for this. Birds, domestic and wild, vary the diet. Fish and shellfish furnish more of the flesh food than does meat, being in most places abundant and cheap. All flesh foods and vegetables are preserved by drying as well as in other ways. "Bombay duck" is dried salted fish. Flesh foods eaten in the East not used in the West include buffalo, cat, dog, field rat, snake, lizard, beetle, cockroach, larvae, ant, worm, shark fin and whale, some of these being held to be great delicacies.

For fat, India uses *ghee* (clarified butter), China peanut oil, Turkey and adjacent countries olive oil, and many sesame oil. Eggs are cooked in many ways. Bread is not in as general use as in the Occident, though in Japan it is growing in popularity. The *chapati* of the Indian peasant is a thin wafer made of whole wheat flour, "pan" fried in *ghee*. The main vegetable food of the Orient is rice, which is almost everywhere served with every meal, and is generally cooked in stock. Cracked wheat, barley, buckwheat, sesame and the millets are used in some countries. Noodles are eaten, and Italian pastes, though not native, are now in Eastern markets. Milk is used in Turkey and kindred countries when curdled (*matzoun*) as a beverage and in sauces. Tea is the universal beverage of the Orient, and in some countries coffee is common. Turkish coffee is made from the following formula: For four small cups, ¾ cup water, 3 teaspoons sugar, 3 teaspoons pulverized coffee. Melt the sugar in the water over the fire, remove from fire, add coffee, stir one minute, return to fire and bring to boiling point three or four times. This is not strained, but sipped from the cup after the coffee has settled to the bottom.

Fruits are usually cooked, except that dates, the staple food of the lands of the Near East, are rarely cooked except in puddings and confections. In China pineapple is often cooked with chicken and other meats. Pastries, sweet with sugar syrup and often with nuts, or a sweet fruit compote, are the usual ending for a Turkish meal. The Chinese and Japanese use sweet cakes, confections and puddings, or cooked or preserved fruits. Salads are much eaten in the Near East, usually of a combination of vegetables and perhaps fruits. Seasonings used in the Orient not common in the Occident include cummin, saffron, coriander seed, tamarind, chilis in variety, curry powder and soy sauce. Vegetable foods form the greater part of the diet.

The most famous dish of India is the curry, in which material cooked with curry powder or in a curry sauce is served in a ring of rice. The epicure insists on curries made from spices ground fresh each day, but curry powder and essence may be made ahead in the home or may be bought bottled. A good formula for curry sauce, hot enough for the average Western taste, but not for that of India, uses 2 tablespoons minced onion, fried a little in ¼ cup butter, 1½ tablespoons curry powder, mixed to a paste with a little of 2 cups of stock or milk, 2 teaspoons curry essence, ¼ teaspoon salt, 1 tablespoon rice flour, 1 cup cocoanut or almond milk (made by soaking an hour in 1 cup milk, ½ cup freshly ground cocoanut or blanched almonds ground fine, and used with or without straining), 1 teaspoon scraped green ginger, 1 teaspoon currant jelly. The meat, fish, shellfish, poultry or vegetables are cooked in the sauce. With a curry is served chutney, a sauce or conserve made of sweet and sour fruits and vegetables, highly spiced.

Chinese and Japanese food are similar, though not the same. Young bamboo sprouts, bean sprouts, water chestnuts, dried mushrooms and *pe-tsai* (Chinese cabbage) are favourite vegetables. The soy bean is used not only in soy sauce, but for the delicate bean curd that adds an agreeable texture and flavour to so many dishes. The famous bird's nests of China are used in dishes with chicken and pigeon as well as for soup. They are a luxury, as are the equally famous ancient eggs. Almonds are used in many combinations.

Chop suey is a dish unknown in China. The Japanese serve many foods cooked in deep fat after being dipped in a very delicate batter.

In Japan the diner in a restaurant often cooks his own food in an iron skillet set on the dining table. (I. E. L.)

ORIENTATION, a term expressing the angular relation of any object to the points of the compass; in architecture, used to express the relation of the main dimensions of a building, with reference to the points of the compass, and especially with reference to the east. In Mesopotamia and Egypt, as well as in primitive Central America, orientation of buildings was common from an early date, with important features, entrances, passages and the like designed to point in the direction of the rising sun. In north Europe the same custom evidently prevailed, as Stonehenge, near Salisbury, England, is carefully orientated. Many Greek temples were also designed to face the rising sun.

In the earliest Christian basilicas at Rome, the apse was placed at the west end, so that the priest who served the altar from behind, facing the congregation, himself faced the east and the rising sun. This orientation has sometimes been traced to the influence of the churches of the Holy Sepulchre at Jerusalem and of the Nativity at Bethlehem. It is more probable, however, that this orientation was due to an underlying tradition whose roots go far back beyond the origin of Christianity.

In St. Sophia, Constantinople, and all the Byzantine churches, the apse was placed at the east end, and the same custom obtains in the early churches in Syria and the Coptic churches in Egypt. During the 6th and 7th centuries this orientation gradually came into use in Italy and the west generally. Orientation of this type, with the apse or altar toward the east, is generally carefully observed in Spain, Germany and England, and

less carefully in France and Italy. It is so common, however, that in an architectural or ecclesiastical description of a church building, the "east end" is always the end with the apse or altar. In Mohammedan mosques the mihrab or prayer niche is so placed that the worshipper looks towards Mecca.

Orientation is an important consideration in the placing of any building, as exposure to the sun, or lack of it, prevailing winds and similar facts in climate must be considered in designing a building for any purpose. Thus in the northern temperate zone, living rooms are usually arranged to get large amounts of south light; studios are arranged with north light, and, in general, buildings like schools, with rooms on both sides of a corridor, are placed, if possible, with the corridor running north and south, so that the rooms on both sides may receive the sun.

ORIENTE or La Region Oriental, a large undefined territory of Ecuador, comprising all that part of the republic lying east of the Andes. Pop. (1950 census) 31,989. The region was divided into two provinces, Napo-Pastaza and Santiago-Zamora. A recurrent border war was fought with Peru in 1941, involving a contested area of more than 150,000 sq.mi. At the Rio de Janeiro conference in Jan. 1942, Peru and Ecuador agreed to submit the dispute to a boundary commission comprised of representatives from their own countries and the United States, but ten years later the border had still not been delineated.

ORIGEN (*c.* 185–*c.* 254), the most distinguished and most influential of all the theologians of the ancient church, with the possible exception of Augustine.

Origen was born, perhaps at Alexandria, of Christian parents in the year 185 or 186. His father Leonidas gave him an excellent education. At a very early age, about the year 200, he listened to the lectures of Pantaenus and Clement in the catechetical school. This school, of which the origin (though assigned to Athenagoras) is unknown, was the first and for a long time the only institution where Christians were instructed simultaneously in the Greek sciences and the doctrines of the holy Scriptures. Asia Minor and the West developed the strict ecclesiastical forms by means of which the church closed her lines against heathenism, and especially against heresy; in Alexandria Christian ideas were handled in a free and speculative fashion and worked out with the help of Greek philosophy. The line between heresy and orthodoxy was less rigidly drawn there than at Ephesus, Lyons, Rome or Carthage.

In the year 202 a persecution arose, in which the father of Origen perished. Origen began about the same time to earn his bread by teaching; and in 203 he was placed, with the sanction of the bishop of Demetrius, at the head of the catechetical school. He regularly attended the lectures of Ammonius Saccas, and made a thorough study of the books of Plato and Numenius, of the Stoics and the Pythagoreans. At the same time he endeavoured to acquire a knowledge of Hebrew, in order to be able to read the Old Testament in the original. His manner of life was ascetic; the sayings of the Sermon on the Mount and the practical maxims of the Stoics were his guiding stars. Four oboli a day, earned by copying manuscripts, sufficed for his bodily sustenance. A rash resolve led him to castrate himself that he might work unhindered in the instruction of women.

He commenced his great work on the textual criticism of the Scriptures; and at the instigation of his friend Ambrosius, who provided him with the necessary amanuenses, he published his commentaries on the Old Testament and his dogmatic investigations. He worked at Alexandria for 28 years (till 231–232). This period, however, was broken by many journeys to Rome, to Arabia, to Antioch, and, in 216, when the imperial executioners were ravaging Alexandria, to Palestine. There the bishops of Jerusalem and Caesarea got him to deliver public lectures in the churches. In the East, especially in Asia Minor, it was still no unusual thing for laymen, with permission of the bishop, to address the people in the church. In Alexandria, however, this custom had been given up, and Demetrius took occasion to express his disapproval and recall Origen to Alexandria.

Probably the bishop was jealous of the high reputation of the teacher; and a coolness arose between them which led, fifteen years later, to an open rupture. On his way to Greece (apparently in the year 230) Origen was ordained a presbyter in Palestine by his friends the bishops. This was undoubtedly an infringement of the rights of the Alexandrian bishop; at the same time it was simply spite on the part of the latter that had kept Origen so long without orders. Demetrius convened a synod, at which it was resolved to banish Origen from Alexandria. A second synod, composed entirely of bishops, determined that Origen must be deprived of his status as a presbyter. This decision seems to have been justified by referring to the self-mutilation of Origen and adducing objectionable doctrines which he was said to have promulgated. No formal excommunication of Origen appears to have been decreed; the sentence of deprivation was approved by most of the churches, in particular by that of Rome. At a later period Origen sought to vindicate his teaching in a letter to the Roman bishop Fabian, but, it would seem, without success.

In these circumstances Origen retired from Alexandria (231–232) to Palestine, where his condemnation had not been acknowledged by the churches. He settled in Caesarea, and established a flourishing school there. Enthusiastic pupils sat at his feet (see the *Panegyric* of Gregory Thaumaturgus), and the methodical instruction which he imparted was famous all over the East. He made frequent journeys. He was for two years together at Caesarea in Cappadocia, where he was overtaken by the Maximinian persecution; here he worked at his recension of the Bible. We find him again in Nicomedia, in Athens, and twice in Arabia. He was called there to combat the unitarian christology of Beryllus, bishop of Bostra, and to clear up certain eschatological questions. As he had formerly had dealings with the house of Alexander Severus, so now he entered into a correspondence with the emperor Philip the Arabian and his wife Severa. But through all situations of his life he preserved his equanimity, his keen interest in science, and his indefatigable zeal for the instruction of others. In the year 250 the Decian persecution broke out, Origen was arrested, imprisoned and maltreated. But he survived these troubles and lived a few years longer in active intercourse with his friends. He died, probably in the year 254 at Tyre.

Writings.—Origen is probably the most prolific author of the ancient church. "Which of us," asks Jerome, "can read all that he has written?" The number of his works was estimated at 6000, but that is certainly an exaggeration. Owing to the increasing unpopularity of Origen in the church, a comparatively small portion of these works have come down to us in the original. We have more in the Latin translation of Rufinus; but this translation is by no means trustworthy, since Rufinus, assuming that Origen's writings had been tampered with by the heretics, considered himself at liberty to omit or amend heterodox statements. Origen's real opinion, however, may frequently be gathered from the *Philocalia*—a sort of anthology from his works prepared by Basil the Great and Gregory Nazianzenus. The fragments in Photius and in the *Apology* of Pamphilus serve for comparison. The writings of Origen consist of letters, and of works in textual criticism, exegesis, apologetics, dogmatic and practical theology.

1. Eusebius (to whom we owe our full knowledge of his life) collected more than a hundred of Origen's letters, arranged them in books, and deposited them in the library at Caesarea (*H.E.* vi. 36). In the church library at Jerusalem (founded by the bishop Alexander) there were also numerous letters of this father (Euseb. *H.E.* vi. 20). But unfortunately they have all been lost except two—one to Julius Africanus and one to Gregory Thaumaturgus. There are, besides, a couple of fragments.

2. Origen's textual studies on the Old Testament were undertaken partly in order to improve the manuscript tradition, and partly for apologetic reasons, to clear up the relation between the LXX and the original Hebrew text. The results of more than twenty years' labour were set forth in his *Hexapla* and *Tetrapla*, in which he placed the Hebrew text side by side with the various Greek versions, examined their mutual relations in detail, and tried to find the basis for a more reliable text of the LXX. The *Hexapla* was probably never fully written out, but excerpts were made from it by various scholars at Caesarea in the 4th century; and thus large sections of it have been saved. He worked at the text of the New Testament, although he produced no recension.

3. The exegetical labours of Origen extend over the whole of the Old and New Testaments. They are divided into *Scholia* (σημειώσεις, short annotations, mostly grammatical), *Homilies* (edifying expositions grounded on exegesis), and *Commentaries* (τόμοι). In the Greek original only a very small portion has been preserved; in Latin translations, however, a good deal. The most important parts are the homilies on Jeremiah, the books of Moses, Joshua and Luke, and the commentaries on Matthew, John and Romans. With grammatical precision, antiquarian learning and critical discernment Origen combines the allegorical method of interpretation—the logical corollary of his conception of the inspiration of the Scriptures. He distinguishes a threefold sense of scripture, a grammatico-historical, a moral and a pneumatic—the last being the proper and highest sense. He thus set up a formal theory of allegorical exegesis, not quite extinct in the churches even yet, and in his own system of fundamental importance.

4. The principal apologetic work of Origen is his book κατὰ Κέλσου (eight books), written at Caesarea in the time of Philip the Arabian. It has been completely preserved in the original. This work is invaluable as a source for the history and situation of the church in the 2nd century; for it contains nearly the whole of the famous work of Celsus (Λόγος ἀληθής) against Christianity. What makes Origen's answer so instructive is that it shows how close an affinity existed between Celsus and himself in their fundamental philosophical and theological presuppositions. The real state of the case is certainly unsuspected by Origen himself; but many of his opponent's arguments he is unable to meet except by a speculative reconstruction of the church doctrine in question. Origen's apologetic is most effective when he appeals to the spirit and power of Christianity. In details his argument is not free from sophistical subterfuges and superficial reasonings.

5. Of the dogmatic writings we possess only one in its integrity, and that only in the translation of Rufinus, Περὶ ἀρχῶν (On the Fundamental Doctrines). This work, which was composed before 228, is the first attempt at a dogmatic at once scientific and accommodated to the needs of the church. The material is drawn from Scripture, but in such a way that the propositions of the *regula fidei* are respected. This material is then formed into a system by all the resources of the intellect and of speculation. Origen thus solved, after his own fashion, a problem which his predecessor Clement had not even ventured to grapple with. The first three books treat of God, the world, the fall of spirits, anthropology and ethics. "Each of these three books really embraces, although not in a strictly comprehensive way, the whole scheme of the Christian view of the world, from different points of view, and with different contents." The fourth book explains the divinity of the Scriptures, and deduces rules for their interpretation. It ought properly to stand as first book at the beginning. The ten books of *Stromata* (in which Origen compared the teaching of the Christians with that of the philosophers, and corroborated all the Christian dogmas from Plato, Aristotle, Numenius and Cornutus) have perished, with the exception of fragments; so have the tractates on the resurrection and freewill.

6. Of practical theological works we have still the Προτρεπτικὸς εἰς μαρτύριον and the Σύνταγμα περὶ εὐχῆς. For a knowledge of Origen's Christian estimate of life and his relation to the faith of the church these two treatises are of great importance. The first was written during the persecution of Maximinus Thrax, and was dedicated to his friends Ambrosius and Protoctetus. The other also dates from the Caesarean period; it mentions many interesting details, and concludes with a fine exposition of the Lord's Prayer.

7. In his own lifetime Origen had to complain of falsifications of his works and forgeries under his name. Many pieces still in existence are wrongly ascribed to him; yet it is doubtful whether a single one of them was composed on purpose to deceive. The most noteworthy are the *Dialogues* of a certain Adamantius "de recta in Deum fide," which seem to have been erroneously attributed to Origen so early as the 4th century.

Outline of Origen's View of the Universe and of Life.—The system of Origen was formulated in opposition to the Greek philosophers on the one hand, and the Christian Gnostics on the other[1]. But the science of faith, as expounded by him, bears unmistakably the stamp both of Neo-Platonism and of Gnosticism. As a theologian, in fact, Origen is not merely an orthodox traditionalist and believing exegete, but a speculative philosopher of Neo-Platonic tendencies. He is, moreover, a judicious critic. The union of these four elements gives character to his theology, and in a certain degree to all subsequent theology. It is this combination which has determined the peculiar and varying relations in which theology and the faith of the church have stood to each other since the time of Origen. That relation depends on the predominance of one or other of the four factors embraced in his theology.

As an orthodox traditionalist Origen holds that Christianity is a practical and religious saving principle, that it has unfolded itself in an historical series of revealing facts, that the church has accurately embodied the substance of her faith in the *regula fidei,* and that simple faith is sufficient for the renewal and salvation of man. As a philosophical idealist, however, he transmutes the whole contents of the faith of the church into ideas which bear the mark of Neo-Platonism, and were accordingly recognized by the later Neo-Platonists as Hellenic[2]. In Origen, however, the mystic and ecstatic element is held in abeyance. The ethico-religious ideal is the sorrowless condition, the state of superiority to all evils, the state of order and of rest. In this condition man enters into likeness to God and blessedness; and it is reached through contemplative isolation and self-knowledge, which is divine wisdom.

As a means to the realization of this ideal, Origen introduces the whole ethics of Stoicism. But the link that connects him with churchly realism, as well as with the Neo-Platonic mysticism, is the conviction that complete and certain knowledge rests wholly on divine revelation, *i.e.,* on oracles. Consequently his theology is cosmological speculation and ethical reflection based on the sacred Scriptures. The Scriptures, however, are treated by Origen on the basis of a matured theory of inspiration in such a way that all their facts appear as the vehicles of ideas, and have their highest value only in this aspect. That is to say, his gnosis neutralizes all that is empirical and historical, if not always as to its actuality, at least absolutely in respect of its value. The most convincing proof of this is that Origen (1) takes the idea of the immutability of God as the regulating idea of his system, and (2) deprives the historical "Word made flesh" of all significance for the true Gnostic. To him Christ appears simply as the Logos who is with the Father from eternity, and works from all eternity, to whom alone the instructed Christian directs his thoughts, requiring nothing more than a perfect—*i.e.,* divine—teacher. In such propositions historical Christianity is stripped off as a mere husk. The objects of religious knowledge are beyond the plane of history, or rather belong to a supra-mundane history.

On this view contact with the faith of the church could only be maintained by distinguishing an exoteric and an esoteric form of Christianity. This distinction was already current in the catechetical school of Alexandria, but Origen gave it its boldest expression, and justified it on the ground of the incapacity of the Christian masses to grasp the deeper sense of Scripture, or unravel the difficulties of exegesis. On the other hand, in dealing with the problem of bringing his heterodox system into conformity with the *regula fidei* he evinced a high degree of technical skill. An external conformity was possible, inasmuch as speculation, proceeding from the higher to the lower, could keep by the stages of the *regula fidei,* which had been developed into a history of salvation. The system itself aims in principle at being thoroughly monistic; but, since matter, although created by God out of nothing, was regarded merely as the sphere in which souls are punished and purified, the system is pervaded by a strongly dualistic element. The immutability of God requires the eternity of the Logos and of the world. At this point Origen succeeded in avoiding the heretical Gnostic idea of God by assigning to the Godhead the attributes of goodness and righteousness. The pre-

[1]The opposition to the unitarians within the church must also be kept in mind.

[2]Porphyry says of Origen, κατὰ τὰς περὶ πραγμάτων καὶ τοῦ θείου δόξας Ἑλληνίζων (Euseb: *H.E.* vi. 19).

existence of souls is another inference from the immutability of God, although Origen also deduced it from the nature of the soul, which as a spiritual potency must be eternal. From this follows the necessity for the created spirit, after apostasy, error and sin, to return always to its origin in God.

The actual sinfulness of all men Origen was able to explain by the theological hypothesis of pre-existence and the premundane fall of each individual soul. He holds that freedom is the inalienable prerogative of the finite spirit; and this is the second point that distinguishes his theology from the heretical Gnosticism. The system unfolds itself like a drama, of which the successive stages are as follows: the transcendental fall, the creation of the material world, inaugurating the history of punishment and redemption, the clothing of fallen souls in flesh, the dominion of sin, evil and the demons on earth, the appearing of the Logos, His union with a pure human soul, His esoteric preaching of salvation, and His death in the flesh, then the imparting of the Spirit, and the ultimate restoration of all things. The doctrine of the restoration appeared necessary because the spirit, in spite of its inherent freedom, cannot lose its true nature, and because the final purposes of God cannot be foiled. The end, however, is only relative, for spirits are continually falling, and God remains through eternity the creator of the world. Moreover the end is not conceived as a transfiguration of the world, but as a liberation of the spirit from its unnatural union with the sensual.

The old Christian eschatology is set aside; no one has dealt such deadly blows to Chiliasm and Christian apocalypticism as Origen. It need hardly be said that he spiritualized the church doctrine of the resurrection of the flesh. But, while in all these doctrines he appears in the character of a Platonic philosopher, traces of rational criticism are not wanting. Where his fundamental conception admits of it, he tries to solve historical problems by historical methods. Even in the christology, where he is treating of the historical Christ, he entertains critical considerations; hence it is not altogether without reason that in after times he was suspected of "Ebionitic" views of the Person of Christ.

Although the theology of Origen exerted a considerable influence as a whole in the two following centuries, it certainly lost nothing by the circumstance that several important propositions were capable of being torn from their original setting and placed in new connections. It is in fact one of the peculiarities of this theology, which professed to be at once churchly and philosophical, that most of its formulae could be interpreted and appreciated *in utramque partem.* By arbitrary divisions and rearrangements the doctrinal statements of this "science of faith" could be made to serve the most diverse dogmatic tendencies. This is seen especially in the doctrine of the Logos. On the basis of his idea of God Origen was obliged to insist in the strongest manner on the personality, the eternity (eternal generation) and the essential divinity of the Logos[1]. On the other hand, when he turned to consider the origin of the Logos he did not hesitate to speak of Him as a *κτίσμα,* and to include Him amongst the rest of God's spiritual creatures. A *κτίσμα,* which is at the same time ὁμοούσιον τῷ Θεῷ, was no contradiction to him, simply because he held the immutability, the pure knowledge and the blessedness which constituted the divine nature to be communicable attributes.

In later times both the orthodox and the Arians appealed to his teaching, both with a certain plausibility; but the inference of Arius, that an imparted divinity must be divinity in the second degree, Origen did not draw. With respect to other doctrines also, such as those of the Holy Spirit and the incarnation of Christ, etc., Origen prepared the way for the later dogmas. The technical terms round which such bitter controversies raged in the 4th and 5th centuries are often found in Origen lying peacefully side by side. But this is just where his epoch-making importance lies, that all the later parties in the church learned from him. And this is true not only of the dogmatic parties; solitary monks and ambitious priests, hard-headed critical exegetes, allegorists, mystics, all found something congenial in his writings. The only man who tried to shake off the theological influence of Origen was Marcellus of Ancyra, who produced no lasting effect on theology.

The attacks on Origen, which had begun in his lifetime, did not cease for centuries, and only subsided during the time of the fierce Arian controversy. It was not so much the relation between *pistis* and *gnosis*—faith and knowledge—as defined by Origen that gave offence, but rather isolated propositions, such as his doctrines of the pre-existence of souls, of the soul and body of Christ, of the resurrection of the flesh, of the final restoration, and of the plurality of worlds. Even in the 3rd century Origen's view of the Trinity and of the Person of Christ was called in question, and that from various points of view. It was not till the 5th century, however, that objections of this kind became frequent. In the 4th century Pamphilus, Eusebius of Caesarea, Athanasius, the Cappadocians, Didymus and Rufinus were on the side of Origen against the attacks of Methodius and many others. But, when the zeal of Epiphanius was kindled against him, when Jerome, alarmed about his own reputation, and in defiance of his past attitude, turned against his once honoured teacher, and Theophilus, patriarch of Alexandria, found it prudent, for political reasons to condemn Origen—then his authority received a shock from which it never recovered.

There were, doubtless, in the 5th century church historians and theologians who still spoke of him with reverence, but such men became fewer and fewer. In the West Vincent of Lerins held up Origen as a warning example (*Commonit.* 23), showing how even the most learned and most eminent of church teachers might become a misleading light. In the East the exegetical school of Antioch had an aversion to Origen; the Alexandrians had utterly repudiated him. Nevertheless his writings were much read, especially in Palestine. The monophysite monks appealed to his authority, but could not prevent Justinian and the fifth oecumenical council at Constantinople (553) from anathematizing his teaching.

BIBLIOGRAPHY.—Next to the works of Origen (*see* Redepenning, "Des Hieronymus wiederaufgefundenes Verzeichnis der Schriften des Origens," in *Zeit. f. d. hist. Theol.* [1851], pp. 66 *seq.*) the most important sources are: Gregory Thaumat., *Panegyricus in Orig.;* Eusebius, *H.E.* vi.; Epiphanius, *Haer.* 64; the works of Methodius, the Cappadocians, Jerome (see *De vir. ill.* 54, 61) and Rufinus; Vincent. Lerin. *Commonit.* 23; Palladius, *Hist. Laus.* 147; Justinian, *Ep. ad Mennam* (Mansi, ix. p. 487 *seq.*); Photius, *Biblioth.* 118, etc. The best of the older editions is that of Delarue (1733–59, 4 vols. fol.; pub. by Migne in *Patrol. Gr.* vols. xi.–xvii.). A critical edition is being brought out by the Preussische Akademie der Wissenschaften; it is not yet completed. Amongst the older works on Origen those of Huetius (printed in Delarue, vol. iv.) are the best; but Tillemont, Fabricius, Walch (*Historie d. Ketzereien,* vii. pp. 362–760) and Schröckh also deserve to be mentioned. In recent times the doctrine of Origen has been expounded in the great works on church history by Baur, Dorner, Böhringer, Neander, Möller (*Geschichte der Kosmologie in der griechischen Kirche*) and Kahnis (*Die Lehre vom h. Geist,* vol. i.); compare with these the works on the history of philosophy by Ritter, Erdmann, Ueberweg and Zeller. Of monographs, the best and most complete is Redepenning, *Origenes, eine Darstellung seines Lebens und seiner Lehre* (2 vols., 1841, 1846). Compare Thomasius, *Orig.* (1837); Krüger, "Über das Verhältnis des Orig. zu Ammonius Sakkas," in the *Ztschr. f. hist. Theol.* (1843), i. p. 46 *seq.;* Fischer, *Comment. de Orig. theologia et cosmologia* (1846); Ramers, *Orig. Lehre von der Auferstehung des Fleisches* (1851); Knittel, "Orig. Lehre von der Menschwerdung," in the *Theol. Quartalschr.* (1872); Schultz, "Christologie des Orig.," in the *Jahrb. f. protest. Theol.* (1875); Mehlhorn, "Die Lehre von der menschlichen Freiheit nach Orig.," in *Zeitschr. f. Kirchengesch.* vol. ii. (1878); Freppel, *Origène,* vol. i., 2nd ed. (Paris, 1875). A full list of the later bibliography will be found in Bardenhewer's *Geschichte der altkirchen litteratur* (2nd ed. 2 vols., 1914) and de Faye *Origène,* vol. i. (1923). (A. HA.)

ORIGINAL PACKAGE, a legal term in America, meaning the package in which goods, intended for inter-State commerce, are actually transported wholesale. The term is used chiefly in determining the boundary between Federal and State jurisdiction in the regulation of commerce, and derives special significance by reason of the conflict between the powers of Congress to regulate commerce and the police legislation of the States with respect to commodities considered injurious to public health and morals.

By the Federal Constitution Congress is vested with the power "to regulate commerce with foreign nations and among the several States, and with the Indian tribes," and each State is forbidden, without the consent of Congress, to "lay any imposts or duties on imports or exports, except what may be absolutely necessary

[1] "Communis substantiae est filio cum patre; ἀπόρροια enim ὁμοούσιος videtur, i.e., unius substantiae cum illo corpore ex quo est ἀπόρροια."

for executing its inspection laws," and the basis of the law on the subject of "original package" was laid when, in 1827, Chief Justice Marshall interpreted these clauses in his decision of the case of *Brown* v. *Maryland* (12 Wheaton 419), which tested the constitutionality of an act of the legislature of Maryland requiring a licence from importers of foreign goods by bale or package and from persons selling the same by wholesale, bale, package, hogshead, barrel or tierce. After pronouncing such a licence to be in effect a tax, the chief justice observed that so long as the thing imported remained "the property of the importer, in his warehouse, in the original form or package in which it was imported," a tax upon it was too plainly a duty on imports to escape the prohibition of the Constitution.

Later decisions agree that the right to import commodities or to ship them from one State to another carries with it the right to sell them, and have established the boundary line between Federal and State control of both foreign imports and inter-State shipments at a sale in the original package (*Waring* v. *Mobile,* 8 Wall. 110) or at the breaking of the original package before sale for other purposes than inspection (*May* v. *New Orleans,* 178 U.S. 498). A State or a municipality may, however, tax while in their original packages any commodities which have been shipped in from another State, provided there be no discrimination against such commodities.

The term occasioned considerable confusion prior to the adoption of the 18th (prohibition) amendment to the Constitution in 1919. The Supreme Court in Jan. 1847, in the licence cases, upheld the constitutionality of Massachusetts, New Hampshire and Rhode Island laws requiring licences for the sale of intoxicating liquors, the liquor having been shipped in the inter-State commerce (5 Howard 504). The justices based their decisions on different opinions and did not even agree that the power of Congress to regulate inter-State commerce included the power to authorize a sale after shipment. The Supreme Court held in *Leisy* v. *Hardin,* in 1889, where a keg of beer sold in Iowa, a prohibition State, had been shipped from Illinois by order of an agent of an Illinois firm, that so long as it was sold in the original package, it remained a matter for Federal regulation only (135 U.S. 100). This overruled in part the doctrine in the licence cases. Congress passed in 1890 the Wilson Act, which provided that where intoxicants were shipped into a State or Territory, they were subject to the police laws of such State or Territory. Even with this act, however, a State was not permitted to interfere with an inter-State shipment of liquor direct to the consumer. The Webb Act, passed by Congress in 1913, did prohibit the shipment of liquor into any State in violation of its police laws.

What constitutes an original package was the principal question in the case of *Schollenberger* v. *Pennsylvania* (171 U.S. 1), the court deciding that the State of Pennsylvania could not prohibit the sale of oleomargarine by retail when it had been shipped from Rhode Island in packages containing only ten pounds each, and the original package doctrine has been sharply criticized because of the difficulty in determining what constitutes an original package, as well as because of the conflict between the doctrine and the police powers of the several States.

See J. B. Uhle, "The Law Governing an Original Package," in *The American Law Register,* vol. xxix. (Philadelphia, 1890); Shackelford Miller, "The Latest Phase of the Original Package Doctrine," and M. M. Townley, "What is the Original Package Doctrine?" both in *The American Law Review,* vol. xxxv. (St. Louis, 1901); also F. H. Cooke, *The Commerce Clause of the Federal Constitution* (1908).

ORIHUELA, a town and episcopal see of eastern Spain, in the province of Alicante; 13 m. N.E. of Murcia and about 15 m. from the Mediterranean Sea, on the Murcia-Elche railway. Pop. (1940) 11,983 (mun., 43,619). It is situated in an exceedingly fertile *huerta,* on both sides of the river Segura, which divides the city into two parts, Roig and San Augusto, and is spanned by two bridges. Orihuela was captured by the Moors in 713, and retaken by James I. of Aragon, for his father-in-law Alphonso of Castile, in 1265. It was sacked during the disturbances at the beginning of the reign of Charles V. (1520), and again in the War of Succession (1706). Local annals specially mention the plague of 1648, the flood of 1651 and the earthquake of 1829. The university of Orihuela, founded in 1568 by the archbishop of Valencia, was closed in 1835. The trade in fruit, cereals, oil and wine is considerable. There are also tanneries, dye and silk works, linen and woollen fabrics, leather and starch.

ORILLIA, a town and port of entry of Simcoe county, Ontario, situated 84 mi. N. of Toronto, on Lake Couchiching (which is on the Trent-Severn canal system) and on the Canadian National and Canadian Pacific railways. Pop. (1951) 12,110. It has an extensive trade in lumber and farm produce. It contains saw and grist mills, iron foundries, farm implement works, seagoing yacht works, woollen mills and other industries. It is a favourite summer resort, and at Couchiching beach there is a beautiful park with a monument commemorating Samuel de Champlain's sojourn in the area in 1618.

ORINOCO, a river and river system of northern South America. Its basin embraces about one-half of the eastern plains of Colombia and nearly all of Venezuela south and east of the Andes; it ranks third in area among the South American river basins. The main river is about 1,700 mi. long from its source in the Sierra Parima on the Venezuela-Brazil boundary to the Atlantic ocean and, except for a stretch of about 200 mi. between the mouths of the Guaviare and Meta rivers, where it forms a part of the Venezuela-Colombia boundary, it is in Venezuela. At about 150 mi. from its source it bifurcates into the Casiquiare canal to the Río Negro of the Amazon system, affording a through waterway to the Amazon basin. Three major rapids and numerous minor ones obstruct the upper river. At the mouth of the Apure the Orinoco is 2 mi. wide in the dry season and often 7 mi. wide in time of floods, and narrows to 800 ft. at the city of Ciudad Bolívar. Large steamers can navigate as far as the Cariben rapids, 700 mi. from the ocean and only 6 mi. from the mouth of the Meta. At the Cariben rapids the difference between high and low water averages 32 ft., while at the Angostura, at Ciudad Bolívar, the average rise is 50 ft. and has been known to reach 60.

The Orinoco enters the ocean by a delta of approximately 700 sq.mi. of islands and swamps covered with dense vegetation and so little above sea level that they are periodically flooded. The Boca Grande at the mouth of the Corosimi river (the southernmost channel of the delta) is the deepest outlet; but the Caño Macareo, one of the outlets of the Vagre river (the westernmost channel of the delta), is usually taken by steamers because it is the most direct navigable route to the Gulf of Paria.

Diego de Ordaz, whose expedition (1531–32) entered the Orinoco by the Boca de Navíos and, with much loss of life, ascended to the mouth of the Meta, was the first to explore any part of the river, although Christopher Columbus, while exploring the Gulf of Paria in 1498, noticed the freshness of its waters without investigating their source, and Alonso de Ojeda, following closely the track of Columbus in 1499, probably passed in sight of one or more of the mouths of the river. There have since been many expeditions and surveys.

Except for a few outliers which form isolated hills north of the lower river, the Orinoco is the dividing line between the *llanos* and the highlands of Venezuelan Guiana. The tributaries from the Guiana highlands are little known. They all have their sources in the divide which carries the Venezuela-Brazil boundary. The largest, the Ventuari, joins the Orinoco about 90 mi. above the mouth of the Guaviare. The Caura, the next large stream to the east, is much obstructed with falls and rapids, while the lower Caroni is more or less navigable for about 400 mi. The *llanos* are divided into a broad, well-watered western section and a narrower and much drier eastern section. North of the upper Guaviare and its tributaries the western section rises gently from an elevation of about 130 ft. at the mouth of the Apure to about 700 ft. at the border of the Andes. Its principal rivers have their sources in innumerable mountain torrents that rise in the eastern ranges of the Eastern Cordillera of Colombia. From the Guaviare north to 6° 30′ N. lat. these streams are fed so abundantly by the condensation of moisture from the northeast trade winds that they have headed far back toward the high savannas of the Eastern Cordillera. The most important tributaries of the Orinoco in

this section are the Apure, Arauca, Meta and Guaviare. The Apure is formed by the confluence of the Uribante and the Sarare. It follows a sluggish course eastward across the *llanos* for about 300 mi. to its junction with the Orinoco. It is in large part navigable for large craft but is obstructed by rapids about 100 mi. from its mouth. Its northern tributaries, which drain the eastern and southern slopes of the Venezuelan Andes, include the Suripá, the Santo Domingo, the Masparro, the Portuguesa and the Guarico. Of these the Portuguesa, which the cattle route from San Fernando to Puerto Cabello follows, and a few others are navigable for short distances.

The Arauca parallels the Apure on the south. The lateral channels between the two mingle in flood season.

The main stream of the Guaviare, southernmost of the great western tributaries of the Orinoco, is known as the Guayabero from its source to the mouth of the Ariari, a large tributary from the north-west. It marks in a general way the dividing line between the low savannas of the north and the higher and more varied topography of the south. The main stream and many of its tributaries after leaving the piedmont cut their way through four distinct zones: (1) a dissected sandstone plateau, the crests of which rise 1,500 ft. above the *llanos;* (2) a zone east of the escarpment of the plateau of sandstone remnants separated by clayey depressions; (3) a crystalline peneplain where the granites and gneisses are mostly covered with lateritic clays; and (4) a low plain on which stand isolated massifs of the dome-like form characteristic of crystalline mountains in wet tropical climates. The Ariari tributary is navigable for large barges for a considerable distance. About 300 m. of the Guayabero-Guaviare are said to be navigable but narrows and rapids which mark the passage of the river from one zone to another offer serious obstacles.

(R. R. P.)

ORIOLE, the name applied in Europe to the members of the family *Oriolidae.* The golden oriole (*Oriolus oriolus*) is an occasional spring visitor to the British Islands, but has rarely bred there. On the continent of Europe it is a well-known bird; its range in summer extends east to Irkutsk, while in winter it is found in Natal and Damaraland. In India it is replaced by an allied form, *O. kundoo,* the mango-bird, and both in Asia and Africa are several other species, some of which have a black head, or even a glowing crimson, instead of the ordinary yellow colouring, while others exhibit the dingy type of plumage seen in the female of the more normal form. Among these last are the species of the group, *Mimeta,* belonging to the Australian region, which mimic friar-birds (*see* A. R. Wallace, *Malay Archipelago;* HONEY-EATER). Another genus which has been referred to the *Oriolidae* is *Sphecotheres,* peculiar to the Australian region, and distinguishable by a bare space round the eye. Orioles are shy and restless birds, frequenting gardens and woods, and living on insects and fruit. The nest is pocket-shaped, of bark, grass, and fibres, and the eggs are white or salmon-coloured with dark spots. The name is applied in America to the *Icteridae* family.

ORION (or OARION), in Greek mythology, son of Hyrieus or Poseidon, a mighty hunter of great beauty and gigantic strength. He is also sometimes represented as sprung from the earth. He was beloved of Eos, the dawn-goddess, who carried him off to Delos; but Artemis slew him with her arrows (*Odyssey,* v. 121). According to other accounts which attribute Orion's death to Artemis, the goddess herself loved him and was deceived by the angry Apollo into shooting him by mistake; or he paid the penalty of offering violence to her, or of challenging her to a contest of quoit-throwing (Apollodorus i. 4; Horace, *Odes,* iii. 4, 71). In the lower world his shade is seen by Odysseus driving the wild beasts before him as he had done on earth (*Odyssey,* xi. 572). After his death he was changed into the constellation which is called by his name. It took the form of a warrior, wearing a girdle of three stars and a lion's skin, and carrying a club and a sword. When it rose early it was a sign of summer; when late, of winter and stormy weather; when it rose about midnight it heralded the season of vintage.

See Küentzle's article in Roscher's *Lexikon;* Preller-Robert, *Griechische Mythologie* (1894), pp. 448–454.

Orion is one of the most conspicuous constellations, containing many bright stars. Of these Betelgeuse is easily distinguished by its yellowish-red colour in contrast to all the other important stars of the constellation which are white B-type stars. Betelgeuse is an irregular variable sometimes above and sometimes below the first magnitude. It was the first star for which the apparent diameter was measured by Michelson's interferometer method (1920). Rigel at the opposite corner of the quadrilateral is rather brighter; and the third brightest star is Bellatrix. The Orion nebula can be seen with the naked eye just below the belt; faint extensions of it have been photographed filling practically the whole constellation. The multiple star θ Orionis is near the centre of the nebula. There is no doubt that the principal stars of the constellation form a single system, and are involved in the nebulosity whose luminescence is stimulated by their intense radiation rich in light of short wave-length. The distance of the nebula is estimated at 1,200 light years.

ORION and **ORUS,** the names of several Greek grammarians, frequently confused. The following are the most important. (1) Orion of Thebes in Egypt (5th century A.D.), the teacher of Proclus the neo-Platonist and of Eudocia, the wife of the younger Theodosius. He taught at Alexandria, Caesarea in Cappadocia and Byzantium. He was the author of a partly extant etymological Lexicon (ed. F. W. Sturz, 1820), largely used by the compilers of the *Etymologicum Magnum,* the *Etymologicum Gudianum* and other similar works; a collection of maxims in three books, addressed to Eudocia, also ascribed to him by Suidas, still exists in a Warsaw ms. (2) Orus of Miletus, who, according to Ritschl, flourished not later than the 2nd century A.D., and was a contemporary of Herodian and a little junior to Phrynichus. His chief works were treatises on orthography; on Atticisms; on the names of nations.

See F. Ritschl, *De Oro et Orione Commentatio* (1834); R. Reitzenstein, *Geschichte der griechischen Etymologika* (1897); and article "Orion" in Smith's *Dictionary of Greek and Roman Biography.*

ORISKANY (ō-rĭs'kạ-nĭ), a village of Oneida county, New York, U.S.A., about 7 mi. N.W. of Utica. Pop. (1950) 1,348. Oriskany is served by the New York Central railway. In a ravine, about 2 m. west of Oriskany, was fought on Aug. 6, 1777 the battle of Oriskany, an important minor engagement of the American Revolution. On Aug. 4, Gen. Nicholas Herkimer had gathered about 800 militiamen at Ft. Dayton (on the site of the present Herkimer, N.Y.) for the relief of Ft. Schuyler (*see* ROME, N.Y.) then besieged by British and Indians under Col. Barry St. Leger and Joseph Brant. On the 6th Gen. Herkimer's force, on its march to Ft. Schuyler, was ambushed by a force of British under Sir John Johnson and Indians under Joseph Brant in the ravine above mentioned. The rear portion of Herkimer's troops escaped from the trap, but were pursued by the Indians, and many of them were overtaken and killed. Between the remainder and the British and Indians there was a desperate hand-to-hand conflict, interrupted by a violent thunderstorm, with no quarter shown by either side. On hearing the firing near Ft. Schuyler (incidental to a sortie by Lt.-Col. Marinus Willett) the British withdrew, after about 200 Americans had been killed and as many more taken prisoners, the loss of the British in killed being about the same. Gen. Herkimer, though his leg had been broken by a shot at the beginning of the action, continued to direct the fighting on the American side, but died on Aug. 16, as a result of the clumsy amputation of his leg. The battle, though indecisive, had an important influence in preventing St. Leger from affecting a junction with Gen. Burgoyne. The battlefield is marked by a monument erected in 1884. The sesquicentennial of the battle was celebrated Aug. 6, 1927. The Oneida Historical society then presented to the state the battle monument and about 5 ac. of land for a state park.

See *Orderly Book of Sir John Johnson during the Oriskany Campaign* (Albany, 1882), with notes by W. L. Stone and J. W. De Peyster; *Publications* of the Oneida Historical Society, vol. i. (Utica, N.Y., 1877); and Phoebe S. Cowen, *The Herkimers and Schuylers* (Albany, 1903); T. G. Best, *A Soldier of Oriskany* (Boonville, N.Y., 1935); T. W. Clarke, *The Bloody Mohawk* (1940).

ORISSA, a state in northeastern India with an area of 59,869 sq.mi. and a population (1951 census) of 14,644,293. Cuttack

is the capital of the province; and Puri, with its temple of Jagannath, is world famous.

The Oriyas trace their traditions back to the ancient kingdom of Utkal. They have always been opposed to the breaking up of Oriya-speaking tracts for political reasons. At the time of the Mogul conquest the Orissa country was broken up, and race consciousness became less intense; but it was revived under the British regime, especially after the famine of 1866. Agitation for the unification of Oriya tracts began to receive official recognition in 1903 and was sustained by the Utkal Union conference.

In 1912 the area of modern Orissa was separated from Bengal and united with Bihar to form the province of Bihar and Orissa. The status of the Oriyas was much improved by this step, but they still continued their agitation for the formation of Orissa into a separate administrative unit on the basis of common language and race. In Jan. 1936 an order in council was issued by the British government constituting Orissa as a separate province. The new province was formed from: (1) the Orissa division of the former province of Bihar and Orissa; (2) areas transferred from the presidency of Madras including (*a*) the Ganjam Agency tracts, (*b*) parts of the Ganjam district and (*c*) parts of the Vizagapatam district; and (3) areas transferred from the Central Provinces including (*a*) the Khariar zamindari in the Raipur district and (*b*) the Padampur tract in the Bilaspur district. The province consists of six districts; viz., Sambalpur, Koraput, Ganjam, Cuttack, Puri and Balasore, the latter three constituting the delta of the Mahanadi, Brahmani and Baitarani rivers. In 1866 Orissa suffered from famine, followed by destructive floods, during which 1,000,000 persons are estimated to have perished, largely because of its isolation.

The danger of the recurrence of such a famine was averted by the Orissa canal system and the railway, as well as by the increased prosperity of the people. The occurrence of floods still occasionally causes distress. The beds of the deltaic rivers have been raised by deposits of silt and their outlets obstructed by sand bars until flood waters are not discharged by natural channels but are liable to burst the embankments and inundate the low-lying country on either side.

Orissa is still a backward region from an industrial and agricultural standpoint. There are no big factories but there are a number of cottage industries producing hand-loom products and metalwork. Production of jute and sugar cane as commercial crops is being steadily increased. There are forest resources of valuable timber. Mineral resources include iron ore of excellent quality, coal, limestone, manganese and mica. Orissa provides more than 60% of the iron ore extracted in India.

In 1948 the 39 minor states, formerly under the Chhattisgarh and Orissa agencies, were merged into the Central Provinces (Madhya Pradesh) and Orissa. In the following year, Mayurbhanj, the last surviving state in the area, was absorbed into Orissa.

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ORISTANO, a town and archiepiscopal see of Sardinia, Italy, 23 ft. above sea level, 3 mi. from the eastern shore of a gulf on the west coast, to which it gives its name and 59 mi. N.W. of Cagliari by rail. Pop. (1936) 9,454 (town), 14,662 (commune). The town has remains of the walls (1290) and two gates, the Porta Manna with a lofty square tower (Torre S. Cristoforo) and the Porta a Mare. The houses are made of sun-dried bricks. Two miles south of Oristano is the village of S. Giusta, with a beautiful Romanesque church of the Pisan period dedicated to this saint, containing several antique columns. The lagoons on the coast are full of fish, but are a cause of malaria. In the environs garden produce is grown; good wine (*vernaccia*) is made, as well as ordinary pottery. It is also a centre of the cattle trade. A mile south of the mouth of the river Tirso is the landing place for shipping. The large orange groves of Milis lie 13 mi. N. of Oristano at the base of Monte Ferru. The inhabitants of Milis manufacture reed baskets and mats, which they sell throughout Sardinia.

Oristano occupies the site of the Roman Othoca, the point at which the inland road and the coast road from Carales to Turris Libisonis bifurcated. The mediaeval town (1070) was the seat onward of the *giudici* (judges) of Arborea, one of the four divisions of the island. Almost the last of these judges was Eleonora (1347–1403); after her death Oristano became the seat of a marquisate, which was suppressed in 1478.

ORIZABA, a city in the Mexican state of Veracruz. Pop. (est. 1950) 65,000, 82 mi. W.S.W. of the port of Veracruz, 203 mi. S.E. of Mexico City, on main roads and the two railways connecting those points. Founded by Spaniards in the 16th century to guard these critical routes, Orizaba's strategic importance made it a centre of Mexican history, to which was added its economic development in a favourable habitat. It stands at 4,211 ft. in a fertile, well-watered and temperate valley of the Sierra Madre Oriental, over which towers the Pico de Orizaba, a famous snow-capped extinct volcano (18,548 ft.) 18 mi. N. Midway between the tropical lowlands on one side, the semiarid plateau on the other, Orizaba's sufficiency of water and temperate conditions make its district an important agricultural and industrial area. Crops include tobacco, maize, sugar, cereals and rum. The Rio Blanco furnishes hydroelectric power for numerous textile mills, tobacco factories and light industry, among which is one of the principal breweries of Mexico. The picturesque vegetation and pleasant climate make it a popular tourist place. Its citizens are famed for literature and business ability.

Though a garrison post of Aztecs, called by them *Ahuaializapan* ("pleasant waters"). Orizaba had a negligible native population. Its public edifices recall a long colonial past. It was chartered as a city in 1774 and was licensed under crown monopoly to produce tobacco. It was one of the first textile centres of Mexico.

(HD. C.)

ORIZABA, in Aztec, *Citlaltepetl,* "star mountain," an extinct or dormant volcano on the boundary between the Mexican states of Puebla and Veracruz and very nearly on the 19th parallel. It rises from the southeastern margin of the great Mexican plateau to an elevation of 18,314 ft., according to Scovell and Bunsen's measurements in 1891–92, or 18,250 and 18,209 ft. according to other authorities, and 18,701 (5,700 m.) by the Comisión Geográfica Exploradora. It is the highest peak in Mexico, probably third highest in North America. Its upper timber line is about 13,500 ft. above sea level, and Hans Gadow found patches of apparently permanent snow at an elevation of 14,400 ft. on its southeast side in 1902. The first ascent of Orizaba was made by Reynolds and Maynard in 1848. Its last eruptive period was 1545–66, and the volcano is now considered to be extinct.

ORJONIKIDZE (formerly VLADIKAVKAZ), a town of the Russian S.F.S.R., in the North Ossetian A.S.S.R., in 43° 3′ N., 44° 42′ E. Pop. (1939) 127,172. The former name Vladikavkaz meant "Key of the Caucasus"; the town stands on a plateau 2,345 ft. high on both sides of the Terek river, where the latter issues from the Darial gorge. Towering above the town is the famous Kasbek peak. A small fort was established there in 1784, but the expansion of the town dates from the completion of the great Georgian military road southward through the gorge to Tiflis, which was begun in 1811 and opened in 1864. Later a railway link was made through Beslan to the Rostov-Baku line to the north. The great gorge has much historic importance for the region; through it came Persian armies and, later, Timur and his Mongol hordes, and its military road brought about the pacification of the warring Caucasian frontier tribes and gave Russia her foothold in the Caucasus. The town was renamed Orjonikidze after the famous soviet leader.

ORKHON INSCRIPTIONS, ancient Turkish inscriptions of the 8th century A.D., discovered near the river Orkhon to the south of Lake Baikal in 1889. They are written in an alphabet derived from an Aramaic source and recount the history of the northern branch of Turks or Tu-kiue of Chinese historians. *See* TURKS.

ORKNEY, EARL OF, a Scottish title held at different periods by various families, including its present possessors the Fitzmaurices. The Orkney Islands (*q.v.*) were ruled by jarls or earls under the supremacy of the kings of Norway from very early times to about 1360, many of these jarls being also earls of Caith-

ness under the supremacy of the Scottish kings. Perhaps the most prominent of them were a certain Paul (d. 1099) who assisted the Norwegian king, Harald III. Haardraada, when he invaded England in 1066; and his grandson Paul the Silent, who built, at least in part, the cathedral of St. Magnus at Kirkwall. They were related to the royal families of Scotland and Norway.

In its more modern sense the earldom dates from about 1380, and the first family to hold it was that of Sinclair, Sir Henry Sinclair (d. *c.* 1400) of Roslin, near Edinburgh, being recognized as earl by the king of Norway. He ruled the islands almost like a king, and employed in his service the Venetian travellers Nicolo and Antonio Zeno. His son Henry (d. 1418) was admiral of Scotland and was taken prisoner by the English in 1406, together with Prince James, afterwards King James I.; his grandson William, the 3rd earl (*c.* 1404–80), was chancellor of Scotland and took some part in public affairs. In 1455 William was created earl of Caithness, and in 1470 he resigned his earldom of Orkney to James III. of Scotland, who had just acquired the sovereignty of these islands through his marriage with Margaret, daughter of Christian I., king of Denmark and Norway. In 1567 Queen Mary's lover, James Hepburn, earl of Bothwell, was created duke of Orkney, and in 1581 her half-brother Robert Stewart (d. 1592), an illegitimate son of James V., was made earl of Orkney. Robert, who was abbot of Holyrood, joined the party of the reformers and was afterwards one of the principal enemies of the regent Morton. His son Patrick acted in a very arbitrary manner in the Orkneys, where he set the royal authority at defiance; in 1609 he was seized and imprisoned, and, after his bastard son Robert had suffered death for heading a rebellion, he himself was executed in Feb. 1614, when his honours and estates were forfeited.

In 1696 Lord George Hamilton was created earl of Orkney. He married Elizabeth Villiers, and was succeeded by his daughter Anne (d. 1756), the wife of William O'Brien, 4th earl of Inchiquin. Anne's daughter Mary (*c.* 1721–91) and her granddaughter Mary (1755–1831) were both countesses in their own right, the younger Mary married Thomas Fitzmaurice (1742–93), son of John Petty, earl of Shelburne, and was succeeded in the title by her grandson, Thomas John Hamilton Fitzmaurice (1803–77), whose descendants still hold the earldom.

See *Records of the Earls of Orkney, 1299–1664*, ed. by J. S. Clouston (1914).

ORKNEY ISLANDS, group forming a county off the north coast of Scotland. They are separated from the mainland by the Pentland firth, which is 6¼ mi. wide between Brough Ness in the island of South Ronaldshay and Duncansbay head in Caithness-shire. The group consists of 67 islands (excluding rocky islets), of which 28 were inhabited in 1931, four of them only by lighthouse attendants. They measure 50 mi. from northeast to southwest, and 29 mi. from east to west, and cover 376.3 sq.mi. Excepting on the west coasts of the larger islands, which present rugged cliff scenery, the group lies somewhat low and is of bleak aspect, owing to the absence of trees. The islands are built up wholly of Old Red Sandstone. The Old Man of Hoy is a fine stack of rock standing detached from the north-west cliffs. The only other islands containing heights of any importance are Pomona, with Ward hill (880 ft.), and Wideford (740 ft.) and Rousay. Erratics of distant origin (*e.g.*, from Moray firth) give evidence of glacial action. Nearly all of the islands possess lakes, the largest being Loch Harray and Loch Stenness in Pomona. The rivers are merely streams. Excepting on the west fronts of Pomona, Hoy and Rousay, the coast-line of the islands is deeply indented, and the islands themselves are divided from each other by straits, generally called *sounds* or *firths,* though off the north-east of Hoy is *Bring Deeps,* south of Pomona is Scapa *Flow* and to the south-west of Eday is the *Fall* of Warness. The topographical names are Norse, and the common terminal of the names of the islands, *a* or *ay*, is the Norse *ey*, meaning "island." The islets are usually called *holms* and the isolated rocks *skerries.* The tidal currents, or *roost* (as some of them are called locally, from the Icelandic), off many of the isles run very fast and whirlpools are frequent.

History.—The Orkneys were the *Orcades* of classical writers, and the word is probably derived from the Norse *Orkn,* seal, and *ey,* island. Evidences of prehistoric occupation include numerous weems or underground houses, chambered mounds, barrows or burial mounds, *brochs* or round towers, and stone circles and standing stones. Three of the most famous are the corbelled tomb at Maeshowe, and the circles of standing stones at Brogar and Stennis with an early village discovered in 1928. If, as seems likely, the Dalriadic Scots towards the beginning of the 6th century established a footing in the islands, their success was short-lived, and the native inhabitants regained power and kept it until dispossessed by the Norsemen in the 9th century. The Celtic missionaries, companions of St. Columba, followed about 565. As the Norse pirates made raids on Norway from the islands, as well as on Scotland, Harold Haarfager ("Fair Hair") subdued the rovers in 875 and added the Orkneys and Shetlands to Norway. They remained under the rule of Norse earls until 1231, when the line of the earls became extinct. In that year the earldom of Caithness was granted to Magnus, second son of the earl of Angus, whom the king of Norway apparently confirmed in the title. In 1468 the Orkneys and Shetlands were pledged by Christian I. of Denmark for the payment of the dowry of his daughter Margaret, betrothed to James III. of Scotland, and as the money was never paid, their connection with the crown of Scotland has been perpetual. In 1471 William, earl of Orkney, exchanged his earldom for lands in Fife, and the islands were annexed to the Scottish crown. In 1581 Lord Robert Stewart, natural son of James V., was created earl of Orkney, but in 1615 the earldom was again annexed to the crown. The islands were the *rendezvous* of Montrose's expedition in 1650 which culminated in his imprisonment and death. In 1707 the islands were granted to the earl of Morton in mortgage, but in 1766 his estates were sold to Sir Lawrence Dundas, ancestor of the marquesses of Zetland.

In early times both the archbishop of Hamburg and the archbishop of York disputed with the Norwegians ecclesiastical jurisdiction over the Orkneys; but ultimately the Norwegian bishops, the first of whom was William the Old, consecrated in 1102, continued the canonical succession. The see, left vacant on several occasions, was finally abolished in 1697, although many of the clergy refused to conform. The Norse tongue, at last extinguished by the constant influx of settlers from Scotland, lingered until the end of the 18th century. When the islands were given as security for the princess's dowry, there seems reason to believe that it was intended to redeem the pledge, because it was then stipulated that the Norse system of government and the law of St. Olaf should continue to be observed in Orkney and Shetland. Thus the *udal* succession and mode of land tenure (or, that is, absolute freehold as distinguished from feudal tenure) still obtain to some extent, and the remaining *udallers* hold their lands and pass them on without written title.

Agriculture and Industries.—The soil generally is a sandy loam or a strong but friable clay, and very fertile. About 45% of the total area was under cultivation in 1938 and farming is now up to the general Scottish standard. The crofters' houses have been rebuilt of stone and lime, and are superior to those in most parts of the Highlands. Of the 3,203 holdings in 1938, about 55% were between 5 and 30 ac., the average being 34 ac. The grain crops are oats and barley, while the favoured root crops are turnips and potatoes. Cattle and sheep are reared, some pigs are kept, and the horses—as a rule hardy, active and small—are numerous. The woollen, linen, straw-plaiting and kelp industries have all successively failed, though the last named has been revived. Sandstone is quarried on several islands, and distilleries are found in Pomona. About half the population is engaged in agriculture. Apart from this, the principal industry is fishing. For several centuries the Dutch practically monopolized the herring fishery, but when their supremacy was destroyed by the salt duty, the fisheries were almost totally neglected. The industry, however, is now of considerable importance, particularly the herring fishery, followed by the cod, ling and lobster fisheries. There is a regular communication by steamer between Stromness and Kirkwall, and Thurso, Wick, Aberdeen and Leith, and also between Kirkwall and Ler-

wick and other points of the Shetlands.

Population and Administration.—The county population was 21,258 in 1951. In 1951 there were 51 persons who spoke Gaelic and English but none who spoke Gaelic only. Orkney unites with Shetland to send one member to parliament. Kirkwall, the county town, is the only royal burgh. Kirkwall (pop. 4,348 in 1951) and Stromness (1,503) are the only small burghs. Orkney forms a sheriffdom with Shetland and Caithness.

The Inhabited Islands.—From south to north, the islands (1931 population in brackets) include Sule Skerry (lighthouse, 6), Pentland Skerries (lighthouse, 5), Swona (6), South Ronaldshay (1,312), Hoy (955). On Hoxa head is a *broch*, or round tower, and the island contains examples of Picts' houses and standing stones. The famous Dwarfie stone, an enormous block of sandstone with rooms hollowed out in it, lies in a valley near Ward hill. Flotta (282), east of Hoy, was the home for a long time of the Scandinavian compiler of the *Codex Flotticensis*, which furnished Thormodr Torfaeus (1636–1719), the Icelandic antiquary, with many of the facts for his *History of Norway*. Pharay (40) also lies east of Hoy. Burray (379) is famous for the *broch* from which the island takes its name (Borgarey, Norse, "island of the broch"). The tower stands on the northwestern shore, is 15 ft. high, has walls from 15 to 20 ft. thick, built of layers of flat stones without cement or mortar, and an interior diameter of 40 feet. Between Hoy and Pomona are Hunda (3 in 1921, nil in 1931), Cava (14) and Graemsay (114). It was around Cava that the 70 vessels of the German navy were scuttled in 1919; 32 were raised between 1924 and 1931, and salvage operations were renewed in 1934. The isle, surrounded by shoals, has two lighthouses. The cliffs of Copinsay (25) are a favourite haunt of sea-birds.

Pomona (*q.v.*) is the principal island and is known as Mainland. Shapinsay (576) was the birthplace of William Irving, father of Washington Irving. It possesses several examples of Pictish and Scandinavian antiquities and Balfour Castle, built in 1848. Gairsay (5) was the home of Sweyn Asleifson, the rover. At Lamb head is a *broch* and Pictish pier, and on Odin bay is a round pit in the rocks called the Vat of Kirbuster. Papa Stronsay (18) commemorates the Celtic *papae*, or missionaries, who preached before the arrival of the Northmen. The adjacent Wyre or Veira has a population of 44; Egilsay (85) is the island on which St. Magnus was murdered by his cousin Hacco in 1115. It derives its name (*ecclesia*) from the little church of St. Magnus, now in ruins. The round tower resembles similar ones found beside Irish churches of the 7th and 8th centuries and has walls 3 ft. thick. Eday (430) contains weems, mounds and standing stones. Carrick village was named after the earl of Carrick. It was off this island that John Gow, the pirate, was taken in 1725. Stronsay (953) and Rousay (468) are other large islands.

Sanday (1,160), one of the largest northern islands, has an area of 19 sq.mi. It produces potatoes and grain and has harbours at Otterswick and Kettletoft. The antiquities include a *broch* in Elsness. Pharay (28). Westray (1,269) has a harbour at Pier-o'-wall. Noltland castle was proposed as the refuge of Queen Mary after her flight from Loch Leven. It was at one time the property of Sir Gilbert Balfour, the master of Queen Mary's household. At the westerly point, there is the Stack of Noup. Gentleman's Cave afforded shelter to five followers of Prince Charles Edward during the winter of 1745–46.

Papa Westray (237) and North Ronaldshay (298) are the most northerly islands. The latter is reached only from Sanday over a dangerous firth 2½ mi. wide. The monumental stone with Ogham inscription, discovered in the *broch* of Burrian, must date from early Christian missionary times.

ORLANDO, VITTORIO EMANUELE (1860–1952), Italian politician and jurist, was born at Palermo on May 19, 1860. Becoming a barrister and a law professor, he was first elected deputy for Partinico in Sicily in 1897. He was minister of education in the Giolitti cabinet of 1903–05, and of justice in the Giolitti cabinet of 1907–09, and again under Salandra in November 1914. Although a Giolittian at heart, he was in favour of Italian intervention in World War I. On the resignation of the Salandra cabinet in June 1916 he remained in office under Boselli as minister of the interior, and when the latter resigned Orlando was entrusted with the formation of a new cabinet. After the Armistice he went to Paris as president of the Italian peace delegation. When President Wilson launched his appeal on Fiume to the Italian people over the heads of their delegates, he returned to Rome, where he was triumphantly received, but after his return to Paris without the guarantees he was supposed to have secured, and without obtaining any satisfactory solution of the Adriatic problem, the chamber voted against him and he resigned on June 19, 1919. On Dec. 2, 1919, he was elected president of the chamber. He at first supported fascism and Mussolini, but after the Matteotti affair he withdrew his support, without, however, abandoning the chamber. At the municipal elections of Palermo in Aug. 1925 he mobilized all his adherents in favour of the antifascist list. He resigned from parliament in protest of the fraudulent fascist victory. After the fall of fascism, he was a member of the constituent assembly and later became a member of the Italian senate. In 1947 he resigned his seat in the constituent assembly. He died in Rome on Dec. 1, 1952.

See L. Hautecoeur, *L'Italie sous le ministère Orlando, 1917–19* (1919); R. Lansing, *The Big Four* (1922).

ORLANDO, a city of Florida, U.S., the county seat of Orange county and largest inland city of the state. It is on federal highways 17 and 441 and is served by the Atlantic Coast Line and the Seaboard Air Line railways. The population in 1950 was 52,367 by federal census.

Orlando is located in the heart of the rich citrus-growing area. Its lakes, parks and largemouth bass fishing attract many visitors. Orlando, originally called Jernigan, was founded in 1843 and incorporated in 1875.

ORLEANAIS, a former French province, of which Orléans was the regional capital; its limits changed from period to period. In ancient Gaul, Cenabum (Orléans) and Carnutum (Chartres) were the chief towns in the *civitas* of the Carnutes, which, in the 4th century, the Romans divided into two parts, Civitas Carnutum and Civitas Aurelianorum, the latter corresponding roughly to the later diocese of Orléans and to the 9th-century county of Orléans. This is Orléanais *stricto sensu*. But a larger territory, spreading over Blésois, Vendômois, Dunois, Beauce and Gâtinais, was sometimes administered from Orléans and lay under its economic and cultural influence; for example, in the 17th and 18th centuries, the above-mentioned territories were included in the *gouvernement* and in the *généralité* of Orléans, which corresponded to the modern departments of Loiret, Loir-et-Cher and Eure-et-Loir.

From the time of Robert the Strong, duke of the country between the Seine and the Loire (861–866), Orléanais was a seat of power of the Robertian family. Hugh Capet was count of Orléans as well as of Etampes and Paris; and under the early Capetians Orléans competed with Paris for the rank of capital. Under the Valois, however, Orléanais became an appanage (*see* ORLEANS, DUKES OF).

See also R. Crozet, *Histoire de l'Orléanais* (Paris, 1936). (F. CT.)

ORLEANISTS, a French political party which arose out of the Revolution. It took its name from the Orléans branch of the house of Bourbon, the descendants of Philippe, duke of Orléans, younger brother of Louis XIV, who were its chiefs. Its aim was to reconcile the monarchical principle with the "rights of man," as proclaimed by the constituent assembly in 1789. The Orléans princes were traditionally marked out as the leaders in such a policy. Enormously rich, within measurable distance of the succession to the throne, but cut off by the jealousy of the crown from all share in public affairs, they had long been the centres of opposition to the encroachment of the royal power. Louis, duke of Orléans, had headed the protest of the princes against the policy of René Maupeou in suppressing the *parlement* of Paris; his son later earned the style of Philippe Egalité by adopting—with ulterior objects—extreme revolutionary views (*see* ORLEANS, LOUIS PHILIPPE JOSEPH); and Egalité's son Louis Philippe (afterward king of the French) fought, as duc de Chartres, at Jemappes, under the republican tricolour. The generation of Orléanists, the immediate supporters of Philippe Egalité, were swamped in the turmoil of the Revolution. But they came naturally to the front when another revolution

overthrew the restored legitimate monarchy of Louis XVIII and Charles X. During the Restoration, 1815–30, everything tended to identify the Liberals with the Orléanists. It is true that Louis XVIII had been induced to grant (*octroyer*) a constitutional charter; but he and his successor claimed to rule by divine right and to confer liberties upon their subjects of their own will. The difference between the Legitimists and the Orléanists was thus fundamental. So was that between the Orléanists and the Bonapartists; for the former aimed at securing political liberty, in addition to equality before the law and in social life, while the latter aimed at subjection to a military despotism.

The revolution of 1830 brought the Orléanists into power, and they marked the profound change made in the character of the government by styling Louis Philippe not "king of France and Navarre by the grace of God," but "king of the French by the grace of God and the will of the people." The Orléanists were led by men eminent in letters and in practical affairs—François Guizot, Louis Thiers, the Broglies, the banker Jacques Laffitte and many others—and the 18 years of their rule were, on the whole, profitable to France. That they ended in another "general overturn" in 1848 was mainly because the Orléanist conception of what was meant by the word "people" led the government to offend the deeply rooted love of the French for equality. On the model of the English constitution they instituted a *pays légal* of about 250,000 voters by whom all the rest of the country was to be "virtually represented." But the nation outside of the *pays légal* soon discovered that it was being governed by a privileged class, less offensive perhaps, but also less brilliant, than the aristocracy of the old monarchy.

The revolution of 1848 swept the Orléanists from power forever. They continued indeed throughout the second republic and the Second Empire (1848–70) to enjoy a marked prestige, because of the wealth and capacity of some of their members, their influence in the French academy and the ability of their organs in the press. But their weakness was demonstrated when the Second Empire was swept away by the German War of 1870–71. The country, in its disgust at the Bonapartists and its fear of the Republicans, chose a great many royalists to represent it in the assembly which met in Bordeaux on Feb. 12, 1872. In this body the Orléanists again exercised a kind of leadership by virtue of individual capacity, but they were counterbalanced by the Legitimists. They defeated Thiers on May 24, 1873, as punishment for his dexterous imposition of the republic on the unwilling majority of the assembly. Their real occupation was to endeavour to bring about a fusion between themselves and the Legitimists. As far back as 1850 Guizot had proposed, or had thought of proposing, such a fusion, but it was on the condition that the comte de Chambord would resign his divine pretentions. The fusion arranged in 1873 was on quite another footing. After much exchange of notes and many agitated conferences, the comte de Paris, the representative of the Orléanists, sought an interview with the comte de Chambord at Frohsdorff, and obtained it by giving a written engagement that he came not only to pay his respects to the head of his house, but also to "accept his principle." Orléanists have declared that the engagement was given with mental reservations; but the country believed that the liberal royalists had been absorbed in the divine-right royalists, and returned republicans at by-elections till it transformed the assembly. The Orléanist princes had still a part to play, particularly when the death of the comte de Chambord in 1883 left them heads of the house of France, but the Orléanist party ceased to exist as an independent political organization.

BIBLIOGRAPHY.—The Orléanists are necessarily more or less dealt with in all histories of France since 1789, and in most political memoirs, but their principles can be learned and their fortunes followed from the following: A. Sorel, *L'Europe et la révolution française* (1885–1904); F. Guizot, *Histoire parlementaire de la France* (1819–48) and *Mémoires pour servir à l'histoire de mon temps* (1858–67); P. de la Gorce, *Histoire du second empire* (1894–1904); and G. Hanotaux, *Histoire de la fondation de la 3ème République* (1925). For the attitude of the Orléans princes towards the crown under the old regime, see Amédée Britsch, *La Jeunesse de Philippe Égalité* (1927).

ORLEANS, DUKES OF. The title of duke of Orléans was first created by King Philip VI in favour of his son Philip, who died without legitimate issue in 1375. The second duke of Orléans, created in 1392, was Louis, a younger son of Charles V, whose heir was his son the poet Charles of Orléans. Charles's son Louis, the succeeding duke, became king of France as Louis XII in 1498, when the duchy of Orléans was united with the royal domain. In 1626 Louis XIII created his brother Jean Baptiste Gaston (d. 1660) duke of Orléans, and the title was revived in 1661 by Louis XIV in favour of his brother Philip. Descendants of this duke have retained the title until the present day, one of them becoming king of France as Louis Philippe in 1830. Two distinguished families are descended from the first house of Orléans: the counts of Angoulême, who were descended from John, a son of Duke Louis I, and who furnished France with a king in the person of Francis I; and the counts and dukes of Longueville, whose founder was John, count of Dunois, the bastard of Orléans, a natural son of the same duke. In addition to the dukes of Orléans the most important members of this family are: Anne Marie Louise, duchess of Montpensier; Francis, prince of Joinville; Louis Philippe Albert, count of Paris; and the traveller Prince Henry of Orléans. (*See* BOURBON, table.)

ORLEANS, CHARLES, DUKE OF (1391–1465), commonly called Charles d'Orléans, French poet, was the eldest son of Louis, duke of Orléans (brother of Charles VI of France), and of Valentina Visconti, daughter of Gian Galeazzo, duke of Milan. He was born on May 26, 1391. He married (June 29, 1406), Isabella, his cousin, widow of Richard II of England. She died three years later. He was already duke of Orléans, for Louis had been assassinated by the Burgundians two years before (1407). He was now the most important person in France, except for the dukes of Burgundy and Brittany, the king being a cipher. He was, however, only nominally one of the leaders of the civil war, the real guidance of his party resting with Bernard VII, the great count of Armagnac, whose daughter Bonne he married, or at least formally espoused, in 1410. Five years of confused negotiations, plots and fightings passed before the English invasion and the battle of Agincourt, where Charles was joint commander in chief. He was taken prisoner and carried to England, where he remained for a full quarter of a century. He hunted and hawked and enjoyed society amply, though the very dignities which secured him these privileges made his ransom great and his release difficult to arrange. Above all, he had leisure, however, for literary work which consisted of short poems in the artificial metres then fashionable in France. Besides these a number of English poems have been attributed to him, but without certainty. For practical purposes his work consists of some hundreds of short French poems, a few in various metres, but the majority either ballades or rondels. Charles d'Orléans is the last representative of the poetry of the middle ages, in which the form was almost everything, and the personality of the poet, save in rare instances, nothing. He has the urbanity of the 18th century without its vicious and prosaic frivolity. His best-known rondels—those on spring, on the harbingers of summer, and others—rank second to nothing of their kind.

The agreement for his release from captivity was concluded on July 2, 1440. He was actually released on Nov. 3, and then married Mary of Cleves, who brought him a considerable dowry to assist the payment of his ransom. After his return to France he maintained at Blois a miniature court, at which the best-known French men of letters at the time—François Villon, Olivier de la Marche, Georges Chastellain, Jean Meschinot and others—were residents or visitors or correspondents. His son, afterward Louis XII, was born in 1462. Charles died on Jan. 4, 1465, at Amboise.

The best edition of Charles d'Orléans's poems, with a brief but sufficient account of his life, is that of C. d'Héricault in the *Nouvelle collection Jannet* (Paris, 1874). For the English poems *see* the edition by Watson Taylor for the Roxburghe Club (1827). *See* also C. Bruneau, *Charles d'Orléans et la poésie aristocratique* (Lyons, 1924).

ORLEANS, FERDINAND PHILIP LOUIS CHARLES HENRY, DUKE OF (1810–1842), born at Palermo on Sept. 3, 1810, was the son of Louis Philippe, duke of Orléans, afterward king of France, and Marie Amélie, princess of the Two Sicilies. Under the Restoration he bore the title of duke of Chartres, and studied classics in Paris at the Collège Henri IV. At the outbreak of the revolution which in 1830 set his father on the throne, he was colonel of a regiment of Hussars. He assumed the title of duke of Orléans, and was sent by the king to put down the riots at Lyons (1831), and then to the siege of Antwerp (1832). He was appointed lieutenant general, and made several campaigns in Algeria (1835, 1839, 1840). On his return to France he organized the *chasseurs d'Orléans*. He died after an accident at Neuilly, near Paris, on July 13, 1842.

The duke of Orléans had married (May 30, 1837) Helène Louise Elisabeth of Mecklenburg-Schwerin, and had by her two sons, the count of Paris and the duke of Chartres. On Feb. 24, 1848, after the abdication of Louis Philippe, the duchess of Orléans went to the chamber of deputies in the Palais Bourbon in the hope of having her eldest son proclaimed and of obtaining the regency; the attitude of the populace forced her to take refuge in England, and she died at Richmond, Eng., on May 18, 1858.

ORLEANS, HENRI, PRINCE OF (1867–1901), eldest son of Robert, duke of Chartres, was born at Ham, near Richmond, Surrey, Eng., on Oct. 16, 1867. In 1889, at the instance of his father, he undertook, in company with P. G. Bonvalot, a journey through Siberia to Siam. They crossed the mountain range of Tibet, and the fruits of their observations, submitted to the

Geographical Society of Paris and later incorporated in *De Paris au Tonkin à travers le Tibet inconnu* (1892), brought them conjointly the gold medal of that society. In 1892 the prince made a short journey in East Africa, and shortly afterward visited Madagascar, proceeding thence to Tongking. From there he set out for Assam, and found the sources of the Irrawaddy, which secured the medal of the Geographical Society of Paris and the cross of the Legion of Honour. In 1897 he revisited Abyssinia, and political differences arising from this trip led to a duel with the comte de Turin, in which both combatants were wounded. While on a trip to Assam he died at Saigon on Aug. 9, 1901.

ORLEANS, HENRIETTA, DUCHESS OF (1644–1670), third daughter of the English king Charles I (*q.v.*) and his queen, Henrietta Maria (*q.v.*), was born during the Civil War at Exeter on June 16, 1644. A few days after her birth her mother left England, and she lived at Exeter under the care of Lady Dalkeith (afterward countess of Morton) until the surrender of the city to the parliamentarians, when she was taken to Oatlands in Surrey. In July 1646 she rejoined her mother in Paris, where her girlhood was spent and where she was educated as a Roman Catholic. Henrietta was mentioned as a possible bride for Louis XIV (*q.v.*), but she was betrothed to his only brother, Philip. After the restoration of her brother Charles II (*q.v.*), she returned to England with her mother, but a few months later she was again in Paris, where she was married to Philip, now duke of Orléans, on March 30, 1661. The duchess was popular at the court of Louis XIV and was on good terms with the "grand monarch," but she was soon estranged from her husband, and her conduct was imprudent. In 1670, at the instigation of Louis, but without Philip's consent, she visited England and obtained the signature of Charles II's ministers to the treaty of Dover (*q.v.*). Shortly after returning to France, Henrietta died at St. Cloud on June 30, 1670, and it was asserted that she had been poisoned by order of her husband. She left two daughters, Maria Louisa, later wife of Charles II (*q.v.*) of Spain, and Anne, later wife of Victor Amadeus II (*q.v.*) of Savoy, king of Sardinia (*see* SAVOY, HOUSE OF).

ORLEANS, JEAN BAPTISTE GASTON, DUKE OF (1608–1660), third son of the French king Henry IV and his wife Marie de Medici, was born at Fontainebleau on April 25, 1608. Known at first as the duke of Anjou, he was created duke of Orléans in 1626, and was nominally in command of the army which besieged La Rochelle in 1628. On several occasions he was obliged to leave France for conspiring against the government of his mother, of Cardinal Richelieu and of Louis XIII. Orléans stirred up Cinq-Mars to attempt Richelieu's murder, and then deserted him. In 1643, on the death of Louis XIII, Gaston became lieutenant general of the kingdom, and fought against Spain on the northern frontiers of France; but during the wars of the Fronde he passed from one party to the other. Exiled by Jules Mazarin in 1652 he remained in Blois until his death on Feb. 2, 1660. Gaston's first wife was Marie (d. 1627), daughter and heiress of Henri de Bourbon, duc de Montpensier (d. 1608), and his second wife, Marguerite (d. 1672), sister of Charles III, duke of Lorraine. By Marie he left a daughter, Anne Marie, duchesse de Montpensier (*q.v.*); and by Marguerite he left three daughters, Marguerite Louise (1645–1721), wife of Cosimo III, grand duke of Tuscany; Elizabeth (1646–96), wife of Louis Joseph, duke of Guise; and Françoise Madeleine (1648–64), wife of Charles Emmanuel II, duke of Savoy.

ORLEANS, LOUIS, DUKE OF (1372–1407), younger son of the French king Charles V, was born on March 13, 1372. Having been made count of Valois and of Beaumont-sur-Oise and then duke of Touraine, he received the duchy of Orléans from his brother, Charles VI, in 1392. In 1388 he played an important part in persuading the king to get rid of the tutelage of his three uncles, after which he in fact ruled France, with the help of the *Marmousets* (the former ministers of Charles V). But when Charles VI became insane in 1392 the *Marmousets* were dismissed, and the king's uncles became influential in the government again. Despite an agreement whereby foreign policy was to be controlled by Louis and general policy by Philip (the Bold), duke of Burgundy, a quarrel soon developed between Louis and Philip and became the dominating factor in French politics. Louis was attractive and intelligent; but his private life was dissolute, and he liked extravagant life at court. He thought of politics as a game, cynically. On Jan. 27, 1389, he had married Valentina (d. 1408), daughter of Gian Galeazzo Visconti, duke of Milan, who brought him the county of Asti (this marriage later furnished Louis XII and Francis I with the pretext for their claims on Milan); and soon Louis's foreign policy was involved in Italian affairs. In 1390 and 1393 there were plans of a great expedition to Italy, where the schismatical pope Clement VII offered Louis a kingdom of Adria; and in 1396 Louis arranged the cession of Genoa to France. Meanwhile, he had bought the duchy of Luxembourg. Hostile to England, he led the campaign of 1406–07 in Guienne, but failed before Blaye. The heavy cost of these adventures and of Louis's court life, the increase of taxation and also Louis's rapacity (he acquired Angoumois, Périgord and the county of Blois), as well as his connection with the queen (Isabeau of Bavaria), whose lover he probably was, made him extremely unpopular. Philip the Bold's death had strengthened his position, but later his quarrel with Philip's son John the Fearless became acute. In 1405 both parties prepared for war, but a reconciliation was brought about on Oct. 16. However, on Nov. 23, 1407, Louis was murdered in Paris by John's retainers. Louis had eight children by his wife, including his successor, the poet Charles of Orléans. One of his natural sons was the famous bastard of Orléans, John, count of Dunois.

See E. Jarry, *La Vie politique de Louis de France duc d'Orléans* (Paris, 1889); F. D. S. Darwin, *Louis d'Orléans* (London, 1936).
(F. CT.)

ORLEANS, LOUIS. DUKE OF (1703–1752), only son of Duke Philip II, the regent Orléans, was born at Versailles on Aug. 4, 1703. He took very little part in the politics of the time, although he was conspicuous for his hostility to Cardinal Dubois in 1723. In 1730 Cardinal Fleury secured his dismissal from the position of colonel general of the infantry. He retired and spent his time mainly in translating the Psalms and the epistles of St. Paul. Having succeeded his father as duke of Orléans in 1723, he died in the abbey of St. Geneviève at Paris on Feb. 4, 1752. His wife Augusta (d. 1726), daughter of Louis William, margrave of Baden, bore him one son, Louis Philippe, who succeeded him.

ORLEANS, LOUIS PHILIPPE, DUKE OF (1725–1785), son of Louis, duke of Orléans, was born at Versailles on May 12, 1725, and was known as the duke of Chartres until his father's death in 1752. He served with the French armies in the campaigns of 1742, 1743 and 1744, and at the battle of Fontenoy in 1745, retiring to Bagnolet in 1757 and occupying his time with theatrical performances. He died at St. Assise on Nov. 18, 1785. The duke married Louise Henriette de Bourbon-Conti, who bore him a son Philippe (Egalité), duke of Orléans, and a daughter, who married the last duke of Bourbon. His second wife, Madame de Montesson, whom he married secretly in 1773, was an authoress of some repute. He had two natural sons, the abbot of St. Far and the abbot of St. Albin.

See *L'Automne d'un prince,* a collection of letters from the duke to his second wife ed. by J. Hermand (1910).

ORLEANS, LOUIS PHILIPPE JOSEPH, DUKE OF (1747–1793), called PHILIPPE EGALITÉ, son of Louis Philippe, duke of Orléans, and of Louise Henriette de Bourbon-Conti, was born at St. Cloud on April 13, 1747. Having borne the title of duke of Montpensier until his grandfather's death in 1752, he became duke of Chartres, and in 1769 married Louise Marie Adelaide de Bourbon-Penthièvre, daughter and heiress of the duke of Penthièvre, grand admiral of France. Her wealth made him the richest man in France, and he determined to play a part equal to that of his great-grandfather, the regent, whom he resembled in character and debauchery. As duke of Chartres he opposed the plans of René Maupeou in 1771, and was exiled to his country estate of Villers-Cotterets (Aisne). When Louis XVI came to the throne in 1774, Chartres still found himself looked on coldly at court. In 1778 he served in the squadron of the comte d'Orvilliers, but the queen obtained his removal from the navy and he was given the honorary post of colonel general of hussars. He then abandoned himself to pleasure; he often visited London, becoming an intimate friend of the prince of

Wales (afterward George IV). He made himself very popular in Paris by his gifts to the poor in time of famine, and by throwing open the gardens of the Palais Royal to the people. Before the meeting of the notables in 1787 he had succeeded his father as duke of Orléans, and advertised his liberalism so boldly that he was believed to be aiming at becoming constitutional king of France. In November he was again exiled to Villers-Cotterets. He was elected to the states-general and led the minority of 47 noblemen who seceded from their own estate (June 1789) and joined the Tiers Etat. The part he played during the summer of 1789 is one of the most debated points in the history of the French Revolution. The court accused him of being at the bottom of every popular movement, and saw the "gold of Orléans" as the cause of the Reveillon riot and the taking of the Bastille. The best testimony for his behaviour during that summer is that of an English woman, Mrs. Grace Dalrymple Elliott, who shared his affections with the comtesse de Buffon; her statement shows that at the time of the riot of July 12 he was on a fishing excursion, and was rudely treated by the king on the next day when going to offer him his services. The marquis de la Fayette persuaded the king to send the duke to England on a mission and he remained in England from Oct. 1789 to July 1790. On July 7 he took his seat in the assembly, and on Oct. 2 both he and the comte de Mirabeau were declared by the assembly entirely free of any complicity in the events of October. He now tried to avoid politics, but the court suspected him and his friends talked about his being king. He made no attempt to get himself made king, regent or lieutenant general of the kingdom at the time of the flight to Varennes in June 1791, but again tried in vain to make his peace with the court in Jan. 1792. In the summer of that year he was present for a short time with the army of the north, but had returned to Paris before Aug. 10. After that day he ran great risks in saving fugitives; in particular, he saved the life of the count of Champcenetz, the governor of the Tuileries, his personal enemy, at the request of Mrs. Elliott. After accepting the title of Citoyen Egalité, conferred on him by the commune of Paris, he was elected 20th and last deputy for Paris to the convention. In that body he sat as quietly as in the national assembly, but at the king's trial he had to speak, and then only to give his vote for the death of Louis. Nevertheless, when the news of the desertion of his eldest son, the duke of Chartres, with Charles Dumouriez became known in Paris, all the Bourbons remaining in France, including Egalité, were arrested April 5. He remained in prison until October, when the Reign of Terror began, and was decreed "of accusation" on Oct. 3. He was tried on Nov. 6, and guillotined on the same day. Personally Orléans possessed the charming manners of a polished grand seigneur; he was debauched and cynical, but never rude or cruel, full of gentle consideration for all about him but selfish in his pursuit of pleasure.

Bibliography.—Armand Baschet, *Histoire de Philippe Égalité; Journal* of Mrs. Grace Dalrymple Elliott (1859); A. Nettement, *Philippe-Égalité* (1842); L. C. R(ousselet), *Correspondance de Louis-Philippe Joseph d'Orléans avec Louis XVI.* (1800); Rivarol, *Portrait du duc d'Orléans et de Madame de Genlis;* Tournois, *Histoire de Louis Philippe Joseph duc d'Orléans* (1842).

ORLEANS, LOUIS PHILIPPE ROBERT, Duke of (1869–1926), eldest son of the comte de Paris, was born at York House, Twickenham, Eng., on Feb. 6, 1869. The law of exile against the French princes having been abrogated in 1871, he returned to France and was educated at Eu and at the Collège Stanislas, Paris. On the death of the comte de Chambord, the comte de Paris became head of the Bourbons; and in 1886 he and his son were exiled from France by the new law of 1886. He then passed through the Royal Military college, Sandhurst, Eng., and received a commission in the 4th battalion of the 60th Rifles, then quartered in India. In Jan. 1888 the duke joined his regiment for a few months. On attaining his majority, he went to Paris (Feb. 7, 1890), and, proceeding to the *mairie,* expressed his desire, as a Frenchman, to perform his military service. He was arrested in conformity with the law of 1886, tried and sentenced to two years' imprisonment; but he was liberated by Pres. Sadi Carnot after a few months' nominal incarceration (June 4), and conducted to the Swiss frontier. This escapade won for him the title of "Le Premier Conscrit de France." After the comte de Paris's funeral (Sept. 12, 1894) the duke received his adherents in London, and was accepted as the head of his house. On Nov. 5, 1896, he married the archduchess Maria Dorothea Amalia of Austria; there was no issue of the marriage. The duke of Orléans was interested in exploration, and published *Une croisière au Spitzberg* (1905). He died on March 28, 1926.

ORLEANS, PHILIP I, Duke of (1640–1701), son of the French king Louis XIII, was born at St. Germain-en-Laye on Sept. 21, 1640. In 1661 he was created duke of Orléans, and married Henrietta, sister of Charles II of England; but the marriage was not happy, and the death of the duchess in 1670 was attributed to poison. Later he married Charlotte Elizabeth, daughter of Charles Louis, elector palatine of the Rhine. Having fought with distinction in Flanders in 1667, Orléans returned to military life in 1672, and in 1677 gained a great victory at Cassel and took St. Omer. Louis XIV, it was said, was jealous of his brother's success; Orléans never commanded an army again. He died at St. Cloud on June 8, 1701, leaving a son, Philip, the regent Orléans, and two daughters: Anne Marie (1669–1728), wife of Victor Amadeus II, duke of Savoy; and Elizabeth Charlotte (1676–1744), wife of Leopold, duke of Lorraine. His eldest daughter, Marie Louise (1662–1689), wife of Charles II of Spain, died before her father.

ORLEANS, PHILIP II, Duke of (1674–1723), regent of France, son of Philip I, duke of Orléans, and his second wife, the princess palatine, was born on Aug. 2, 1674, and fought at the siege of Mons in 1691. His marriage with Mlle. de Blois, the legitimized daughter of Louis XIV, won him the favour of the king. He fought at Steinkerk, Neerwinden and Namur (1692–95). During the next few years he studied natural science. He was next given a command in Italy (1706) and in Spain (1707–08), where he gained some important successes, but his suspected desire to succeed Philip V on the throne of Spain gained him Louis XIV's disfavour. In Louis's will, however, he was appointed president of the council of regency of the young king Louis XV (1715). After the death of the king, Orléans had the will annulled by the *parlement,* and himself invested with absolute power. At first he made a good use of this, counselling economy, decreasing taxation, disbanding 25,000 soldiers and restoring liberty to the persecuted Jansenists. But the inquisitorial measures which he had begun against the financiers led to disturbances. He also countenanced the risky operations of the banker John Law (1717), whose bankruptcy led to a disastrous crisis.

A conspiracy under the inspiration of Cardinal Alberoni, first minister of Spain, to transfer the regency from Orléans to Philip V of Spain was discovered and defeated in 1718. Dubois, formerly tutor to the duke of Orléans and now his all-powerful minister, caused war to be declared against Spain, with the support of the emperor, and of England and the Netherlands (Quadruple alliance). Philip V made peace with the regent in 1720.

On the majority of the king (Feb. 15, 1723), the duke of Orléans resigned the supreme power; but he became first minister to the king, and remained in office till his death on Dec. 23, 1723. The regent had great qualities, both brilliant and solid, but his dissolute manners found only too many imitators, and the regency was one of the most corrupt periods in French history.

Bibliography.—J. B. H. R. Capefigue, *Histoire de Philippe d'Orléans, régent de France* (2 vols., 1838); A. Baudrillart, *Philippe V. et la cour de France,* vol. ii. (1890); and L. Wiesener, *Le régent, l'abbé Dubois et les Anglais* (3 vols., 1891–99).

ORLEANS (Orleans), a city of France, the chief town of Loiret, on the Loire, 77 mi. S.S.W. of Paris by rail. Pop. (1946) 70,240. Les Aubrais, 1 mi. to the north, is one of the chief railway junctions in the country. An early trading post among the Gauls, Orléans was known as *Genabum* by the Romans, and its people led the revolt against Julius Caesar in 52 B.C. In the 5th century it had taken the name *Aurelianum* from either Marcus Aurelius or Aurelian. It was vainly besieged in 451 by Attila, and by Odoacer in 471, but Clovis took it in 498 and held there in 511 the first ecclesiastical council in France. It then became the capital of a separate kingdom, but was united with that of Paris in 613. In the 10th century the town was given in fief to the counts of Paris, who in 987 ousted the Carolingians. Philip, fifth son of Philip VI, was the first duke of Orléans. After the assassination of his successor, Louis, the people of Orléans sided with the Armagnacs, and thus brought upon themselves the attacks of the Burgundians and the English. Joan of Arc relieved the city in 1429. In 1562 it became the headquarters of Louis I of Bourbon, prince of Condé, the Protestant commander in chief. In 1563 Francis, duke of Guise, laid siege to it, but was assassinated. Orléans was surrendered to the king, who raised the fortifications. It was held by the Huguenots from 1567 to 1568. The St. Bartholomew massacre there in 1572 lasted a week. It

was given as a *lieu de sûreté* to the League under Henry III, but surrendered to Henry IV in person in 1594. The town is surrounded by boulevards, and is connected with the suburb of St. Marceau by an 18th century stone bridge of nine arches. The river is canalized on the right, and serves as a continuation of the Orléans canal.

In the Place du Martroi is a statue of Joan of Arc. A simple cross marks the site, on the left bank of the Loire, of the *Fort des Tourelles,* captured by Joan of Arc in 1429. The cathedral of Ste. Croix, begun in 1287, was burned by the Huguenots in 1567 before its completion. Henry IV, in 1601, laid the first stone, the building of which continued until 1829. The church of St. Aignan mutilated by the Protestants consists of a transept and choir of the second half of the 15th century; it contains in a gilded and carved wooden shrine the remains of its patron saint. St. Euverte, dedicated to one of the oldest bishops of Orléans (d. 391), is an early Gothic building dating from the 13th, completely restored in the 15th century. The church of St. Paul (15th and 16th century) has an isolated tower, and Notre-Dame de Recouvrance was rebuilt between 1517 and 1519 in the Renaissance style and dedicated to the memory of the deliverance of the city. The *hôtel de ville,* built under Francis I and Henry II and restored in the 19th century, was formerly the residence of the governors of Orléans, and was occupied by the kings and queens of France from Francis II to Henry IV. The public library comprises among its manuscripts a number dating from the 7th century. The *salle des fêtes,* formerly the corn-market, stands within a vast cloister formed by 15th-century arcades, once belonging to the old cemetery. Among old houses are that of Agnès Sorel (15th and 16th centuries), containing objects relating to Joan of Arc, that of Francis I, of the first half of the 16th century, that occupied by Joan of Arc during the siege of 1429, and that known as the house of Diane de Poitiers (16th century), which contains the historical museum. The anniversary of the raising of the siege in 1429 by Joan of Arc is celebrated yearly. Orléans is the seat of a bishopric under the archbishop of Paris, a prefect, a court of appeal, and a court of assizes and headquarters of the V army corps.

The more important industries are the manufacture of tobacco (by the state), blankets, pins, vinegar, machinery, agricultural implements, hosiery, tools and ironware, and the preparation of preserved vegetables. Wine, wool, grain and live stock are commercial staples, round which there are important nurseries.

ORLÉANS CAMPAIGN OF 1870

Orléans was the pivot of the second phase of the Franco-German War, called the "People's War," when the new armies began their attempt to relieve Paris. After the fall of the empire, the Government of National Defense, deciding to remain in Paris, delegated three of its members, Crémieux, Glais-Bizoin and Fourichon, proceeded to the provinces to hasten the levy of troops. General de la Motte-Rouge was appointed to command the "territorial division of Tours." From many scattered units, most of them ill equipped, he formed the XV corps. The Germans, however, were only able to spare the I Bavarian corps and three cavalry divisions (2nd, 4th and 6th), the investment of Paris and Metz occupying their forces. On Oct. 5 the German 4th cavalry division was forced to retire before a French detachment under Reyau. Von der Tann, commanding the I Bavarian corps, was reinforced by the 22nd infantry and 2nd and 6th cavalry divisions. Reyau was attacked at Artenay on Oct. 10 and was thrown back in disorder, Orléans being captured in the evening of the following day, whereupon the French fell back on Sologne. Meanwhile Gambetta, minister of defense, arriving at Tours by balloon from Paris, assumed virtual control on Oct. 11, being aided by De Freycinet, the deputy minister. He forthwith appointed General d'Aurelle de Paladines in place of La Motte-Rouge. The change gave impetus to the training and reorganization of the troops and by Oct. 23 a further force was concentrated at Blois, which formed the XVI corps.

After the withdrawal of the 22nd infantry division from Von der Tann, its commander, General Wittich advanced to Châteaudun which he captured on Oct. 18. He now made for Chartres, which also fell into his hands. The resistance he had met with led the Germans to believe in the existence of a new army as the French who defended them did not belong to either the XV or XVI corps. The "Army of the West," as they called this phantom force, originated from the defenders of Châteaudun and Chartres and was never formed into a fighting unit.

The French command decided to advance against the Germans massed around Orléans whom it mistakenly estimated at 60,000 men, whereas they barely numbered 26,000. As a mystification empty trains were run to Le Mans to confirm the Germans in their belief in the existence of an army west of Paris. But the contemplated offensive was postponed owing to bad weather and the discouraging news of Bazaine's capitulation with his 150,000 troops at Metz.

Moltke directed the II army, released from the siege of Metz, towards Bourges, sending it by Chalon-sur-Saône, while he formed a new detachment under the grand duke of Mecklenburg-Schwerin consisting of the I Bavarian army corps, 17th and 22nd infantry and 2nd, 3rd and 4th cavalry divisions. This force was to concentrate between Châteaudun and Chartres.

The French advance began auspiciously, the German cavalry retiring before them on Nov. 8. The following day, moving across the country in battle formation, the French attacked Von der Tann who was drawn up at Coulmiers, forcing him to retreat unpursued. The 2,500 Germans guarding Orléans thereupon evacuated the city and joined Von der Tann at Angerville.

Meanwhile, the grand duke with his detachment had not encountered any strong hostile forces and by Nov. 19 Moltke began to believe that after all the French must still be concentrated in the neighbourhood of Orléans to the number of 150,000 men. He fully realized the gravity of the situation—the expected sortie from Paris coupled with the advance of the army of the Loire. The king of Prussia was prepared, as he said to Waldersee at Versailles, to raise the siege of Paris if the II army sustained a defeat.

The members of the government in Paris urged Trochu, the governor, to attempt a sortie toward Fontainebleau, thereby joining hands with the army of the Loire. The sortie was to begin Nov. 29, but the balloon carrying the message to Gambetta alighted in Norway, which caused a delay. D'Aurelle still remained on the defensive near Orléans though pressed by Freycinet to advance.

The battle of Beaune-la-Rolande took place on Nov. 28, General Crouzat's XX corps attacking the German X corps between Turanville and Beaune-la-Rolande, while Billot's XVIII corps pushed back the Prussian left. In the afternoon Crouzat was himself assailed in the rear from Pithiviers by a cavalry and infantry division, Billot also falling back.

After further operations in which the French sustained defeat, the Germans moved toward Orléans on Dec. 3 in a scythe-like line of battle 40 miles long. Serious resistance was only encountered at Chilleurs. Orléans was entered on Dec. 4th. (*See* further FRANCO-GERMAN WAR.)

ORLEY, BERNARD VAN (*c.* 1490–1540), Flemish painter, son of the painter, Valentyn van Orley, was born at Brussels about 1490. The date of his birth is estimated from his portrait by Dürer painted in 1521, now in the Dresden gallery. It represents an attractive and intelligent man of about 30. In 1515 he was employed by Margaret of Austria, then regent of the Netherlands, and three years later he was appointed her court painter. He died in 1540. His earliest important work is the altarpiece of SS. Thomas and Matthias, of which the centrepiece is at Vienna and the wings at Brussels painted about 1512. The style of the picture seems to be inspired by the school of Autrey. From 1516–22 Bernard van Orley imitated Mabuse—to this period belongs the "Madonna" in the Wied collection and the "Holy Family" in the Louvre. In the "Holy Family" in the Prado (1522) the influence of Mabuse has given way to that of Raphael. In the altarpiece representing the "Patience of Job," (1521) now in the Brussels gallery, we find the two influences combined. The artist had many opportunities to see designs by Raphael whose tapestry cartoons were in Brussels for many years. Important works of his later period are the "Hanneton

Family" altarpiece in the Brussels gallery; the "Last Judgment" (1525) at Antwerp; and the "Crucifixion" at Rotterdam. He painted several portraits; the one of Dr. Georg Zelk in the Brussels gallery is the only one which is signed and dated (1519). Van Orley was a designer of tapestries; for instance, "Hunts of Maximilian," in the Louvre, and "Victory of Pavia" at Naples.

See M. Friedlander, *Annual of Prussian Museums* (1908–09).

ORLOV, ALEXIS FEDOROVICH, Prince (1787–1862), Russian statesman, natural son of Count Theodore Grigorievich Orlov, took part in all the Napoleonic wars from 1805 to the capture of Paris. For his services as commander of the cavalry regiment of the Life Guards on the occasion of the rebellion of 1825 he was created a count, and in the Turkish War of 1828–29 rose to the rank of lieutenant-general. Orlov was the Russian plenipotentiary at the Peace of Adrianople, and in 1833 was appointed Russian ambassador at Constantinople, holding at the same time the post of commander-in-chief of the Black Sea Fleet. He was one of the most trusted agents of Nicholas I., whom in 1837 he accompanied on his foreign tour. In 1854 he was sent to Vienna to bring Austria over to the side of Russia, but without success. In 1856 he was one of the plenipotentiaries who concluded the Peace of Paris, and was rewarded with the dignity of prince, and the presidency of the imperial council of state and of the council of ministers. In 1857 he presided over the commission formed to consider the question of the emancipation of the serfs, to which he was altogether hostile.

ORLOV, ALEXIS GRIGORIEVICH, Count (1737–1808), brother of Gregory, Count Orlov (*q.v.*), was remarkable for his athletic strength and dexterity. In the revolution of 1762 he played an even more important part than his brother. He conveyed Peter III. to the château of Ropsha and is said to have murdered him there. In 1770 he was appointed commander-in-chief of the fleet sent against the Turks, whose far superior navy he annihilated at Cheshme (July 5, 1770), a victory which led to the conquest of the Greek archipelago. He devoted himself to horse-breeding, and produced the finest race of horses then known by crossing Arab and Frisian, and Arab and English studs. In the war with Napoleon during 1806–07 Orlov commanded the militia of the fifth district, which was placed on a war footing almost entirely at his own expense. He left an estate worth five millions of roubles and 30,000 serfs.

See article, "The Associates of Catherine II.," No. 2, in *Russkaya Starina* (Rus.) (St. Petersburg, 1873).

ORLOV, GREGORY (Grigorii) **GRIGORIEVICH,** Count (1734–1783), Russian statesman, was the son of Gregory Orlov, governor of Great Novgorod. While serving in the capital as an artillery officer he caught the fancy of Catherine II., and was the leader of the conspiracy which resulted in the dethronement and death of Peter III. (1762). Catherine made him a count and adjutant-general, director-general of engineers and general-in-chief. At one time the empress thought of marrying her favourite, but the plan was frustrated by Nikita Panin. Orlov's influence became paramount after the discovery of the Khitrovo plot to murder the whole Orlov family. Gregory Orlov entered with enthusiasm, both from patriotic and from economic motives, into the question of the improvement of the condition of the serfs and their partial emancipation. He was their advocate in the great commission of 1767. One of the earliest propagandists of the Slavophil idea of the emancipation of the Christians from the Turkish yoke, he was sent as first Russian plenipotentiary to the peace-congress of Focsani (1771), but he failed in his mission, owing partly to the obstinacy of the Turks, and partly (according to Panin) to his own insolence. He was superseded in the empress's favour by Vasil'chikov.

See A. P. Barsukov, *Narratives from Russian History in the 18th Century* (Rus.) (St. Petersburg, 1885).

ORLOV, NIKOLAI ALEKSYEEVICH, Prince (1827–1885), entered the diplomatic service, and represented Russia successively at Brussels (1860–1870), Paris (1870–1882) and Berlin (1882–1885). As a publicist he stood in the forefront of reform. His articles on corporal punishment, which appeared in *Russkaya Starina* in 1881, brought about its abolition. He also advocated tolerance towards the dissenters. He wrote a *Sketch of Three Weeks' Campaign in 1806* (St. Petersburg, 1856).

ORLOV, THEODORE (Fedor) **GRIGORIEVICH,** Count (1741–1790), Russian general, participated with his elder brothers, Gregory (*q.v.*) and Alexis (*q.v.*), in the *coup d'état* of 1762, after which he was appointed chief procurator of the senate. His naval exploits in the first Turkish War were commemorated by a triumphal column, crowned with naval trophies, erected at Tsarskoe Selo. He retired in 1775.

ORM or **ORMIN,** the author of an English book, called by himself *Ormulum* ("because Orm made it"), consisting of metrical homilies on the gospels read at mass. The unique ms., now in the Bodleian library, is certainly Orm's autograph, and contains abundant corrections by his own hand. On palaeographical grounds it is referred to about A.D. 1200, and this date is supported by the linguistic evidence. The dialect is midland, with some northern features. The orthography of the *Ormulum* is the most valuable existing source of information on the development of sound in Middle English. On the whole, the language of the *Ormulum* seems to point to north Lincolnshire as the author's native district. There are reasons for thinking that Orm and the Walter to whom it is dedicated may have been inmates of the Augustinian priory of Elsham, near the Humber, which was established about the middle of the 12th century by Walter de Amundeville.

The *Ormulum* is written in lines alternately of eight and seven syllables, without either rhyme or alliteration. The rhythm may be seen from the opening couplet:

Nu, broþerr Wallter, broþerr min
Affterr þe flæshess kinde.

The extant portion of the work, not including the dedication and introduction, consists of about 20,000 lines. But the table of contents refers to 242 homilies, of which only 31 are preserved; and as the dedication implies that the book had been completed, and that it included homilies on the gospels for nearly all the year, it would seem that the huge fragment which we possess is not much more than one-eighth of this extraordinary monument of pious industry.

The *Ormulum* was edited for the first time by R. M. White in 1852. A revised edition, by R. Holt, was published in 1878. Many important corrections of the text were given by E. Kölbing in the first volume of *Englische Studien*. With reference to the three forms of the letter g, *see* A. S. Napier, *Notes on the Orthography of the Ormulum*, printed with *A History of the Holy Rood Tree* (Early English Text Society, 1894).

ORME, ROBERT (1728–1801), English historian of India, was born at Anjengo on the Malabar coast on Dec. 25, 1728, the son of a surgeon in the Company's service. Educated at Harrow, he was appointed to a writership in Bengal in 1743. He returned to England in 1753 in the same ship with Clive, with whom he formed a close friendship. From 1754 to 1758 he was a member of council at Madras. His great work was *A History of the Military Transactions of the British Nation in Indostan from 1745* (3 vols., 1763–78). This was followed by a volume of *Historical Fragments* (1781), dealing with an earlier period. In 1769 he was appointed historiographer to the East India Company. He died at Ealing on Jan. 13, 1801. His valuable collections of mss. are in the India Office library. Not a few of the most picturesque passages in Macaulay's Essay on Clive are borrowed from Orme.

ORMER, the name given in the Channel Isles and on the coasts of France to *Haliotis tuberculata,* a gastropod mollusc. It has a shell with a widely open aperture, more or less resembling a human ear in outline. The animal lives beneath stones and rocks close to the low-water mark of spring tides. For a sedentary organism it can move remarkably fast, and observers have commented on its strength and agility. The ormer is an article of human food in the Channel Isles and elsewhere (*see* Abalone). The States of Guernsey introduced legislation in 1926 for its protection.

See T. A. Stephenson (1924), *Journ. Marine Biol. Assocn.*, xiii. No. 2, p. 480.

ORMEROD, ELEANOR A. (1828–1901), English entomologist, the daughter of George Ormerod, F.R.S., author of *The History of Cheshire,* was born at Sedbury Park, Gloucestershire,

on May 11, 1828. The opportunity afforded for entomological study by the large estate upon which she grew up and the interest she took in agriculture soon made her an authority upon this subject. In 1868, she aided the Royal Horticultural Society in forming a collection of insect pests of the farm for practical purposes, and was awarded the Flora medal of the society. In 1877 she issued a pamphlet, *Notes for Observations on Injurious Insects,* which was distributed among persons interested in this line of inquiry, who readily sent in the results of their researches, and was thus the beginning of the well-known *Annual Series of Reports on Injurious Insects and Farm Pests.* In 1881 Miss Ormerod published a special report upon the "turnip-fly," and she was consulting entomologist to the Royal Agricultural Society from 1882 to 1892. For several years she was lecturer on scientific entomology at the Royal Agricultural college, Cirencester. Eleanor Ormerod died at St. Albans on July 19, 1901.

Her works include: *The Cobden Journals; Manual of Injurious Insects; Handbook of Insects Injurious to Orchard and Bush Fruits;* and her *Autobiography and Correspondence* (1904). *See* also: *Canadian Entomologist,* vol. 33, 1901; *Royal Agric. Soc. Journ.* vol. 62, 1901.

ORMOC, a municipality (with administrative centre and 46 *barrios* or districts), of the island and province of Leyte, Philippine Islands, on the west coast about 35 mi. S.W. of Tacloban, the provincial capital. Pop. (1939), 77,349; 32 were whites. Ormoc is the centre of an extensive abacá- (Manila hemp) producing region and has a large coastwise trade, especially with Cebu. The vernacular is Cebuano. Of the inhabitants aged 6 to 19 inclusive, 18·4% in 1939 attended school, while 32·6% of the population 10 years old and over was literate.

ORMOLU, an alloy of copper and zinc, sometimes with an addition of tin. The name is also used to describe gilded brass or copper. The tint of ormolu approximates closely to that of gold; it is heightened by a wash of gold lacquer, by immersion in dilute sulphuric acid or by burnishing. The principal use of ormolu is for the mountings of furniture. With it the great French *ébénistes* of the 18th century obtained results which, in the most finished examples, are almost as fine as jewellers' work. The mounts were usually cast and then chiselled with extraordinary skill and delicacy. (*See* also SILVERSMITHS' AND GOLDSMITHS' WORK.)

ORMOND, a town of Volusia county, Florida, U.S.A., on the Halifax river (an arm of the Atlantic ocean extending along the east coast for 25 mi.) just N. of Daytona Beach. It is on federal highway 1 and is served by the Florida East Coast railway. The resident population was 3,350 in 1950; 1,914 in 1940, federal census. It is a winter resort with large hotels and beautiful residences. The hard, compact Ormond-Daytona beach (200 ft. wide and 20 mi. long), formerly the scene of automobile speed tests, is used by tourists, winter and summer, for bathing and motoring. Ormond was incorporated in 1880. Until his death in 1937, it was the winter home of John D. Rockefeller.

ORMONDE, EARL AND MARQUESS OF, titles still held by the famous Irish family of Butler (*q.v.*), the name being taken from a district now part of co. Tipperary. In 1328 James Butler (*c.* 1305–37), a son of Edmund Butler, was created earl of Ormonde, one reason for his elevation being that his wife Eleanor Bohun was a granddaughter of Edward I. His son James, the 2nd earl (1331–82), was four times governor of Ireland; the latter's grandson James, the 4th earl (d. 1452), held the same position several times, and won repute not only as a soldier, but as a scholar. His son, James, the 5th earl (1420–*c.* 1461), was created an English peer as earl of Wiltshire in 1449. He was lord high treasurer of England in 1455 and again in 1459, and was taken prisoner by the Yorkists after the battle of Towton in 1461. He and his two brothers were then attainted, and he died without issue, the exact date of his death being unknown. The attainder was repealed in the Irish parliament in 1476, when his brother Sir John Butler (*c.* 1422–78), who had been pardoned by Edward IV. a few years previously, became 6th earl of Ormonde. John, who was a fine linguist, served Edward IV. as ambassador to many European princes. His brother Thomas, the 7th earl (*c.* 1424–1515), a courtier and an English baron under Richard III. and Henry VII., was ambassador to France and to Burgundy; he left no sons, and on his death in August 1515 his earldom reverted to the crown.

Margaret, a daughter of this earl, married Sir William Boleyn of Blickling, and their son Sir Thomas Boleyn (1477–1539) was created earl of Ormonde and of Wiltshire in 1529. He arranged the preliminaries for the Field of the Cloth of Gold; he was lord privy seal from 1530 to 1536, and served the king in many other ways. He was the father of Anne Boleyn.

Meanwhile in 1515 the title of earl of Ormonde had been assumed by Sir Piers Butler (*c.* 1467–1539), a cousin of the 7th earl. He was lord deputy, and later lord treasurer of Ireland, and in 1528 he surrendered his claim to the earldom of Ormonde and was created earl of Ossory. Then in 1538 he was made earl of Ormonde, this being a new creation; however, he counts as the 8th earl of the Butler family. In 1550 his second son Richard (d. 1571) was created Viscount Mountgarret, a title still held by the Butlers. The 8th earl's son, James, the 9th earl (*c.* 1490–1546), lord high treasurer of Ireland, was created Viscount Thurles in 1536. In 1544 an act of parliament confirmed him in the possession of his earldom, which, for practical purposes, was declared to be the creation of 1328, and not of 1538.

Thomas, the 10th earl (1532–1614), a son of the 9th earl, was lord high treasurer of Ireland. He was a Protestant, and threw his great influence on the side of the English queen and her ministers in their efforts to crush the Irish rebels, but he was perhaps more anxious to prosecute a fierce feud with his hereditary foe, the earl of Desmond, this struggle between the two factions desolating Munster for many years. His successor was his nephew Walter (1569–1633), who was imprisoned from 1617 to 1625 for refusing to surrender the Ormonde estates to his cousin Elizabeth, the wife of Sir R. Preston and the only daughter of the 10th earl. He was deprived of the palatine rights in the county of Tipperary, which had belonged to his ancestors for 400 years, but he recovered many of the family estates after his release from prison in 1625.

Walter's grandson, James, the 12th earl, was created marquess of Ormonde in 1642 and duke of Ormonde in 1661 (*see* below); his son was Thomas Butler, earl of Ossory, and his grandson was James Butler, 2nd duke of Ormonde (*see* below).

When Charles Butler, earl of Arran (1671–1758), the brother and successor of the 2nd duke, died in December 1758, the dukedom and marquessate became extinct, but the earldom was claimed by a kinsman, John Butler (d. 1766). John's cousin, Walter (1703–83), inherited this claim, and Walter's son, John (1740–95), obtained a confirmation of it from the Irish House of Lords in 1791. He is reckoned as the 17th earl. His son Walter, the 18th earl (1770–1820), was created marquess of Ormonde in 1816, a title which became extinct on his death, but was revived in favour of his brother James (1774–1838) in 1825, and was retained by his descendants.

See J. H. Round on "The Earldoms of Ormonde" in Joseph Foster's *Collectanea Genealogica* (1881–83).

ORMONDE, JAMES BUTLER, 1ST DUKE OF (1610–1688), Irish statesman and soldier, eldest son of Thomas Butler, Viscount Thurles, and of Elizabeth, daughter of Sir John Poyntz, and grandson of Walter, 11th earl of Ormonde (*see* above), was born in London on Oct. 19, 1610. On the death of his father by drowning in 1619, the boy was made a royal ward by James I., removed from his Roman Catholic tutor, and placed in the household of Abbot, archbishop of Canterbury, with whom he stayed until 1625, residing afterwards in Ireland with his grandfather. In 1629, by his marriage with his cousin, the Lady Elizabeth Preston, daughter and heiress of Richard, earl of Desmond, he put an end to the long-standing quarrel between the families and united their estates. He succeeded his grandfather in 1632.

His active career began in 1633 with the arrival of Strafford, whom he supported consistently. In 1640 during Strafford's absence he was made commander-in-chief of the forces, and in August he was appointed lieutenant-general. On the outbreak of the rebellion in 1641 he rendered great service in the expedition to Naas, and in the march into the Pale in 1642, though much hampered by the lords justices, who were jealous of his power and

recalled him after he had succeeded in relieving Drogheda. On April 15, 1642, he gained the battle of Kilrush against Lord Mountgarret. He was created a marquess, and lieutenant-general with a commission direct from the king. He won the battle of New Ross (March 18, 1643) against Thomas Preston, afterward Viscount Tara. In September, the civil war in England having meanwhile broken out, Ormonde, in view of the successes of the rebels and the uncertain loyalty of the Scots in Ulster, concluded (Sept. 15) with the latter, in opposition to the lords justices, the "cessation" by which the greater part of Ireland was given up into the hands of the Catholic confederation, leaving only small districts on the east coast and around Cork, together with certain fortresses in the north and west then actually in their possession, to the English commanders. He subsequently, by the king's orders, despatched a body of troops into England (shortly afterward routed by Fairfax at Nantwich) and was appointed in Jan. 1644 lord lieutenant, with orders to keep the Scotch army occupied.

In the midst of all the plots and struggles of Scots, Old Irish, Catholic Irish of English race, and Protestants, and in spite of the intrigues of the pope's nuncio, as well as of attempts by the parliament's commissioners to ruin his power, Ormonde showed the greatest firmness and ability. He assisted Antrim in his unsuccessful expedition into Scotland. On March 28, 1646, he concluded a treaty with the Irish which granted religious concessions and removed various grievances. Meanwhile the difficulties of his position had been greatly increased by Glamorgan's treaty (Aug. 25, 1645) with the Roman Catholics, and it became clear that he could not long hope to hold Dublin against the Irish rebels. He thereupon applied to the English parliament, signed a treaty on June 19, 1647, gave Dublin into their hands upon terms and sailed for England at the beginning of August. He attended Charles during August and October at Hampton Court, but subsequently, in March 1648, in order to avoid arrest by the parliament, he joined the queen and prince of Wales at Paris. In September of the same year, he returned to Ireland to endeavour to unite all parties for the king. On Jan. 17, 1649, he concluded a peace with the rebels on the basis of the free exercise of their religion; on the execution of the king he proclaimed Charles II and was created a knight of the Garter in September. On the conquest of the island by Cromwell he returned to France in Dec. 1650.

Ormonde accompanied Charles to Aix and Cologne when expelled from France by Mazarin's treaty with Cromwell in 1655. In 1658 he went disguised, and at great risk, upon a secret mission into England. He attended the king at Fuenterrabia in 1659 and had an interview with Mazarin; and was actively engaged in the secret transactions immediately preceding the Restoration. On the return of the king he was at once appointed a commissioner for the treasury and the navy, and received other important places, together with an English peerage, and (1661) the dukedom of Ormonde in the Irish peerage. On Nov. 4, 1661 he once more received the lord lieutenantship of Ireland. The Act of Explanation (on land settlement) was passed through the Irish parliament by Ormonde in 1665. His heart was in his government, and he vehemently opposed the bill prohibiting the importation of Irish cattle which struck so fatal a blow at Irish trade; and retaliated by prohibiting the import into Ireland of Scottish commodities, and obtained leave to trade with foreign countries. He encouraged Irish manufactures and learning to the utmost, and it was to his efforts that the Irish College of Physicians owes its incorporation.

Faced by the loss of royal favour, Ormonde declared "However ill I may stand at court I am resolved to lye well in the chronicle." His irresponsible government was no doubt open to criticism. He had billeted soldiers on civilians, and had executed martial law. The impeachment, however, threatened by Buckingham in 1667 and 1668 fell through. Nevertheless by 1669 constant importunity had had its usual effect upon Charles, and in March Ormonde was dismissed. That year, he was, however, elected chancellor of Oxford university. On Dec. 6, 1670, an attempt was made to assassinate the duke by Thomas Blood. He was dragged out of his coach, and taken on horseback along Piccadilly with the intention of hanging him at Tyburn. Ormonde, however, succeeded in overcoming the horseman to whom he was bound, and his servants coming up, he escaped. The king pardoned Blood, and even treated him with favour after his apprehension while endeavouring to steal the crown jewels.

In 1671 Ormonde successfully opposed Richard Talbot's attempt to upset the Act of Settlement. In 1677 he was restored to favour and reappointed to the lord lieutenancy. On his arrival in Ireland he placed the revenue and the army upon a proper footing. In 1682 Charles summoned Ormonde to court. On Nov. 9, 1683 an English dukedom was conferred upon him, and in June 1684 he returned to Ireland; but he was recalled in October in consequence of fresh intrigues. Before, however, he could give up his government to Rochester, Charles II died; and Ormonde's last act as lord lieutenant was to proclaim James II in Dublin. Subsequently he lived at Cornbury in Oxfordshire. He refused the king his support over the Indulgence but James held him in respect. He died on July 21, 1688, and was buried in Westminster abbey.

Bibliography.—Thomas Carte, *Life of the Duke of Ormonde;* the same author's *Collection of Original Letters, found among the Duke of Ormonde's Papers* (1739), and the Carte mss. in the Bodleian library at Oxford; Sir Robert Southwell, *Life of Ormonde,* printed in the *History of the Irish Parliament,* by Lord Mountmorres, vol. i (1792); *Correspondence between Archbishop Williams and the Marquess of Ormonde,* ed. by B. H. Beedham (reprinted from *Archaeologia Cambrensis,* 1869); *Observations on the Articles of Peace between James, Earl of Ormonde, and the Irish Rebels,* by John Milton; *Hist. mss. Comm.,* Reps. ii–iv and vi–x, esp. Rep. viii, appendix p. 499, and Rep. xiv App.: pt. vii, *Mss. of Marquis of Ormonde,* together with new series; *Notes and Queries,* vi, ser. v, pp. 343, 431; Gardiner, *Hist. of the Civil War; Calendar of State Papers (Domestic)* and *Irish, 1633–1662,* with introductions; *Biographia Britannica* (Kippis); *Scottish Hist. Soc. Publications: Letters and Papers of 1650,* ed. by S. R. Gardiner, vol. xvii (1894); and G. Coffey, *O'Neill and Ormonde, a Chapter in Irish History* (1914).

ORMONDE, JAMES BUTLER, 2nd Duke of (1665–1745), Irish statesman and soldier, son of Thomas, earl of Ossory, and grandson of the 1st duke, was born in Dublin on April 29, 1665, and was educated in France and afterwards at Christ Church, Oxford. He commanded a regiment of horse in William's army at the battle of the Boyne. In 1691 he served on the continent under William, and after the accession of Anne he was placed in command of the land forces co-operating with Sir George Rooke in Spain. He succeeded Rochester as viceroy of Ireland in 1703, a post which he held till 1707.

On the dismissal of the duke of Marlborough in 1711, Ormonde was appointed captain-general in his place, and allowed himself to be made the tool of the Tory ministry, whose policy was to carry on the war in the Netherlands while giving secret orders to Ormonde to take no active part in supporting their allies under Prince Eugene. Though he had supported the revolution of 1688, Ormonde was traditionally a Tory, and Lord Bolingbroke was his political leader. During the last years of Queen Anne he almost certainly had Jacobite leanings, and corresponded with the duke of Berwick. He joined Bolingbroke and Oxford, however, in signing the proclamation of King George I, by whom he was nevertheless deprived of the captain-generalship. In June 1715 he was impeached, and fled to France, where he for some time resided with Bolingbroke, and in 1716 his immense estates were confiscated to the crown by act of parliament, though by a subsequent act his brother, Charles Butler, earl of Arran, was enabled to repurchase them. After taking part in the Jacobite invasion in 1715, Ormonde settled in Spain, where he was in favour at court and enjoyed a pension from the crown. He died on Nov. 16, 1745, and was buried in Westminster abbey.

See Thomas Carte, *Hist. of the Life of James, Duke of Ormonde,* 6 vols. (Oxford, 1851), which contains much information respecting the life of the second duke; Earl Stanhope, *Hist. of England, comprising the Reign of Queen Anne until the Peace of Utrecht* (1870); F. W. Wyon, *Hist. of Great Britain during the Reign of Queen Anne,* 2 vols. (1876); William Coxe, *Memoirs of Marlborough,* 3 vols., new edition (1847).

ORMSKIRK, a market town, urban district, Ormskirk parliamentary division, Lancashire, England, 11 mi. N.E. of Liverpool by the L.M.S.R. Pop. (1938) 18,400. Area, 24.4 sq.mi. The name and church existed in the time of Richard I, when the priory of Burscough was founded. Edward I granted the prior a char-

ter for a market at the manor of Ormskirk. On the dissolution of the monasteries the manor was granted to the earl of Derby.

The church of SS. Peter and Paul is a spacious building in various styles, principally Perpendicular. It possesses two western towers, the one square and embattled, the other octagonal and bearing a short spire. There are various Norman fragments, including a fine early window in the chancel. To the south-east of the church, is the Derby chapel, the property of the earls of Derby, whose vault is contained within. A grammar school was founded about 1614. Rope and twine making, iron-founding and brewing are carried on. The town has long been famous for its gingerbread, and is the centre of an important potato-growing district.

ORNAMENT, ARCHITECTURAL. In decorative art ornament is that element which supplies beauty in detail by the addition of anything which gives an aesthetic pleasure.

In all beginnings of primitive culture man shows a marked tendency to decorate his utensils, fabrics and ceramics with some sort of ornament. These early designs, consisting largely of overlapping stitches, lines, triangles, dots, zigzags, spirals and crosses, are purely linear even when colour is used to heighten the effectiveness of the designs. All have very similar motifs, and crude as this early ornament is, it still persists as a basis for much of the so-called abstract ornament in use to-day. These forms may be due to a lack of handicraft ability. For whether or not these early designs in the cultural growth of a people are representative of natural objects—the scales of fishes, the feather patterns of birds, plants and things of common everyday experience—the technical difficulties in the way of making free designs in the art of basketry, weaving or pottery tend to make the designs geometric in character. It is also possible that such designs may have lost their pure form through the tendency to standardize that comes of the endless copying by craftsmen of different degrees of skill. It is evident to the casual observer that more culture is necessary to produce free designs than is the case with the use and development of geometric art, because of the greater technical difficulties, and that naturalistic ornament while deriving its sources from nature tends to become abstract owing to the conventionalization of the motifs employed. At the same time, the abstract ornament tends to revert back to the natural as it takes on complexity.

The theory of the evolution of the natural to the geometric, while not accepted by all the authorities on primitive art, has, if the psychology of the designer or artist is taken into consideration, much to commend it. A conventionalization of design takes place without fail in any art due to the very great difficulty in inventing new motifs and to the natural inclination of the average craftsman to be content with imitation, and finally the design motifs conventionalize in primitive art because of a special symbolic meaning associated with the religion and customs of the tribe and so become difficult to change. In fact, it is this very conventionalization of ornament for all uses, for whatever reason, that formalizes into the standards which we call styles. Historically, these styles mark the evolution of ornamental design and are definitely related to the customs and civilization of the people who produced them. Furthermore, a style is known not by its beginnings but by its decadence, and is named not by its creator but by historians.

Influences.—All ornament is affected very strongly by the philosophy and thought of the time in which it is designed. It is interesting in that respect that primitive art fundamentally shows a clear desire on the part of the group design to express a complete and definite sense of fulfilment, a straightforward expression of a thing or things of the present only. Each unit or repeat in primitive design is wholly complete in itself and only establishes its relation as part of the whole through a very simple rhythm of the necessary repetition. And while it is true that primitive design may be very elaborate it is rarely complex but rather indicates a desire for richness. The slight degree of complexity that is gained is by the use of different primary colours added to the same linear motif or by increasing the number of rows of different patterns, each simple in itself.

Historically, all ornament has passed through this primitive stage to a period of larger viewpoint, when the artist becomes more interested in a sense of a lack of completeness and the design motifs gather or lose a quality of freshness and time appreciation in ratio to the existence or lack of that sense. For example, architectural ornament of the nature of the chevron, the dentil, the egg and dart, and the bead and reel, are primitive forms, each complete in itself, in which as a repetition the timebeat, the interval and the rhythm are uniform and are therefore rigid and mechanical, easily comprehended, and lacking in time appreciation; whereas such motifs as the arabesque, the vine and flamboyant tracery are without that limited sense of completeness, and in so far as the rhythm interacts with the interval and against the timebeat, they lose the quality of the mechanical and become more enduring in interest. (*See* Greek Architecture and Roman Architecture.)

Appreciation of any art presupposes sufficient leisure for its enjoyment, so that in designing ornament it would seem necessary to consider a time element as well as whether or not it is proper both as to position and technical fitness. This time element engenders space elements by means of which appreciation must be led from one detail to another, and as all ornament is static in nature it should include, therefore, within the design a stimulus toward, and an opportunity for, fresh viewpoints, and so encourage a more continuous period of appreciation. It is the thought or emotion behind the ornament that lives, while its surface aspects, because of the always evident desire to change, must become out-moded in time.

As all ornament is designed to form a pattern, whether it is composed of repeat units or as a general composition, the rhythms and interrelations of the structural background on which the ornamental detail is composed are as important as the primary functions of the design itself. It is this structure which gives coherence, unity and the sense of space and time to the ornamental design. In the consideration that all ornament must bear the repetition of being seen not only once but many times, the longer the element of time appreciation that is consciously set up within the design the more enduring in interest it will become. Yet it must not be so extended and involved as to be incomprehensible upon close inspection. It seems evident that a design whose rhythmic quality is purely mechanical, even though colour is used to superimpose an additional rhythm, must fail in possessing a sustained interest. The design motif fulfills its sole purpose when it creates a longer time interest in the object ornamented through its added beauty. This growth in time interest in appreciation of ornament is closely allied with the same growth in the complexity of the manners and philosophy of the people who are creating or modifying the ornamental design. A very clear conception of this interrelation of thought and design can be obtained from the study of the differences in growth of oriental and occidental ornamental motifs; the differences remain even when there are signs of influence of one thought upon the other, or through the gradual change from simplicity to complexity which is evident in the difference between the early ornament and thought of the Gothic period (*see* Gothic Architecture) and its later development. And while it is evident that the technical ability of the craftsman has contributed a great deal as to whether the design motifs are simple or complex—for instance, compare the wood carving of the Jacobean craftsmen with the work of Grinling Gibbons and the later English wood carvers—it would seem that the technical skill had but kept pace with the civilization with which it is associated, for as a civilization advances it is apparent that ornamental design becomes more complex rather than less, that the design motifs become fuller in nature, richer in detail and more nearly perfect in technique.

Materials.—It is generally thought that the treatment of ornament is definitely limited by and related to processes and materials, although throughout the history of ornament motifs and technique have been freely translated from one material to another without loss of harmony. The architectural motifs, for example, both structural and ornamental have always been used as pure ornament in the furniture and accessories of the same style. Ornamental design in which the design is not inherently manufactured

can be considered apart from the material it embellishes. The material of which the structure is built limits only the coarseness or fineness of the technique of the detail employed, although, for example, most stones or woods may be carved crudely or delicately according to the effect desired by the designer, the scale desired or the technical ability of the craftsman. This being so, the actual design motif may be thought of for its effect as such and is only limited in its possibilities by the thought and ability of the creator who might use it to obtain a difference in texture as a help in making a transition between two materials, or to create the pattern interest that comes from employing detail. In its relations to the material employed, it may be either structurally inherent or applied. Structural ornament is either integral, that is part of the structure as in weaving or where a structural member is changed for added grace, or as in veneers where the inherent pattern of wood or marble is used; whereas applied ornament may have little or no relation to the structure other than being placed upon it, and as its name implies is added later for pure embellishment.

Modern Tendency.—The ornament of the present, because of the almost immediate world-wide communication of ideas, is breaking away from the local or national boundaries and is becoming more universal in its characteristics. This will not necessarily lead to a tighter standardization because the means by which design is produced has undergone a great change. Since ornament has always had a very definite relation to the tools and technical ability of the period in which it is produced, it would seem natural that ornament, which is becoming more and more dependent upon the machine for its production and upon designers of greater perceptibility, will become less standardized because of the ease with which the tools are changed and improved, and as the self-consciousness of the designer in designing for the machine becomes less as the communities become more completely industrialized. This loss in standardization will tend to give a sense of greater freshness and creativeness in design and will give, because of the freedom in execution, a maximum individuality to the work of the designer.

For a complete list of the various architectural subjects treated in this work *see* ARCHITECTURAL ARTICLES.

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ORNAMENTS, PRIMITIVE. The term "ornament" is strictly applied to objects worn from a sense of aesthetic value and intrinsic beauty either in gratification of the personal taste of the wearer, or in accord with fashion. But it can also be applied to objects which are worn for other reasons, such as the various objects worn for magico-religious reasons, as indications of social distinction and status, for the purpose of protection, as amulets and charms or even as curatives. As Professor Radcliffe Brown pointed out, the desire for protection and the desire for display "are very intimately related and are really both involved in every kind of ornament. All ornament in some way marks the relation of the individual to the society." (*Andaman Islanders,* p. 319.) Classes of ornaments in primitive society mark distinctions of sex and social status, the unmarried having ornaments peculiar to their status which differ conspicuously from those allowed to or required of married people. Articles worn as dress, that is, either for protection against climatic conditions, or from modesty may become ornaments if an element of aesthetic appreciation helps to determine individual choice or fashionable vogue. Decorations may be worked on or fashioned to plain materials to make the whole ornamental. In communities of a more permanent order, ornament and embellishment, external and internal, are applied to architecture in personal rivalry or in token of social status. To religious zeal is due the wealth of ornament often found in the Men's House—the centre of the communal life, the repository of the cult objects of the community, the origin of the temple.

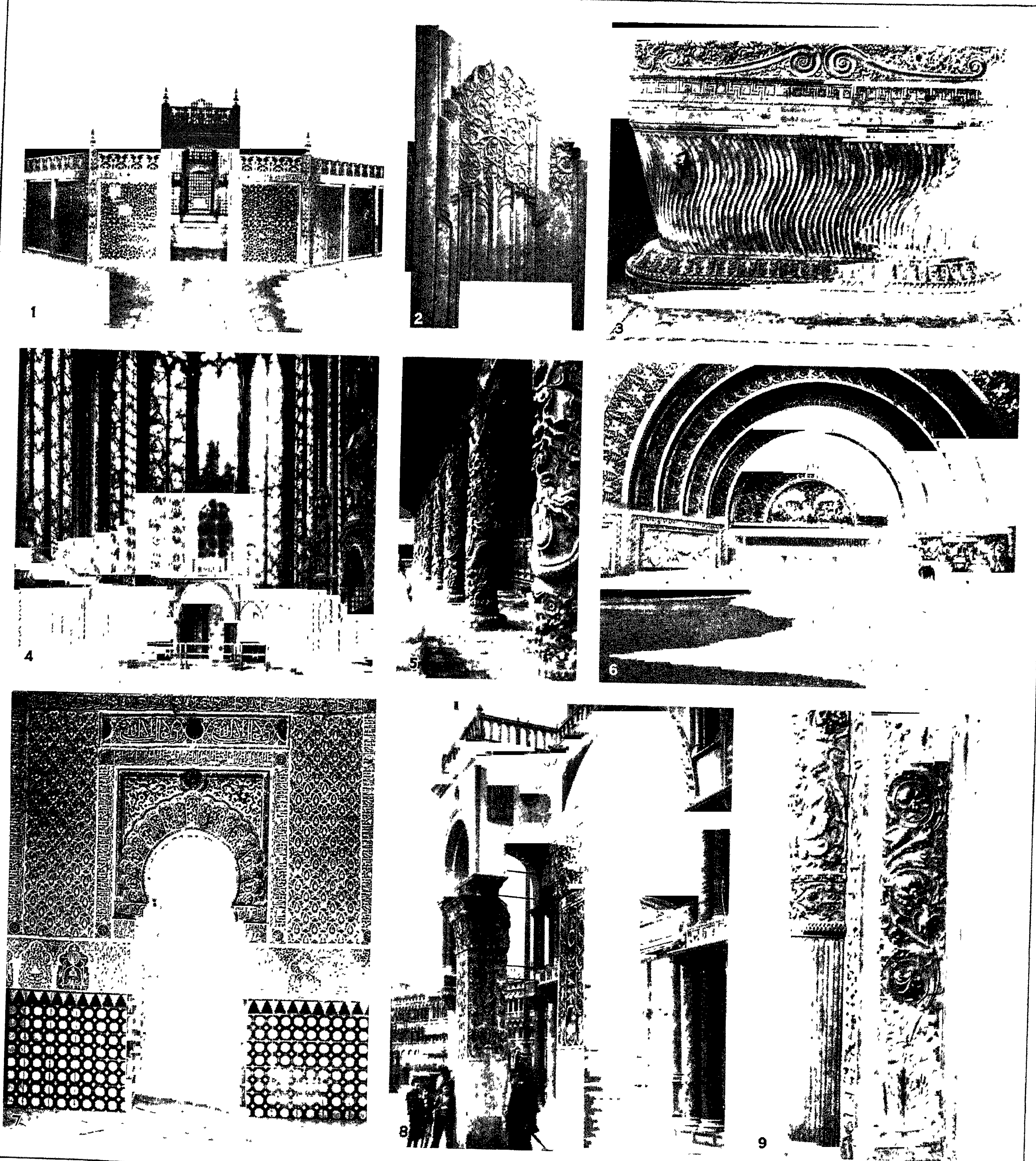
The objects worn as ornaments are sometimes of a considerable degree of elaboration. Wings of butterflies, gorgeous tropical beetles, seeds, berries, flowers, variegated leaves, bright stones and all sorts of natural products are employed. The manufacture of ornaments as prescribed by the social order is an occupation of importance. Thus, "The Akamba wear a great number of ornaments (*mapa*) of various kinds, especially metal ones, but they never overload their bodies with them on ordinary occasions. On account of the composition and choice of colours these ornaments are attractive even to European ideas of beauty, and the fine execution of the work must arouse admiration." (G. Lindblom, *Akamba,* p. 375 [1920].) Nature provides the materials and the models. The sense of colour is expressed by using different coloured earths, the quest for which is a stimulus towards economic development. Conventionalization, vulgarization, degradation and imperfect, unintelligent imitations are notable in primitive art but at one and the same time in one community there may be artists of very different capacities.

ORNE, a department of the northwest of France, about half of which formerly belonged to the province of Normandy and the rest to the duchy of Alençon and to Perche. Pop. (1936) 269,331. Area, 2,372 sq.mi. West of the Orne and the railway from Argentan to Alençon lie primitive rocks connected with those of Brittany; to the east begin the Jurassic and Cretaceous formations of Normandy. The district of the newer rocks is rich agriculturally, that of the older rocks poor, but the whole department is relatively high land, by far the greater portion being over the 600-ft. contour (highest point, forest of Écouves, 1,368 ft.). It forms a centre whence rivers diverge in all directions, traversing deeply cut and picturesque valleys, in many cases well-wooded with fine oaks.

Horse breeding is very important in the rural districts; there are three breeds—those of Perche, Le Merlerault and Brittany. The great government stud of Le Pin (which was established in 1714), with its school of horse breeding, is situated between Le Merlerault and Argentan. A large number of lean cattle are bought in the neighbouring departments to be fattened; the farms near Vimoutiers, on the borders of Calvados, produce the famous Camembert cheese, and others produce excellent butter. The bee industry is very flourishing. Oats, wheat, barley and buckwheat are the chief cereals, and fodder in great quantity and variety, potatoes and some hemp are grown. The variety of production is due to the great natural diversity of the soils. Small farms are the rule, and the fields are surrounded by hedges relieved by pollarded trees. Along the roads or in the enclosures are numerous pear and apple trees, the latter yielding cider, part of which is manufactured into brandy. Orne has iron mines and freestone quarries; a kind of smoky quartz known as Alençon diamond is found. The hot springs of Bagnoles, which contain salt, sulphur and arsenic, are famous. In the forest of Bellême is the chalybeate spring of La Hesse, which was used by the Romans.

Cotton and linen weaving, notably at Flers (*q.v.*) and La Ferté-Macé (pop. [1936] 3,704), forms the staple industry of Orne. Alençon and Vimoutiers make linen and canvas. Vimoutiers has bleacheries, which, with dyeworks, are found in the textile centres. At Alençon only a little of the lace which takes its name from the town is still made. There are foundries and wireworks in the department, and articles in copper, zinc and lead are manufactured. Pins, needles, wire and hardware are produced at Laigle (pop. 5,145), and hardware also at Tinchebray. There are glass-works, paper mills, tanneries (the waters of the Orne being reputed to give a special quality to the leather), and gloveworks. Coal, raw cotton, metals and machinery are imported. The exports include woven and metal manufacture, livestock, farm produce.

The department is served by the Ouest-Etat railway. There are two arrondissements, with Alençon, the capital, and Argentan as their chief towns, 36 cantons and 513 communes. The department forms the diocese of Sées (province of Rouen) and part of



BY COURTESY OF (2) VOORHEES, GMELIN AND WALKER, ARCHITECTS, PHOTOGRAPHS, (1, 6, 7) EWING GALLOWAY, (3, 9) ALINARI, (4) DE COU, FROM EWING GALLOWAY, (5) ORIENT AND OCCIDENT, (8) PUBLISHERS PHOTO SERVICE

ORNAMENTAL DETAIL IN ARCHITECTURE

1. Taj Mahal, Agra, India; alabaster screen inlaid with precious stones enclosing the tombs of Shah Jahan and his empress, Mumtaz Mahal, for whom Shah Jahan built (*c.* A.D. 1631) the Taj Mahal. 2 Models of ornament for the Telephone Building, Washington, D C., an illustration of modern vertical design. 3. Sarcophagus from the tomb of Caecilia Metella, Augustan era; now in the court of the Farnese Palace, Rome. 4. Interior of *La Sainte-Chapelle*, Paris, built 1246–58 by Louis IX. (Saint Louis). (See *Gothic Architecture*, Plate I.) 5. Pillars of the Confucius Temple at Chu Fu, Shantung Province (Yuan dynasty, 1280–1368), with the Chinese dragon and other forms in high relief. 6. Entrance to the Transportation Building, Chicago World's Fair, 1893. Louis Sullivan, architect. 7. The Alhambra, Granada, Spain, 13th and 14th centuries; *mihrab* or prayer niche in the private mosque, adorned with lace-like carvings in stone of Arabic inscriptions, delicate arabesques, and geometric designs; and with horseshoe and lobar arch forms and coloured tiles, characteristic of Moorish art in Spain. 8. St. Mark's, Venice. Two isolated marble columns, near the arcades of the south side, brought in the 18th century, from St. Jean d'Acre, Palestine, by Tiepolo. 5th century, Hellenistic style. 9. Detail of a marble altar, by Benedetto da Rovezzano (1476–1556), in the Church of the Holy Trinity (Santa Trinità), Florence

the *académie* (educational division) of Caen, and the region of the IV army corps; its court of appeal is at Caen.

ORNITHOLOGY is the science of birds. We begin with the records of birds made by Aurignacian man during the last glacial epoch of the Ice age in France and Spain—paintings on the walls of caves, or figures or incisions carved on bits of horn, bone or stone. The birds that have been identified thus far from this remote Palaeolithic art include the crane, duck, goose, grouse, owl, partridge and swan. In the more recent Neolithic period, outlines of birds are more common, so that in the cave at Tajo Segura, in the province of Cadiz, southern Spain, Col. Willoughby Verner found figures of 12 species of birds, the great bustard, crane, duck, goose, raven, spoonbill, flamingo, purple gallinule, glossy ibis, stork, eagle and marsh harrier. To these archaeologists assign an antiquity of 6,000–8,000 years. The Palaeolithic designs are much older.

From a painting and a statuette of the common fowl from Egypt, made about 4400 B.C., it is believed that this bird was even then kept in captivity, while knowledge of the domesticated pigeon in the same country, according to Canon Tristram, goes back to the 5th dynasty, about 3500 B.C. Record of the use of pigeons as carriers of messages is found a little later. In a tomb of the 4th dynasty of about 3700 B.C., at Meidoum, in Egypt, Auguste Mariette discovered a fresco showing red-breasted and white-fronted geese, whose painted colours are said to be exactly like those seen in the two species to-day.

Early Writings.—There are many incidental references to birds in the Bible, those in the Old Testament being of considerable antiquity. The writings of Aristotle (384–322 B.C.), though they do not attempt to give a connected account, include statements (according to Sundevall) that concern about 170 species of birds. He obtained part of his information from still earlier writers whose works are lost. Pliny the elder (d. A.D. 79), in his *Historia Naturalis,* devoted Book X to birds, taking much from Aristotle. Aelian (d. about A.D. 140) made various notes on birds, compiled in part from older authors.

Early Saxon poets mention the gannet and several other birds of uncertain identity in songs current during the 6th and 7th centuries, and during the latter came early records of falconry, apparently introduced by the Saxons into Britain. About the middle of the 8th century the *Epistolae Sancti Bonifacie* informs us that Boniface, archbishop of Mons in Belgium, presented to Ethelbert, king of Kent, a hawk and two falcons. In the laws of Howel, king of Cambria, supposedly in the 10th century, there is statement of the hunting of the pheasant, and allusion to hawking. Incidental references to hunting with hawks are found in accounts of the activities of Athelstan, and of Edward the Confessor. Aelfric's *Vocabulary,* a list of words prepared in the 10th century, possibly for educational use, and another of somewhat later date, contain names of more than 100 birds, while in the *Colloquy of Aelfric,* a series of dialogues between a master and his pupils, are references to hunting with and training of hawks. In the writings and manuscripts of the 12th and 13th centuries are many references to hawking, descriptions of decoys in which ducks were captured alive, records of heronries and an account of a great flight of crossbills into England in the year 1251.

Following the invention of printing, William Turner published in 1544 a commentary on the birds of Aristotle and Pliny, prepared in accordance with treatment that was the forerunner of modern methods. This was followed in 1555 by Konrad von Gesner's *Historia Animalium,* whose third book dealt with birds and contained many original observations, as the author travelled extensively and recorded his impressions first-hand. Pierre Belon, whose *Histoire de la nature des oyseaux* appeared also in 1555, had considerable knowledge of the anatomy of birds, and seems to have been the first to correlate the various parts of the avian skeleton with those of man's.

In the joint observations of Francis Willughby and John Ray, published by the latter in 1678, after the death of Willughby, there is found a division of all known birds into two great groups of landfowl and waterfowl, an arbitrary classification that has been current to the present generation, though now superseded by a more modern grouping based on structural characters.

Linnaeus, the founder of the modern system of scientific names used in systematic zoology, began publication of his *Systema Naturae* in 1735. His attempt was to be terse and concise, and in 1758, in the 10th edition of his work, he proposed that each species of animal be designated by two names, the first of generic significance applying in most cases to a number of somewhat similar allied forms, and the second specific in nature and used in connection with the genus name for the species in question alone. (*See* ZOOLOGICAL NOMENCLATURE.) In recent years, a category of subspecies, or geographic races, designated by a third Latin term or subspecific name, has been added where required.

Natural history collections made in connection with the many exploring expeditions of the late 18th and early 19th centuries brought to Europe, particularly to England and France, many specimens of birds that greatly broadened knowledge of the ornithology of the world. In early explorations paintings or drawings were made of birds, or specimens were preserved in spirits, or sometimes dried as mummies. At the beginning of the 19th century, as travellers increased and interest in natural objects expanded, methods of preparing skins of birds were evolved that led finally to the making of what are known as scientific specimens, where the skin, with the feathers intact, is removed from the bird, leaving only the bones of the skull, wings, feet and base of the tail. The inner surface of the skin is poisoned, usually with arsenic, filled with cotton, tow or other light vegetable substance and dried after being wrapped or otherwise arranged so that it resembles a dead bird. By means of such preparations it is possible to assemble collections of birds that may be preserved indefinitely for continued study and examination. The growth of such collections and their expansion into museums, where birds were mounted in natural positions, changed completely the style and method of published treatises dealing with ornithology. To this time these had been mainly accounts and descriptions written from hearsay or memory, and involving constant repetition of the writings of previous authors. Such accounts were now in large measure supplanted by detailed statements regarding specimens secured during voyages, or monographs that brought together all available knowledge concerning genera, families, or larger groups of birds. The art of illustration was amplified, and many works contained series of coloured representations that delineated the bird under discussion more definitely than words. Among early writers of such illustrated works or monographs may be mentioned E. L. Daubenton, whose *Planches enluminées* contained 1,008 plates mainly on birds; F. le Vaillant, who published on hornbills, cotingas, birds of paradise and many others; L. J. P. Vieillot, who produced an array of volumes that dealt with the majority of the known birds of the world, and C. J. Temminck, who wrote on the pigeons and gallinaceous birds.

John James Audubon's *Birds of America,* in 4 vols. of elephant folio size, containing 435 plates, was published in London between 1827 and 1838, and was followed by his *Ornithological Biography,* in which, with the aid of William Macgillivray, he gave accounts of the habits of North American birds. The writings of John Gould, which began in 1832, covered descriptions and beautiful paintings in colour of birds of all parts of the world and included in all more than 40 folio volumes illustrated by more than 3,000 plates.

After the middle of the 19th century ornithological publications increased to a point where it becomes impossible briefly to enumerate them. In America increase of knowledge in ornithology subsequent to Audubon and Alexander Wilson (who was a contemporary of Audubon in the study of American birds and published an excellent and painstaking account of them) came rapidly with the appointment in 1850 of Spencer Fullerton Baird as assistant secretary of the Smithsonian institution. Baird's early years in this new position were coincident with the initiation of the great exploratory surveys, including the Hayden surveys and the survey of the 40th parallel of latitude, undertaken by the government to develop the western part of the United States. Baird established the U.S. National museum as a depository for specimens of all kinds belonging to the U.S. government, and arranged to send

naturalists with the different survey parties, with the result that large collections, particularly of birds and mammals, went to Washington, furnishing the material for many important reports.

Ornithological Societies.—As ornithologists increased in number, desire for discussion of their problems grew, to take shape finally in serials devoted to birds alone. Among the early periodicals that continue today there may be mentioned especially the *Journal für Ornithologie* begun in 1853, the *Ibis,* founded by the British Ornithologists' union in 1859, and the *Auk,* originated by the American Ornithologists' union in 1883. The last mentioned is a direct continuation of the *Bulletin* of the Nuttall Ornithological club, established by that organization in April 1876. The Zoological Society of London, especially in its earlier years, had a profound influence on the development of ornithology through the labours of its prosectors, particularly A. H. Garrod, W. A. Forbes and Frank E. Beddard, and through its publications, especially the *Proceedings of the Zoological Society of London,* and its precursor, the *Proceedings of the Committee of Science* and *Correspondence of the Zoological Society* (1830, etc.).

Today, there is an ornithological or similar society in most of the principal countries of the world. In 1947 there were more than 30 periodicals devoted to various phases of bird study alone. Of these, one of the most important to the ornithologist has been the *Zoological Record,* published annually after 1864 by the Zoological Society of London. The section devoted to Aves annually contains reference to more than 1,000 separate papers.

Bird Protection.—Another phase of ornithological interest that has obtained extended popular support in the past two decades is that of the protection of useful or harmless birds. (*See* BIRDS, PROTECTION OF; BIRD SANCTUARIES.) Legislation intended to restrict the killing of ducks, grouse and other birds considered as game, began in very early times, indication of recognition of the propriety of such action being found in the Old Testament (Deuteronomy, xxii, 6–7) where there is a prohibition against the killing of a bird on the nest.

In the laws of the Welsh king, Howel of Cambria, about the 10th century A.D., there are definitions of the various kinds of hunts, including the hunting of the pheasant. Such penalties as the loss of both eyes were provided by William, duke of Normandy, for peasants who had the temerity to kill game reserved for the nobility. Game protection was thus one of the early tenets of Anglo-Saxon law, and so came early to the new world, particularly to the United States, though, unfortunately, it has not been possible to show clearly the need for rigid protective measures until the destruction of game had greatly reduced valuable species of birds. In America protective measures to conserve valuable birds antedate the coming of the Caucasian, however, since the Inca rulers, recognizing the value of the sea birds of the coasts of Peru as producers of fertilizers, forbade anyone under penalty of death to enter or disturb their rookeries during the breeding season. For many years in America legislation for the protection of game birds was considered a local matter and was applied by states or territories individually. It became recognized that this procedure, through lack of uniformity, did not give proper protection to ducks, geese and other migratory game birds, which led finally to assumption by the federal government of control over nonsedentary species and a covenant with Great Britain known as the Migratory Bird treaty, arranged in 1916, which provided uniform regulations for the United States and Canada. The success of this measure was so pronounced that it attracted wide attention and led to a similar convention with Mexico concluded in 1937. This was followed in 1940 by an inter-American agreement among the American republics for nature protection in general.

As human interest in birds spread, there arose considerable feeling against the killing of small birds for food or game. It was realized that insectivorous birds were of benefit to man through their assistance in keeping down the abundance of insects injurious to agriculture, to which was coupled the aesthetic appeal of birds in general, through their beauty of form, colour and note, to the sympathetic and understanding mind. Use of the feathers of birds in decorative dress has been the custom from remote times, a custom that at the close of the last century culminated in a fashion that required the placing of stuffed skins or parts of skins of birds in more or less grotesque attitudes upon women's hats. The resultant demand for feathers led to the destruction of birds by the hundred thousand. Plume-hunting became a lucrative business, and led to search for strange and beautiful feathers throughout the world. Terns, gulls, herons, birds of paradise, hummingbirds, to say nothing of countless familiar songbirds, were slaughtered to supply an unthinking and somewhat senseless desire for decoration, a course that led to great diminution in numbers in many species of birds. The destruction wrought was especially rapid in species that breed in colonies. Herons, terns and grebes, brought together by the paramount instinct for reproduction, were held by their eggs or young to a limited area, and so were easy to kill in large numbers. As this killing entailed the loss of eggs and the starvation of young, these species suffered to such an extent that some almost disappeared as living forms. As understanding of the results of such brutal methods arose, there resulted a revulsion against this fashion which led to the formation of such bird-protective organizations as the National Audubon society which brought forcibly to public attention the evils of plume-hunting. This resulted in a partial change in fashion, and in legislation against plume importation and traffic. It is now generally recognized in England and the United States that bird protection is meritorious, a sentiment spreading rapidly to other countries so that international conventions have been held to promote it.

In connection with protective measures it is realized that the Caucasian race in its present civilization has modified natural environments to such an extent that many avian inhabitants of our earth are being crowded out of existence. To procure the continuance of interesting forms, some for their economic worth and some for their aesthetic interest, reservations or sanctuaries have been formed which birds may frequent without molestation. In Europe such preserves were made primarily to protect upland game birds and are thrown open to hunting at the proper season. In the United States reservations have been established to cover areas where herons, terns or similar birds nest and consist of low coastal islands, or swamp and marsh lands of little monetary value. Both types of sanctuary are now found in many countries.

The result of such protection, enforced in most instances by paid wardens, has been to increase the numbers of many birds. The egret and snowy heron, at one time reduced from a great multitude whose breeding colonies were so populous that, from a distance, they appeared like vast white blankets, to a condition where it was unusual to see a single individual, have become again common in extensive areas. Terns have returned to colonies that were deserted for years, and the pelican maintains its numbers in spite of much unthinking persecution.

In the United States after 1935 there was a tremendous expansion of the reservation program so that by 1944 there were 278 refuges covering 17,626,916 ac., under jurisdiction of the department of the interior. These reservations ranged in size from a few acres to several hundred square miles, while lighthouse reservations, national parks and similar tracts were designated as bird preserves. In addition, various states developed the idea of game sanctuaries which also became refuges for birds. Private sanctuaries also multiplied and afforded much protection; many were established as local enterprises by cities, towns or by groups of private individuals.

Economic Studies.—Early information on the economic value of birds was based largely on field observation of living birds, and many of the data obtained were erroneous. The method should be checked by the stomach examination, as developed largely by the bureau of biological survey, of the U.S. department of agriculture (now part of the fish and wildlife service, department of the interior). In this, a series of stomachs of any given species of bird is secured, so far as practicable, at intervals throughout the year, under as many varying conditions of life as possible. These contents are examined under a microscope with low magnification, and the different kinds of insects, seeds, bones or other materials sorted. There is thus afforded a picture of the actual

food preferences of the species concerned and the status of the bird is decided on this basis as useful or harmful. These data have been of great use in arranging protection for species that assist in the war on insects injurious to crops, or that are proved to be harmless, since such information offers a certain check against observations on living birds in the field. (*See* publications of the fish and wildlife service [*q.v.*] of the U.S. department of the interior.)

Aviculture.—Aviculture (*see* AVIARY AND AVICULTURE), or the keeping of birds alive, goes back to a remote period, of unknown date, when primitive man brought young birds of various kinds to his rude domicile, partly through curiosity and partly to use as food. Parrots are mentioned by Ctesias, a Greek writer, a century before the time of Aristotle, as birds that spoke the language of man, and a little later the Romans are known to have kept them in ornate, silver-wired cages of tortoise shell and ivory.

The domestication of falcons for hunting is recorded in Persia as early as 1700 B.C., and is said to have antedated that period in China. Falconry (*q.v.*) is believed to have spread to Europe as early as three centuries before the Christian era. In America the Pueblo Indians of New Mexico and Arizona held the turkey (*Meleagris gallopavo*) in captivity at least 1,000 years ago, and probably at a much earlier period, not for use as food, but for the feathers, which were plucked from the living bird and burned in prayer offerings to propitiate the Deity. The accumulations of turkey bones in a number of pueblo ruins indicate the numbers maintained.

The original canary (*Serinus serinus canarius*) is believed to have come from the Canary Islands, but in its original gray, olive-green and yellowish plumage, with sides and flanks streaked with dusky, is so similar to the serin finch (*Serinus serinus serinus*) of southern Europe that it is probable that both these closely related geographic races furnished the stock from which have come our modern birds. Canaries were known in a domesticated state at the close of the 14th century, though they seem at that time to have been rare, as Konrad von Gesner, in 1555, mentions that he had never seen one. Variation in colour among them began early, as partly yellow canaries were known at Nuernberg in 1614, and in 1677 pure yellow canaries as well as white ones were recorded at Augsburg. Modern interest in canaries is shown by the many societies of canary breeders and several journals that deal with their needs.

The keeping in captivity of exotic birds of all kinds originally was the field of zoological gardens, but has engaged the attention of many individuals and until World War II gained greatly in vogue, particularly in western Europe and in the United States. Aviaries were brought to a high state of perfection, and the requirements of many delicate species of birds were studied with the utmost care to permit success in their breeding and rearing in confinement, the highest goal of achievement of the bird fancier.

TYPES OF LIVING BIRDS

Mammals have specialized for life on land (as the deer and mouse), in water (as the whale), in the air (as the bat), for night life (as the lemur) and in the earth (as the mole). But birds specialize for existence or progression through the air. Though it is common for birds to nest in holes or tunnels in the earth, which, in many cases, are excavated specially for this purpose, no bird has been able to adapt itself to continuous life underground, probably because its covering of feathers is not designed to withstand the constant abrasion that would take place in burrowing. Also, though many birds frequent the water, none are so wholly adapted to life beneath the surface as the whales. The bird thus has failed to utilize completely the ecological environments that have been available for it—a manifestation of its inferior adaptability compared to the mammal.

Birds adapted to a terrestrial existence are found in many widely separated groups, as for example ostriches, bustards, plovers, larks and pipits. Most of these adopt a terrestrial habit to secure food and safety from enemies. They run about on the earth and, though the greater number retain power for flight, often trust to their legs to avoid or escape ordinary pursuit. Most of them show greatest variety in regions of extensive plains, prairies or broad, open downs. The wholly terrestrial forms that have entirely lost the power of flight are comparatively few, and (so far as continental areas are concerned) are birds of considerable size and strength. Among living forms they include the ostriches of Africa, which extend into Eurasia as far as southern Iran, the cassowaries of New Guinea and adjacent areas, the emus of Australia, the kiwis of New Zealand and the rheas of South America. These birds, though united by certain peculiarities, differ widely from one another and seem to represent ancient types of bird that were formerly more abundant, as a number of fossil forms are known. It will be noted that large flightless birds exist in modern times in all of the continents except North America, where they have not been represented since the Eocene.

The kiwis (*Apteryx*) of New Zealand, the queerest and most unbirdlike of living birds, are nocturnal and have different habits from the other species mentioned. They have long bills with the nostrils at the extreme tip, and move about by using the bill to test the ground before them as a blind man uses a cane, noting their surroundings partly by touch and partly by smell. On casual examination they seem to have no wings, but on investigation the wing is found concealed beneath the feathers, a tiny structure, a little more than three inches long when fully extended, and entirely without flying function, as the bird is heavier than an ordinary fowl. The cassowaries, like the kiwis, inhabit forest areas, but are far less peculiar. The wings are small, with heavy, naked quills nearly concealed beneath the long, hairlike feathers, and there is a curious casque on the head. It is said that the bird uses both casque and wing-quills to fend off entangling vines in travelling through the jungle.

Ostriches and rheas have larger wings and may extend them while running, but are wholly without power of flight. In all these birds the body is heavy and the legs are large and strong. With those fleetest in running there is a tendency to reduction in the number of toes, so that the rhea has three and the ostrich only two. That these birds have come from flying ancestors is apparently indicated by the wing, which, while small and weak, has the bones formed as in flying species. All the species discussed have the external surface of the breastbone smooth, without the great keel so characteristic of the flying birds, there being no necessity for such attachment, as in flightless birds the muscles usually concerned in flying have little development.

There is another type of terrestrial bird that has developed more recently than those just discussed, found mainly on oceanic islands. This includes various species of flightless rails, and some other birds that have lived under conditions in which they had no enemies from whom it has been necessary to escape by flying, so that through disuse the power of flight has been lessened until, finally, the birds are not able to rise from the ground, though the wing retains the same form encountered in flying birds and the breastbone still has a keel, though this may be greatly reduced in size. The weka rails of New Zealand are the most striking living examples of this group; they are nearly as large as a fowl, and run with great ease and rapidity. Some other flightless rails are much smaller, for example, the Laysan rail (*Porzanula palmeri*), of Laysan Island in the Hawaiian Islands, which is not much larger than a newly hatched chicken. In running fast this bird extends its wings and flaps them rapidly, but is unable to rise from the ground. Many other insular birds show a tendency to degeneration of the wing but still can fly.

Among birds adapted to life in the water, the penguins are preeminent. These include about 17 species found in southern seas, ranging in size from the great emperor penguin (*Aptenodytes forsteri*), which is 48 in. long and weighs up to 78 lb., to the little blue penguin (*Eudyptula minor*) of New Zealand and the Chatham Islands, which is only 16 in. in length. Penguins have thick, heavy bodies, more or less elongated, and are covered uniformly with dense, short feathers, without the bare spaces or apteria that in other birds divide the feather-growths into distinct tracts. The wing is a short, broad paddle, without developed quills, the feathers being close-set and stiff, almost like the scales of a reptile. In the water the penguin rests comparatively low.

Beneath the surface it progresses literally by flying, the flattened wings driving the bird through its aquatic medium swiftly and gracefully, while the feet are extended behind and serve as a rudder. Penguins have possessed their present type of body since early Tertiary times; but they came originally from a flying stock.

Other types of birds developed for life in the water include loons or divers and grebes, whose progress beneath the surface is accomplished, usually, by the use of the broad feet alone, the wings being held close to the sides, except when the birds are frightened or under other unusual circumstances. The downy young dive, by use of both wings and feet, indicating that flying under water is a primitive method. The many species of auks and guillemots use the wings beneath the surface as in the air above. The cormorant and the snakebird progress by use of feet alone. Mergansers, scaups, redheads, pochards and goldeneyes among ducks dive regularly with the feet alone, while in the same group old squaws, scoters and eiders as regularly use both wings and feet beneath the surface. The curious diving petrels (*Pelecanoides*) of the southern hemisphere fly swiftly beneath the water and may burst out through the surface in full flight.

Birds adapted for life at night are fairly numerous and are typified especially by members of the nightjar and owl families, though specialized forms occur among a number of other families. Most nocturnal birds have large eyes that usually reflect light with a prominent reddish colour so that the eyes of many nightjars glow like dull coals of fire by the reflected light of an electric torch and may be seen for a considerable distance. One of the American nighthawks (*Chordeiles acutipennis*) is an exception, since the eyes shine faintly with a yellowish green hue. Most nocturnal birds actually see at night by a specialized eye adapted to collect the faintest rays of light. Only the kiwis (*Apteryx*) among habitually nocturnal species appear almost blind.

GEOGRAPHIC DISTRIBUTION

The laws governing geographic distribution (*see* DISTRIBUTION OF ANIMALS), through which each faunal area has its own peculiar forms, apply to birds as to all other animals, in spite of the easy method of travel possible for the bird. Few birds are cosmopolitan. As an example may be mentioned the sanderling (*Crocethia alba*) which at some season may be found along water almost anywhere on the earth, but which nests only in the arctic regions, passing southward in migration throughout the world, to return in spring to its breeding area. The barn owl (*Tyto*), resident through wide areas in the temperate and tropical regions of the earth so that it reaches all the continents, has reacted to its environment in such a way that 50 geographic forms, some sufficiently distinct to be called species, were recognized by 1945. In contrast to this, many species are confined within very narrow limits, as the very distinct Laysan teal (*Anas laysanensis*), found only about the shores of one small lagoon on Laysan Island in the Hawaiian Bird reservation, where it has a range of only about 1 sq.mi.

Every continent has its peculiar forms of life, so that the earth's surface has been divided into great regions, each characterized by certain groups or by the lack of some found elsewhere. According to a usually accepted classification, these are given the following names: Nearctic region, for North America south to include the Mexican tableland; Neotropical region, for southern Mexico, Central and South America and the West Indies; Palaearctic region for Europe, Algeria and Morocco and Asia north of the Himalayas and the Gobi desert; Ethiopian region, for the remainder of Africa; Oriental region, for India, Indo-China, China, the Philippine Islands and the East Indian islands to, and including, Bali; Australian region, for Australia and the Pacific Islands south of the Tropic of Cancer; and New Zealand region, for New Zealand. The life of the northern hemisphere is so evidently allied that what are here designated Nearctic and Palaearctic regions are frequently united under the term Holarctic, a vast area that extends throughout the entire north temperate and arctic area.

These great regions, which cover continents, are divided into life-zones, where temperature and certain other general conditions control the distribution of species within narrower limits. The life-zones are more sharply delimited in temperate regions than in tropical and subtropical areas, and to some extent are more easily distinguished in the northern hemisphere than in the southern. They change with difference in altitude on the slopes of mountains as they do with difference in latitude in travelling north or south, and are most easily perceived on the slopes of steep mountains, where the successive zonal bands may be compared without great difficulty. Life-zones to the present time have been most intensively studied in North America. By the student the life-zone is further divided into faunas, where conditions imposed by rainfall, geological formation and similar factors produce sections characterized by aggregations of species or subspecies.

Birds, in general, have attained a vast distribution over the surface of the globe because of their ability in flight and their specialization for life on both land and water. As a result of this versatility and adaptability some form of bird is found at some season everywhere over the world, except perhaps in the centre of the great unexplored Antarctic continent. Broad areas of the sea, away from the great ocean currents that flow like rivers through this aquatic medium, may appear birdless for days and weeks, but are crossed at certain seasons by some of the petrels in their wanderings. The seas and lands within the Arctic circle are visited by many birds, some of which, as the raven and snow bunting, nest far north in Greenland, and some, as ducks and gulls, in summer traverse the solitudes of the north polar sea.

As individuals, birds may be tremendously abundant in temperate regions, but it is within the tropics that the greatest variety of forms occur within small limits. The largest aggregations are found in regions of diversified topography, where the life-zones change within a comparatively few miles from tropical to alpine. The greatest number of forms recorded as of 1945 from a limited area is that reported by Dr. Frank M. Chapman from Ecuador, where within approximately 75,000 sq.mi., an area less in extent than Great Britain, there are known at present 1,508 forms of birds, and this list is far from complete.

THE AVIAN LIFE-CYCLE

The circle of annual activities of any bird, in general, includes a period for nesting, the rearing of the young to maturity, and a subsequent resting time when a moult occurs to renew the covering of feathers. With many birds there is included in this program a migration or journey to some other region, and a subsequent return to the native area at the coming of a new breeding period. The cycle of activities thus corresponds to the seasonal round of the year, as the necessities of the bird are influenced by climatic conditions, which change from month to month, except in limited areas in the tropics, and even there the life of birds is influenced to a greater extent than might be imagined through the incidence of wet or dry seasons.

REPRODUCTION

With the approach of the breeding season there is instituted at once a conflict, active or passive, as the case may be, between males of the same kind for a breeding area in which, later, the nest will be located. (*See* also BIRDS: *Reproductive Habits.*) Each male selects some section suited to nesting needs and remains within or near it until a mate appears, if he is not already mated, and protects this tract against encroachment by others that may be considered rivals. In the case of gregarious species, like the sooty tern (*Sterna fuscata*) that nests in great colonies on islands in the sea, the nesting territory for each pair may be only a yard square, or even less, being a space in which the egg may be located, so that the incubating bird and her mate, on guard beside her, can not quite reach the adjacent pair with whom, and with any others that intrude, they spar and fight on the slightest provocation. The male red-winged blackbird (*Agelaius phoeniceus*) of North America, also gregarious, selects an area of marsh or swamp, with his neighbours situated at a distance of a few feet or a few yards, and remains on guard, forbidding entrance of another male in that limited space. Solitary species hold larger areas, so that a red-eyed vireo (*Vireo olivaceus*) may hold a clump of three or four trees, or a blackbird (*Turdus merula*) may

pre-empt a small section, including thickets, trees and open ground. Possession of such a breeding ground at the beginning of the nesting season is a paramount passion with each male, and to retain possession he will battle fiercely, even until death, with any others of his kind that may attempt definitely to locate within what have been selected as his limits. Under this urge, sanguinary combats are not unusual among species whose individuals live for the rest of the year wholly at peace with their kind.

Mating.—At the mating season the male bird resorts to a variety of artifices to attract attention on the part of the female, and to arouse her interest to the end that a nest be established. (*See* also COURTSHIP OF ANIMALS; SELECTION: *Sexual Selection;* BIRDS: *Reproductive Habits.*) Among perching birds this is first indicated by song (*q.v.*), by which the male not only gives expression to the pleasant sensations of merely living, but also, when established on his breeding ground, gives notice to rivals of his presence as a guard over his territory and advice to females that he is in search of a mate. The song may range from the polished effort of an expert, like many thrushes, the nightingale, or the mockingbird, to sounds that, to some human ears, may be merely disagreeable noise, as the chatter of the house sparrow, or the strange music of the plant cutter of South America (*Phytotoma rutila*), whose song is a curious squeaking that resembles exactly the rubbing produced by tree-limbs touching in the wind. The rhea booms, the hawk screams and the owl hoots, each producing music in the estimation of others of its kind.

Actual mating may be accompanied by a great variety of strange and unusual actions which the male alone, both sexes or more rarely the female alone may undertake (*see* COURTSHIP OF ANIMALS). The male ruffed grouse (*Bonasa umbellus*), of North America, selects a stand on some sheltered log or stump, to which he resorts each day to drum, a resonant love call for which he draws himself fully erect and begins a steady beat of his short, stiffly feathered wings. The action of these against the air between wing and body is so strong and abrupt that a dull thumping sound is produced, at first slowly and then with increasing rapidity, until the sound comes as a steady, pulsating roar. The display of the peacock, in which the long, ornamented upper tail-coverts (mistaken by many for the tail, which is short, stiff and dull in colour, entirely concealed beneath the longer feathers) are erected and fully spread, to be shaken finally with a dry rattle as the male faces the apparently indifferent female, is another well-known example of activity on the part of the male alone.

The great crested grebe has a complicated courtship-display in which both sexes participate. A pair approach, facing one another with head wagging from side to side, then raise one wing and preen the feathers beneath, an action varied in many ways to culminate finally in a weird dance in which the pair rise erect, treading water, and remain bolt upright with breasts nearly touching for a brief space.

In some species of albatross mutual courtship-displays have progressed to a point where they have far exceeded mere mating antics, and have become social customs that continue through a period of months, beginning with the arrival of the birds on the breeding grounds, and continuing until the young are grown. In the Laysan albatross (*Diomedea immutabilis*) of the islands west of Hawaii, the display begins with two birds approaching with quick bows, shaking their heads rapidly from side to side, raising the wing to preen the feathers beneath and finally throwing the head and neck fully erect, with the bill pointing perpendicularly to the sky, while both birds emit a hollow groan. This action is of daily occurrence when the birds are on land, from October to May, and is participated in by mates or neighbours.

As an example of the third type of display there may be mentioned the courtship of the phalaropes, in which the female has brighter plumage than the male and takes much of the initiative. In Wilson's phalarope (*Phalaropus tricolor*) both birds bow and nod, but in the culmination of this action the male flees with one, or sometimes two, females in close pursuit.

The site for the nest that is to contain the eggs is sometimes chosen by the female, sometimes indicated by the male, though the female may exhibit certain supposed prerogatives of her sex in such matters by modifying considerably the original plans proposed by her mate. The male house sparrow (*Passer domesticus*) when it chooses to nest in a cavity selects some suitable hollow, and rests beside the entrance, calling and chattering until a female comes to inspect the premises. If these appear suitable, nest construction may proceed. With species that nest in trees or bushes, or on the ground, where there is greater latitude of site, various locations may be examined before definite selection is made, both male and female apparently exhibiting directive impulse in choice. When suitable sites are numerous it is probable that final selection comes frequently through the chance that directs the placing of the first nesting-material when the courtship shall have proceeded to the point of actual nest construction. In some instances, where numerous sites all exactly alike are available, as where barn swallows (*Hirundo rustica erythrogaster*) make their nests of mud on rafters of a building, there is often confusion, so that birds may carry pellets of mud to a dozen rafters until one of the several foundations assumes more importance in their eyes than the others and a nest is brought to completion. In such species as the ruby-throated hummingbird (*Archilochus colubris*) and prairie hen (*Tympanuchus americanus*), where mating takes place at a point away from the nest and the male does not visit the nest-site, selection of a suitable spot rests entirely with the female.

With most birds mating is temporary, and may be for the period of a single brood, or, where two or more families are reared, for one nesting season. Some interesting information has been secured on this subject through marking birds with numbered bands which serve to distinguish such individuals from others of their kind. In these studies one male house wren (*Troglodytes aëdon*) was found mated with three different females in three successive years, and this same individual mated with two different mates for first and second broods during one season. Another wren mated with one companion for one brood, and in the following year took a new mate, with which it was found in the year succeeding. This shifting in the mating relation is not because of the death of one of the birds.

Though the majority of birds associate in pairs only during the nesting season there are some exceptions to this. The white-breasted nuthatch (*Sitta carolinensis*) of North America is found so invariably in pairs that when one appears alone the assumption is that something has killed its mate. Cardinals (*Richmondena cardinalis*) also may be found in pairs throughout the year. It is commonly stated that some birds, as eagles, mate for life, but this remains definitely to be proven.

Polygamy is practised by numbers of birds, particularly among the pheasant-like species. The males of the capercaillie (*Tetrao urogallus*), black grouse (*Lyrurus tetrix*) and wild turkey (*Meleagris gallopavo*) regularly take several mates, though the bobwhite (*Colinus virginianus*), a related species, is monogamous. Polyandry has been alleged for a number of species but needs verification as to regular occurrence since one of the forms concerned, the cowbird (*Molothrus ater*), where the female has been said to mate with several males, has been found to pair as regularly as is normal in small birds.

Nests.—The nests of birds (*see* NEST) exhibit a wide range in form and many have wonderful features.

The skimmer (*Rynchops nigra*) and the least tern (*Sterna antillarum*) excavate a slight hollow in sand or gravel to contain the eggs. The American avocet (*Recurvirostra americana*) may line a slight depression near the water's edge with a few bits of weed stem, and there deposit its four eggs. Subsequently, should the waters increase in freshet the avocet hustles about gathering grass, bits of wood, feathers, small bones and weeds to raise its treasures above the flood, so that where necessity arose, these birds have been known to erect piles of rubbish a foot in height. If the waters subsequently subside, these elevated nests become conspicuous structures but are not removed.

Some ground-nesting birds regularly conceal their eggs in holes. The Manx shearwater (*Puffinus puffinus*) digs burrows in loose soil and makes its nest at the end of the tunnel. There may be variation in method in one species, however, as the wedge-tailed shearwater (*Puffinus pacificus cuneatus*) of the Pacific Islands

ordinarily excavates a hole for nesting, but on rocky islands, where there is little soil, may deposit its egg on the ground, under bushes, or even in the open. The little auk or dovekie (*Plautus alle*) searches out a crevice or shelter beneath boulders, often on talus slopes where rock fragments are piled in great confusion. The belted kingfisher (*Megaceryle alcyon*) digs a tunnel on the face of a steep bank and lays its eggs at the end, gradually building up a mass of fish bones from regurgitated pellets for a nest.

Concealment is sought also by some tree-nesting birds. The scops owl (*Otus scops*) of Europe and the screech owl (*Otus asio*) of North America seek hollows in trees, where the eggs are placed without nest lining of any kind. Woodpeckers excavate special chambers in the trunks of trees, placing their eggs on an accumulation of chips at the bottom. Though dead trunks are usually chosen, the yellow-bellied woodpecker (*Sphyrapicus varius*) frequently drills its home in a living hardwood tree, and the Puerto Rican woodpecker (*Melanerpes portoricensis*) may nest in a living palm trunk.

Nests of many herons, *e.g.*, the night heron (*Nycticorax nycticorax*), are placed in trees, and are flat structures of twigs and sticks that form a mere platform, so loosely built that the eggs may often be seen from below. Among larger nests there is every variation from this type to that of the osprey (*Pandion haliaetus*) to which material may be added year after year until the mass is 8 or 10 ft. in diameter and makes a cartload in bulk.

Among smaller birds, the tree nest is usually a simple cup that has a foundation of rough material on which the nest proper of finer material rests; the lining is made of soft substances, as rootlets or plant downs. The blackbird (*Turdus merula*) and the American robin (*Turdus migratorius*) line their nests with cups of mud, within which are placed soft grasses. Many birds place nests of grasses and rootlets under herbage or in thickets on the ground. For protection, many tree-nesting birds build homes with arched tops that wholly conceal the eggs. There is a great group of birds in South America, the so-called tracheophones, many of whose species have this habit. Conspicuous among them in the Argentine is the leñatero, or firewood-gatherer (*Anumbius annumbi*), that gathers a quantity of thorny twigs to form a spherical mass, within which is placed the nest proper, reached by a runway, the whole so firmly constructed that the eggs inside may be reached only with difficulty. These nests are durable and last for several years, until the materials composing them decay. The ovenbirds (*Furnarius*) in this group construct rounded masses of mud, with an entrance at one side, the walls being an inch or more in thickness, and so built that they will withstand the beating of heavy rains without damage.

Many of the troupial family (*Icteridae*) make purselike nests that are suspended in the tops of trees. The nest of the oropendola (*Gymnostinops montezuma*) of Central America may be five feet in length, suspended by the upper end, below which is located the entrance which leads through a long, constricted neck to the expanded lower part, where the nest proper is placed. The oropendola nests in colonies, but nests of the orioles, as the Baltimore oriole (*Icterus galbula*) which also constructs a purse-shaped nest from 8 to 10 in. in length, are found alone. The nests of the social weaver finches of southern Africa are among the most remarkable structures known in the bird world. These birds are gregarious and, in company, accumulate masses of grass in trees to form a roof, under which each pair of birds has its separate cubicle, lined warmly with feathers. From 20 to 300 pairs may inhabit a single structure, which grows in size as it is inhabited year after year, until it may contain several wagonloads of material.

Among other curious nests there may be mentioned those of the edible-nest swiftlets of the Indian, Australian and Southwest Pacific areas, that are cupped platforms, composed of a coagulated mucus secreted by the mouth-glands of the birds, placed on the walls of caves. These are gathered commercially and form the basis for a soup highly prized by the Chinese. The American chimney swift (*Chaetura pelagica*) makes a nest of twigs, cemented together by mucus from the mouth, to form a tiny basket. In early times these nests were placed on the inside of hollow tree trunks, but with the advent of the Caucasian race and the building of houses, hollow trees have been forsaken for chimneys.

Nest-building with most birds usually seems to be the duty of the female. The male may assist by bringing material and may lay it on the nest, but it is mainly arranged by the female. In many species the entire work devolves upon the female.

EGGS

In birds, as in all other vertebrates, the gonads are paired organs on the dorsal wall of the body-cavity. In most birds the right ovary disappears early in life, leaving only the left to grow and mature. This rule, though usual, is not invariable, since in many hawks, particularly the harriers (*Circus*), and the small bird-eating forms (*Accipiter*) usually, but not invariably, we find both ovaries present and functional. The ovum, or yolk, in birds is a relatively enormous cell which passes from the ovary into the mouth of a convoluted tube, the oviduct. As the yolk moves down the oviduct it receives first a deposit of gelatinous albumen, the "white," next a membranous sheath and then is enclosed in a hard, calcareous shell, and is deposited as an egg (*q.v.*).

Eggs are ordinarily oval in shape, though this is not invariable, since the eggs of swifts are usually elliptical, and those of owls are nearly round. Eggs of birds that breed on rock ledges without constructing nests are much pointed, which allows them to roll about in a relatively small circle and so lessens the danger of a fall over the edge. Eggs of many shore birds, which are relatively large in relation to the size of the birds, are also strongly pointed, which permits them to pack closely with the pointed ends toward the centre, thus bringing the whole into a compass that permits the parent to cover them.

Eggs of owls, kingfishers and woodpeckers, which are laid usually in holes or cavities (though some owls occupy open nests) are white, and whitish eggs are found in grebes, albatrosses and petrels. Most eggs have, however, a coloured shell, or spots and blotches of colour spread over a lighter background. Where there is a pattern of markings present there is usually a wreath of heavy colour about the large end of the eggs. Most herons' eggs are pale blue or bluish-green, and plain green or blue eggs are found in various perching birds. The tinamous of the new world, a primitive group, have very striking eggs, with smooth and highly polished shells, varying from green or pink to deep brown, their lustre suggesting porcelain.

The eggshells are penetrated by pores which usually can not be seen, except under a lens, but that in some eggs, as those of the ostrich, are easily visible to the unaided eye. Evaporation takes place through these openings, so that the egg loses steadily in weight during the incubation period.

The number of eggs produced annually varies widely in different groups, being adjusted to the requirements of each species, to enable maintenance of its normal numbers. The migratory species that covers a considerable range encounters more dangers than one that is sedentary and, therefore, must produce more of its kind. This statement, however, has many exceptions. Migratory wild ducks lay from 5 to 12 eggs, while the bobwhite, which is sedentary, may have as many as 21, though usually not more than a dozen. Among small birds, on the average more eggs are deposited annually by the migratory species of the temperate zones than by the sedentary forms of the tropics. On the other hand, the nonmigratory titmice and wrens lay many more eggs than the migratory warblers (*Sylviidae*). Most perching birds of temperate regions have from three to five eggs, rarely six, in a setting, but may nest two or three times each season. Most sandpipers deposit four eggs, though in some the number is reduced to three. Many gulls, hummingbirds, loons and some species of pigeons lay two eggs regularly. Other kinds of pigeons, with auks, petrels and albatrosses, lay but one egg. Boobies lay two eggs, but never seem to rear more than one young.

Adjustment of birds to their environment as regards the number of eggs deposited, to ensure continuance of each species, was made before the rise of man, who has been an active factor in the life of the earth for a relatively brief period compared to other animals. In some cases, where man has kept in check enemies of

birds, these species have increased. In other instances, where man has been an active enemy, he has brought about reduction in numbers or actual extermination, because the birds concerned had become adjusted to a certain annual drain on their numbers from natural enemies and were unable to change to counteract added destruction by man. The great auk laid only one egg, and since it nested in colonies was quickly exterminated. The passenger pigeon of North America, which existed in colonial days in innumerable hosts, also produced but one egg at a setting, which did not enable it to withstand the drain of hunting, so that it has become extinct. Usually, only those birds which rear a number of young each year can be maintained as game, and these must have protective regulation to enable them to hold their own.

Incubation.—After the egg is deposited it requires a certain definite temperature to develop to the point of hatching. This is normally accomplished by incubation on the part of one of the parents, usually the female, a period during which the bird remains closely on the nest, except for brief intervals required for a hasty search for food. The eggs are warmed by being brought into close contact with the breast and abdomen of the brooding bird, there being usually a sloughing of down and other feathers over a part of this area, to permit close contact between the skin and the eggs, and at the same time an increase in the blood supply to the skin, to bring a more even heat to bear. The actual degree of heat required to develop the embryo in the egg is known for only a few forms of birds. In the case of the domestic fowl the average incubation temperature is about 103° F. In charts published by Baldwin and Kendeigh, showing by use of a thermocouple fluctuating temperature in the nest of a house wren (*Troglodytes aëdon*), the incubating temperature is shown to vary from 39° to 41° C., or 102° to 106° F., the average being about 104° F.

Though, ordinarily, care of the eggs involves their being heated from the body of the incubating bird, in species that nest in the open, in warm climates, where the sun is torrid, brooding may be required to shade the eggs from too powerful sunrays. The body of the bird here acts as a shelter and an equalizer of heat.

Though incubation falls ordinarily to the lot of the female, there are many species in which both sexes alternate in this duty. This is true in the ostrich, various auklets, herons, grebes, petrels, etc. The male rose-breasted grosbeak (*Pheucticus ludovicianus*) broods devotedly, though in this case his action would seem disadvantageous, as his plumage is strikingly variegated with black and white, and the rose-red spot on his breast often shows above the rim of the nest, while his mate is inconspicuous in a brown, streaked dress. In the phalaropes, the bustard quails (*Turnix*), the emu and the rhea the male alone incubates, the female taking no part in this duty. It is believed that this also obtains in some other shore birds.

The megapodes or mound-builders (*Megapodiidae*), found from the Nicobars and Philippine Islands to Australia, carry on no incubation whatever. For example, the scrub fowl (*Megapodius reinwardt*), of Northern Territory and Queensland in Australia, scrapes together a mound of sand, earth, sticks and other debris, to which a small amount of vegetation is added, during the wet season. The mound may be used for a number of consecutive seasons; and mounds 14 ft. in height and 35 ft. in diameter have been discovered. The eggs of one pair of birds are buried in the top of such a mound, and, through heat generated by decomposition of the included vegetation, are maintained at an even temperature of 95° F. The nesting activities of these curious birds are strongly reminiscent of the breeding habits of the reptilian group, from which the class of birds as a whole is descended.

The period of incubation varies greatly in different groups, in general, being longer in large birds. The period may be shortened slightly by slight increase in incubation temperature or prolonged somewhat by irregular attention on the part of the parent. The incubation period of the emu is said to range from 56 to 63 days, that of the ostrich is reported as 42 days, the domestic mallard requires 4 weeks and the domestic fowl 3 weeks. Most small perching birds require from 12 to 14 days, with magpies and jays running from 16 to 18 days. One of the shortest incubation periods known is that of the American cowbird (*Molothrus ater*), whose eggs hatch after 10½ days' incubation. The ruddy quail-dove also is given as 10 days.

In the gallinaceous birds; *e.g.*, the domestic fowl, and many other species, the nest is used merely to house and incubate the eggs and the young, which are born covered with down and follow the mother in search of food as soon as their plumage is dry. In some mound birds the young are hatched with developed wing quills, so that they are able to fly within half-an-hour of hatching. In most tree-nesting species the young undergo a shorter period of development in the egg, and consequently must remain in the nest under close parental care for a period after hatching. The nest is thus a home during early juvenile development. Food is sought by the parents and brought to the young, and what guard may be possible is maintained against destructive enemies. In hole-nesting species like the hoopoes and woodpeckers there is indifference to nest sanitation, since immunity against dangerous bacteria that multiply actively when heat and moisture are available has apparently been developed. Such nests become extremely foul as the period of occupancy progresses. Hawks, herons and numerous others, even when very young, instinctively void their excrement beyond the nest, so that such unsanitary condition is obviated. In most of the smaller perching birds the excrement of the young is of such a consistency that it maintains a globular form and is removed from the nest by the parent. In a few finches, as the American goldfinch and crossbills, the excreta are voided by the young about the margin of the nest and are not removed.

In most birds the young remain with the parents for a time after leaving the nest, and gradually become self-reliant, so that they procure their own food. At this stage family parties usually separate as the young drift away from their parents, or the adults tire of importunate begging for food on the part of progeny able to procure their own sustenance, and so either drive the young away or themselves leave. When the young learn early to search for food, they may remain in bands with their parents.

Parasitism.—Breeding parasitism is found in several groups of birds in which no nest is built, the eggs being deposited with those of other birds and left entirely to the foster parent for care. The European cuckoo (*Cuculus canorus*) has long been known to have such habits. The female places a single egg in the nest of some bird, usually a species of small size, ordinarily choosing a nest in which the eggs are fresh, and removing one of the rightful set when leaving her own (*see* CUCKOO). Although about 100 species of birds have been recorded as parasitized, ordinarily each female cuckoo places her eggs in the nests of one particular species of bird. Each female cuckoo is supposed to lay from 5 to 16 eggs during the season. There is argument as to whether the cuckoo deposits her egg directly in the nest of the fosterer or whether she extrudes the egg elsewhere and carries it in her throat to the nest chosen. The former is certainly the more usual. An egg of the foster parent is almost invariably removed and eaten by the cuckoo after she has deposited her own. The process of placing the egg requires only a few seconds, and then the bird leaves at once, which renders definite observation difficult. The young cuckoo's back, hypersensitive to touch, has a spasmodic reaction when it comes in contact with objects other than the nest; aided by a curious depression on the back, the parasite casts out the rightful young, or the eggs until finally it occupies the nest alone.

Similar parasitic habits are known for a number of other cuckoos in other parts of the world. Stuart Baker, in discussing parasitism in Indian cuckoos, shows that a number are parasitic on one species or group of species of birds, and that the cuckoo's egg is specialized to resemble the foster parent's rather closely. In some cases one cuckoo may have widely different eggs in different parts of its range, as the hawk cuckoo (*Cuculus sparverioïdes*), which, when it parasitizes the streaked spider hunter (*Arachnothera magna*), lays a dark olive-brown egg like that of the bird parasitized, but that elsewhere foists on the laughing thrushes or allied species a bright blue egg like that of its dupes.

Some of the American cowbirds are also parasitic. The common North American cowbird (*Molothrus ater*) has developed no particular resemblance in egg colour to the egg of the fosterer, except

that many of its dupes lay spotted eggs like its own. In South America the bay-winged cowbird (*Molothrus badius*) cares for its own eggs in a normal manner, but is parasitized by a related species, the screaming cowbird (*Molothrus rufo-axillaris*), which uses this species alone as foster parent. Parasitism is also known in the rice grackles (*Psomocolax orizivorus*) which lay in the nests of related oriole-like birds. Certain species of weaverbirds (*Ploceidae*) and the honey guides (*Indicatoridae*) of Africa also parasitize other birds. The origin of such habits is obscure.

POST-BREEDING LIFE

The period of reproduction is the most active part of the annual life-cycle of the bird, from a biological standpoint, since it brings in play instincts and activities different and more complex from those apparent during the remainder of the year. Reproductive activity reaches its climax with the maturity of the young. With these on the wing the individual pair have done their utmost in the perpetuation of their kind, and there ensue a number of months of more restful life, with search for food and escape from enemies as the principal activities. For many species there is immediately a period of moult to renew the feathers, a period during which birds are quiet and sluggish, often seeking haunts where they will be disturbed as little as possible. With the drain on vitality brought by feather production at an end, there comes a time of greater activity, when old and young seem to attain greater vitality.

Moult.—The close of the breeding season finds adult birds with worn feathers, so that most species immediately undergo a moult, during which the old feathers are dropped and new ones are grown. The process is one that, in totality, requires more than a month to complete and progresses in regular routine, varying in sequence over the body in the different orders. In most species the feathers of the wing are shed and renewed one or two at a time, so that the bird still retains the power of flight. Ducks, geese, flamingos, cranes, rails and grebes drop all the wing and tail feathers in a very short time, so that they become flightless for several weeks until new feathers are grown. Penguins shed their feathers in patches, almost as a lizard drops its old skin. The epidermis of the tarsus and feet is sloughed during the moult, and any ornamental coverings of the beak are dropped at the same time.

Young birds have a first plumage, grown during their period of development, that is replaced by a post-juvenile dress of feathers that comes when they are fully grown and able to care for themselves. In most, the flight feathers remain until the following year, but in some, as the house sparrow (*Passer domesticus*), the wing and tail quills are also completely renewed at this first moult.

In most adult birds the moult comes immediately after the close of the breeding season, and in temperate regions occurs in late summer. The birds are thus again in full dress when the time for migration arrives, or, if resident, by the approach of cold weather. Swallows, many shore birds and hawks moult during the winter, the two former groups undergoing this process in the winter home after migration.

Most birds have one complete moult annually; but in many, particularly among the perching birds, there is another, partial or complete, through which the bird acquires nuptial plumes. In the bobolink (*Dolichonyx orizivorus*) and the whinchat (*Saxicola rubetra*), for example, the body plumage is completely changed in late winter and early spring. Many of the sparrow family, as the cirl bunting (*Emberiza cirlus*) and the Harris's sparrow (*Zonotrichia querula*), have a partial moult of the feathers about the head that produces new plumes for the breeding dress.

Change in colour is not necessarily accompanied by moult, as often the tip of a feather may be one colour and the middle portion another. In the throat of the male house sparrow, for example, in autumn and early winter the black throat is obscured by greyish feather tips. As spring arrives the gray tips wear away, so that the black is fully revealed. The most striking change of this type is found in the snow bunting (*Plectrophenax nivalis*), which is white or light brown above in autumn and winter, but through sloughing of the feather tips becomes entirely black on the back in spring.

MIGRATION

Aristotle (384–322 B.C.), the first to discourse connectedly on bird migration (*see* BIRDS, MIGRATION OF), tells in his writings that the crane flies from the steppes of Scythia to the marshlands at the source of the Nile, south of Egypt. He noted migration also in the swan, land rail, lesser goose, quail, rock dove and turtle dove, though he reports that of the last three a few may linger through the winter in protected localities. The cuckoo disappeared with the rising of the dog star in July. Pliny, in his *Natural History,* repeats much that had been said by Aristotle. adding that the European blackbird, starlings and thrushes pass to neighbouring countries, while storks and cranes travel to a great distance. There are scattered references to migration in the writings of the middle ages, Olaus Magnus, in 1555, speaking of the migrations of swallows, and Francis Willughby, in 1678, mentioning various migratory birds. In the succeeding century Gilbert White, Thomas Pennant and George Edwards kept regular records of the arrival and departure of birds. Interest in the subject was considerable by the opening of the 19th century, and from that time forward the number of observers and the mass of published information on migration have increased yearly.

Superstitious Beliefs.—Though the migrations of larger birds were understood, since these travelled openly across the spring and autumn skies, the movement of smaller species, that appeared or disappeared under cover of night, so that they were present one day and gone the next, or were present suddenly after an absence of several months, was the basis of considerable superstitious belief. It was thought that the smaller species were too weak to travel far, so that, in 1740, J. G. Gmelin was told by the Tatars of Krasnojarsk that each crane carried a corn crake on its back in its journeys. In southern Europe the peasantry believe today that small birds congregate on the shores of the Mediterranean, and as opportunity offers flutter on the backs of storks and cranes who carry them across to Africa.

Somewhat more unusual is a belief promulgated in an anonymous tract published in London in 1703 "By a person of Learning and Piety," entitled in part "An Essay Towards the Probable Solution of this Question. Whence come the Stork and the Turtle. the Crane, and the Swallow, when they Know and Observe the Appointed Time of their Coming." The author announces a belief that migratory birds travel to the moon, where they pass the winter, the journey in either direction requiring 60 days to compass, during which the author (who, according to Hugh Gladstone, was Charles Moreton, a minister who in late life moved to New England), informs us that they required no food, since they travelled in a rarefied ether.

Another superstition centring around migration has been the supposed hibernation on the part of some birds, a belief that dates back to early times and has been prevalent both in Europe and America. Aristotle attributed hibernation to the swallow and various other birds, saying that some individuals became torpid and so passed the winter in the shelter of caves or hollow trees in a state of suspended animation. In later years hibernation was used mainly to explain the disappearance of swifts, swallows and the sora rail. Many and detailed have been the arguments over this matter, and more than 200 papers have been written dealing with supposed cases of hibernation. It was related that the sora rail abounded in its favourite marshes, until, overnight, the birds turned into frogs, or sank in the mud, to remain until the following spring. Naturalists with great detail describe how swallows gathered on reeds growing in water until their combined weights bent down these slender supports and the birds were submerged in the water. Those to whom this theory did not appeal stated that swallows and swifts hibernated in hollow trees and clefts in rocks, and the finding of birds in such situations in winter was described in great detail in a number of instances, all, however, under some misunderstanding of the circumstances. In short, though hibernation, or its correlate aestivation, is common among mammals, reptiles, amphibians and even in fishes, it has never been proved among birds. The frequent coupling of this superstition with swallows may be explained, perhaps, by the fact that these birds in autumn regularly roost at night in marshes, and that

during storms many perish to fall into the water and sink into the mud, never, however, to revive.

Among other superstitious beliefs mention may be made also of a transmutation theory prevalent among early writers, who supposed that at the approach of winter a bird might be transformed into another species, to remain thus until spring, when it resumed its proper form. Apparently this was first suggested by Aristotle, who held that the redbreast or robin (of Europe) changed to the redstart. The confusion resulted, apparently, from similarity of form and difference of plumage in two related species, where one disappeared in southward migration about the time that another arrived from northern regions, thus lending colour to a transmutation argument.

Theories of Origin.—An explanation of migrational movement has been that of seasonal change in food supply. According to this belief, with the approach of winter in areas remote from the equator, there is failure of the food supply that causes birds to travel, and as the food supplies remain more constant toward the tropics, birds move in that direction. When, with the approach of spring, the instinct for reproduction becomes paramount, since the food supplies of the broad equatorial area are not sufficient to support the great host of young birds that will appear, the adults move out again to their summer homes in temperate or boreal regions, where they rear their families. It may be argued against this that the tropical belt supports the migratory hosts when they have become grown, so that it would seem that these same individuals might obtain sustenance there while in younger stages.

An allied theory contends that migration is controlled by cold, from which birds retreat in autumn. Under this hypothesis some have held that birds originated in the north, were driven south by the advance of ice in the Pleistocene, and have returned to the north with the coming of milder climate. Each year now they retreat before the breath of approaching winter, while each spring a love of birthplace calls them to their natal homes. It must be noted that many birds retreat south early in the season, long before there is climatic necessity for their movement. This, with similar facts, has given rise to the theory that all species of birds have had their origin in the south, and through a natural struggle among individuals have spread to the north, especially for the period when each pair must be bound to a restricted territory for its breeding ground.

A somewhat different theory is that of phototropism, which holds that birds move toward the region of greatest light, this bringing a natural ebb and flow of bird life with the changing seasons as the sun moves north and south across the equator. It is true that the course of migration, in general, follows the advance and retreat of the sun, but it would seem that it is the changing season and not the change in intensity in light itself that affects our bird life. Through phototropism we may not, for example, explain the migrations of nightjars, which are nocturnal, and which, therefore, find in darkness the period of their activity. Such birds should find their optimum conditions of life in the equatorial regions, where the hours of the day are divided between daylight and darkness. The nightjar and whippoorwill, to give two well-known examples, travel north to breed, and in June in their northern ranges have their hours of activity greatly curtailed through the lengthened period of daylight. Recent studies based on considerable experimentation show that the onset of migration is physiologically controlled by the relative length of day and night, as is known to be the case with the flowering of plants. In other words, it is correlated with the effect of light. The factors appear complex but when they are better understood it seems probable that through them we will have understanding of the method of migration as it exists, if not of its origin.

The main difficulty with these and a number of other theories that have been promulgated in connection with migration is that they attempt to explain this great and impelling semiannual movement by some single factor. When we consider that the known history of the bird in its evolutionary development, from present knowledge goes back through an enormous stretch of time, so vast that it may be noted in figures but is beyond human comprehension, to the fossil species known as *Archaeopteryx* and *Archaeornis* of the Jurassic period, it must be recognized that our present-day species have had their instincts and habits moulded by many factors, so that it seems reasonable to consider that such a widespread phenomenon as migration may be because of a complex association of a number of powerful causes, some of which may have affected one species and some another, but no one of which may serve to explain the entire activity as it exists at present.

We may believe, therefore, that the underlying basis of migration is founded on a combination of a number of causes, and we may look upon the present migratory instinct as an outgrowth of all the complex circumstances that have affected birds during their entire evolution, though it seems evident that the actual routes followed by migratory birds, at least in the northern hemisphere, have been shaped during the climatic changes of the Pleistocene.

During breeding period the bird is restricted closely to the region in which the nest is located, and though some young are free to move about when recently hatched, the parents are, as a rule, confined to one neighbourhood until their offspring may be old enough to require no further care. This close confinement is seen easily in the smaller perching birds that are held within a limited range until the young are finally on the wing. When the young are grown the adults may linger to rear other broods, but the young, driven often by antagonism of erstwhile attentive parents, wander away, borne by their newly developed wings, and though they may not go far, do not usually remain for long in the immediate vicinity of the nest. This is one type of wandering in its simplest form. Somewhat more complex is the condition found in some parts of Australia, where prolonged droughts occur, vegetation is not developed and the majority of birds disappear. With the incidence of rains the country again becomes green and birds return. Though both kinds of movement that have been described may appear as vagrancy, yet such impulses need only to become synchronized with seasonal climatic change to become true migration.

Tropical regions offer interesting data in this connection, since, though hundreds of birds found in these areas are strictly sedentary, there are some that shift about with changing conditions. Climatic variation within the tropics is confined mainly to a cycle, in which periods of relatively little precipitation alternate with those of heavy rains. There is thus a seasonal shift that is influenced by changes in the vegetation. Some species of tree or vine come into flower or fruit and immediately there appear tanagers, honey eaters and other birds hitherto absent to live upon the newly available food.

It is idle to suppose all birds have arisen within either tropical or temperate areas. Birds, as a group, have been in existence for many million years, and during all that period there has been constant unceasing competition between individuals. In virile species individuals have been produced in abundance, and many have necessarily been forced out into new range. Some have reacted to new conditions, or have become modified through some inherent quality, so that they have been changed so greatly that they have finally become species apart from the parent stock, and have thus set up their own *loci* for subsequent radiation. The complexity of overlapping ranges under such conditions is easily apparent.

HOW MIGRATION PROCEEDS

Some students have indicated that the spring and fall migrations correspond to advance to the breeding station and subsequent retreat therefrom, and indicate correctly that the stimulus for this may be a hormone arising from physiological change in the gonads. This, however, is merely an activating principle for migration as it exists at the moment, and may not be considered the cause through which migration itself has originated.

Briefly, migration may be defined as advance and retreat, with fluctuation in conditions favourable to each species separately, which, as each form has its own reaction to its environment, has originated from varying causes. The origin of the present-day regular, seasonal movements is thus complex.

Methods of Migration.—Migration may take place by day or by night, according to the species. Geese, ducks, cranes and pelicans crossing the sky, flying abreast or in angular formation, are

accepted as portents of changing season throughout the world. Though seen regularly by day, these birds may also migrate by night, since we frequently hear the calls of geese and swans coming from darkened skies during the height of their movements. The smaller birds travel mainly by night, and descend on us in hordes, so that frequently we go out in early morning to find fields and hedgerows crowded with songsters that were absent the previous evening. During the proper season, when a full moon rides the sky in evening, it is possible to detect the forms of these nocturnal travellers silhouetted against the illuminated disk of light as they pass far above the earth, and occasionally to recognize a feathered friend by some peculiarity of form or wing movement. Many such observations have been made through large telescopes, and birds may be seen occasionally against the moon through ordinary field glasses. It is probable that timid wrens, warblers and sparrows, that live ordinarily under shelter, feel greater safety in prolonged flights under the protecting cover of darkness. Kingbirds, robins, bluebirds, bluejays and many others, however, regularly fly by day.

The matter of procurement of food may be as great a factor as timidity in inducing nocturnal flight. Digestion in birds is rapid, so that food must be obtained at regular intervals to maintain the activity especially characteristic of smaller species, whose tiny bodies have necessarily smaller reserves of energy than their larger brethren. Stomachs of small birds killed at night by striking lights or other obstructions are nearly always entirely empty, which, though an entirely natural thing, in some cases has given rise to belief that the individuals in question were in the throes of starvation. If tiny migrants flew long distances by day they would arrive at some distant destination with empty stomachs and depleted energies, perhaps almost exhausted, and because of darkness would not be able to procure food until the following morning. Such circumstances would lead to delay in further flights through need for recuperation or, if accompanied by cold or storm, might prove fatal because of lowered vitality. By arrival at daybreak it is possible for migrants to rest for a time and then search for food, and so to recuperate that they may continue the following evening if desired. At the same time there is often detected among these smaller species an indication of continuation of migratory flight by day, since in feeding they frequently tend to move in the general direction toward which the seasonal flight trends. It was thought formerly that migrants flew at great altitudes above the earth, there being a somewhat hazy notion that rarefied atmosphere in some uncertain way facilitated flight. Modern observations from aircraft show, however, that this belief is unfounded, and that the bulk of migrant birds travel at less than 3,000 ft. above the earth. It is unusual to meet with birds above 5,000 ft., though exceptionally aviators have recorded shore birds at 10,000 and 12,000 feet. In many instances birds pass at moderate altitudes, particularly above the sea, where they may barely clear the waves. At night, the calls of migrants may be often heard, apparently only short distances above the trees.

There has been much discussion of the method by which birds direct their courses in flights to distant lands, without arrival at definite explanation. Memory of routes previously travelled, some magnetic sense, courses laid by the positions of the heavenly bodies, as a mariner directs his navigation, the direction of regular winds, telepathy and hereditary memory have all had their champions. It may be said that there appears great probability that young birds of the season, on occasion, migrate southward without the guidance of others that have previously made the journey, that sea birds return across apparently trackless oceans to remote islands where they nest, and that sea birds have returned to their breeding stations when removed forcibly to waters that they do not ordinarily frequent. This may, perhaps, be explained in the somewhat general terms, by supposition, that the birds are directed by some special sense of direction, but must be regarded at present as something of which there is no definite explanation in spite of theories that have been advanced.

One of the most interesting facts connected with migration is the almost unfailing regularity that accompanies the movements of birds in the temperate regions. Through records kept over a long period of years, the average dates of arrival in spring of the common birds are now known, and it is found that they appear with almost uncanny regularity, often on the average day and always within a range of a few days earlier or later. Among small birds the seedeaters generally migrate earlier in spring and later in autumn than insect eaters since their food is available regardless of colder weather, unless covered by snow. The first arrivals in spring or fall are usually few, and it may be days or weeks before the mass of individuals appear.

The length of the journeys made by individual birds varies greatly. Inhabitants of high mountains, in a flight of a mile or two, descend to some sheltered valley, where they may spend the winter in comfort, or the migration flight may entail a movement to a great distance, as from central Europe to southern Africa. The arctic tern is supposed to have the longest migration route known, since it nests in the far north and spends the northern winter near the shores of the Antarctic continent, with 11,000 mi. in an air line separating its northern and southern homes. Incidentally, this tern probably enjoys longer hours of daylight than any other living creature, since it lives under the midnight sun in both northern and southern hemispheres, and only in its travels through the equatorial belt does it meet extended periods of darkness. There are numerous shore birds, such as the American golden plover, that nest in the arctic and spend the northern winter on the plains of Argentina. Many birds nest in Canada or in the northern United States and winter in the Gulf states, Mexico, Central America, the West Indies or northern South America. Likewise, many pass from northern Europe to Africa, some going as far as Cape Colony.

Through prolonged journeys birds encounter constant perils and dangers, so that many are destroyed. Storms, unfamiliar coverts, with consequent exposure to the attacks of enemies, and wandering from the direct course in crossing broad reaches of water annually exact a toll of unknown thousands of individuals, as has been indicated in a previous section. To enable maintenance of their proper number migratory species, therefore, are required to produce a sufficient number of young to permit this toll, and at the same time leave a pair to continue the species at the next breeding season. On the average, the migratory species of the north and south temperate zones produce from three to six eggs in each nesting, four or five being the rule, with from one to three families each season, while the more strictly resident form of the tropics may produce only two or three eggs and have only one nesting annually. In spite of apparent prolificness the more northern species do not increase inordinately. The song sparrow family, in August, at the close of the breeding season, if there has been no mortality, may have 10 or 14 individuals, depending upon whether 2 or 3 broods have been reared, yet by next spring does not show any appreciable increase in abundance; so that there has been a tremendous wastage in individual life during the migrations and the intervening winter.

In final consideration, it may be said that residents in Europe and North America are often prone to consider migration as something peculiar to birds breeding in the northern hemisphere. It must be noted, however, that in South America, southern Africa and Australia there are native species that, at the approach of the southern winter, travel north toward the equator, to return at the proper season to their breeding grounds. (*See* also BIRDS, MIGRATION OF.)

Until the beginning of the present century the study of migration was carried on by mass observation, under which records were kept of the first appearance for each species and of its subsequent fluctuations in abundance, the value of the records depending to a certain degree upon the skill and experience of the observer. Much valuable data has thus been assembled, and this method of study is still highly useful. As the next forward step in these studies, methods were developed in marking individual birds with numbered bands that have added greatly to knowledge of migration, since by this means it is possible to single out the individual bird from the great army of his fellows, and to learn something of the separate flights that make up this mass movement. (*See* BIRD BANDING.)

SONGS AND CALLS

The voice in mammals, including man, is produced in the voice box, or larynx, in the upper part of the throat. The bird possesses a similar larynx; but its sounds and notes are formed in another voice box, the syrinx, at the lower end of the windpipe, where it divides to send a bronchial tube to either lung. The syrinx is composed of firm walls derived from the rings of the trachea, or in part from the bronchi, and has within delicate membranes whose tension is controlled by slender muscles. Air expelled forcibly over these membranes produces sound which may be of many kinds, according to the species concerned. The adult turkey vulture (*Cathartes aura*) and the brown pelican (*Pelecanus occidentalis*) have as their only note a sighing aspiration made by expelling the air unmodulated, though their young utter harsh calls in some variety, either in begging for food or in attempting to repel possible enemies. The voiceless condition in the adult is unusual. The rhea sends forth a booming call, ventriloquial in effect, that carries for long distances; the wedge-tailed shearwater utters a series of indescribable groans and shrieks, which combine with those of thousands of its kind to produce a vast volume of sound; the gull or tern calls in constant iteration with a note of harshest sound. In the highest groups of birds, among the oscines or songbirds, song has reached high development, and in many follows lines of human music sufficiently to give deep aesthetic pleasure. The male mockingbird (*Mimus polyglottos*) of America, is stirred by spring to a period of vocal utterance that includes a varied repertoire of utterances peculiar to his own expression, as well as notes borrowed from tuneful neighbours. In the height of the breeding season his efforts continue day and night in apparently ceaseless expression of virile energy. The nightingale (*Luscinia megarhyncha*) of Europe, a dweller of tangled copses, would be overlooked by many were it not for his impassioned outburst of song (which, contrary to popular belief, may be heard at all hours of day and night). The two just mentioned, with the addition of the hermit thrush and the skylark, are the songsters of greatest renown among English-speaking peoples.

A number of bird songs, even where they have variety of note, are frequently unpleasant to some human ears. Many complain of the doleful cadence of the cooing of mourning doves (*Zenaidura macroura*), or are unpleasantly affected by the harsh chatter of the house sparrow. The song of the plant cutter (*Phytotoma rutila*) of Argentina exactly resembles the creaking of two tree-limbs rubbing against one another in the wind. The song of the Henslow's sparrow (*Passerherbulus henslowii*) is a low double note barely audible at a hundred yards.

The song impulse is so predominant at the height of its period that it is given expression on the slightest disturbance. Birds awakened at night frequently sing for an instant as clearly as during the day, and song also may be used to express emotions of fear and anger.

Though modulated speech for the expression of abstract ideas may be peculiar to man, there is no question but that birds possess a rudimentary language in the sense that they use their calls to communicate with one another. A low call on the part of a parrot or paroquet at detection of a sound or sight that may denote danger will instantly cause the entire group of its companions to become motionless, or send them in screaming confusion into the air. The mother pheasant warns her young, who immediately hide and can not be found. The rooster, by rapid repetition of a certain note, calls the members of his harem to some supply of food. There are also cries of anger, and others that may be interpreted as conversational, that enable species of social habit to keep in touch with one another. Bird calls are often intelligible to other creatures, as the alarm call of a jay or plover will often startle deer or other game.

There are a number of birds that possess a strong imitative faculty which, in domesticated individuals, may be adapted to the mimicry of human sounds. Canaries and other finches may be taught to whistle a few notes of musical airs. The Amazon parrots are particularly adept at mimicry of the human voice, and similar ability is found in some macaws, paroquets and other parrots. Crows, jays and magpies also may learn to repeat a few words, as may starlings and mynahs. According to a widely current superstition the tongues of the latter birds must be split to enable them to articulate human speech, a belief for which there is no valid basis whatever, and which, when practised, imposes a needless cruelty. This curious belief may be based on the fact that the tongue of crows and jays is naturally bifid at the tip.

FLIGHT

The wing membranes of the ancient reptilian pterosaur (*see* PTERODACTYL) were supported by elongated finger bones, as are the wings of bats (though differently), but birds have developed another mechanism for flying, since the forelimb, including the hand, has long feathers projecting from its posterior margin that are extended to form a supporting surface, by which flight is accomplished (*see* also BIRDS). The hand is stiffened, being flexible only at the wrist, the number of hand and finger bones is reduced and those that remain are partly fused together. The wing thus developed folds against the sides, so that it causes no embarrassment when the bird is at rest or is walking or climbing, but at the same time may be extended instantly should need or desire for flight arise. It appears thus perfectly adapted for its purpose.

Methods in Flight.—Avian flight is accomplished, except when soaring, by strokes of the wings, which may be slow or fast according to circumstances or the custom of the bird. A certain momentum must be acquired before the bird actually moves through the air. From a level surface ordinarily this is accomplished by an initial spring, through which the flexed legs throw the body as though from a catapult. From an elevation, as from a cliff or the limb of a tree, a fall of a few inches or a few feet may occur before the bird is under way. Albatrosses take off from land facing the wind, running a few steps forward with beating wings and then spreading their pinions, to rise and sail gracefully away. Some aquatic birds with small wings and heavy bodies, as coots, diving ducks, grebes and loons, rush across the water surface with beating wings and alternately striking feet until they acquire sufficient momentum to carry them into the air. Surface-feeding ducks, on the contrary, spring directly into the air with one tremendous impulse that gives such impetus that they fly without appreciable pause. Grebes rise with difficulty except from the water. From a smooth, hard surface they can sometimes take off in flight, but in herbage they are unable to rise, since the slightest obstructions break their momentum.

There is a considerable group of birds which in their active moments are so constantly in the air that they may almost be termed aerial creatures. The swallows are an excellent example of these since they secure their entire supply of food in the air, and for hours on end circle and swing with tirelessly moving wings, only perching when their appetite is satisfied, for the purpose of rest at night, or at their nests.

Aerial existence of a stronger, more placid type, is exemplified by the great vultures and the larger hawks that circle and turn on broadly extended wings above the earth, frequently at great heights. Such birds may soar for hours with only an occasional stroke of the wings, since they use the force of rising or laterally moving air currents to maintain themselves, the only motion being a constant slight adjustment of the angle of the wings, particularly at the tips, and of the tail to secure the proper amount of upward thrust to enable them to maintain the desired altitude and at the same time move ahead. The turkey vulture (*Cathartes aura*), which uses a soaring flight constantly for its progress through the air, is seldom abroad on foggy days when the air is still, but on such occasions remains quietly in its roost. Many other birds soar merely for the pleasure that this occasions. Pelicans, cormorants, storks and screamers, to mention only a few, are seen wheeling for hours so high above the earth that they appear as mere specks in the sky, though these birds search for food near, or on, the surface of water or the ground. Soaring flight of a different kind is seen where gulls glide beside or over a vessel, holding steady position in one place for minutes at a time without movement of the wings. This is accomplished by utiliza-

tion of the steady air currents that are deflected from the surfaces of the boat at a constant angle.

Hawks and the other soaring birds mentioned which perform their flights relatively high in the air have wings wide in proportion to their length. Albatrosses and other sea birds that travel habitually near the surface of the water have long, narrow wings which when fully extended are more or less of equal width throughout their length. These birds progress by utilization of air currents induced by wind, and are most common in pelagic regions where there are regular winds, and are rare in regions of calm. Their flight is quick and subject to sudden turns, so that the method of progression differs somewhat from the smooth, spiralling turns that mark the soaring of hawks and vultures. As the larger petrel-like birds follow in the wake of ships they bank and turn rapidly with stiffly extended wings, frequently swinging so that the plane of the wings for a brief space is at right angles to the line of the horizon. It is common to see shearwaters caught in the trough of a wave fly rapidly to the crest and then scale with set wings down the succeeding moving slope of water.

Birds like magpies and ducks, which habitually fly long distances, travel with a steady beat of the wings that carries them in a smooth, direct line. Inhabitants of thickets and hedgerows, as sparrows and wrens, progress with a tilting flight in which the short, rounded wings move rapidly for a few quick strokes and then pause for a very brief instant, so that the flight is rapidly tilting, or irregular in a vertical plane. Another group of birds, as many woodpeckers, fly in long undulations with a regular rise, during which the wings are stroked rapidly, and a slow descent, during which they are closed and the bird progresses through a combination of its previous momentum and the pull of gravity.

Such ground-haunting birds as the grouse and quails regularly walk or run, and use their wings extensively only to carry them from danger. In these the wings move rapidly, so that flight is swift and is accompanied by a roaring sound. The rapid movement is maintained for a comparatively short distance when the bird drops to the ground to hide in cover. Flight at high speed is thus maintained for only a brief space. The tinamous (*Tinamidae*) of South and Central America, birds of grouselike appearance related to the rheas, like grouse, fly only when pressed. They rise violently and drive rapidly away for fair distances, but are reluctant to rise again, and when forced to fly a second or third time do so with some difficulty. They are so seldom in the air that in violent winds they can not easily control their direction and often alight so clumsily that they fall.

Ground-inhabiting birds that reside on islands where they have no regular persistent enemies, have little incentive to flight, with the result that wings become shortened and their movement weakened. In many instances, particularly among rails, this has resulted in species in which the power of flight is completely lost, and the wings, though they may beat rapidly as the bird runs, can not raise it from the ground. In some species now living loss of power of flight is now taking place. The Laysan teal (*Anas laysanensis*) is now in this process, so that, though an initial flight of about 100 yd. may be made, the birds are then exhausted and may sometimes be caught by hand.

Speed of Flight.—The speed that birds attain in flight, until comparatively recent years, has been a matter of uncertainty, in many cases subject to gross exaggerations. Most of these may be traced to H. Gätke, who in his otherwise admirable studies of migration on the island of Heligoland became seized with the hypothesis that birds perform most of their migration flight during the course of a single night. On this theory, he placed the migratory speed of the northern blue-throat at 180 to 240 mi. per hour, the hooded crow at 108 mi. and plovers and related species at 240 mi. per hour, or 4 mi. per minute. He believed that these tremendous speeds were possible through flight at great altitudes, even to 40,000 ft. above the earth, where he supposed that the thin air offered little resistance. These statements, which have been widely quoted, are wholly erroneous.

Reliable data on the rate of flight accumulated slowly after 1915. Alexander Wetmore and others secured information on the subject by timing birds flying parallel to roads by means of the speedometer of an automobile. In such diverse forms as herons, hawks, horned larks, ravens and shrikes the usual flight varies from 22 to 28 mi. per hour. The Arkansas kingbird and scissor-tailed flycatcher may fly at only 10 to 17 mi. per hour.

Richard Meinertzhagen gave very definite data on the speed of flight in birds from observations made by theodolites designed to estimate the speed of planes at anti-aircraft stations, by stop watches along measured courses and by observations from travelling planes. From his records it appears that members of the crow family may travel from 31 to 45 mi. per hour, the smaller perching birds, as larks, pipits and buntings from 20 to 37 mi. per hour, starlings from 38 to 49 mi., geese from 42 to 55 mi., ducks 44 to 59 mi., falcons 40 to 48 mi. and sand grouse 43 to 47 mi. per hour. The fastest flying birds known are found in the family of swifts (*Apodidae*). One species (apparently the common swift of Eurasia), observed from an airship in Mesopotamia, circled easily about a plane flying at 68 mi. per hour. From this and other observations it appears that ordinary swifts fly regularly at 70 mi. and may accelerate this to 100 mi. per hour for necessity or pleasure. The speed of falcons in striking at prey is estimated at more than 150 mi. per hour.

The running speed on the ground of Gambel's quail is 11 to 14 mi. per hour, and that of the road runner, a terrestrial cuckoo, 12 to 15 mi. per hour.

FOOD

During their long period of evolution, birds have become adapted to all foods available to their methods of feeding. Geese graze on tender herbage as readily as cattle, rheas and ostriches select a miscellaneous vegetable diet, the plant cutter (*Phytotoma*) eats buds, berries and other vegetable matter, the palm chat of Haiti (*Dulus dominicus*) frequently consumes blossoms, the sage grouse (*Centrocercus urophasianus*) delights in the bitter twigs and leaves of sage (*Artemisia*), ducks are fond of succulent roots, tubers and leaves of aquatic plants and many other birds have similar propensities for plant stems or leaves. Fruits are taken by many birds, while the number of birds that depend upon starchy seeds for the major part of their diet is myriad, and includes a great variety of species. The finches with their strong bills crack off the investing hulls of large seeds and consume only the starchy interior. Small hard seeds, as those of lambs-quarter (*Chenopodium*), are swallowed entire and are ground up by sand and bits of gravel swallowed for the purpose. Grackles (*Quiscalus*) by means of a keeled process on the palate, cut around the shells of acorns until they crack in two and the meat is exposed. Jays hold nuts between the toes and break them open by strong blows of the beak. Some woodpeckers force acorns into crevices in trees, where they are held until they may be broken open. The mallard and wood duck swallow acorns and even entire nuts of the hickory, which have a shell so thick that it requires a strong blow of a hammer to break them, and grind them up in their gizzards. Seeds form a standard autumn and winter food when other sustenance is lacking and are eaten in tremendous quantity. From the stomach and gullet of 1 mallard duck there have been taken 102,400 seeds of the primrose willow (*Jussiaea leptocarpa*).

Birds that feed on insect life abound, and include a large proportion of the smaller species. Vireos, warblers and kinglets search actively for insects among leaves and twigs, picking off their prey at rest or flying out a few inches after some escaping titbit. Flycatchers (*Tyrannidae*) watch from commanding perches and fly out to snap up passing insects on the wing, or occasionally to pick them from the ground. Nuthatches and creepers search over the bark of trees for insects, spiders or eggs hidden in the crevices, and woodpeckers chisel out coleopterous grubs from their hidden tunnels in wood. Usually these are found in decaying trunks, but occasionally some of the stronger woodpeckers will cut in through one inch of hard wood to secure a grub. The flicker (*Colaptes*) feeds much on the ground on ants, which it secures by its long tongue as the insects run about their hills. More than 6,000 ants have been taken from the stomach of one flicker. Swifts, swallows and nightjars feed exclusively on the wing, securing flying insects in their capacious mouths. In the stomach of 1 nighthawk there have been found 50 species of flying insects

comprising several thousand individuals. Cuckoos consume large numbers of hairy caterpillars, from which the stomach becomes so filled with hairs stuck in the lining that its inner surface appears covered with short, stiff fur. Hummingbirds live on the nectar of flowers and tiny flies, Hymenoptera, beetles and spiders that find a home in blossoms or in the bark of trees.

Grebes, divers, herons, mergansers, cormorants and pelicans feed on fish of various kinds, most often on species not especially desirable from a human standpoint. Albatrosses and shearwaters take quantities of squid, and the smaller petrels seem to secure the miscellaneous array of smaller marine creatures known collectively as plankton (*q.v.*). Hawks and owls feed extensively on small mammals and other birds. Some eat frogs, snakes and large insects, as well as crayfish. Larger owls may capture and consume smaller ones, and partly grown brown pelicans, when ravenous with hunger, may seize and swallow a small member of the colony, that has just been fed. The flesh of dead animals, even in the form of putrid carrion, is sought by vultures that eat with impunity where death from poison from bacillary action would be the fate of another creature.

Though most birds seek their food day by day and so live an existence that involves continual search for sustenance, a few species form food stores against a time of scarcity. Most remarkable among these is a group of North American woodpeckers (*Balanosphyra formicivora*), that drill holes in the trunks of trees, in which they fit acorns, and so preserve a part of the acorn harvest for subsequent consumption. The birds work assiduously, since 13,200 acorns have been estimated as the store on 1 large tree trunk, with an average density of 60 to the square foot. That the instinct for storage sometimes goes astray is shown when the carefully drilled holes are filled with pebbles instead of nuts. The red-headed woodpecker (*Melanerpes erythrocephalus*) fills cavities with quantities of acorns or other small nuts, over which it piles bits of bark to conceal them. Many shrikes (*Lanius*), when food is abundant, frequently impale the bodies of grasshoppers, birds, mice or other prey on thorns, to return to them later if needed.

Hawks and owls swallow their prey entire or in large fragments, digest out all nutritive matter and form the bones, fur, scales, feathers or chitin into pellets, which are subsequently regurgitated, leaving the stomach empty to receive another meal. Albatrosses eject pellets composed of the beaks of squids, flycatchers masses of insect chitin, and even hummingbirds may throw up tiny pellets made up of the indigestible portions of their animal food. Birds with strong, muscular gizzards, that feed on seeds, swallow sand or gravel that serve as millstones to triturate into digestible starch meal the seeds they have eaten.

The Brahmans maintain towers where food for birds is placed, and where birds may nest. In Japanese temples shelves are built where swallows may erect their homes. Indians in the eastern United States placed hollow gourds on bare stubs of trees to provide nesting cavities for the purple martin (*Progne subis*), a species of swallow, a practice that was adopted by early colonists from Europe and that is followed today in country districts in the southern states. From these somewhat rude foundations there have developed complicated procedures for the attraction of birds about human homes. The martin gourd has been transformed into ornate martin houses containing many compartments, each of a size to house a pair of birds, and boxes or houses have been designed for many other hole-nesting birds. Though in use in many places, particularly in Germany, at an earlier date, it is since the beginning of the present century that methods for the attraction of birds have received widespread attention. In the United States and Europe single-compartment houses (nesting boxes) are set up for wrens, bluebirds, tits, woodpeckers and similar birds, and where favourably located are occupied without the slightest hesitation. These bird houses are of many types, and so many are used that commercial companies have been formed for their manufacture.

Large pieces of suet tied to the trunks or limbs of trees, where birds may feed without fear of capture from cats, draw woodpeckers, nuthatches and titmice. A shelf built on an outside window ledge will attract many birds where they may be seen to the best advantage. Sunflower and canary seed, wheat, chickfeed, moderately fine-ground corn, nut meats and crumbs of bread are all relished by feathered neighbours. A mixture of suet and nut meats, preferably peanuts, ground medium fine in a food grinder, is especially relished by titmice and jays. Birds come to such feeding stands throughout the year.

ORIGIN AND EVOLUTION

Bizarre as the idea may seem at first, birds are more closely allied to reptiles (*q.v.*) than to any other living group of vertebrates. The bird, while similar to the reptile in much of its structure, in its superior mental capacity, and concomitant adaptations that this has permitted, has far outstripped its lowly cousins, and so has flourished and multiplied while its cold-blooded relatives with decreasing numbers have fallen behind in the race of life. From one viewpoint we may look upon the bird as the attempt of the reptilian groups to retain the dominance of the earth that was theirs during the Mesozoic era, a design that was frustrated by the development of mammals.

The earliest birds known were contemporaneous with dinosaurs (*see* DINOSAURIA), to which, structurally, they seem to have close affinity, particularly to the hollow-boned, agile, birdlike groups. Since these creatures existed at a time when primitive birds were also known, search must be carried farther into the ages for a generalized reptilian group from which both birds and dinosaurs may have sprung. This, apparently, is found in the fossil reptiles known as the Pseudosuchians, of early Triassic times; though according to some the original ancestor of the birdlike creatures should be sought in still older ages in the Permian.

Fossil Birds.—The bones of birds are so poorly preserved in the fossil state that there is record now of only about 800 fossil forms, including some of questionable identity. The earliest fossils known are *Archaeopteryx* (*q.v.*) and *Archaeornis* (*see* ARCHAEOPTERYX) of the Jurassic beds of Bavaria, creatures with toothed jaws, long, bony tails with feathers projecting along the sides and free fingers, that in spite of their reptilian form, were birds, since they were covered with feathers and were able to fly. In the Cretaceous period two types of birds, both possessing teeth, are known from nearly complete skeletons, *Hesperornis* (*q.v.*) and its allies, diverlike species that lived in water and seemed to have had no functional wings, and *Ichthyornis* (*q.v.*) which was aerial and may have had the habits of a gull. These four are the most peculiar fossil birds known at present, since others, while often strange, are allied more or less closely to modern families.

At the beginning of the Tertiary period the types of birds found were suggestive, in form, of existing birds, though in the Eocene some were highly peculiar, and most seem to pertain to extinct families. In the Miocene there occur a number of birds closely similar to those existing today, and in the Pleistocene are found bones of numerous birds still in existence, in addition to many that differed from modern forms.

The progress of the avian group since the coming of the Pleistocene ice seems to have been one of extermination rather than of consistent evolutionary progress, since peculiar types seem to have been exterminated in numbers during the Pleistocene, and there is no indication that others have developed to take their places except for the minor characters that distinguish subspecies or poorly marked species. The story of fossil birds is far from complete, and much work remains to be done on many of those at present discovered, to establish their relationship.

SYSTEMATIC CLASSIFICATION

It is difficult to arrive at an exact figure for the number of kinds of birds now known, but at a conservative estimate it is believed this may reach 28,000 distinct forms.

The primary group or class, Aves, is one of the great divisions of the vertebrates and is equal in rank to the fishes, amphibians, reptiles and mammals. This class is divided into two subclasses, the first, the Archaeornithes, containing the most primitive birds which are very close to reptiles, and the second, the Neornithes, all other known birds. The Neornithes are divided again into

four major divisions or superorders, the Odontognathae, containing forms with teeth, the Palaeognathae, for the ostrichlike birds and their allies, which have a primitive arrangement of the bones of the palate, the Impennes and the Neognathae, including the remaining species with a more specialized modern type of palatal structure. These superorders are divided again into orders, suborders, superfamilies and families. An arrangement embodying modern ideas of classification follows:

Class Aves, Birds
Subclass ARCHAEORNITHES, ancestral birds
Order Archaeopterygiformes, *Archaeopteryx, Archaeornis* (fossil)
Family Archaeopterygidae, *Archaeopteryx* (fossil)
„ Archaeornithidae, *Archaeornis* (fossil)
Subclass NEORNITHES, true birds
Superorder Odontognathae, new world toothed birds
Order Hesperornithiformes, Hesperornithes
Family Hesperornithidae, *Hesperornis, Hargeria* (fossil)
„ Enaliornithidae, *Enaliornis* (fossil)
„ Baptornithidae, *Baptornis* (fossil)
Order Ichthyornithiformes, Ichthyornithes
Family Ichthyornithidae, *Ichthyornis* (fossil)
„ Apatornithidae, *Apatornis* (fossil)
Superorder Palaeognathae, struthious birds and allies
Order Caenagnathiformes, Caenagnathus
Family Caenagnathidae, *Caenagnathus* (fossil)
Order Struthioniformes, ostriches
Family Struthionidae, ostriches (old world)
Order Rheiformes, rheas
Family Rheidae, rheas (South America)
Order Casuariiformes, cassowaries, emus
Family Casuariidae, cassowaries (Australian region)
„ Dromiceidae, emus (Australian region)
„ Dromornithidae, *Dromornis* (fossil)
Order Dinornithiformes, moas
Family Dinornithidae, moas (fossil and extinct, New Zealand)
„ Anomalopterygidae, *Anomalopteryx, Emeus* and allies (fossil and extinct)
Order Aepyornithiformes, elephant birds
Family Aepyornithidae, *Aepyornis* (fossil and extinct, Madagascar)
Order Apterygiformes, kiwis
Family Apterygidae, kiwis (New Zealand)
Order Tinamiformes, tinamous
Family Tinamidae, tinamous (Mexico to South America)
Superorder Impennes, penguins
Order Sphenisciformes, penguins
Family Spheniscidae, penguins (southern hemisphere)
„ Cladornithidae, *Cladornis* (fossil)
Superorder Neognathae, typical birds
Order Gaviiformes, loons
Family Gaviidae, loons (northern hemisphere)
Order Colymbiformes, grebes
Family Colymbidae, grebes (cosmopolitan)
Order Procellariiformes, albatrosses, shearwaters, petrels and allies
Family Diomedeidae, albatrosses (southern hemisphere and North Pacific)
„ Procellariidae, shearwaters, fulmars (cosmopolitan)
„ Hydrobatidae, stormy petrels (cosmopolitan)
„ Pelecanoididae, diving petrels (southern hemisphere)
Order Pelecaniformes, tropic birds, pelicans, frigate birds and allies
Suborder Phaëthontes, tropic birds
Family Phaëthontidae, tropic birds (tropical seas)
Suborder Pelecani, pelicans, boobies, cormorants, snakebirds
Superfamily Pelecanoidea, pelicans and allies
Family Pelecanidae, pelicans (tropics to warm temperate)
„ Cyphornithidae, *Cyphornis, Palaeochenöides* (fossil)
Superfamily Suloidea, boobies, cormorants and allies
Family Pelagornithidae, *Pelagornis* (fossil)
„ Sulidae, boobies, gannets (cosmopolitan)
„ Elopterygidae, *Elopteryx, Eostega, Actiornis* (fossil)
„ Phalacrocoracidae, cormorants (cosmopolitan)
„ Anhingidae, snakebirds (tropics and subtropics)
Suborder Fregatae, frigate birds
Family Fregatidae, frigate birds (tropics and subtropics)
Suborder Odontopteryges, *Odontopteryx, Pseudodontornis* (fossil)
Family Odontopterygidae, *Odontopteryx* (fossil)
„ Pseudodontornithidae, *Pseudodontornis* (fossil)
Order Ciconiiformes, herons, storks and allies
Suborder Ardeae, herons, bitterns
Family Ardeidae, herons, bitterns (cosmopolitan)
„ Cochleariidae, boat-billed herons (tropical America)
Suborder Balaenicipites, whale-headed storks
Family Balaenicipitidae, whale-headed storks (Africa)
Suborder Ciconiae, storks, ibises, spoonbills
Superfamily Scopoidea, hammerheads
Family Scopidae, hammerheads (Africa)
Superfamily Ciconioidea, storks
Family Ciconiidae, storks, jabirus (cosmopolitan)
Superfamily Threskiornithoidea, ibises
Family Threskiornithidae, ibises, spoonbills (cosmopolitan)
Suborder Phoenicopteri, flamingos
Family Agnopteridae, *Agnopterus* (fossil)
„ Scaniornithidae, *Scaniornis, Parascaniornis* (fossil)
„ Phoenicopteridae, flamingos (temperate and tropical regions)
Order Anseriformes, screamers, ducks, geese, swans
Suborder Anhimae, screamers
Family Anhimidae, screamers (South America)
Suborder Anseres, ducks, geese, swans
Family Paranyrocidae, *Paranyroca* (fossil)
„ Anatidae, ducks, geese, swans (cosmopolitan)
Order Falconiformes, vultures, hawks, falcons
Suborder Cathartae, new world vultures
Superfamily Eocathartoidea, Eocathartes
Family Eocathartidae, *Eocathartes* (fossil)
Superfamily Cathartoidea, new world vultures
Family Cathartidae, new world vultures (the Americas)
„ Teratornithidae, *Teratornis, Cathartornis* (fossil)
Suborder Falcones, secretary birds, hawks, falcons
Superfamily Sagittarioidea, secretary birds
Family Sagittariidae, secretary birds (Africa)
Superfamily Falconoidea, hawks, falcons and allies
Family Accipitridae, hawks, old world vultures, harriers (cosmopolitan)
„ Pandionidae, ospreys (cosmopolitan)
„ Falconidae, falcons, caracaras (cosmopolitan)
Order Galliformes, megapodes, curassows, pheasants, hoatzins
Suborder Galli, megapodes, curassows, grouse, pheasants
Superfamily Cracoidea, megapodes, curassows
Family Megapodiidae, megapodes (Australian region)
„ Gallinuloididae, *Gallinuloides* (fossil)
„ Cracidae, curassows, guans, chachalacas (Mexico to South America)
Superfamily Phasianoidea, grouse, pheasants, turkeys
Family Tetraonidae, grouse (cosmopolitan)
„ Phasianidae, quails, pheasants, peacocks (cosmopolitan)
„ Numididae, guinea fowl (Africa)
„ Meleagrididae, turkeys (North America)
Suborder Opisthocomi, hoatzins
Family Opisthocomidae, hoatzins (tropical South America)
Order Gruiformes, cranes, rails and allies
Suborder Mesoenatides, roatelos, monias
Family Mesoenatidae, roatelos, monias (Madagascar)
Suborder Turnices, bustard-quails, hemipodes
Family Turnicidae, bustard-quails (old world)
„ Pedionomidae, collared hemipodes (Australia)
Suborder Grues, cranes, limpkins, trumpeters, rails
Superfamily Gruoidea, cranes, limpkins, trumpeters
Family Geranoididae, *Geranoides* (fossil)
„ Eogruidae, *Eogrus* (fossil)
„ Gruidae, cranes (cosmopolitan, except South America)
„ Aramidae, limpkins (tropical and subtropical America)
„ Psophiidae, trumpeters (South America)
Superfamily Ralloidea, rails
Family Orthocnemidae, *Orthocnemus, Elaphrocnemus* (fossil)
„ Rallidae, rails, coots, gallinules (cosmopolitan)
Suborder Heliornithes, sun grebes
Family Heliornithidae, sun grebes (Africa, southern Asia, tropical America)
Suborder Rhynocheti, kagus
Family Rhynochetidae, kagus (New Caledonia)

Suborder Eurypygae, sun bitterns
Family Eurypygidae, sun bitterns (Central and South America)
Suborder Phororhaci, *Phororhacos* and allies
Family Phororhacidae, *Phororhacos, Pelecyornis* and allies (fossil)
„ Brontornithidae, *Brontornis, Liornis* and allies (fossil)
„ Opisthodactylidae, *Opisthodactylus* (fossil)
Suborder Cariamae, cariamas and allies
Family Bathornithidae, *Bathornis* (fossil)
„ Hermosiornithidae, *Hermosiornis, Procariama* (fossil)
„ Cariamidae, cariamas (South America)
Suborder Otides, bustards
Family Otididae, bustards (old world)
Order Diatrymiformes, *Diatryma, Omorhamphus* and allies
Family Diatrymidae, *Diatryma* (fossil)
„ Gastornithidae, *Gastornis, Remiornis* (fossil)
Order Charadriiformes, shore birds, gulls, auks
Suborder Charadrii, shore birds
Superfamily Jacanoidea, jaçanas
Family Jacanidae, jaçanas (tropics)
Superfamily Charadrioidea, plovers, sandpipers and allies
Family Rostratulidae, painted snipe (cosmopolitan, except North America and Europe)
„ Haematopodidae, oyster catchers (cosmopolitan)
„ Charadriidae, plovers, turnstones, surfbirds (cosmopolitan)
„ Scolopacidae, snipe, woodcock, sandpipers (cosmopolitan)
„ Recurvirostridae, avocets, stilts (cosmopolitan)
„ Presbyornithidae, *Presbyornis* (fossil)
„ Phalaropodidae, phalaropes (cosmopolitan, except Australia)
Superfamily Dromadoidea, crab plovers
Family Dromadidae, crab plovers (India to East Africa)
Superfamily Burhinoidea, thick-knees
Family Burhinidae, thick-knees (cosmopolitan, except North America)
Superfamily Glareoloidea, pratincoles, coursers
Family Glareolidae, pratincoles, coursers (old world)
Superfamily Thinocoroidea, seed snipe
Family Thinocoridae, seed snipe (South America)
Superfamily Chionoidea, sheathbills
Family Chionidae, sheathbills (southern hemisphere)
Suborder Lari, gulls, terns, skimmers
Family Stercorariidae, skuas, jaegers (cosmopolitan)
„ Laridae, gulls, terns (cosmopolitan)
„ Rynchopidae, skimmers (America, southern Asia and Africa)
Suborder Alcae, auks
Family Alcidae, auks, auklets, murres (northern hemisphere)
Order Columbiformes, sand grouse, pigeons, doves
Suborder Pterocletes, sand grouse
Family Pteroclidae, sand grouse (old world)
Suborder Columbae, pigeons and doves
Family Raphidae, dodos, solitaires (Mauritius Réunion, Rodriguez)
„ Columbidae, pigeons, doves (cosmopolitan)
Order Psittaciformes, lories, parrots, macaws
Family Psittacidae, lories, parrots, macaws (cosmopolitan, except northern Eurasia)
Order Cuculiformes, plantain eaters, cuckoos
Suborder Musophagi, plantain eaters
Family Musophagidae, plantain eaters (Africa)
Suborder Cuculi, cuckoos, roadrunners, anis
Family Cuculidae, cuckoos, roadrunners, anis (cosmopolitan)
Order Strigiformes, owls
Family Protostrigidae, *Protostrix* (fossil)
„ Tytonidae, barn owls (cosmopolitan)
„ Strigidae, owls (cosmopolitan)
Order Caprimulgiformes, oilbirds, goatsuckers
Suborder Steatornithes, oilbirds
Family Steatornithidae, oilbirds (northern South America)
Suborder Caprimulgi, frogmouths, goatsuckers
Family Podargidae, frogmouths (India to Australia)
„ Nyctibiidae, potoos (new world tropics)
„ Aegothelidae, owlet-frogmouths (Australian region)
„ Caprimulgidae, goatsuckers (cosmopolitan except eastern Pacific)

Order Apodiformes, swifts, hummingbirds
Suborder Apodi, swifts
Family Aegialornithidae, *Aegialornis* (fossil)
„ Apodidae, swifts (cosmopolitan)
„ Hemiprocnidae, crested swifts (India to New Guinea)
Suborder Trochili, hummingbirds
Family Trochilidae, hummingbirds (new world)
Order Coliiformes, colies
Family Coliidae, colies (Africa)
Order Trogoniformes, trogons
Family Trogonidae, trogons (cosmopolitan except Holarctic region)
Order Coraciiformes, kingfishers, bee eaters, rollers, hornbills
Suborder Alcedines, kingfishers, todies, motmots
Superfamily Alcedinoidea, kingfishers
Family Alcedinidae, kingfishers (cosmopolitan)
Superfamily Todoidea, todies
Family Todidae, todies (Greater Antilles)
Superfamily Momotoidea, motmots
Family Momotidae, motmots (tropical America)
Suborder Meropes, bee eaters
Family Meropidae, bee eaters (old world)
Suborder Coracii, rollers, hoopoes
Family Coraciidae, rollers (old world)
„ Leptosomatidae, cuckoo rollers and ground rollers (Madagascar)
„ Upupidae, hoopoes (Eurasia and Africa)
„ Phoeniculidae, wood hoopoes (Africa)
Suborder Bucerotes, hornbills
Family Bucerotidae, hornbills (Africa and southern Asia)
Order Piciformes, jacamars, barbets, toucans, woodpeckers
Suborder Galbulae, jacamars, barbets, toucans
Superfamily Galbuloidea, jacamars, puffbirds
Family Galbulidae, jacamars (tropical Mexico to South America)
„ Bucconidae, puff-birds (Central and South America)
Superfamily Capitonoidea, barbets, honey guides
Family Capitonidae, barbets (tropics)
„ Indicatoridae, honey guides (Africa and southern Asia)
Superfamily Ramphastoidea, toucans
Family Ramphastidae, toucans (Mexico to South America)
Suborder Pici, woodpeckers
Family Picidae, woodpeckers, piculets (cosmopolitan, except Madagascar and Australia)
Order Passeriformes, perching birds
Suborder Eurylaimi, broadbills
Family Eurylaimidae, broadbills (tropical Africa and Indo-Malaya)
Suborder Tyranni, ovenbirds, tyrant flycatchers and allies
Superfamily Furnarioidea, ovenbirds, wood hewers and allies
Family Dendrocolaptidae, wood hewers (Mexico to South America)
„ Furnariidae, ovenbirds (Mexico to South America)
„ Formicariidae, ant thrushes (Mexico to South America)
„ Conopophagidae, ant pipits (South America)
„ Rhinocryptidae, tapaculos (Central and South America)
Superfamily Tyrannoidea, tyrant flycatchers, pittas and allies
Family Cotingidae, cotingas (new world)
„ Pipridae, manakins (Mexico to South America)
„ Tyrannidae, tyrant flycatchers (new world)
„ Oxyruncidae, sharp-bills (Central and South America)
„ Phytotomidae, plant cutters (South America)
„ Pittidae, pittas (old world tropics)
„ Acanthisittidae, New Zealand wrens (New Zealand)
„ Philepittidae, asities (Madagascar)
Suborder Menurae, lyrebirds
Family Menuridae, lyrebirds (Australia)
„ Atrichornithidae, scrubbirds (Australia)
Suborder Passeres, song birds
Family Alaudidae, larks (cosmopolitan)
„ Palaeospizidae, *Palaeospiza* (fossil)
„ Hirundinidae, swallows (cosmopolitan)
„ Campephagidae, cuckoo shrikes (old world)
„ Dicruridae, drongos (old world tropics)
„ Oriolidae, old world orioles (old world)
„ Corvidae, crows, magpies, jays (cosmopolitan)

Family Paradiseidae, birds of paradise, bowerbirds (Australian region)
" Paradoxornithidae, parrotbills, suthoras (Nepal to China)
" Paridae, titmice (Eurasia, Africa, North America)
" Sittidae, nuthatches (northern hemisphere, Australian region)
" Hyposittidae, coral-billed nuthatches (Madagascar)
" Certhiidae, creepers (Eurasia, North America, Australia)
" Chamaeidae, wren tits (Oregon and California)
" Timaliidae, babbling thrushes (old world)
" Pycnonotidae, bulbuls (old world)
" Cinclidae, dippers (northern hemisphere)
" Troglodytidae, wrens (cosmopolitan, except Africa and Australia)
" Mimidae, thrashers, mockingbirds (new world)
" Turdidae, thrushes (cosmopolitan)
" Zeledoniidae, wren thrushes (Costa Rica and Panamá)
" Sylviidae, old world warblers (cosmopolitan)
" Regulidae, kinglets (northern hemisphere)
" Muscicapidae, old world flycatchers (old world)
" Prunellidae, accentors, hedge sparrows (Europe and northern Asia)
" Motacillidae, wagtails, pipits (cosmopolitan)
" Bombycillidae, waxwings (northern hemisphere)
" Ptilogonatidae, silky flycatchers (tropical America)
" Dulidae, palm chats (Hispaniola)
" Artamidae, wood swallows (Africa, India and Australian region)
" Vangidae, Vanga shrikes (Madagascar)
" Laniidae, shrikes (cosmopolitan, except South America)
" Prionopidae, wood shrikes (old world tropics)
" Cyclarhidae, pepper shrikes (Mexico to South America)
" Vireolaniidae, shrike vireos (continental tropical America)
" Callaeidae, wattled crows (New Zealand)
" Sturnidae, starlings, glossy starlings (old world)
" Meliphagidae, honey eaters (Australian region)
" Nectariniidae, sunbirds (Africa, Asia and Australian region)
" Dicaeidae, flowerpeckers (Africa, Indo-Malaya and Australian region)
" Zosteropidae, white-eyes (Africa, southern Asia and Australian region)
" Vireonidae, vireos (new world)
" Coerebidae, honey creepers (tropical America)
" Drepanididae, Hawaiian honey creepers (Hawaiian Islands)
" Parulidae, wood warblers (new world)
" Ploceidae, weaver finches (Africa, Eurasia and Australia)
" Icteridae, blackbirds, troupials (new world)
" Tersinidae, swallow-tanagers (tropical South America)
" Thraupidae, tanagers (new world)
" Catamblyrhynchidae, plush-capped finches (northern Andes)
" Fringillidae, grosbeaks, finches, buntings (cosmopolitan, except Australian region)

(*See* also BIRDS; BIRDS, MIGRATION OF; BIRDS, PROTECTION OF; BIRD SANCTUARIES and articles on individual birds.)

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ECONOMIC ORNITHOLOGY

Economic ornithology deals with the study of birds in their relation to man and his various activities, such as agriculture, forestry, trade, sport, etc., or in other words, "it is the practical application of the knowledge of birds to the affairs of everyday life." It is a difficult and intricate study and of the greatest importance to mankind.

The scientific study of wild birds from an economic standpoint may be said to date from the publication of a paper by Prevost in 1858, and one by Jenks in 1859. Since then, thanks largely to the workers in the United States department of agriculture (bureau of biological survey), great progress has been made and numerous intensive studies undertaken. As a result it is now almost universally admitted, with very few exceptions, that the wholesale destruction of wild birds as a means of protecting crops, etc., is, economically, an unsound policy. A bird which does a considerable amount of harm at a particular season of the year may more than compensate for it by the nature of the food consumed at another season, and in a like manner a bird which is injurious in one district may be beneficial in another. It must ever be borne in mind that, as a rule, insect-eating birds feed upon those species of insects that are the easiest to obtain, and that the variation in a bird's diet depends to a large extent upon the abundance of the supply and the ease with which it may be obtained. Moreover, where destructive irruptions of insect life occur and wild birds concentrate on one particular species of insect, no especial chance is given for the rise of new fluctuations among the commoner species eaten, for the species which is unusually numerous is so widely distributed among the ordinary food elements. The more numerous insectivorous birds are, both in species and numbers, the fewer and shorter the insect oscillations are likely to be.

The Amount of Food Consumed by Birds.—As a class birds are distinctly beneficial, and experience shows that it is possible to learn with very considerable precision the exact amounts of the different kinds of food that each species requires in a year. This precision is attained by measuring the percentage volumes of the different items of food found in the stomach, crop, etc., during the various months of the year, from a large series of specimens obtained from different localities. This volumetric method, or the expression of the contents in terms of bulk, is much more exact than any numerical count of the different food items, and enables the investigator not only to express himself in exact quantities, but to compare one bird's diet with another; further, it admits of the stating of the definite ratios each element bears to the other. Every bird requires a certain bulk of food per day, not a certain number of insects, seeds, etc., and to estimate correctly the importance of any item in its diet it is necessary to know what proportion the insects, seeds, etc., bear to the standard requirements, and to do so it is necessary to use some method of measurement. Take the case of the skylark. This bird requires about 6 lb. of food per year; in other words 10,000 larks would require about 27 tons of food in a year. Knowing the percentage of food eaten by this species, it is possible to analyze this figure. Of the total bulk of food consumed in a year 35.5% consists of injurious insects, 3.5% of neutral insects, 2.5% of beneficial insects, 9.5% of grain, 1% of leaves, 2% of earthworms, 1% of slugs, 1.5% of miscellaneous animal matter and 43.5% of weed seeds. In other words, the lark benefits the farmer in regard to 36.5% of its food eaten, is neutral in respect of 50.5% and injurious only in respect of 13%. If the debit and credit account is further examined it shows on the former side a loss of 2½ tons of cereals, and on the latter something like 30,000,000 injurious insects and 30,000 slugs. Such a plague of insects left to themselves would have destroyed many more tons of cereals, root crops, etc. Thus, the farmer is undoubtedly the gainer from the activities of this bird by an enormous tonnage of produce.

The Effects of Fluctuations in the Number of Birds.—It is now fully recognized that wherever the insect-feeding birds of a district or of districts are destroyed, either wantonly or through climatic and other causes, there is an accompanying insect oscillation which is not reduced until the balance of bird life is restored. In the case of many insects whose numbers remain relatively constant, the controlling influence is largely, if not entirely, because of the uniformity of the bird life which prevails from year to year. Any factor, therefore, that tends to modify or upset the restraining influences of wild birds in their relationship to injurious insects is distinctly detrimental. In a like manner, where raptorial birds and owls are destroyed, farm vermin, such as rats, voles and mice, rapidly increase in numbers.

Some species of wild birds are injurious because they are too numerous, and as a result there are too many birds feeding upon the same kind of food in a given area, in consequence of which certain species supplement their diet by feeding upon cultivated crops. No better instance of this can be found than the European house sparrow. It has been estimated that in Great Britain alone the losses caused by this species reach the incredible figure of £8,000,000 per annum. Wherever it has been introduced it has increased and spread with startling rapidity, and proved an enemy to the cultivator. Injury to crops invariably proceeds from an excessive number of individuals rather than from the natural habits of the species. Once any species exceeds what may be described as its high-water mark of abundance, its food habits change and it becomes a source of danger to mankind. The failure of a normal source of food supply occasionally leads birds to injure crops which under ordinary conditions they seldom attack. Many fluctuations in number are either only local or temporary, and if not interfered with will adjust themselves.

The contention that insectivorous birds do more harm than good by attacking beneficial insects and parasitized caterpillars does not appear to be well founded. Similarly, those species which feed largely upon the seeds of weeds have been regarded as beneficial, but it is now known that many of these species act as distributors of the seeds. In any economic consideration of such birds it is perhaps best to regard such activities as neutral, but on this point considerable diversity of opinion exists.

The Food of Nestlings.—No consideration of the economic status of wild birds can be complete without a reference to the food of the young birds in the nest. During the first few days of life nestlings consume daily considerably more than their own weight of food and add 20 to 50% to their weight. From sunrise to sunset feeding continues, 200 to 300 visits being paid to the nest by the parent birds. With the exception of doves and pigeons, and aquatic and raptorial species, the food brought to the young consists of caterpillars, soft-bodied insects, spiders, worms and slugs. Moreover, during the whole of the nesting period the parent birds are feeding upon food similar to that fed to the young. "Few people," states H. C. Bryant, "have any realization of the great quantities consumed by birds. For instance, if we consider that there is an average of one meadowlark to every two acres of available land for cultivation (11,000,000 ac.) in the Sacramento and San Joaquin valleys, and that each pair of birds raises an average of four young, each one of which averages one ounce in weight while in the nest, and consumes half of its own weight of food each day, it takes over 343½ tons of insect food each day to feed the young birds in the great valleys alone."

It is difficult to bring home to the mind by an expression of figures the millions of caterpillars, grubs, flies, beetles, etc., that birds consume. Careful investigations have shown that the British song thrush during the breeding season, April to June, consumes on an average 10,080 caterpillars, flies, grubs, etc., per month; assuming that there are 100,000 of these birds in the British Isles, they would account for 3,024,000,000 insects, etc., weighing more than 520 tons. Such a number are capable of destroying in 3 months more than 65,000 tons of produce, and assuming that this was worth £5 per ton, the activities of the thrushes would result in a saving of £325,000. Other species are equally beneficial, so that these figures might be multiplied by 20 or 30, thus showing a saving of produce every spring approaching £10,000,000.

To summarize:—"A careful examination of the circumstances in which birds have done harm leads to the belief that the damage is usually caused by an abnormal abundance of a species within a limited territory. In such cases so great is the demand for food that the natural supply is exhausted and the birds attack some of the products of garden or orchard.

"Economically considered, birds are simply natural forces, and it should be our purpose to ascertain how they may be turned to our greatest advantage. The best economic conditions are probably fulfilled when birds are numerous as species and moderately abundant as individuals. Under such conditions there will be a demand for food of many kinds, without excessive demand for any one kind. The most desirable status would seem to be such a relation of numbers and species between birds and insects that the birds would find plenty of food without preying on useful products, while the insects would be held in such check that they would neither increase to a harmful extent nor be completely exterminated. The proper course to pursue, apparently, is to study the food habits of both birds and insects, to favour the increase of species which seem best adapted to preserve the proper balance, and to reduce the numbers of those that prey too greatly on the products of orchard or farm."—(F. E. L. BEAL.)

COMMERCIAL USES

Game.—Commercially, birds are utilized in various ways. Some are used as food, others are valued for their plumage and others for their guano.

Most game birds are beneficial to agriculture. While accurate statistics are difficult to obtain, there is a larger consumption of such birds today than ever, and most nations have enacted special laws for their preservation. When and where such laws do not exist the danger of extermination is great. In practically all cases the preservation of game birds has, economically, proved of great value.

Eggs.—In some parts of the world the eggs of various species of wild birds are highly esteemed as food, and large quantities are annually gathered, but here again there is the same tendency toward extermination unless the gatherings are limited, or close seasons instituted. In the U.S. and Canada the gathering of the eggs of wild birds is illegal.

Feathers.—The feathers of birds are commercially of considerable value apart altogether from the demand of the millinery trade. There is a large trade carried on for upholstery purposes in which the feathers of gulls, guillemots, puffins, ducks and the domestic fowl are utilized. The soft feathers or down of the eiderduck are preferred to all others because of their superior warmth, lightness and elasticity. Large quantities are imported from Iceland, Greenland and the Faeroe Islands. The great mercantile value of the plumes of the ostrich has led to the establishment of ostrich farms, which yield considerable profits.

What is known as the plumage trade; *i.e.*, the trade in birds' feathers for millinery purposes, has, quite apart from many repulsive aspects, led to more wanton destruction of certain species of birds than all other causes combined. The almost complete extinction of the egrets in the United States between 1880 and 1890 and the appalling destruction of birds of paradise, gulls, terns, grebes, tanagers, orioles, bluebirds and numerous other small birds was a blot on present-day civilization. Restrictive measures have been, or are being, taken in most civilized countries.

Guano.—Prior to the introduction of artificial manures, guano from the various islands of the Pacific ocean was greatly sought after. Although utilized by the Peruvians more than three centuries ago, it was not until the middle of the 19th century that it assumed any importance as an article of commerce. So great was the demand that the better qualities were soon exhausted, and the poorer ones proved unprofitable when compared with the better artificial fertilizers. Small quantities are still collected. Schemes for protection and conservation of the birds and their product have, however, now been introduced.

Legislation.—In the absence, until recent years, of really comprehensive and reliable statistics with reference to the precise economic status of the different species of wild birds, it is not surprising that the various acts and orders relating to the preservation or destruction of wild birds have proved largely abortive. Many of these have been ill-considered and often hastily prepared, others have been largely selfish in nature, while the advocates of uniform protection have indirectly contributed to the wanton destruction of many useful birds. What would be the probable ultimate effect of such legislation was never seriously considered at the time.

In the U.S. and Canada the principles on which legislation has been based are, that all wild birds are the property of the state, hence that without permission no one has a right to destroy them; the state has the right to impose restrictions and birds may be captured, killed, possessed, etc., only under such conditions as the state enacts; in a like manner landowners can kill or capture only as a privilege and according as the law specifically grants.

International co-operation in Europe as regards the protection of wild birds has proved difficult, so many and diverse are the interests of the different countries. Valuable work has, however, been done by the International Ornithological congresses and other organizations. An international committee was founded in London in 1922, and the International Treaty of 1916 between Great Britain and the United States of America for the protection of migratory birds constitutes one of the most important and far-reaching measures in the history of wild-bird protection.

The immediate need of the present is for (1) wide and comprehensive measures that will ensure protection to all noninjurious and beneficial wild birds, and provide adequate repressive measures for those species which have, or do, become too numerous and destructive; (2) the establishment of an ornithological bureau, which would have full control of all matters relating to wild birds, including game birds. Such an organization should be the sole authority for framing new laws or making special local orders, and for granting licences to persons to collect birds or their eggs for scientific or other purposes, or to destroy birds which the bureau considers to be injurious. Such a bureau would of course be in close touch with other similar bodies, so that international action could be taken where desirable.

(*See* EGG; FEATHER.)

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ORNITHOPTER, a flying machine with flapping wings operated either mechanically or manually. The type is of historic interest only, and represents man's attempt to imitate the flight of birds.

(*See* FLIGHT [NATURAL].)

ORODES, the name of two Parthian kings. Orodes I reigned about 57–37 B.C., succeeding his father, Phraates III whom, in conjunction with his brother, Mithradates III, he had murdered. He was in turn murdered by his son and successor, Phraates IV. Orodes II succeeded Phraates V about A.D. 5 and within two years was murdered because of his cruelty. (Joseph. Ant., xviii, 2, 4.)

(*See* PARTHIA; PHRAATES.)

ORONTES, the ancient name of the chief river of Syria, also called Draco, Typhon, Axius, the last name being probably the name whence has sprung the modern name El-ʿĀsī (rebel). Taking its rise on the east side of the Bekaʿ, it flows northward expanding into the lake of Homs, and in the plain of Antioch, it is joined by two tributaries, the Afrīn and Kara-su. It reaches the sea near the small port of Suedia (Seleucia Pieriae). In its 170 mi. course it is mainly unnavigable and of small value for irrigation. Its valley, however, has served as a highway for armies and trade between Egypt and Palestine, and Asia Minor.

OROPUS, an ancient Greek seaport on the Euripus which, falling finally to Athens, remained an Attic town under the Roman empire. The oracle of Amphiarus was there.

(*See* ALTAR.)

OROSIUS, PAULUS (*fl.* 415), historian and theologian, was born in Spain (possibly at Braga in Galicia) toward the close of the 4th century. Having entered the Christian priesthood, he naturally took an interest in the Priscillianist controversy then going on in his native country, and it may have been in connection with this that he went to consult Augustine at Hippo in 413 or 414. After staying for some time in Africa as the disciple of Augustine, he was sent by him in 415 to Palestine with a letter of introduction to Jerome, then at Bethlehem, the result of his arrival being that John, bishop of Jerusalem, was induced to summon at his capital in June 415 a synod at which Orosius communicated the decisions of Carthage and read such of Augustine's writings against Pelagius as had at that time appeared.

Success, however, was scarcely to be hoped for among orientals who did not understand Latin, and whose sense of reverence was unshocked by the question of Pelagius, *et quis est mihi Augustinus?* All that Orosius succeeded in obtaining was John's consent to send letters and deputies to Innocent of Rome; and, after having waited long enough to learn the unfavourable decision of the synod of Diospolis or Lydda in December of the same year, he returned to North Africa, where he is believed to have died.

The earliest work of Orosius, *Consultatio sive commonitorium ad Augustinum de errore Priscillianistarum et Origenistarum,* explains its object by its title; it was written soon after his arrival in Africa, and is usually printed in the works of Augustine along with the reply of the latter, *Contra Priscillianistas et Origenistas liber ad Orosium.*

His next treatise, *Liber apologeticus de arbitrii libertate,* was written during his stay in Palestine, and in connection with the controversy which engaged him there. It is a keen but not always fair criticism of the Pelagian position from that of Augustine. The *Historiae adversum Paganos* was undertaken at the suggestion of Augustine, to whom it is dedicated.

Nearly 200 manuscripts of the *Historiae* have survived. A free abridged translation by King Alfred is still extant. The *editio princeps* of the original appeared at Augsburg (1471), and has been superseded by C. Zangemeister, who has edited the *Hist.* and also the *Lib. apol.* Besides the Old and New Testaments, Orosius appears to have consulted Caesar, Livy, Justin, Tacitus, Suetonius, Florus and a cosmography, attaching also great value to Jerome's translation of the *Chronicles* of Eusebius.

ORPEN, SIR WILLIAM NEWENHAM MONTAGUE (1878–1931), British painter, was born at Stillorgan, County Dublin, on Nov. 27, 1878, and studied at the Dublin Metropolitan School of Art and at the Slade school, London. He was elected A.R.A. in 1910 and R.A. in 1919. He first exhibited at the New English Art club, of which he became a member in 1900, his early work being marked by preoccupation with spacing and silhouette and the use of quiet harmonies of gray and brown, with a note of vivid red or blue. He soon turned to the use of bright colour and the study of light, seen in a series of brilliant portrait interiors such as the "Hon. Percy Wyndham" (1907), "Myself and Venus" (1910, now in Pittsburgh gallery, Pittsburgh, Pa.).

About this time he became well known for his vigorously characterized portraits. During World War I Orpen received an appointment as official artist and in 1918 an exhibition of his war pictures was held in London. Many of these are now in the Imperial War museum. He was created K.B.E. in 1918. He wrote *An Onlooker in France* (1921) and *Stories of Old Ireland and Myself* (1924).

ORPHEUS. The legendary founder of the cult known as Orphism, ὁ Ὀρφικὸς βίος. The derivation of the name is uncertain, possibly from the same root as ὀρφνη, signifying darkness. What original figure, human or divine, lies behind the legend, is unknown; it seems possible, however, that Orpheus is the name or title of Thraco-Phrygian priest-kings, who may have been regarded as incarnating the god Dionysus (*q.v.*) or some similar deity, and were perhaps killed by the worshippers of the god after a period of years (*see* James Frazer, *Golden Bough,* 3rd ed., vi, 99).

Legend.—Orpheus was the son, in most accounts, of the Thracian king Oeagrus (sometimes of Apollo), and a Muse, generally Calliope, sometimes Polyhymnia. He took part in the Argonautic expedition (*see* ARGONAUTS), and there was an Orphic version of that exploit, preserved in a late form in the Orphic *Argonautica.* The best-known episode of his career is that of his marriage. His wife Eurydice was bitten by a serpent (while fleeing from Aristaeus, according to Virgil, *Georg.,* iv, 457; this detail is not found earlier, but the story itself is old and widespread; *see* Rose in *Aberystwyth Studies,* iv, p. 21). Orpheus, inconsolable at her death, went down to Hades to get her back. The infernal deities, softened by his music, allowed her to return, on condition that she should walk behind Orpheus and he should not look back. He broke this condition, and she became a ghost once more (Plato, *Sympos.,* 179 D., seems to allude to a slightly different account). He now refused to have anything more to do with women, and consequently the Thracian women, during a Dionysiac orgy, set upon him and tore him to pieces. His head floated down the Hebrus and finally came ashore on Lesbos, where there was apparently an oracular shrine of Orpheus. The legend may be founded on the practice of the *omophagia* (*see* DIONYSUS).

Orpheus is represented as a musician so marvellous that the wild beasts, and even trees and rivers, came to listen to him. He is also represented as a seer, a founder of mystic rites, particularly Dionysiac, a magician, and later as an astrologer also. Sometimes his adventures tend to be assimilated to the stock incidents in the career of a philosopher, for he is represented as travelling in search of knowledge (as Plato, for example, is said to have visited Egypt).

Several writers speak of him as a sort of missionary of civilization (*e.g.,* Aristophanes, *Frogs,* 1032; Horace, *A.P.,* 391). He is also the reputed author of a number of books, some dating from the time of Peisistratus of Athens (*see* ONOMACRITUS).

The Orphic Doctrines and "Life."—There was no Orphic church but there existed a number of *thiasoi* (conventicles) of initiates into the Orphic mysteries, all having a similar doctrine and rules of life, but lacking any sort of central organization and probably having no common standard of orthodoxy. Orphic initiators (ὀρφεοτελεσταί) were numerous, and are spoken of with the utmost contempt by Plato and others. We hear of Orphism from about the 6th century on, and the doctrine, which seems to have grown out of a combination of the Thraco-Phrygian worship of Dionysus with certain religious speculations characteristic of that age, and probably resulting from the contact of Greece with the east, was in outline as follows. When Zagreus was devoured by the Titans (*see* DIONYSUS) and they were consumed by the thunderbolt, man sprang from their ashes. Hence, man is partly divine (Zagreus), partly desperately wicked (the Titans). It is his chief end to get rid of the latter element, which is accomplished by a life of ritual and moral purity during the soul's incarnation in a series of bodies. When completely purified, it will be freed from the "circle of birth or becoming" (κύκλος τῆς γενέσεως) and be made fully divine. The rules of purity included abstinence from animal food of all kinds, avoidance of polluting actions, such as contact with death or birth, wearing of white garments and other ascetic practices. There were mysteries of some kind, at which we may conjecture that the death of Zagreus was enacted (*see* MYSTERY), also various Dionysiac practices, such as the *omophagia.* In some cases, at least, the Orphic dead were provided with extracts from the sacred writings of their sect, inscribed on gold tablets, containing directions for their conduct in the underworld. Several of these have been recovered (*see* next paragraph). The influence of Orphism on Pythagoreanism was great, so much so that it is often impossible to separate the two, although one was primarily a religion, the other a system of philosophy.

Orphic Literature.—A great number of books existing in antiquity were ascribed to Orpheus, or his son Musaeus. This literature was well known to Pindar and Euripides, and exercised great influence, directly or through Pythagoreanism, on Plato, and probably on Socrates also (*see* A. E. Taylor, *Varia Socratica*). It is now lost save for (1) the gold tablets already mentioned, which clearly contain extracts from a poem dealing with the underworld; (2) a collection of hymns of late date; (3) *Lithica*

(on the virtues of minerals) and the *Argonautica,* also late. There are, however, numerous quotations in writers of various dates, which together make up a large collection of fragments, some early and undoubtedly genuine Orphic, others much later, including palpable forgeries, showing Jewish and other foreign influence. A principal source for these is the controversialists, Christian and pagan, of the 3rd and 4th centuries A.D. Among editions may be mentioned E. Abel, *Orphica* (1885); and O. Kern, *Orphicorum fragmenta* (1922). The former contains the hymns, *Lithica* and *Argonautica.*

The story of Orpheus, as was to be expected of a legend told both by Ovid and Boethius, retained its popularity throughout the middle ages and was transformed into the likeness of a northern fairy tale. In English mediaeval literature it appears in three somewhat different versions: *Sir Orpheo,* a "lay of Brittany" printed from the Harleian manuscript in J. Ritson's *Ancient English Metrical Romances,* vol. ii (1802); *Orpheo and Heurodis* from the Auchinleck manuscript in David Laing's *Select Remains of the Ancient Popular Poetry of Scotland* (new ed. 1885); and *Kyng Orfew* from the Ashmolean manuscript in J. O. Halliwell's *Illustrations of Fairy Mythology* (Shakespeare Soc., 1842). The poems show traces of French influence.

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On the representations of Orpheus in heathen and Christian art (in which he is finally transformed into the Good Shepherd with his sheep), *see* A. Baumeister, *Denkmäler des classischen Altertums,* ii, p. 1120; P. Knapp, *Über Orpheusdarstellungen* (Tübingen, 1895); F. X. Kraus, *Realencyklopädie des christlichen Altertums,* ii (1886); J. A. Martigny, *Dictionnaire des antiquités chrétiennes* (1889); A. Heussner, *Die altchristlichen Orpheusdarstellungen* (Leipzig, 1893); R. Eisler, *Vorträge der Bibliothek Warburg 1922–23 ii, Teil* (1925); and the articles in Roscher's and Daremberg and Saglio's lexicons.

ORPINGTON, a residential urban district (after 1934) of Kent, England, 13¾ mi. S.E. of London, on the S.R. Pop. (est. 1951) 63,344. Area 32.6 sq.mi. The church is Early English.

ORRERY, CHARLES BOYLE, 4th EARL OF (1676–1731), British author, soldier and statesman, the second son of Roger, 2nd earl, born at Chelsea, was educated at Christ Church, Oxford. He translated Plutarch's life of Lysander, and published an edition of the epistles of Phalaris, which engaged him in the famous controversy with Richard Bentley. Orrery was imprisoned for a short time in 1721 on suspicion of being concerned in Layer's Jacobite plot. He died on Aug. 28, 1731. Among the works of Roger, earl of Orrery, will be found a comedy, entitled *As You Find It,* written by Charles Boyle.

ORRERY, ROGER BOYLE, 1ST EARL OF (1621–1679), British soldier, statesman and dramatist, 3rd surviving son of Richard Boyle, 1st earl of Cork, was born on April 25, 1621, created baron of Broghill on Feb. 28, 1627, and educated at Trinity college, Dublin, and, according to Wood, also at Oxford. He travelled in France and Italy, and coming home took part in the expedition against the Scots. He returned to Ireland on the outbreak of the rebellion in 1641 and fought with his brothers at the battle of Liscarrol in Sept. 1642. On the resignation of the marquis of Ormonde, Lord Broghill consented to serve under the parliamentary commissioners till the execution of the king, when he retired from public life.

He was engaged in royalist schemes, however, when Oliver Cromwell visited him, and, explaining that he knew all about his activities, offered him a chance of clearing himself by serving the commonwealth in Ireland. He accepted, and served Cromwell faithfully throughout the Irish campaign.

Orrery was returned to Cromwell's parliaments of 1654 and 1656 as member for the county of Cork, and also in the latter assembly for Edinburgh, for which he elected to sit. He served that year as lord president of the council in Scotland; and when he returned to England, he was included in the inner cabinet of Cromwell's council, and was nominated in 1657 a member of the new house of lords. On Cromwell's death he gave his support to Richard; but since he saw no possibility of maintaining the government, he left for Ireland, where by resuming his command in Munster he secured the island for Charles and anticipated George Monk's overtures by inviting him to land at Cork. He sat for Arundel in the convention and in the parliament of 1661, and at the Restoration was taken into great favour. On Sept. 5, 1660, he was created earl of Orrery. The same year he was appointed a lord justice of Ireland and drew up the act of settlement. He continued to exercise his office as lord-president of Munster till 1668, when he resigned it because of disputes with the duke of Ormonde, the lord-lieutenant.

On Nov. 25 he was impeached by the house of commons for "raising of money by his own authority upon his majesty's subjects," but the proceedings were interrupted by the prorogation of parliament and were not afterward renewed. He died on Oct. 26, 1679.

In addition to Lord Orrery's achievements as a statesman and administrator, he gained some reputation as a writer and a dramatist. He was the author of *An Answer to a Scandalous Letter . . . A Full Discovery of the Treachery of the Irish Rebels* (1662), printed with the letter itself in his *State Letters* (1742), another answer to the same letter entitled *Irish Colours Displayed . . .* being also ascribed to him; *Parthenissa, a novel* (1654); *English Adventures by a Person of Honour* (1676), whence Thomas Otway drew his tragedy of the *Orphan; Treatise of the Art of War* (1677), a work of considerable historical value; poems, of little interest, including verses *On His Majesty's Happy Restoration* (unprinted), *On the Death of Abraham Cowley* (1677), *The Dream* (unprinted), *Poems on Most of the Festivals of the Church* (1681); plays in verse, of some literary but no dramatic merit, of which *Henry V* (1664), *Mustapha* (1665), *Tryphon* (acted 1668), *The Black Prince* (1669), *Herod the Great* (published 1694) and *Altemira* (1702) were tragedies, and *Guzman* (1669) and *Mr. Anthony* comedies. A collected edition was published in 1737, to which was added the comedy *As You Find It. The General* is also attributed to him.

BIBLIOGRAPHY.—*State Letters of Roger Boyle, 1st Earl of Orrery,* ed. with his life by Thomas Morrice (1742); *Letter Book whilst Governor of Munster,* Add. ms. 25,287 (Brit. Mus.); *Letters to Sir John Malet,* Add. ms. 32,095, ff. 109–188; article in the *Dict. of Nat. Biog.* and authorities there collected; Anthony Wood, *Athenae Oxonienses,* iii, 1200; *Biographia Britannica* (Kippis); Lady Cork and Orrery, ed., *Orrery Papers* (preface) (1903); John T. Gilbert, ed., *Contemporary Hist. of Affairs in Ireland* (1879–80); *Cal. of State Pap., Irish and Domestic.*

ORRISROOT (apparently a corruption of iris root), the rhizomes or underground stems of three species of *Iris, I. germanica, I. florentina* and *I. pallida,* closely allied plants growing in subtropical and temperate latitudes, but principally identified with north Italy.

The three plants are indiscriminately cultivated in the neighbourhood of Florence as an agricultural product under the name of ghiaggiuolo.

In August the rhizomes are dug up and freed of the rootlets and brown outer bark; they are then dried and packed in casks for sale. In drying they acquire a delicate but distinct odour of violets. They are principally powdered for use in dentifrices and other scented dry preparations.

ORRVILLE, a city of Wayne county, northeastern Ohio, U.S. It is about 44 mi. S. of Cleveland and is served by the Pennsylvania and the New York, Chicago and St. Louis railways.

The population was 5,153 in 1950 and was 4,484 in 1940 by the federal census.

Products manufactured include castings, hardware, truck bodies, lumber and boiler-room equipment; there is also a meat-packing plant. Agricultural produce of the area includes dairy products and grain.

The city owns and operates a waterworks, a sewage treatment plant and an electric generator. The public library contains more than 10,000 volumes. A semiweekly newspaper, the *Courier-Crescent,* which was established in 1868, is published there.

ORSHA (Polish, Orsza), a town of the White Russian S.S.R., in 54° 34′ N., 30° 20′ E., on the Dnieper river, and at a junction

on the Moscow-Warsaw railway. Pop. (1933) 32,200. It is an entrepôt for grain and timber and has iron works and a brewery. It is mentioned in the annals in 1067 as Rsha and was captured by the Lithuanians in the 13th century.

A Polish Jesuit college was founded there in 1604. During the 16th and 17th centuries it was several times besieged by the Russians, and finally annexed in 1772.

ORSINI, the name of a Roman princely family of great antiquity. According to tradition the popes Paul I (757) and Eugenius II (824) were of the Orsini family, but the probable founder of the house was a certain Ursus (the Bear), about whom little is known, and the first authentic Orsini pope was Giacinto Orsini, son of Petrus Bobo, who assumed the name of Celestin III (1191).

The latter endowed his nephews with church lands and founded the fortunes of the family, which alone of the Guelph houses was able to confront the Ghibelline Colonna. "Orsini for the church" was their war cry in opposition to "Colonna for the people." In the 13th century the "Sons of the Bear" were already powerful and rich, and under Innocent III they waged incessant war against other families, including that of the pope himself (Conti).

In 1241 Matteo Orsini was elected senator of Rome, and sided with Pope Gregory IX against the Colonna and the Emperor Frederick II, saving Rome for the Guelphic cause. In 1266 the family acquired Marino, and in 1277 Giovanni Orsini was elected pope as Nicholas III.

When Boniface VIII proclaimed a crusade against the Colonna in 1297, the Orsini played a conspicuous part in the expedition and captured Nepi, which the pope granted them as a fief. On the death of Benedict XI (1304) fierce civil warfare broke out in Rome and the Campagna for the election of his successor, and Cardinal Napoleone Orsini appears as the leader of the French faction at the conclave. The Campagna was laid waste by the feuds of the Orsini, the Colonna and the Caetani. At this time the Orsini held the castle of S. Angelo, and palaces on the Monte Giordano, which formed a fortified and walled quarter.

In 1332, during the absence of the popes at Avignon, the feuds between Orsini and Colonna, in which even Giovanni Orsini, although cardinal legate, took part, reduced Rome to a state of complete anarchy. The Orsini were again at war with the Colonna at the time of Rienzi. In 1435 Francesco Orsini was appointed prefect of Rome, and created duke of Gravina by Pope Eugenius IV. In 1484 war between the Orsini and the Colonna broke out once more, the former supporting the pope (Sixtus IV). Virginio Orsini led his faction against the rival house's strongholds, which were stormed, the Colonna being defeated.

The Orsini fortunes waxed and waned many times, and their property was often confiscated, but they always remained a powerful family and gave many soldiers, statesmen and prelates to the church. The title of prince of Solofra was conferred on them in 1620, and that of prince of the Holy Roman empire in 1629. In 1724 Vincenzo Maria Orsini was elected pope (Benedict XIII) and gave his family the title of Roman princes.

See F. Sansovino, *Storia di casa Orsina* (Venice, 1565); F. Gregorovius, *Geschichte der Stadt Rom* (Stuttgart, 1872); A. von Reumont, *Geschichte der Stadt Rom* (1868); *Almanach de Gotha.*

ORSINI, FELICE (1819–1858), Italian revolutionist, was born at Meldola in Romagna He joined the Giovane Italia, a society founded by Giuseppe Mazzini. Implicated together with his father in revolutionary plots, he was arrested in 1844 and condemned to imprisonment for life. The new pope, Pius IX, released him, and he led a company of young Romagnols in the first war of Italian independence (1848). He was elected member of the Roman constituent assembly in 1849, and after the fall of the republic he conspired against the papal autocracy once more in the interest of the Mazzinian party.

Mazzini sent him on a secret mission to Hungary, but he was arrested in 1854 and imprisoned at Mantua, escaping a few months later. His account of his prison experiences, *Austrian Dungeons in Italy* (1857), led to a rupture between him and Mazzini.

He then formed a plot to assassinate Napoleon III, whom he regarded as the principal obstacle to Italian independence. On the evening of Jan. 14, 1858, while the emperor and empress were on their way to the theatre, Orsini and his accomplices threw three bombs at the imperial carriage. The intended victims were unhurt, but several other persons were killed or wounded. Orsini was arrested; on Feb. 11 he wrote a letter to Napoleon, exhorting him to take up the cause of Italian freedom. He addressed another letter to the youth of Italy, stigmatizing political assassination. He was executed on March 13, 1858.

Of his accomplices, Joseph Pieri also was executed, Rudio was condemned to death but obtained a commutation of sentence and Gomez was condemned to hard labour for life. Orsini's attempt terrified Napoleon, who may have been so induced to take up Italy's cause.

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ORTA, LAKE OF, in north Italy, west of Lago Maggiore. Its southern end is about 22 mi. by rail N.W. of Novara on the main Turin-Milan line, while its north end is about 4 mi. by rail S. of the Gravellona-Toce railway station. It has an area of about $6\frac{1}{4}$ sq.mi., it is about 8 mi. in length, its greatest depth is 469 ft. and the surface is 951 ft. above sea level, while its width varies from $\frac{1}{2}$ to $1\frac{1}{4}$ mi. The island of San Giulio (just west of the village of Orta) has a picturesque church. The chief place is Orta, on a peninsula projecting from the east shore of the lake, while Omegna is at its northern extremity. The lake is the remnant of a larger sheet of water by which the waters of the Toce flowed south toward Novara. As the glaciers retreated, the waters flowing from them sank and were gradually diverted into Lago Maggiore.

This explains why no considerable stream feeds the Lake of Orta, while at its north end the Nigoglia torrent flows out of it, ultimately joining Lago Maggiore.

ORTELIUS (Wortels), **ABRAHAM** (1527–1598), next to Mercator the greatest geographer of his age, was born at Antwerp on April 14, 1527, and died in the same city on July 4, 1598. He was of German origin, his family coming from Augsburg. He travelled extensively in western Europe. Beginning as a map engraver, he became a merchant, and most of his journeys before 1560 were for commercial purposes. In 1560, however, when travelling with Gerhard Kremer (*see* Mercator, Gerardus), he became interested in scientific geography and began to prepare that atlas or *Theatre of the World* by which he became famous. In 1564 he completed a *mappemonde,* which afterward appeared in the *Theatrum.* In 1570 (May 20) was issued, by Gilles Coppens de Diest at Antwerp, Ortelius' *Theatrum Orbis Terrarum,* the "first modern atlas" (of 53 maps). Many editions, Flemish, Latin and German, appeared in his lifetime. Most of the maps were admittedly reproductions (a list of 87 authors is given by Ortelius himself), and many discrepancies of delineation or nomenclature occur; but, taken as a whole, this atlas with its accompanying text was a monument of rare erudition and industry. In 1573 Ortelius published 17 supplementary maps under the title of *Additamentum Theatri Orbis Terrarum.*

In 1575 Ortelius was appointed geographer to the king of Spain, Philip II, on the recommendation of Arius Montanus, who vouched for his orthodoxy (his family, as early as 1535, had fallen under suspicion of Protestantism). Other important works are: *Synonymia geographica* (1578); *Nomenclator Ptolemaicus* (1584); his *Parergon* (a series of maps illustrating ancient history, sacred and secular), and his *Itinerarium per nonnullas Galliae Belgicae partes,* a record of a journey in Belgium and the Rhineland made in 1575; an edition of Caesar (*C. I. Caesaris omnia quae extant,* Leyden, Raphelingen, 1593) and the *Aurei saeculi imago, sive Germanorum veterum vita* (Philippe Galle, Antwerp, 1596). He also aided Welser in his edition of the Peutinger Table in 1598. His death and burial (in St. Michael's Abbey church) in 1598 were marked by public mourning.

See Emmanuel van Meteren, *Historia Belgica* (Amsterdam, 1670); General Wauwermans, *Histoire de l'école cartographique belge et anversoise* (Antwerp, 1895), and article "Ortelius" in *Biographie nationale* (Belgian), vol. xvi (Brussels, 1901); J. H. Hessels, *Abrahami Ortelii epistulae* (Cambridge, 1887); Max Rooses, *Ortelius et Plantin* (1880); Génard, "Généalogie d'Ortelius," in the *Bulletin de la Soc. roy. de Géog. d'Anvers* (1880 and 1881).

ORTHEZ, a town of S.W. France, department of Basses-Pyrénées, 25 mi. N.W. of Pau on the Southern railway. Pop. (1946) 4,872.

At the end of the 12th century Orthez passed from the viscounts of Dax to the viscounts of Béarn, who resided there in the 13th century. Jeanne d'Albret founded a Calvinist university in the town and Theodore Beza taught there for some time. An envoy sent in 1569 by Charles IX to revive the Catholic faith was besieged in Orthez, which was taken by the Protestant captain, Gabriel, count of Montgomery. In 1684 Nicholas Foucault, intendant under Louis XIV, was more successful, as the inhabitants, ostensibly at least, renounced Protestantism, which however is still strong there. It stands on the right bank of the Gave de Pau there crossed by a 14th-century bridge with four arches and surmounted by a central tower. The Tour de Moncade, a pentagonal tower of the 13th century, was once the keep of a castle of the viscounts of Béarn and is now used as a meteorological observatory. The work of spinning and weaving cotton, especially of the fabric called *toile de Béarn,* the manufacture of paper and of leather and the preparation of hams known as *jambons de Bayonne* and of other delicacies are carried on.

ORTHOCLASE, an important rock-forming mineral belonging to the felspar group (*see* FELSPAR).

ORTHODONTIA, a special department of dentistry concerned with the prevention and correction of irregular and of malposed teeth. Orthodontic treatment is usually effected by means of the spring force of delicate wires attached to the teeth. The earliest attempt in the literature at systematic treatment of orthodontia was by Fauchard in 1728. In 1836 Kneisel published a special work on the subject. Between these two it was variously treated by several writers in the field of mechanical dentistry (Bunon 1743; Bourdet 1757; Fox 1803; Delabarre 1819). At the beginning of the 20th century in America orthodontia emerged from the general field of mechanical dentistry as a recognized specialty. Its advent was heralded by the appearance of many "systems of regulating." These systems were marketable combinations of mechanical appliances designed to effect various movements of the teeth, and were identified by the names of their inventors (Angle, Case, Jackson, *et al*). While this period of the exploitation of apparatus undoubtedly was a great stimulus to the development of technique, the literature which it evoked took the form of personal opinion rather than the presentation of scientific evidence. Expert technicians soon demonstrated the limitations of the mechanical conception of the subject whereupon interest centred in its biological aspect. Since then the results of treatment have been more satisfactory. Great advances have been made in America where specialization is more common while the conservative influence of the dental profession in Great Britain and European countries has acted as a stabilizing force in its growth. The condition of irregular and malposed teeth (*i.e.,* malocclusion) may be caused by bad diet in both its chemical and physical aspects (Howe, McCollum, Mellanby). Habits of infancy and childhood as thumb-sucking, tongue-biting and mouth-breathing, and mutilations from trauma and disease are also important causes. In fact any abnormal function in or about the mouth when persisted in may result in irregular and malposed teeth. (A. L. J.)

ORTHODOX CATHOLIC CHURCH: *see* ORTHODOX EASTERN CHURCH.

ORTHODOX EASTERN CHURCH (frequently spoken of as the Greek Church and described officially as The Holy Orthodox Catholic Apostolic Eastern Church), the historical representative of the churches of the ancient east. It consists of (1) those churches which accepted all the decrees of the first seven general councils and have remained in full communion with one another, (2) such churches as derived their origin from these by missionary activity, or by abscission without loss of communion.

Origins of the Greek or Eastern Church.—Christianity arose in the east, and Greek was the language of the Scriptures and early services of the church, but when Latin Christianity established itself in Europe and Africa, and when the old Roman empire fell in two and the eastern half became separate in government, interests and ideas from the western, the term Greek or Eastern Church acquired gradually a fixed meaning. It denoted the church which included the patriarchates of Constantinople, Alexandria, Antioch and Jerusalem and their dependencies. The ecclesiastical division of the early church, at least within the empire, was based upon the civil. Constantine introduced a new partition of the empire into dioceses, and the church adopted a similar division. The bishop of the chief city in each diocese naturally rose to a pre-eminence, and was commonly called exarch —a title borrowed from the civil jurisdiction. In process of time the common title patriarch was restricted to the most eminent of these exarchs, and councils decided who were worthy of the dignity. The council of Nicaea recognized three patriarchs—the bishops of Rome, Alexandria and Antioch. To these were afterward added the bishops of Constantinople and Jerusalem.

When the empire was divided, there was one patriarch in the west, the bishop of Rome, while in the east there were at first two, then four. At present there are seven. This geographical fact has had a great deal to do in determining the character of the Eastern Church. It is not a despotic monarchy governed from one centre and by a monarch in whom plenitude of power resides. It is an oligarchy of the great body of bishops, ranging through the various grades of metropolitan, archbishop, exarch and patriarch. Each head of an autocephalous church (whether patriarch, exarch or archbishop) is supreme and not amenable to any of his peers but is within the jurisdiction of an ecumenical council. The schismatic churches of the east have always reproduced the ecclesiastical policy of the church from which they seceded.

The Byzantine Church, like the Roman, soon spread far beyond the imperial dioceses which at first fixed its boundaries, but it was far less successful than the Roman in preserving its conquests for Christianity. This was due in the main to the differing quality of the forces by which the area covered by the two churches was respectively invaded. Byzantine Christianity became the religion of the majority of the Slavs as Latin Christianity became that of the Germans; but the Orthodox Church never conquered its conquerors. The great dogmatic work of the Eastern Church was the definition of that portion of the creed of Christendom which concerns theology proper—the doctrines of the essential nature of the Godhead and the doctrine of the Godhead in relation with manhood in the incarnation.

All the churches of the east, schismatic as well as Orthodox, accept unreservedly the decrees of the first two councils. The schismatic churches protest against the additions made to the creeds of Nicaea and Constantinople by succeeding councils. The Niceao-Constantinopolitan creed declared that Christ was consubstantial (ὁμοούσιος) with the Father, and that He had become man (ἐνανθρωπήσας). Disputes arose when theologians tried to explain the latter phrase. These differences took two separate and extreme types, the one of which separated the two natures so as to assert a union by means of the harmony of the divine and human wills, while the other insisted upon an absorption of the human nature in the divine. The former was the creed of Nestorianism, the latter of Monophysitism. The Nestorians accept the decisions of the first two councils and reject the decrees of all the rest as unwarranted alterations of the creed of Nicaea. The Monophysites accept the first three councils but reject the decree of Chalcedon and all that come after it. They gave rise to numerous sects and to at least three separate national churches,—the Jacobites of Syria, the Copts of Egypt and the Abyssinian Church, which are treated under separate headings. (*See* also NICAEA, COUNCIL OF; CHALCEDON, COUNCIL OF; NESTORIUS; NESTORIANS; MONOPHYSITES.)

CONFLICT WITH ROME

The relation of the Byzantine Church to the Roman may be

described as one of growing estrangement from the 5th to the 11th century and a series of abortive attempts at reconciliation since the latter date. The estrangement and final rupture may be traced to political and cultural causes as well as the increasing claims of the Roman bishops and to western innovations in practice and in the doctrine of the Holy Spirit, accompanied by an alteration of creed. In the early church three bishops stood forth prominently, principally from the political eminence of the cities in which they ruled—the bishops of Rome, Alexandria and Antioch. The transfer of the seat of empire from Rome to Constantinople gave the bishops of Rome a possible rival in the patriarch of Constantinople, but the absence of an overawing court and of meddling statesmen did more than recoup the loss to the head of the Roman Church. The theological calmness of the west, amid the violent theological disputes which troubled the eastern patriarchates, and the statesmanlike wisdom of Rome's greater bishops, combined to give a unique position to the pope, which councils in vain strove to shake and which in time of difficulty the eastern patriarchs were fain to acknowledge and make use of, however they might protest against it and the conclusions deduced from it.

But this pre-eminence, or rather the Roman idea of what was involved in it, was never acknowledged in the east; to press it upon the eastern patriarchs was to prepare the way for separation, to insist upon it in times of irritation was to cause a schism. The theological genius of the east was different from that of the west. The eastern theology had its roots in Greek philosophy, while a great deal of western theology was based on Roman law. This gave rise to misunderstandings, and at last led to two widely separate ways of regarding and defining one important doctrine—the procession of the Holy Spirit from the Father or from the Father and the Son. Political jealousies and interests intensified the disputes; and at last, after many premonitory symptoms, the final break came in 1054, when Pope Leo IX smote Michael Cerularius and his adherents in the Eastern Church with an excommunication. There had been mutual excommunications before, but they had not resulted in permanent schisms. Now, however, the separation was final, and the ostensible cause of its finality was the introduction by the Latins of two words *Filioque* into the creed. (After the words "and in the Holy Ghost" of the Apostles' Creed the Constantinopolitan creed added "who proceedeth from the Father." The Roman Church, without the sanction of an ecumenical council and without consulting the easterns, added "and the Son." The addition was first made at Toledo [589] in opposition to Arianism. The easterns also resented the Roman enforcement of clerical celibacy, the limitation of the right of confirmation to the bishop and the use of unleavened bread in the Eucharist.) It is this addition which was and which still remains the permanent cause of separation. Other causes were added later.

Doctrines and Creeds.—The Eastern Church has no creeds in the modern western use of the word, no normative summaries of what must be believed. It has preserved the older idea that a creed is an adoring confession of the church engaged in worship; and, when occasion called for more, the belief of the church was expressed more by way of public testimony than in symbolical books. Still the doctrines of the church can be gathered from these confessions of faith. The eastern creeds may thus be roughly placed in two classes—the ecumenical creeds of the early undivided church, and later testimonies defining the position of the Orthodox Church of the east with regard to the belief of the Roman Catholic and of Protestant Churches. These testimonies were called forth mainly by the protest of Orthodox theologians against Jesuitism on the one hand and against the reforming tendencies of the patriarch Cyrillos Lucaris (*q.v.*) on the other. The Orthodox Church adopts the doctrinal decisions of the seven ecumenical councils, together with the canons of the Concilium Quinisextum or second Trullan council (692); and they further hold that all these definitions and canons are simply explanations and enforcements of the Nicaeo-Constantinopolitan creed and the decrees of the first council of Nicaea. The first four councils settled the orthodox faith on the doctrines of the Trinity and of the two natures of the one person of Jesus Christ; the fifth supplemented the decisions of the first four. The sixth declared against Monothelitism; the seventh sanctioned the worship (*δουλεία*, not *ἀληθινὴλατρεία*) of images; the council held in the Trullus (a saloon in the palace at Constantinople) supplemented by canons of discipline the doctrinal decrees of the fifth and sixth councils.

The most important later doctrinal testimonies of the Eastern Churches are: (1) the Orthodox profession of faith of Peter Mogila, confirmed by the eastern patriarchs and by the synod of Jerusalem (1643), and (2) the decree of the synod of Jerusalem or the confession of Dositheus (1672). Besides these, the answer of the eastern patriarchs to Pius IX (1849) may likewise be included. But none of these is authoritative in the western credal sense.

The Church of Christ is the fellowship of ALL THOSE WHO ACCEPT AND PROFESS ALL THE ARTICLES TRANSMITTED BY THE APOSTLES AND APPROVED BY GENERAL SYNODS. *Without this visible church there is no salvation.*[1] It is under the abiding influence of the Holy Ghost, and *therefore cannot err in matters of faith.* Specially appointed persons are necessary in the service of the church, *and they form a threefold order, distinct jure divino from other Christians, of bishops, priests and deacons.* THE PATRIARCHS HAVE THE HIGHEST RANK AMONG THE BISHOPS, AND THE BISHOPS *united in a general council represent the church and decide,* under the guidance of the Holy Ghost, all matters of faith and ecclesiastical life. But it is only as the decisions of the councils have been accepted by the whole body of believers, clergy and laymen alike, that they become authoritative as living tradition. All ministers of Christ must be regularly called and appointed to their office and are consecrated *by the sacrament of orders. Bishops must be unmarried,* and PRIESTS AND DEACONS MUST NOT CONTRACT A SECOND MARRIAGE. To all priests in common belongs, besides the preaching of the word, the administration of the SIX SACRAMENTS—BAPTISM, CONFIRMATION, PENANCE, EUCHARIST, MATRIMONY, UNCTION OF THE SICK. The *bishops* alone can administer the seventh, the *sacrament* of orders.

Ecclesiastical ceremonies are part of the divine liturgy; most of them have apostolic origin; and those connected with the sacrament must not be omitted by priests under pain of mortal sin.

Liturgy and Worship.—The ancient liturgies of the Eastern Church were numerous but a strong desire for uniformity led to the almost exclusive use of the liturgy of Jerusalem or of St. James. It is used in two forms, a shorter revised by Chrysostom, and a longer called the liturgy of St. Basil. This liturgy and the service generally are either in Old Greek or in Church Slavonic, and frequent disputes have arisen in particular districts about the language to be employed. Both sacred languages differ from the language of the people, but it cannot be said that in the Eastern Church worship is conducted in an unknown tongue—"the actual difference," says J. M. Neale, "may be about that between Chaucer's English and our own." There are 11 chief service books and no such compendium as the Roman breviary. Fasting is frequent and severe. Besides Wednesdays and Fridays, there are four fasting seasons, Lent, Pentecost to SS. Peter and Paul, Aug. 1–15 preceding the Feast of the Sleep of the Theotokos and the six weeks before Christmas. Indulgences are not recognized; an intermediate and purificatory state of the dead is held but not systematized into a doctrine of purgatory. The Virgin receives homage, but the dogma of her Immaculate Conception is not admitted. While ikons are found in the churches, there is no "graven image" apart from the crucifix.

Monasticism is, as it has always been, an important feature in the Eastern Church. An Orthodox monastery is perhaps the most perfect extant relic of the 4th century. The simple idea that possesses the monks is that of fleeing the world; they have no distinctions of orders, and though they follow the rule of St. Basil object to being called Basilians. A few monasteries (Mt. Sinai and some on Lebanon) follow the rule of St. Anthony. K. Lake in *Early Days of Monasticism on Mount Athos* (1909) traces the development through three well-defined stages in the

[1] Small capitals denote differences from Roman Catholic, italics differences from Protestant, doctrine.

9th and 10th centuries—(1) the hermit period, (2) the loose organization of hermits in lauras, (3) the stricter rule of the monastery, with definite buildings and fixed rules under an ἡγούμενος or abbot. (*See* ABBEY; MONASTICISM and related articles.)

The Branches of the Church.—In the early years of the 20th century the Orthodox Eastern Church consisted of 13 mutually independent churches, using their own language in divine service (or some ancient form of it, as in the Greek-speaking churches, Russia and other Slavic churches) and varying not a little in points of detail, but standing in full communion with one another and united as equals in what has been described as one great ecclesiastical federation. However, in using such language it must be remembered that we are not dealing with bodies which were originally separated from one another and have now entered into fellowship, but with bodies which have grown naturally from a single origin and have not become estranged. The most ancient of these divisions depended on the jurisdiction of the four patriarchates. (1) The ancient patriarchate of Constantinople included the imperial dioceses of Pontus, Asia, Thrace and eastern Illyricum; *i.e.*, speaking roughly, the greater part of Asia Minor, European Turkey and Greece, with a small portion of Austria-Hungary. The ecumenical patriarch, as he has been called since early in the 6th century, was the most exalted ecclesiastic of the eastern churches, and his influence reached far outside the lands of the patriarchate. His jurisdiction extended over all the dominions of the sultan. There were 82 metropolitans under him and the "monastic republic" of Mount Athos. He had great privileges and responsibilities as the recognized head of the Greek community in Turkey and enjoyed also many personal honours which had survived from the days of the eastern emperors. (2) The patriarchate of Alexandria, consisting of Egypt and its dependencies, was at one time the most powerful, as it was the most centralized, of all; but the secession of the greater part of the church to Monophysitism, and the Mohammedan conquest of Egypt, have left the patriarch but the shadow of his former greatness. (3) The patriarchate of Antioch has undergone most changes in extent of jurisdiction, arising from the transfer of sees to Constantinople and Jerusalem, from the progress of the schismatic churches of the east and from the conquests of the Mohammedans. The patriarch retains little of his old importance. His jurisdiction includes Cilicia, Syria (except Palestine) and Mesopotamia. After 1899 the native Syrian element secured supremacy. (4) The Patriarchate of Jerusalem was constituted at the council of Chalcedon in 451, with jurisdiction over Palestine. The inroads of the Saracens reduced its importance. At present, the numerically insignificant Greek monastic brotherhood is trying to retain control over the Arabic majority. (X.)

Russian Church.—Although the ancient patriarchates (particularly the ecumenical) still enjoy the highest rank, other Orthodox Churches have far outstripped them in numbers, importance and influence. The Russian Church, for instance, has been, ever since the downfall of the Byzantine empire, the dominant member of Orthodox Christendom. Russia's conversion to Christianity took place in the reign of the grand prince Vladimir (988). It became a metropolitanate of the patriarchate of Constantinople. This situation persisted until 1448, when the Russian Church chose a native for the metropolitan see. By this act it repudiated its dependence upon Constantinople, on the ground that the latter had betrayed orthodoxy by the terms of union with Rome at the council of Florence (1439). It was then the only large Orthodox Church not subject to the Turks. In 1589 it obtained the patriarchal rank; but what is more important, it had long before regarded itself as possessing hegemony of orthodoxy.

In 1666, as the result of the reforming projects of Patriarch Nikon, the Russian Church suffered a schism. The schismatics (*Raskolniki*) repudiated the state church as corrupted by the reforms.

Even greater calamity overtook the church in the reign of Tsar Peter. Upon the death of Patriarch Adrian (1700), Peter refused to allow the election of another patriarch. In 1721 he abolished the patriarchate altogether and radically reorganized the church by creating as the highest administrative organ the Holy Governing synod. By this measure he subordinated the church to the state.

The 19th century may be regarded as the flowering of Russian culture; the astounding creativity of the Russian writers and thinkers won for them a dominant place. Two schools of thought developed: the Westernists, who became revolutionaries in politics, materialists in science and philosophy and atheists in religion. The other school, the Slavophils, developed the native cultural elements. A group loosely associated with them created out of the native religious elements the modern Orthodox world view which seems likely to revivify entire eastern orthodoxy. Among the chief figures of this movement—all laymen—were A. S. Khomyakov, F. M. Dostoievski, V. S. Soloviev and N. A Berdyaev.

Serbian Church.—The other Slavic Orthodox Churches comprise the Serbian and the Bulgarian. The former goes back for its autonomy to 1219, when an independent metropolitanate was organized by St. Sava. It gained the patriarchal rank in 1346 during the reign of the mighty tsar Stephen Dushan. But when Serbia fell prey to the Turks at the fateful battle of Kosovo (1389), a chaotic condition set in. For about five centuries the Serbs bore the heavy Turkish yoke. In 1766 the patriarchate of Pech was abolished and the Serbian Church subjected to the ecumenical patriarch. The fateful rule of the Greek Phanariots left its legacy of hatred to this day. Nevertheless, the church succeeded in preserving, during those dark times, whatever national spirit was left among the degraded Serbian peasants.

But a good-sized group of Serbs escaped the domination of the Turks and of the ecumenical patriarch. In 1690 Patriarch Arsen Crnojević (Arsenius III) escaped with about 37,000 Serbian families into the Austrian territory. Emperor Leopold I granted them political and ecclesiastical autonomy. Thus arose the Karlovci patriarchate in southern Hungary (Banat).

The Serbian War of Independence broke out in 1804 and resulted in 1830 in the recognition of Prince Miloš Obrenović as the hereditary ruler, subject to the sultan's suzereignty. Two years later the Serbian Church won a conditional autonomy. It was not until 1879 that it became fully autocephalous, after Serbia secured political independence (1876).

Besides these two churches, there existed the Serbian metropolitanate in Bosnia-Herzegovina, which was freed from the jurisdiction of Constantinople in 1880, when the territory became part of Austria-Hungary. Another ecclesiastical unit within the Austrian empire was the metropolitanate of Czernowitz in Bukovina, with which were united the Dalmatian bishoprics of Zara and Kotor. Lastly, the metropolitanate of Montenegro was likewise an independent Serbian church.

Bulgarian Church.—Bulgaria was converted to Christianity in 864 when Tsar Boris was baptized by Byzantine emissaries of Patriarch Photius. The Bulgarian Church became a patriarchate in 917 during the glorious reign of Tsar Simeon. But the Byzantine emperor Basil II put an end to the independence of Bulgaria in 1018, and the Bulgarian Church was reduced to the rank of an archbishopric. Moreover, the see was gradually Hellenized by Greek appointees. In 1186 Bulgarians revolted and established the second Bulgarian empire. The church recovered the patriarchal rank in 1235. Unfortunately, the Turkish victory over the Balkan allies in 1389 put an end to the political independence of the Bulgars for the next five centuries. In 1767 the ancient patriarchate of Ohrid was abolished altogether and the Bulgarian Church subjected to the harsh rule of the ecumenical patriarchate. It did not regain its autonomy until 1870 when the Turkish sultan granted it against the strenuous objections of the ecumenical patriarch. In consequence, there occurred a schism between the Greek churches and the Bulgarian exarchate which was not terminated until 1945.

Rumanian Church.—The Rumanian Church had its origin in the principality of Ugro-Walachia and was at first subject to the Ohrid archbishopric. But in 1359 it passed under the jurisdiction of the ecumenical patriarchate. In Moldavia the first Orthodox episcopal see was organized in the reign of Voivode Peter Musat (1375–91) and acknowledged the supreme jurisdiction of Con-

stantinople (1401). When both these principalities were conquered by the Turks, the two metropolitanates retained a considerable measure of autonomy. But when the Rumanians supported the Russian Peter the Great in his war with Turkey, the latter, upon defeating Peter, imposed upon the Rumanians a harsh rule. The Greek Phanariots then became powerful both in state and church.

As in the other Balkan countries (with the exception of Bulgaria), the independence of the Rumanian Church followed upon the political liberation of the country. In 1858 the autonomy of the two principalities was recognized under a general all-European protectorate. Thereupon, Walachia and Moldavia united to form Rumania. In 1865 the Rumanian Orthodox Church was declared independent of all foreign ecclesiastical rule, but in reality a certain degree of dependence upon the ecumenical patriarchate continued. When Rumania proclaimed itself a kingdom in 1881, the church at last threw off the last vestiges of dependence (1882).

AFTER WORLD WAR I

At the conclusion of World War I, the situation of the Orthodox Churches was greatly changed. For a time, the previous balance of power was radically upset. This was caused by the tragic eclipse of the Russian Church, which had hitherto been the most numerous and powerful (comprising about 110,000,000 members) and the consequent shift of hegemony to the Balkan churches. The victorious soviets as early as Jan. 1918 enacted fundamental ecclesiastical legislation separating the church from the state and from the school. All property, including ecclesiastical possessions, was nationalized. All subsidies ceased. Although in theory full liberty of conscience was granted, in practice the church was treated as the bulwark of the old order and suffered accordingly. Clergy were disfranchized and deprived of the possibility of securing livelihood except by voluntary support of the impoverished congregations. Free use of church buildings was permitted, but later such staggering charges for insurance and other purposes were imposed that many congregations were unable to retain the use of the buildings. All organized teaching of religion to children and youth was forbidden.

Patriarch Tikhon, elected by the sobor of 1917 which had abolished the Holy Governing synod and restored the patriarchate, protested against the spoliation of the church and other inimical acts. He was arrested but a year later was released after he had signed a "confession" promising not to interfere with the new political orientation. In the meantime, there arose schisms within the church, aided and abetted by the government. In 1929 the constitution of the Russian Soviet Federated Socialist Republic reserved the right of "propaganda" only to the antireligious forces and granted to the religious bodies the mere right of "confession." The congregations were restricted to bare liturgical services. Many churches were closed. By the adoption of the five-day week attendance on church services was made extremely difficult. Clergy were singled out for particularly harsh treatment; lay members were discriminated against; children were subjected to antireligious school training. The government went all out for every form of antireligious propaganda.

But all these measures proved inadequate. After the government became aware of the failure of its policy, and at the same time recognized that the church offered no political opposition, it inaugurated a new religious policy in Jan. 1939. Efforts to liquidate religion were discontinued. Antireligious periodicals were restricted or withdrawn. The seven-day week was restored. Many churches were reopened. Even some new ones were built. Group religious instruction was permitted in private. Seminaries for the education of clergy were allowed. In 1946 a theological academy was opened in Moscow. In 1943 the national council for the election of a new patriarch was held, and Metropolitan Sergei was chosen for the post. This was done with the approval of Marshal Joseph Stalin. After Sergei's death, Metropolitan Alexei was raised to the patriarchal throne (1945). The government established two offices for the supervision of religious affairs. Thus, a direct relationship between the church and the state was re-established. In Aug. 1945 the church was recognized as possessing corporate juridical rights. It was officially reported in 1946 that there existed at the time 65 fully constituted dioceses within the U.S.S.R. (10 others abroad), but there were only 59 bishops to serve them. There were about 25,000 parishes, as against 4,225 in 1941. Of the total 46,457 church buildings which had been in existence in 1917, about 57% were in religious use in 1946.

The Balkan churches, during the eclipse of the Russian Church, became the dominant Orthodox bodies. Numerically the largest among them, Rumania, which more than doubled its territory after World War I, consolidated four formerly autocephalous organizations into one, 13,000,000 strong. These four bodies comprised the churches of the old kingdom of Rumania, Transylvania, Bukovina and Bessarabia. In 1925 the process of consolidation was completed. The new constitution proclaimed the Orthodox Church the dominant body, while the Uniates were granted "priority among the cults." The rank of the church was raised to that of patriarchate.

As the result of World War II, Rumania lost Bessarabia and Bukovina; but Transylvania, which had been awarded to Hungary by Adolf Hitler, was restored to Rumania. The postwar government, which was under communist influence, had not by early 1947 made radical changes in the ecclesiastical situation.

The Serbian Orthodox Church was likewise consolidated after World War I in keeping with the great territorial expansion of the kingdom. The six formerly independent ecclesiastical units—metropolitanate of Serbia, patriarchate of Karlovci, Bosnia-Herzegovina, Montenegro, the Dalmatian eparchy and the newly acquired Macedonia—were consolidated into the national Serbian Orthodox Church. The ancient patriarchate of Pech was revived (1920), and the metropolitan of Belgrade, Demetrije, was elected the first occupant of the see.

True to the traditional close relationship between the church and the state, Patriarch Gavrilo (1937–) was influential in the coup d'état which placed young King Peter II on the throne in order to nullify the pact with the Germans which had been negotiated by the regent, Prince Paul. When the nazis invaded Yugoslavia (1941), Gavrilo was imprisoned and later sent to a German concentration camp. He returned to resume his office late in 1946.

In the meantime, Marshal Tito (Josip Brozovich) subjected the country to a totalitarian communist regime. He introduced most radical changes in the status of the Orthodox Church. Church and state were separated. Ecclesiastical property was nationalized. All financial support was withdrawn. Antireligious propaganda was legalized. Compulsory civil marriage legislation was passed. Religious instruction in schools was made optional. Even the territory under the jurisdiction of the Serbian patriarch was reduced in size by the creation of an autonomous Macedonian Church.

Similar radical changes occurred in the Bulgarian Orthodox Church, which in 1945 was restored to communion with the Greek churches. Thereupon, the metropolitan of Sophia, Stephan, was elected exarch (an office which had been vacant from the death of Exarch Joseph, who died in 1915). The country fell under communist domination and in 1946 established a republic. It was planned to separate the church and state. Some of the property of the church had already been nationalized, and the church was faced with the problem of support. A new constitution, which was expected to democratize the administration of the church, was in the process of preparation. The church was forbidden to engage in any social or benevolent service. Religious instruction in schools was suppressed, although it was allowed in private.

The Greek family of Orthodox churches comprises the Church of Greece; the patriarchates of Constantinople, Alexandria and Jerusalem; the Church of Cyprus; the Dodecanese Islands; and Mount Sinai. The Church of Greece, which was constituted in 1833, after Greece had secured political independence from Turkey, did not gain the recognition of the ecumenical patriarchate until 1850. There has always existed a close relation between the Greek Church and the government so that political changes

usually were reflected in the ecclesiastical sphere. Under Eleutherios Venizelos, during World War I, the royalist archbishop Theocletos lost his post to the liberal metropolitan Meletios. But when in 1920 the political situation was reversed and King Constantine regained his throne, Theocletos likewise was restored to the see of Athens.

During and after World War II, the archbishop of Athens, Damaskinos, exercised great political influence. Although not subservient to the German masters during their occupation of Greece, he escaped being deposed by them as his predecessor, Archbishop Chrysanthos, had been. After the country's liberation, Damaskinos became the regent of Greece and retained the office until the recall of King George II to the throne in 1946.

The patriarchate of Constantinople suffered greater and more lasting damage as the result of World War I than any other Orthodox Church. When the nationalist armies under Mustafa Kemal Pasha gained victory over the invading Greek forces under King Constantine, Mustafa at first intended to abolish the ecumenical patriarchate altogether, for Patriarch Meletios had openly sided with King Constantine. But the British, at the Lausanne conference (1923), persuaded him to moderate his plan. Thereupon Mustafa expelled Meletios and stripped the patriarchal office of all but the strictly ecclesiastical functions. Later, by the exchange of population between Turkey and Greece, 1,500,000 Greeks were forced to leave the country. The patriarchate which in 1914 numbered 1,800,000 members, was reduced to 300,000 Greek residents of Constantinople and the immediate environs. In early 1947 the membership was estimated at 100,000. Nevertheless, the ecumenical patriarch still held the pre-eminence of honour among his peers and exercised jurisdiction among the Orthodox in the dispersion.

The number of autocephalous or autonomous Orthodox Churches after World War I was 21. Since then, the patriarchate of Moscow secured the subjection to its authority of the churches of Estonia, Finland and Czechoslovakia. The churches of Lithuania, Latvia and Poland were perhaps likewise absorbed by the Moscow patriarchate, but an official statement to that effect had not been made by 1950. The total number of Eastern Orthodox Churches therefore was reduced accordingly. The Uniate Church of Western Ukrainia renounced its allegiance to the pope in 1946 and re-entered orthodoxy. The small Czechoslovak Orthodox Church suffered greatly during the nazi occupation of the country because the parachutists who had killed the notorious "protector" of Czechoslovakia, Reinhard Heydrich, had taken refuge in the Prague Orthodox church, Bishop Gorazd-Pavlik and the parish priest were put to death. Moreover, the entire organization of the Orthodox Church was dissolved. After the liberation of Czechoslovakia the Orthodox Church in that country was reconstituted. The Albanian Church was also weak after World War II, having been subjected to much hostile treatment on the part of the Italians.

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THE EASTERN ORTHODOX CHURCHES IN AMERICA

The beginnings of the Russian settlement of the Aleutian Islands and of Alaska go back to the expedition under the command of Capt. Vitus Bering and Capt. Alexei Chirikov. The latter sighted the territory of Alaska on July 15, 1741. Five days later Captain Bering landed on Kayak Island, where he soon afterward died and was buried. The first Russian to baptize some natives was a Cossack, Andreyan Tolstykh, on the islands bearing his name—the Andreanof Islands (1743). In 1759 a Russian merchant, Ivan Glotov, was the first preacher of Christianity to the Aleutians. He baptized the son of a native "toen" or chieftain of the territory of Umnak. Later he took the young man to Kamchatka where the neophyte, named Ivan after Glotov, learned Russian.

Upon his return, he became a chieftain and was active in spreading Christianity. In 1774 Grigori Ivanovich Shelekhov is said to have baptized 40 natives of Kodiak Island. It was he who organized the first permanent commercial settlement on Kodiak, the Shelekhov-Golikov company. It was named Three Saints, after the ship which had brought Shelekhov to the Aleutians. In 1787 Shelekhov returned to St. Petersburg and laid before Empress Catherine II his plans for the commercial exploitation of the northeastern coast of America. The empress sent an Englishman, Joseph Billings, who had visited Alaska, on a tour of exploration. He arrived at Three Saints on June 20, 1790, and apparently found conditions sufficiently promising to report favourably to Catherine. Shelekhov also urged the empress to send missionaries to Kodiak and promised to assume, with his associate, the payment of their travelling expenses as well as their support.

Thereupon, Alexander A. Baranof, a merchant of Kargopol, was appointed manager of the colony. Under his energetic leadership the colony became a powerful factor in the development of the territory. He transferred the headquarters to the northeast part of the island and named the new settlement Paul's Harbor in honour of the heir to the throne, Grand Duke Paul. He likewise requested the home management for priests to evangelize the natives as well as to serve the religious needs of the Russians.

Such a mission, headed by the archimandrite Joasaph Bogolov, who was accompanied by seven monks, arrived in Sept. 1794. The trip lasted ten months. The missionaries came from the Valaam monastery on Lake Lagoda. Along with them arrived 150 administrators and 30 families of settlers. This group laid the foundations of Russian orthodoxy in America. Within two months of their arrival, two of their number, hieromonks Macarius and Juvenal, travelled over the whole island and baptized about 6,000 natives (another account says "all the inhabitants"). The letters of some of these earliest missionaries are extant. They were written to the hegumenos of the home monastery of Valaam. German, for instance, wrote: "The Aleuts greatly surprised us by their dexterity and desire to be baptized." Another monk, Joasaph, wrote: "On Kodiak almost 6,000 were baptized. They accepted the baptism so sincerely that they broke all their shaman paraphernalia and burned it." But "the apostle of the Aleuts," Bishop Innocent, writing more than 50 years later, complained that Kodiak natives were still half pagan, adhering to their shaman practices, although the Unalaska Aleuts persevered sincerely in their Christianity. During the winter of 1794 the missionaries established the first Russian church and school at Paul's Harbor and consecrated it to the Resurrection of Our Lord. It was destroyed by fire in 1943.

The next spring they extended their missionary labours to other Aleutian islands and within two years claimed to have baptized 12,000 natives and to have built a church or chapel "in every more or less important" community. In 1795 Juvenal left Kodiak for Nuchen and Kenai bay and the following year went to the Alaskan mainland. It is not clear how far north he penetrated, but he met his death near the Iliamna lake. He had persuaded some chieftains to entrust him with their children so that he might educate them; but later they changed their minds, perhaps because he had prohibited polygamy, and after a pursuit caught up with him and killed him as "a deceiver."

The commercial company prospered so well that Emperor Paul I enlarged it by combining the Shelekhov-Golikov company with the Mylnikov company, renaming the new organization the Russian-American company. It was under obligation to provide for the religious needs of the colonists as well as of the natives. Shelekhov, who then lived in Russia, was not satisfied with the progress of the missionary work. He estimated the number of inhabitants of Kodiak Island at 50,000, of whom only about 6,000 had been baptized. It is possible that Shelekhov's estimate refers to all the natives of the Aleutian Islands and Alaska; but Bishop Innocent, who mentions it twice, plainly applies it to Kodiak alone. At any rate, Shelekhov now urged the authorities to establish an episcopal see for Russian America. In 1799 the Holy synod, heeding this request, raised the archimandrite Joasaph to the episcopal rank. The new diocese comprised Kodiak, Kamchatka and Alaska. Unfortunately, the new bishop, upon his return from Irkutsk, Siberia, where he had received consecration, was drowned when his ship foundered off Kodiak Island. Thereupon, the see remained vacant for 40 years.

Nineteenth Century.—For the next 17 years, the work of evangelization was largely at a standstill. Shelekhov died in 1800. Only three members of the original mission were left: of these, Athanasius alone was at Kodiak. German outlived the rest, having retired as a hermit to Spruce Island, where he lived in a cave, although he carried on some work of teaching and preaching. He remained there 40 years, dying in his 81st year in 1837. It was not until 1816 that an additional priest, Alexei Sokolov, was sent to join the depleted staff.

Between 1808 and 1816 the success of the Russian-American company was gratifying. Baranov transferred the headquarters from Kodiak to Baranov Island, where Sitka was chosen as the new capital.

A MANUAL OF THE SACRED VESTMENTS AS USED IN THE HOLY ORTHODOX CHURCH IN AMERICA

1. Robe (*riassa*); 2. Sticharion; 3. Orarion; 4. Zone (girdle); 5. Cuffs; 6. Stole; 7. Phelonion (chasuble); 8. Epigonation; 9. Thigh Shield; 10. Eagle rug; 11. Saccos and the omophorion; 12. Kamalavka; 13. Crown; 14. Panagia; 15. Crozier; 16. Cross; 17. Bishop's mantle

The natives, Koloshi, were different from the meek and friendly Aleuts. They looked upon the Russians "as their terrible enemies, and only bided their time when they could drive them out," as Father Venyaminov (who later became Bishop Innocent) reported. To deal with them, Baranov requested the Holy synod to send him missionaries. He also established a settlement in California, calling it Ross; but this colonization venture did not succeed. At the time Father Venyaminov visited the place in 1838, there were 216 colonists composed of Russians, Aleuts and those of mixed parentage, besides 39 Indians. In 1841 the land was sold by the Russian government to a certain Mr. Sutter for $30,000.

In 1821 the government gave the company a new charter. This document stipulated that the company must provide adequately for the religious needs of the settlers. Thus spurred, the company requested the Holy synod to send them more missionaries. The latter turned to the bishop of Irkutsk with the request that he provide them, but the bishop could find no volunteers. At last a local priest, Father John Venyaminov, offered himself, having learned of the conditions at Unalaska from a colonist Ivan Kryukov who had recently returned from the island after having lived 40 years among the Aleuts. In 1823 Father John moved with his whole family—consisting of his widowed mother, his wife and one-year-old son—to Unalaska. He took a boat to Yakutsk and then travelled on horseback to Okhotsk, about 700 mi. away. From there he took a sailing boat to Unalaska. He arrived there on July 29, 1824. His parish included not only Unalaska, but also other Fox and Pribilov Islands. He lived in an earthen hut but later built himself a wooden house. Having found only one frame chapel on Unalaska, he undertook, first of all, to build a new church. Upon its completion he dedicated it to the Ascension of the Lord. His sermons preached to the natives are still extant and are not exactly "milk for babes."

The zealous young priest—he was only 27 at the time of his arrival—soon extended his missionary efforts to other islands, spending the greater part of the year in sailing in his "haidarka" from island to island. Two other priests who had come about the same time, Father Frumentius Mordovsky and Jacob Netsvyetov, worked at Kodiak and Atlaha.

Father John soon learned the native languages and then composed a primer and translated, with the aid of others, the Gospel of St. Matthew, the catechism and the liturgical books. In order to reduce the language to the written form, he had to invent an appropriate alphabet. After spending ten years in such fruitful labours at Unalaska, he was transferred to the port of New Archangel, or Sitka. There he had to begin his missionary and linguistic labours anew, for there he worked among the Kolosh tribe belonging to the Thlinket Indians. The work among them was much more difficult than that done previously among the Aleuts. Nevertheless, it was crowned with considerable success. Within five years he established schools for native children whom he taught from textbooks of his own composition. He likewise taught them trades. He even introduced inoculation.

However, the work soon grew so large that he needed help. He left Sitka in 1838 for St. Petersburg "exclusively for the purpose of publishing, under my own supervision, my translation of the holy books into the Aleut language," as he reports in his autobiographical sketch. While he stayed in the Russian capital, his wife died. Upon the advice of Metropolitan Philaret of Moscow, who greatly admired the intrepid missionary, Father John assumed the monastic habit, adopting the name of Innocent on this occasion. He was made an archimandrite. Soon after, the Holy synod chose him for the episcopal see vacant after the drowning of Bishop Joasaph in 1799. He was consecrated on Dec. 15, 1840, in the Kazan cathedral in St. Petersburg. Ten months later he was back in Sitka.

Upon his return, Bishop Innocent ordained several priests and in 1842 began extensive episcopal visitation, which he described with minute detail in his *Diary*. This is a mine of information concerning the condition of the churches. He built the cathedral church of St. Michael in Sitka, which was consecrated in 1848 and which still stands. Also he founded a missionary school and a seminary for the training of the native priesthood. His diocese was enormous, comprising not only the colonies in America, but also Okhotsk and Kamchatka. He travelled on dog sleds, often in temperatures of 20° below zero. His energy and zeal were inexhaustible. For his truly great labours he was made archbishop in 1850.

But this was not the end of his career. The holy synod further enlarged his diocese by adding Yakutsk in Siberia to the already enormous territory under his care. The archbishop was obliged to transfer his residence from Sitka to Yakutsk. Thereupon, in 1857, he was granted the aid of two vicars, one for Sitka and the other for Yakutsk. When the famous metropolitan Philaret of Moscow died in 1867, it was the intrepid missionary to the Aleuts and the Koloshi, Archbishop Innocent, who succeeded him. He died in 1879.

The period just described came to an abrupt termination when the United States government purchased Alaska from Russia in 1867. The sum paid for it was $7,200,000. Since many Russian settlers thereafter left the country and the Russian government lost interest in those who remained, the missionary work declined. At that time the membership of the Sitka diocese was in excess of 12,000. Archbishop Innocent had secured, at the time of the sale, the incorporation of a clause guaranteeing the property and rights of the Russian Orthodox Church so that missionary work could be continued. Innocent appointed Bishop Paul to serve the Alaska diocese. His term of service lasted from 1867 to 1870. During this time, Protestant and Catholic missionaries entered Alaska. When it became apparent that more aggressive methods were needed to conserve the gains made by the Russian Church, a new bishop was sent out to replace the non-aggressive Paul.

Such a person was found in Bishop John who was consecrated "Bishop of the Aleutian Islands and Alaska." He was a scholar and a church historian who published a five-volume work on the history of American Christianity. In 1872 he moved the episcopal see to San Francisco, Calif. A beginning of the Russian, Serbian and Greek colony near San Francisco was made at Ross, the ancient Russian settlement abandoned in 1841. When gold was found in the vicinity, fortune hunters of all nations, including the above-mentioned Orthodox nationals, were attracted to the place. But Bishop John was recalled to Russia in 1876 and three years later was succeeded by Bishop Nestor.

Under Bishop Nicholas (1891–98) the diocese was enlarged by the inclusion of Canada and the eastern states of the Atlantic seacoast. Moreover, his predecessor, Bishop Vladimir, had succeeded in extending his jurisdiction over the Uniate Ruthenians (or Carpatho-Russians), who had repudiated the Roman Catholic jurisdiction and returned to orthodoxy.

During the 1880s, Russian immigration increased greatly. Likewise, other Orthodox immigrants, such as Bulgarians, Rumanians and Albanians, settled in the east and the middle west in large numbers. In such manner, the centre of gravity shifted to the east. Consequently, in 1898 Bishop Tikhon, who had succeeded Nicholas in 1898, transferred the see once more, this time to New York city, where the first Russian parish had been organized 35 years previously.

Twentieth Century.—In 1901 St. Nicholas cathedral was founded. The rank of the American hierarch was raised two years later to that of an archbishop. Moreover, Tikhon was assisted in the administration of his enormous archdiocese by two vicar bishops: Innocent for the diocese of Alaska, and Raphael for the Syrian diocese. The latter, though a Syrian born in Damascus, had been educated at the Kazan Theological academy and had been brought to America, along with two other Syrian as well as many Russian priests, by Bishop Nicholas. Later, two other bishoprics were founded—one in Pittsburgh, Pa., and another in Canada. In 1905 the Orthodox Theological seminary opened its doors, and the following year the first Russian monastery was founded. By 1916 there were 343 Orthodox churches, comprising 465,000 members under the jurisdiction of the Russian archbishop.

Tikhon, like his illustrious predecessor in the first half of the 19th century, Archbishop Innocent, attained to the high dignity of the metropolitan of Moscow. In fact, he rose to the highest post in the gift of his church, the patriarchate. When in 1917 the patriarchal office, abolished by Peter the Great, was restored, Metropolitan Tikhon was elected its first occupant.

The bolshevist revolution of 1917 had a disastrous effect upon the dominant position of the Russian Church in America as well as at home. For the hegemony of the Russians among the other Orthodox communions in America was utterly shattered, and the American Russian archdiocese itself suffered disorganization. Archbishop Evdokim (1914–17), who ruled the archdiocese at the time of the downfall of the tsarist regime, returned to Russia in 1917 to attend the All-Russian Territorial council held in Moscow. Since, however, his sympathies turned prorevolutionary, and he joined the Living Church group, it appeared that he would not return to his American see. One of the suffragan bishops left in charge of the administration in America took steps to terminate the anomalous situation thus created. This was Bishop Alexander (Nemolovsky) of Canada, who in 1919 called an All-American convention to meet at Pittsburgh, Pa. This body declared the Russian Church in America "temporarily autonomous," although within the framework of the dogmatic, canonical and liturgical system of eastern orthodoxy. Furthermore, it elected Alexander the archbishop of the new organization. Henceforth, this body assumed the name the Russian Orthodox Church of North America. In this fashion, a new era of the life of the American Russian Church was begun. The action was taken in line with the policy of Patriarch Tikhon, who had instructed the bishops under his jurisdiction to conduct the administration of their dioceses independently since for the time being the soviet government did not allow him to carry on his constitutional jurisdiction over them. Despite the self-governing status, however, the church "did not sever at all the spiritual ties and communion with the Russian church."

But greater troubles were in store. Upon the imprisonment of Patriarch Tikhon in 1922, a group of clergy of the Living Church seized the patriarchal chancery and usurped the supreme administration of the church. In 1923 after they had purged the episcopal ranks of their opponents, they called a council for the reorganization of the church. This revolutionary gathering reversed the political trend of Tikhon's administration by acknowledging the soviet regime, abolished the patriarchate, deprived Patriarch Tikhon of all his authority and functions and reduced him to the status of a layman, instituted married episcopate and adopted other radical reforms. As far as the American archdiocese was concerned, the council appointed as its head the Rev. John Savitz Kedrovsky, then pastor of All Saints' church in Hartford, Conn., and consecrated him to the archiepiscopal rank.

But Patriarch Tikhon, although in prison, did not cease to exercise his patriarchal functions. In 1922 by a verbal order (since he was prevented from putting it in writing) he appointed Metropolitan Platon, then of Kherson and Odessa, but formerly of the American archdiocese (1907–14), as the head of the Russian Church in America. He was acknowledged as such by the convention held in Detroit, Mich., in 1924 and retained the office until his death in 1934. Archbishop Alexander left for Russia and during World War II was killed by the nazis. Naturally, a struggle ensued between Platon and Kedrovsky. The latter appealed to civil courts to decide the jurisdictional dispute. In the end, the court decided in favour of Archbishop Kedrovsky, who thereupon was awarded the possession of the Cathedral of St. Nicholas and the archiepiscopal residence. The congregation of St. Nicholas, however, followed Archbishop Platon to a temporary home offered them by the Trinity Episcopal Church.

In the meantime, the Russian Orthodox Church under the leadership of Metropolitan Sergei made its peace with the soviet regime sufficiently to make it possible for him to carry on its administration. In 1933 Sergei dispatched to America Bishop Benjamin as his exarch. The latter demanded not only submission of the American churches to his jurisdiction but also a pledge of loyalty to the soviet government. When this pledge was refused, Sergei laid the American church under suspension, without any formal trial.

After Platon's death, Bishop Theophilus of San Francisco was elected to the vacant see by the convention of Cleveland, held on Nov. 21, 1934. He had come to America in 1891 in the suite of Bishop Nicholas so that he brought to his archiepiscopal task long experience in the American service. The new archbishop visited Patriarch Barnabas of Serbia in 1935 and negotiated an agreement with the Karlovci synod, which claimed jurisdiction over the Russians outside the U.S.S.R. in opposition to the Moscow patriarchate. Two years after his return, Archbishop Theophilus called a convention which met in New York city on Oct. 5–8, 1937, and approved the reorganization of the administration. The most important change then instituted was that the so-called Metropolitan council was set up as the permanent executive body. It is composed of both lay and clerical members and acts with the approval of the metropolitan (which title was conferred upon Theophilus).

In the meantime, an astonishing *volte-face* in the religious policy of the soviet government brought about a great improvement in the outward condition of the Russian Church. An All-Russian council for the election of the patriarch was permitted in 1943; and the *locum tenens,* Metropolitan Sergei, was chosen for that office, the duties of which he had so long performed. However, he died the next year, and on Feb. 2, 1945, Metropolitan Alexei was elected to succeed him. On this occasion, and despite the sentence of suspension still in force, the American metropolitanate received an invitation to be represented at the council. Four delegates were chosen for this purpose, but only three received visas. Furthermore, because of transportation difficulties, the delegates arrived ten days after the conclusion of the council. Nevertheless, they presented their case to Patriarch Alexei, intimating the desire of the American metropolitanate for a renewal of canonical intercourse with the Moscow patriarchate. The patriarch, a few days later, replied in his *Ukaz* of Feb. 16, in which he laid down the following conditions: a new delimitation of the territory of the American metropolitanate; a council was to be called for the settlement of the outstanding issues, to be presided over by the patriarch's representative, Archbishop Alexei of Yaroslav and Rostov; this council must renounce, in behalf of the American Russian Church, all political activities against the soviet government; and it was to elect a new metropolitan; for this office the patriarch recommended Metropolitan Benjamin or Archbishop Alexei, although he permitted the council "to nominate and elect its own candidate"; nevertheless, the patriarch reserved for himself "the right to refuse confirmation of the chosen candidate if considered unsuitable for any motivated reasons whatsoever." Besides, the patriarch reserved to himself the rights of hearing appeals from American bishops and clergy and of confirming all episcopal appointments.

The American Bishops' council met in Chicago, Ill., on May 22–24 and carefully considered the patriarchal *Ukaz.* The conditions laid down in that document were carefully scrutinized and declared unacceptable on the ground that the autonomy of the American church must be retained. The Russian Church in America "is an American church and an American church it must continue to be." American citizens cannot be ordered by their ecclesiastical superiors what political views they should accept or reject. Nevertheless, this decision did not altogether terminate the negotiations.

The loss of Russian hegemony among the American Orthodox resulted, or greatly aided, in the organization of independent Orthodox churches among the various non-Russian nationalities. Among them, the largest Orthodox Church in the United States was the Greek, comprising, according to the U.S. census of 1936, almost 190,000 members. The earliest Greek Church in the United States was organized in New Orleans, La., in 1867. As the Greek immigration increased, Greek Churches were organized in many American cities. They were left, however, without episcopal supervision by the patriarchate of Constantinople or the Holy synod of Greece, to which bodies they were, in a loose fashion, related. In order to remedy this situation, the patriarchate of Constantinople in 1908 assigned its jurisdiction over American Greeks to the Holy synod of Greece, with the understanding that the latter was to organize the Greek Churches in America into a diocese.

But the actual realization of this plan was delayed another ten years. At last in 1918 the archbishop of Athens, Meletios Metaxakis,

came to the United States with the intention of setting up a Hellenic diocese. But soon he realized that the time was not yet ripe for such an action. Accordingly, he created a synodical trusteeship and placed Bishop Alexander of Rodostolos in charge.

However, soon after his return to Athens, Archbishop Meletios was deposed because of the radical political upheaval which had occurred; in 1920 Venizelos was displaced by King Constantine. The latter signalized his resumption of office by a correspondingly radical change in the ecclesiastical policy. The reverberations of this upheaval were felt even in America, for Bishop Alexander was likewise deposed by the Holy Synod, along with Archbishop Meletios. In his place a synodical exarch, in the person of Bishop Germanos of Sparta, was sent to the United States.

But the deposed Archbishop Meletios was elected in 1921 to the vacant see of the patriarchate of Constantinople. The next year he issued the so-called Founding tome, whereby he rescinded the tome of 1908, giving the synod of Greece jurisdiction over America, and assumed that jurisdiction himself. He sent Bishop Alexander back to his former charge but with the rank of archbishop of North and South America. Unfortunately, an influential royalist faction among the American Greeks refused to acknowledge him and gave support to Metropolitan Basil, whom they had invited to America in the meantime.

The confused situation remained essentially unchanged until the arrival of Metropolitan Damascenos of Corinth; he came to America in 1928 in order to raise money. Upon his return to Greece, he reported to the patriarch the sad state of American affairs. The latter empowered him to return to America and to bring order out of the existing chaos. In order to accomplish this laudable object, both Alexander and Basil were recalled, along with all American bishops. Damascenos arrived in America in 1930 and succeeded in the difficult task of uniting the existing rival factions into the newly created ecumenical province. The man chosen to head the new archdiocese was Metropolitan Athenagoras of Corfu, who as archbishop of the Greek Orthodox Church (Hellenic) held sway over all American Greek Churches.

The remaining Orthodox communions in America are numerically smaller than the Greek and the Russian. Although the numerical relationship and proportion of these communions has perhaps changed since 1936, for which year the U.S. census reports them, it is the statistical basis given in this official publication which has been followed. The Serbian Orthodox Church, which prior to 1921 was under the Russian jurisdiction, organized itself separately in that year. The first Serbian Church in the United States was gathered in 1894 by the Rev. Sebastian Dabovich in Jackson, Calif., and he became its first pastor. He was born in San Francisco and was educated for the priesthood in his native city and in St. Petersburg, Russia. He died in 1940 in the famous historic Serbian monastery of Zicha and is buried there.

In 1921 it was thought advisable to organize the Serbian Churches in America into an independent diocese. The Serbian patriarchate appointed in 1927, as the first bishop of America, the first hegumenos of the Serbian monastery of St. Sava, which is located near Libertyville, Ill., the archimandrite Mardary Uskokovich.

The Syrian Antiochian Orthodox Church established its independent organization in 1927. Originally, the Syrians were ecclesiastically subject to the Russian archbishop, who had raised their mission to the rank of a diocese in 1905, at which time he had appointed the archimandrite Raphael Gavanini as its first bishop. Ten years later Bishop Raphael was succeeded by Bishop Aftimios, who continued in canonical obedience of the Russian Church until 1927, when he withdrew. Later, when he married, he was excommunicated. Thereupon, the Syrian parishes divided into five groups, each acknowledging a different bishop. Some of the bishops died, others were excommunicated. In order to unify the American parishes under one jurisdiction, the Antiochene patriarch in 1934 appointed the archimandrite Antony Bashir as his vicar and charged him with the task of setting up the Syrian Antiochian Orthodox archdiocese. Two years later, at the request of the archdiocese, Archimandrite Bashir was consecrated by the patriarch of Antioch as the first Syrian archbishop of New York and of all North America.

The Rumanian Orthodox Missionary Episcopate in America goes back to 1918 for its organization. At that time there was a sufficient number of churches in existence to form a diocese. The earliest of these was organized in 1905 in Cleveland, O. In 1918 Bishop Policarp Morusca arrived in the United States with the purpose of uniting the scattered congregations into the first Rumanian episcopal diocese with headquarters in Youngstown, O. But in 1929 the general congress which met in Detroit, Mich., decided to move the headquarters to Grass Lakes, Mich., although this was not actually accomplished until Dec. 1943. The president of the Episcopal council, the Very Rev. S. Mihaltian, reported the number of communicants in 1947 as numbering 80,000, although the census of 1936 gives only a little more than 15,000.

The Ukrainian Orthodox Church of America was recruited from among the Uniates. These immigrants became greatly dissatisfied with the American Roman Catholic hierarchy because the latter objected to the Uniate married priesthood, suspended many Ukrainian priests and in general tried to Latinize them. In the end, the Rev. Dr. Alexis G. Toth of Minneapolis, Minn., went over to the jurisdiction of the Russian bishop Vladimir. This occurred in 1891. He was quickly followed by other Ukrainian priests and congregations.

But many Ukrainians did not favour this method of solving their difficulties for they disliked the Russian jurisdiction as much as the Roman Catholic. In 1927 they cut themselves off from the latter and established an independent Ukrainian Orthodox Church in America. At first they elected an administrator to conduct the new organization In 1930 Dr. Joseph Zuk was chosen for this office. Under his leadership, the Ukrainian Church submitted to the jurisdiction of the ecumenical patriarch, whose authority was preferred to that of the Russian hierarchy. Dr. Zuk was then consecrated bishop. But he died in 1934 and was succeeded three years later by Bishop Bohdan. The latter was consecrated by Archbishop Athenagoras, the ranking hierarch of the patriarchate of Constantinople in America. But otherwise the Ukrainian Church is administratively quite independent of the Greek archdiocese.

A group closely related racially to the Ukrainian Orthodox Church is the Carpatho-Russian Greek Catholic Diocese of Orthodox Christian Church, U.S.A., for it comprises the Ruthenians from Sub-Carpathian Ruthenia. Uniatism had been imposed on these originally Orthodox people, just as had been the case with the Ukrainians. As has already been mentioned, after 1891 many of these people submitted to the jurisdiction of the Russian Church in the United States. Their numbers were so considerable, that in 1916 the Russian archbishop Evdokim consecrated the Rev. Stephen Dziubay bishop for their parishes. But during the troubles in which the Russian Church became involved after 1917, both in America and abroad, the Ruthenians became dissatisfied. Thereupon, Bishop Dziubay withdrew from the jurisdiction of Metropolitan Platon and decided to lead his flock back into submission to the Roman Catholic Church. But in this plan he was opposed by many of his own people for whom Catholicism was as distasteful as the Russian Church. This group secured the leadership of the Canadian Ruthenian bishop, Adam Philipovsky, who decided to establish an independent Ruthenian Orthodox Church. In this project he was naturally opposed by Metropolitan Platon, who fought against such diminution of his archdiocese on the ground that no separate ecclesiastical jurisdiction should exist for Ruthenians, who are but a branch of the Russian Church. Both parties appealed the case to the Karlovci synod in Yugoslavia. This body decided in favour of Bishop Adam. Accordingly, in 1931 he organized the North American Russian Orthodox Greek Catholic diocese. It is interesting to note that although this group had renounced Uniatism and became Orthodox, yet it retained in its title the phrase "Greek Catholic" which is the usual designation for the Slavic Uniates. Nevertheless, although an attempt was made on the part of the Roman Catholic authorities to restrain them from the use of the term, the court decided in their favour. In 1935 Bishop Adam was raised to the rank of archbishop.

In the meantime, the group which had followed Bishop Dziubay into affiliation with the Roman Catholic Church soon grew dissatisfied with the new arrangement. Many churches repudiated the Roman jurisdiction and sought to effect a separate, independent organization. But for about ten years they were unable to do so, being involved in lawsuits with the Roman Catholic authorities. Finally, in 1937 they declared themselves independent and organized a self-governing body under the cumbersome name of the Russian Greek Catholic Orthodox Diocese of Eastern Rite Church of North and South America. At the same convention they elected the Rev. Orestes P. Chornock as their bishop, and the next year he obtained consecration as such at the hands of the patriarch of Constantinople. Consequently, he was excommunicated by the Roman Catholic Church.

Beside these communions, there exist smaller foreign-language Orthodox bodies in the United States, such as the Albanian and the Bulgarian Orthodox Churches; but their membership is relatively small. In addition, there are in existence three native American Orthodox Churches, the purpose of which is to naturalize eastern orthodoxy among native Americans, give it "a definite place in American life" and integrate it with American Christianity in general. These bodies were organized independently of each other, the oldest among them being the Holy Eastern Catholic and Apostolic Church. Its first congregation was gathered in 1922. Three years later, its first bishop was consecrated in the person of the former Anglican priest, the Rev. Arthur Wolfort Brooks, who assumed the name of Mar John Emmanuel. The consecrator was the Chaldean bishop Mar Antony who was assisted by two other Chaldean bishops.

The second of these communions is the Holy Orthodox Church in America. This body traces its beginnings to the act of the Russian metropolitan Platon, dated Feb. 2, 1927, directing Archbishop Aftimios to establish means and methods whereby Orthodox services would be provided for English-speaking members of parishes or for any "American residents of parishes." The Very Rev. Leonid Turkevich was to be consecrated the first bishop in charge of this work. But for some reason this intention was not carried out. Instead, in 1932 Archbishop Aftimios consecrated the Rev. William A. Nichols as the first bishop of Washington, D.C. He assumed the name of Ignatius. In 1934 the projected American Orthodox Church was organized, and it was incorporated two years later. The liturgical and other services of this church are in English.

The third of these native Orthodox communions is the American Holy Orthodox Catholic Apostolic Eastern Church, which was insti-

tuted in 1932 and incorporated the next year. Three years later the national council of this body created a patriarchate of Washington for the purpose of federating "Christian bodies of other rites who accept or have adopted for themselves the confession of faith of the Orthodox Catholic Eastern Church."

Organization.—Despite the hierarchical organization of the Orthodox Churches, the conduct of ecclesiastical affairs, both locally and on the diocesan and national levels, is quite democratic. Thus, the Russian council which elects the metropolitan is composed of both lay and clerical elements and possesses supreme authority as the governing body. The same is true of the Serbian and Rumanian ecclesiastical organizations; these churches are governed by representative national conventions in which lay members from all local churches and all the priests participate. The Serbian sabor legislates for the church, reviews the work of the local congregations and elects the members of the Diocesan council which is composed of seven priests and nine laymen. The Rumanian Church congress meets annually. Each local congregation sends to it its priest and two laymen so that the lay element predominates. The congress elects the Episcopal council, which consists of four priests and eight laymen, and to which are entrusted the administrative duties. Essentially the same democratic organization, in which the lay membership often is in majority, is characteristic of the other Orthodox communions. An exception to this statement is the Greek archdiocese, which is governed by the archbishop assisted by four bishops. A convention composed of all the clergy and one lay representative from each congregation meets every three years, but its functions are largely advisory.

The most significant characteristic of American orthodoxy is that with the exception of the three native groups, the rest of the communions are aligned with the jurisdiction of their respective mother churches. Their bishops and other hierarchs are usually appointees of the ecclesiastical authorities abroad and often are actually members of such bodies. The chief exception is the Russian Church, which is autonomous. Nevertheless, even in this case a strong effort is made by the patriarch of Moscow to induce it to surrender its autonomy. Accordingly, although the American Orthodox communions are as a rule self-governing, many of them do not possess hierarchical autonomy.

Furthermore, just as there exists such a close bond of union between the American daughter churches and their mother organizations, there is a marked lack of co-operation among the Orthodox bodies in America. Consequently, instead of attempting to solve such common problems as the education of the American-born priesthood, each communion tries to do it separately or depends upon clergy educated abroad. Another consequence of this situation is that every foreign-speaking Orthodox communion attempts to preserve, as far as possible, its native language and culture and opposes by all means possible the assimilation of its members in the American majority. In fact, the church often serves as the chief agency of such a program. The liturgical services are conducted almost exclusively in the language of the respective community—Greek, Rumanian, Syriac or Church Slavonic. There is, accordingly, a need for weekday schools in which the language of the respective group would be taught to the children. In this educational program the Greeks are pre-eminently successful, although the Russians in 1947 reported almost 70% of the total number of their children in the weekday schools. The publication of church periodical literature is largely motivated by the same intent.

The above considerations apply to practically all Orthodox communions, with the exception of the three native American bodies mentioned previously. Although necessarily depending for their orders upon one or another of the ancient eastern Orthodox communions, they aim to make eastern orthodoxy an integral part of American Christianity, to make available to the native American the riches of the faith and cultus of the Christian east and to acquaint western Christendom with the spirit of orthodoxy. This is in line with the ecumenical character of the emerging new Christendom as it takes form in the World Council of Churches. Thus, these communions perform a useful and necessary function of helping the eastern Orthodox nationals in America to become integrated as component elements of American Christianity.

It is, furthermore, the declared purpose of these native Orthodox bodies to foster a broad social and civic outlook in keeping with the modern needs of American life. They emphasize practical, Christian living, the establishment of better human relations, as well as the spiritual aspects of Christianity. The missionary work is not proselytizing in intention and spirit.

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(M. SPI.)

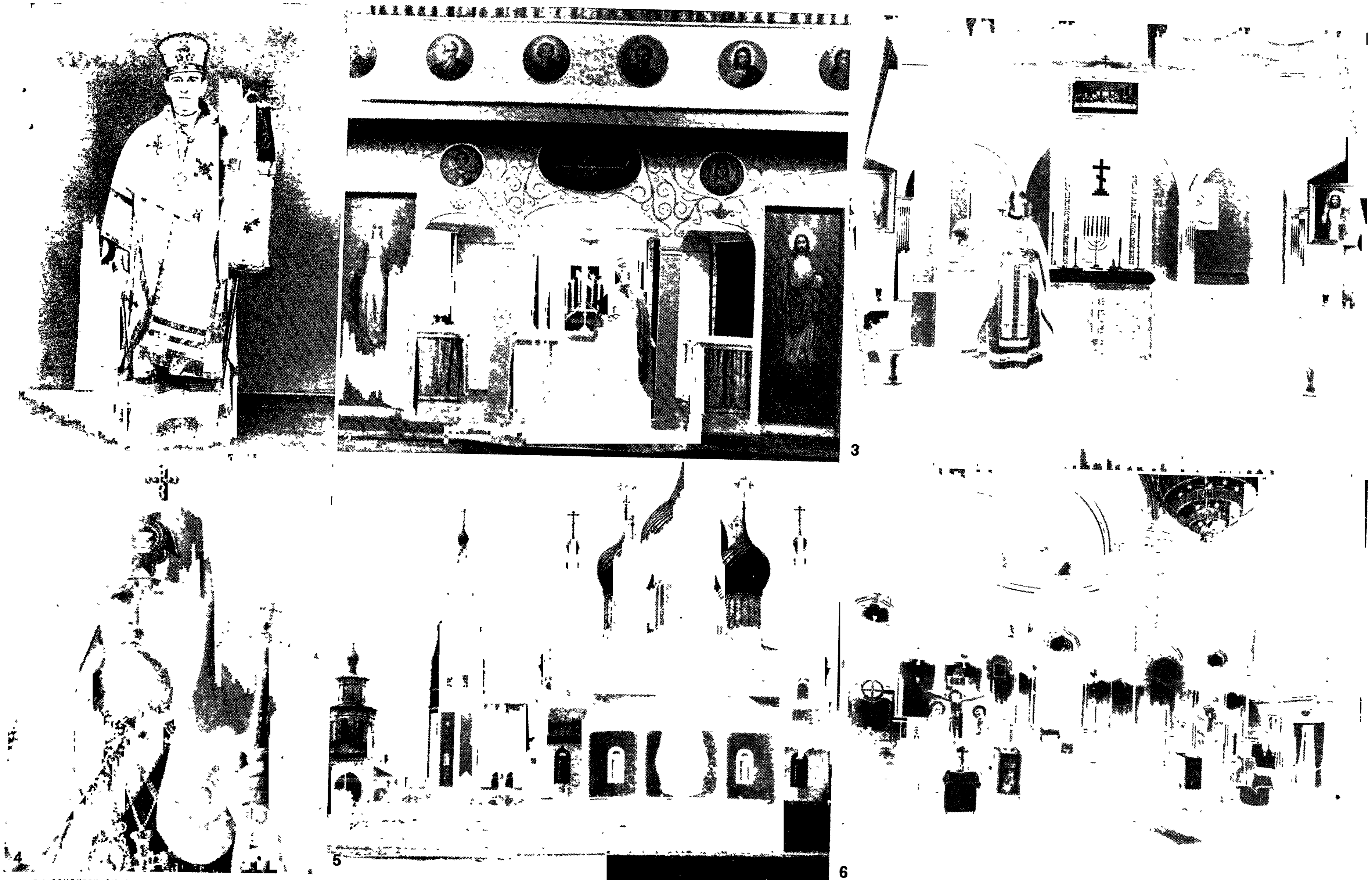
ORTHOGENESIS, "straight-line evolution," a term descriptive of the phenomenon in which successive members of an evolutionary series become increasingly modified in a single undeviating direction; the word is further used to designate theories framed to explain such phenomena. Ortho-evolution, ortho-selection, aristogenesis, undeviating evolution, rectilinear evolution are synonymous or related terms. That evolution frequently proceeds in orthogenetic fashion is undeniable. Theodor Eimer, an early exponent of orthogenesis, based his work on butterfly wing venation; fossil invertebrates show many orthogenetic sequences; H. F. Osborn, W. K. Gregory and others have cited numerous examples in vertebrate palaeontology. In some cases the structural changes concerned are obviously adaptive and a Darwinian explanation (ortho-selection) is reasonable. An orthogenetic "family tree" presents the picture of a single straight stem rather than a branching structure; this appearance may be because of the fact that side branches, when begun, were vigorously pruned by natural selection.

In many instances, however, the striking features developed in an orthogenetic phylum appear to have little if any adaptive value and may even be markedly disadvantageous. To explain such cases is more difficult. No genetic evidence has been found (despite search for it) of progressive mutation in a given direction. Various theories have been proposed involving an "inner urge" toward a predestined evolutionary goal or some other mystical or theological concept. But many workers feel that more rational explanations are possible. Recent work in genetics has shown that even very small mutations may have a definite survival value. Further, the action of a gene is not confined to a single character; the growth of disadvantageous structures (as for example the huge antlers of the extinct Irish "elk") may well have been merely unfortunate genetic concomitants of the development of other structural or functional features of great utility.

Related evolutionary phenomena are parallelism and the so-called law of the irreversibility of evolution. Parallel trends are frequently seen in related but distinct evolutionary phyla; these trends are often orthogenetic in pattern. The "law" of irreversibility is based upon the occurrence of orthogenesis. However, there are many known non-orthogenetic evolutionary lines, and there are numerous instances of reversibility. (*See* EVOLUTION, ORGANIC.) (A. S. RR.)

ORTHOPAEDIC SURGERY is that branch of surgery the purposes of which are to prevent and correct deformity and to improve and preserve the functions of the bones, joints and motor apparatus.

History.—The term orthopaedics was given to this specialty in 1741 by Nicholas André, professor of medicine at the University of Paris. The term was synthesized from the Greek roots *orthos* (straight) and *pais* (child). Although the scope of orthopaedic surgery has gone far beyond the prevention and care of deformities in children, the name lasts and seems to be a permanent part of medical nomenclature in spite of sporadic efforts to have the specialty designated by some other term. According to E. M. Bick, the establishment of the first institute for the treatment of skeletal deformities at Orbe, Switzerland, by Jean André Venel, a physician of Geneva, was a milestone in the development of orthopaedic surgery in the 18th century. During the remaining portion of the 18th century, outstanding work in orthopaedic surgery was done by William Hunter, who contributed to our knowledge of the structure of joints, and by John Hunter (1728–93), his younger brother, who contributed to our knowledge of muscular function and bony growth and development. John Hilton (1804–78) exerted a great influence on the development of orthopaedic surgery with his book *On Rest and Pain,* which undoubtedly helped to influence thinking during the long period in which rest was considered to be the most important part of orthopaedic care. G. F. L. Stromeyer (1804–76), a German surgeon of Hanover, developed the operation of tenotomy (cutting of tendons) by which deformities could be more easily corrected. It was to Stromeyer that William J. Little (1810–94), himself a cripple with a paralytic deformed foot, went to have the deformity corrected in 1836. Arthur Keith said that "there can be no doubt that Little was the pioneer of orthopaedic surgery in England." His studies on the causes of clubfoot and his introduction of tenotomy in England were outstanding steps in the development of orthopaedic surgery. Hugh Owen Thomas (1834–91) was one of the outstanding leaders in the development of this specialty. A direct descendant of a long line of bonesetters, he studied medicine in Edinburgh, London and Paris, and practised in Liverpool. Among his more outstanding contributions to orthopaedic surgery was the Thomas splint, which is still widely used in the treatment of fractures of the long bones.



BY COURTESY OF (1-3) THE ARCHDIOCESE OF THE HOLY ORTHODOX CHURCH IN AMERICA; PHOTOGRAPHS, (4-5) SOVFOTO, (6) UNDERWOOD-STRATTON

ORTHODOX CATHOLIC CHURCHES AND CLERGY

1. Archbishop of the Orthodox American Church, in vestments
2. Icon screen, sanctuary and archpriest of the Orthodox American Church
3. Typical mission chapel and priest of the Orthodox American Church
4. Patriarch of the Russian Orthodox Church
5. Typical exterior view of a Russian Orthodox Church in Russia
6. Interior view of a Russian Orthodox Church in America

The modern era in the development of orthopaedic surgery usually is regarded as beginning with the work of Sir Robert Jones (1858–1933). His recognition became world-wide during World War I. The organization of the orthopaedic centres and curative workshops was carried out under his direction, and many orthopaedic surgeons, both British and American, came under his influence. The introduction of surgical methods which could be used in conjunction with splinting in the treatment of fractures and severe injuries of the extremities may be ascribed to the period of World War I and to the leadership of Sir Robert Jones.

In the United States the names of L. A. Sayre, Henry G. Davis and Charles F. Taylor are outstanding in New York city, while in Boston, Mass., orthopaedic surgery was developed by John Ball Brown and Buckminster Brown, to be followed by E. H. Bradford, Robert W. Lovett and others.

One of the modern leaders in the development of orthopaedic surgery in the United States was F. H. Albee (1876–1945), whose development of the motor bone saw in 1909 led to an entirely new era in bone-grafting methods which are commonly used in the correction of deformities and disabilities of bones and joints. Robert W. Lovett (1859–1924), a leader in the Boston group, did much to develop knowledge of the care of patients affected with infantile paralysis (anterior poliomyelitis) and also helped to develop knowledge of scoliosis (curvature of the spinal column) and its treatment. Michael Hoke (1874–1944) of Atlanta, Ga., contributed much to the correction of foot deformities and stabilization of joints. Royal Whitman (1857–1946) was an outstanding teacher and orthopaedic surgeon, and Willis Campbell (1880–1941) contributed much to the development of modern orthopaedic methods and technique.

Scope.—In discussing the scope of modern orthopaedic surgery, the prevention of disabilities and deformities, as well as their correction, must be stressed. Orthopaedic surgery may be divided into two parts, preventive and reconstructive. Deformities may be either congenital or acquired. Of the congenital deformities, there are three types: (1) those caused by disturbances in embryologic development and intra-uterine growth; (2) those which are actually inherited and transmitted from generation to generation; and (3) those which are based on evolutionary changes in the human species. Examples of the first group are intra-uterine amputations; examples of the second group are congenital dislocations of the hip and the related condition known as congenital dysplasia of the hip; examples of the third group are anomalies of the lumbosacral portion of the vertebral column, resulting from man's change from the quadruped to the biped gait. Many developmental changes in the spinal column have taken place and certain anomalies are occasionally seen.

All congenital deformities cannot be classified into these groups in the light of present knowledge although many of them no doubt may be so classified as that knowledge improves. Prevention of congenital deformities may seem impossible although the results of work done in the last few years on the influence of certain deficiency diets in pregnant animals seem to indicate that some of the embryologic maldevelopments may be influenced by nutrition.

Developmental anomalies are likewise a source of troubling and disabling deformities. Among these may be mentioned certain disturbances of growth in the epiphyses of children which are known as epiphyseal osteochondrosis. Such conditions lead to deformities of the surfaces of the joints and later in life cause painful joints. Severe infections of joints due to pyogenic (pus-forming) organisms formerly were a frequent cause of severe damage which often led to deformities and disabilities, but with the development of chemotherapy (sulfonamide drugs, penicillin and streptomycin) these infections were greatly reduced if not prevented. Anterior poliomyelitis is another outstanding cause of disabilities and deformities of adolescence and adult life.

Deformities with their attending disabilities may follow injuries of the bones, joints, muscles and tendons or skin. Any one of these structures, if severely injured and not adequately repaired, will become a potential source of deformity and disability. A fracture that is allowed to heal with fragments of bone in an improper position may cause the patient to walk with the extremity out of proper alignment and in time may lead to serious disability of the neighbouring joint. In the same way, a fracture of the bones in the region of the ankle not accurately reduced, in time, because of abnormal wear and tear on the joint surfaces, may lead to traumatic arthritis and severe disability. Injuries of muscles and tendons not adequately cared for may produce an unbalanced function of an extremity or part and lead to deformity and disability. In a like manner, scars from severe burns often cause contractures or shortening of the soft tissues on one side of a joint and lead to severe deformities and marked disability. In all these instances, the best prevention is early and adequate treatment designed to produce the best possible function with the least possible deformity. Thus, it may be seen that orthopaedic surgery must always be regarded as a preventive form of medical or surgical treatment as well as a curative and reconstructive form of treatment.

Methods and Procedures.—From a specialty which originally depended on the use of heavy braces, splints and methods of treatment which produced rest has evolved an active surgical specialty which is concerned with the correction of existing faults and prevention of the later development of deformities and disabilities by surgical procedures. With the availability of newer adjuncts to surgical treatment, such as chemotherapy, blood substitutes and improved methods of anaesthesia, early restoration of badly shattered parts can be accomplished. The achievements of orthopaedic surgery in World War II are ample evidence of this fact. Wounds were surgically cleaned, transfusions were given and chemotherapy was started so that after a few days the wound could be closed if necessary by a skin graft and the patient returned to a general hospital where his fracture could heal under nearly ideal circumstances. Much time was saved, a great deal of suffering was eliminated and early restoration of function was brought about.

Orthopaedic surgeons have for a considerable time recognized the importance of reconstructive surgery of the spinal column and extremities. Fractures which have failed to unite or have united in a faulty position are constantly being treated by operation. Bone grafts are being used every day and many types of bone grafting have been developed to adapt this useful technique to a wide variety of purposes.

Tendons are being repaired by tendon grafting and by tendon transplantation if indicated. It is possible, for instance, in the case of hopeless destruction of the musculospiral nerve in the arm, to restore the function of the hand almost to normal by the transplantation of two or three tendons. The common use of skin-grafting procedures to replace extensive scars has greatly advanced reconstructive surgery. The various types of skin-grafting procedures are also used to repair extensive chronic ulcers which are painful and disabling.

Surgical methods have been developed to equalize the length of a lower extremity in cases in which a marked difference in length of the extremities impairs the patient's usefulness or threatens to cause further disability. This may be accomplished by lengthening the shorter leg, by shortening the longer leg or by retarding growth in the longer leg.

The development of better metals for use in the internal fixation and repair of fractures has occupied the attention of many orthopaedic surgeons. There were available at mid-20th century much stronger metals that produced much less reaction in the tissues than the metals that were used previously. With the improved materials has grown a better understanding of how to use these devices and better tools for their handling have been invented.

Many diseases of the skeleton are being studied and their relationship to other organs of the body gradually revealed. Deficiency states and bony diseases secondary to tumours of the parathyroid glands and to other glands of internal secretion are gradually becoming better understood, and better means of treating them are being found. The importance of prevention of deformities caused by various types of arthritis is well known and the more crippling deformities are much less frequently seen

than they were in the past.

The knowledge of malignant tumours of bone and of tumours of muscles and tendons is slowly improving. Early recognition of these conditions and the prompt use of surgical procedures or X-ray treatment have made many patients more comfortable and in many instances have saved lives.

Improvement in our knowledge of methods of amputation when such procedures become necessary and improvement in the types of artificial limbs have greatly reduced the disabling effects of these procedures. Improvements in kineplasty (plastic amputation) made this procedure practicable. By this means, tendons and muscles in amputation stumps can be used to move artificial hands.

The recognition of the fact that long periods of rest in bed, which were once strongly advocated by orthopaedic surgeons, are in many instances deleterious has shortened the period of hospitalization for many patients and has greatly reduced the long periods of convalescence which frequently were thought necessary in the treatment of diseases and injuries of the spinal column and extremities.

Methods of diagnosis and treatment are constantly changing. New ideas are presented, tried and cast off or developed. As the specialist develops he finds himself more and more confronted with new things to learn. As specialties develop and each field grows larger, the individual specialists find themselves more and more dependent on other specialists for collaboration in the care of complicated problems in medicine. In this respect the orthopaedic surgeon is in the same position as specialists in other branches.

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ORTHOPTERA, the zoological name of that order of insects which, in conventional classification, includes the cockroaches, mantids, stick insects, grasshoppers, locusts, katydids, crickets and their allies. The earwigs, also long included, are placed in a separate order, the Dermaptera (*see* EARWIG). Essentially terrestrial, many Orthoptera run rapidly or jump vigorously, but few are strong fliers, and wings are often reduced or absent. Most are relatively large, and some are giants among insects. Many possess sound-producing organs and stridulate loudly, while others make crackling noises in flight. The wings are net-veined, the fore wings being narrower than the hind and more or less hardened to form tegmina; the membranous hind wings have a large posterior lobe that folds fanwise in repose. The mouth parts are of biting type with a four-lobed ligula, and most often the antennae are long and threadlike and ocelli are present. The prothorax is large and movable, the mesothorax and metathorax are more or less fused and a pair of cerci terminates the abdomen. Metamorphosis is incomplete. About 16,000 species are known; the United States has about 1,300 species and subspecies, Europe about 550 and Britain 31 (exclusive of naturalized alien species).

As usually defined, the Orthoptera is an order of convenience, for it includes only part of the orthopteroid insects and comprises five groups equal in rank to others customarily treated as orders. Thus, termites (order Isoptera) are closer to cockroaches than the latter are to grasshoppers. Many classifications of orthopteroid insects were proposed from 1908 to 1940, but none became standard. The classification here used is derived from those of L. Chopard, F. E. Zeuner and Kjell Ander (1938–39). For convenience all groups except the Saltatoria are often lumped as Cursoria.

SERIES I. GRYLLOBLATTARIA, contains one order (Grylloblattoidea), one family (Grylloblattidae), two genera and five species found in Japan and western North America. Wingless, thysanuriform, with five-jointed tarsi, long many-jointed cerci, long ovipositor and styles, these most primitive of living Orthoptera seem to be only slightly modified survivors of the ancient Protorthoptera and resemble the ancestors of the other two series.

SERIES II. DICTYOPTERA (OÖTHECARIA), includes the cockroaches (Blattoidea, fam. Blattidae) and mantids (Mantoidea, fam. Mantidae), both descended, together with the termites and

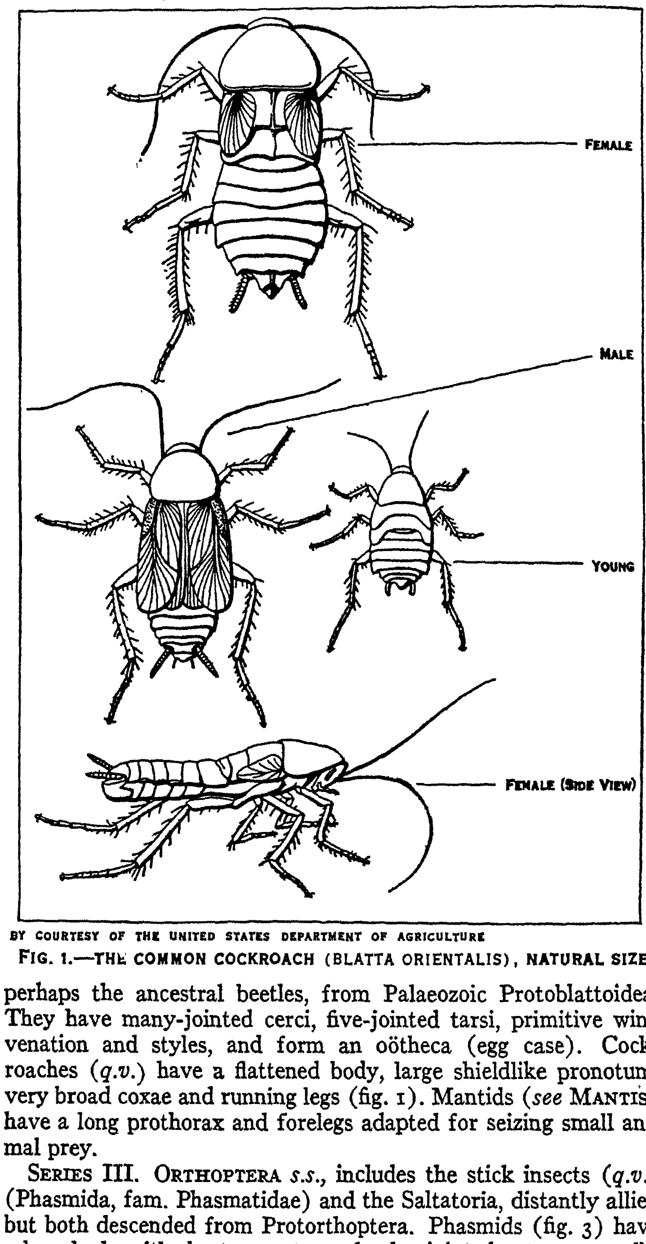

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FIG. 1.—THE COMMON COCKROACH (BLATTA ORIENTALIS), NATURAL SIZE

perhaps the ancestral beetles, from Palaeozoic Protoblattoidea. They have many-jointed cerci, five-jointed tarsi, primitive wing venation and styles, and form an oötheca (egg case). Cockroaches (*q.v.*) have a flattened body, large shieldlike pronotum, very broad coxae and running legs (fig. 1). Mantids (*see* MANTIS) have a long prothorax and forelegs adapted for seizing small animal prey.

SERIES III. ORTHOPTERA *s.s.*, includes the stick insects (*q.v.*) (Phasmida, fam. Phasmatidae) and the Saltatoria, distantly allied but both descended from Protorthoptera. Phasmids (fig. 3) have a long body with short pronotum, slender jointed antennae, walking legs, five-jointed tarsi and short ovipositor. Wings are often absent; tegmina are very short except in the leaf insects (*q.v.*).

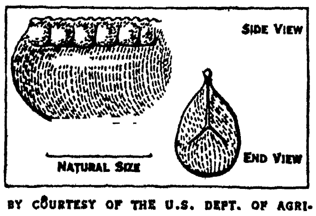

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FIG. 2.—EGG CAPSULE (OÖTHECA) OF AMERICAN COCKROACH (PERIPLANETA AMERICANA)

The Jumping Orthoptera (Saltatoria) are the dominant order of orthopteroid insects, and include the familiar grasshoppers, locusts, katydids and crickets. They have hind legs adapted for leaping, tarsi less than five-jointed, a well-developed ovipositor and often stridulatory organs in the male.

Those of the first suborder, ENSIFERA, have long threadlike antennae, three- or four-jointed tarsi, a long ovipositor, auditory organs on the fore tibiae and male tegmina often formed for stridulation. Of the three chief families, the Gryllacrididae include cricket locusts and cave crickets. The Tettigoniidae are long-horned grasshoppers (*see* GRASSHOPPER) and katydids (*q.v.*), with four-jointed tarsi and a long broad ovipositor. The Gryllidae

are crickets (*q.v.*), with three-jointed tarsi and a slender ovipositor; their tegmina lie flat on the back and bend abruptly down at the sides (fig. 4).

The second suborder, CAELIFERA, has short, jointed antennae and tarsi with three or fewer joints. The Tridactylidae resemble mole crickets but are closer to locusts in structure. The Acrididae are the short-horned grasshoppers (*see* GRASSHOPPER) and true locusts (*q.v.*), with narrow horny tegmina, short ovipositor, short unjointed cerci and auditory organs on the base of the abdomen. Many stridulate by scraping a toothed ridge on the hind femur against a sharp-edged vein on the closed tegmen; some make buzzing or crackling noises in flight.

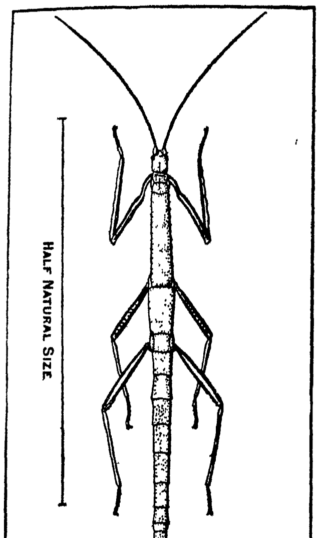

FIG. 3.—STICK INSECT (CARAUSIUS MOROSUS)

Natural History.—Eggs of Orthoptera are cylindrical to oval; the oöthecae of blattids (fig. 2) and mantids contain ten or more eggs. Spermatophore fertilization is the rule, and parthenogenesis is common, notably in phasmids. Newly hatched nymphs are wingless, the wing pads developing as growth proceeds. Many Saltatoria are notorious stridulators, especially the katydids and crickets, some of which can be heard a mile away. Apterism, or lack of wings, is common (fig. 3), and among Saltatoria wings are often reduced to the sound-producing portions of the tegmina only. Most Orthoptera are herbivorous, some being serious crop pests. Many cockroaches and crickets are omnivorous, and the domestic species injure a great variety of materials; mantids are predacious upon insects.

Each major family of Saltatoria has tree-, shrub-, herb- and ground-dwelling species, though Tettigoniidae are more arboreal than Acrididae or Gryllidae. Many Gryllacrididae and Gryllidae, notably the mole crickets, are subterranean, while the small wingless cricket *Myrmecophila* lives in ant nests. The cricket *Hydropedeticus,* one of the very few aquatic Orthoptera, skates actively over streams in Fiji much as do the Gerridae.

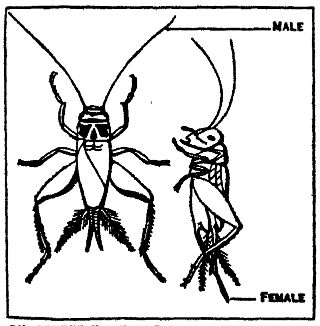

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FIG. 4.—HOUSE CRICKET (GRYLLULUS DOMESTICUS)

The largest families are worldwide in range, though all diminish rapidly in species as the cooler zones are approached, and very few mantids or phasmids occur outside the tropics. Some house pests, such as the oriental cockroach (*Blatta orientalis*), have become cosmopolitan. Primitive cockroaches (Protoblattoidea) are among the oldest known insects, exceeding all other insect fossils in some Upper Carboniferous strata.

After the Permian period cockroaches lost their pre-eminence, and gradually declined to their present insignificant status among insects.

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ORTIGUEIRA, a seaport of northwestern Spain, in the province of Corunna; on the northern slope of the Sierra de la Faladoira, on the river Nera and on the eastern shore of the Ría de Santa Marta—a winding, rock-bound and much indented inlet of the Bay of Biscay, between Capes Ortegal and Vares. Pop. (1940) 1,479 (mun., 22,152). The population is scattered. The industries are fishing and farming. There is an important coasting trade, despite the dangerous coastline and the fogs and gales.

ORTLER, the highest point (12,802 ft.) in Tirol, and in the whole of the Eastern Alps. It is a great snow-clad mass, which rises east of the Stelvio pass, and a little south of the upper valley

ORTLER ALP FARM, ON THE SLOPES OF THE HIGHEST PEAK (12,802 FT.) IN THE EASTERN ALPS, BETWEEN THE VALLEYS OF TRAFOI AND SULDEN

of the Adige between the valleys of Trafoi (northwest) and of Sulden (northeast). It was long considered inaccessible, but was conquered in 1804 by three Tirolese peasants. The first traveller to make the climb was Herr Gebhard in 1805 (sixth ascent). Many routes to the summit are now known.

ORTNIT or **OTNIT,** German hero of romance, was originally Hertnit or Hartnit, the elder of two brothers known as the Hartungs, who correspond in German mythology to the Dioscuri. His seat was at Holmgard (Novgorod), according to the *Thidrekssaga* (chapter 45), and he was related to the Russian saga heroes. Later on his city of Holmgard became Garda, and in ordinary German legend he ruled in Lombardy. Hartnit won his bride, a Valkyrie, by hard fighting against the giant Isungs, but was killed in a later fight by a dragon. His younger brother, Hardheri (replaced in later German legend by Wolfdietrich), avenged Ortnit by killing the dragon, and then married his brother's widow. Ortnit's wooing was corrupted by the popular interest in the crusades to an Oriental *Brautfahrtsaga,* bearing a resemblance to the French romance of Huon of Bordeaux (*q.v.*).

See editions of the *Heldenbuch* and one of *Ortnit* and *Wolfdietrich* by Dr. J. L. Edlen von Lindhausen (Tuebingen, 1906).

ORTOLAN, *Emberiza hortulana,* a bunting (*q.v.*) celebrated for the delicate flavour of its flesh. A native of most European countries—the British Islands excepted—as well as of western Asia, it migrates southwards in autumn and returns about the end of April. Its distribution throughout its breeding range seems to

be very local. In habits it much resembles the yellowhammer, but it wants the bright colouring of that species. The monotonous song of the cock is also much of the same kind. The nest is placed on or near the ground, but the eggs seldom show the hair-like markings which characterize those of most buntings. Its natural food consists of beetles, other insects and seeds. Ortolans are netted in great numbers, kept alive in a darkened room and fed with oats and millet. In a very short time they become enormously fat and are then killed for the table.

ORTONA A MARE, seaport and episcopal see, Abruzzi, Italy, province of Chieti, 12 mi. directly E. of that town, 105 mi. by rail S.S.E. of Ancona. Pop. (1936) 9,215 (town); 20,210 (commune). It is on a promontory 230 ft. above sea level, and connected with the port below by a funicular railway. The ruined castle has magnificent views. The cathedral (1127) has a fine portal by a local artist, Nicolo Mancini (1311). The town occupies the site of the ancient Ortona, a seaport of the Frentani.

ORURO, a department and town of Bolivia. The department is bounded north by La Paz, east by Cochabamba and Potosí, south by Potosí and west by Chile; it occupies part of an ancient lacustrine basin lying between the eastern and western ranges of the Andes, and has an area of 20,386 sq.mi., the greater part of which is semiarid and covered with extensive saline deposits. The Desaguadero river, the outlet of Lake Titicaca, flows southward into Lake Pampa-Aullagas, or Poopó, on the eastern side of the department near the Cordillera de los Frailes. Lake Poopó is 12,106 ft. above sea level, or 400 ft. lower than Titicaca, and its waters discharge through a small outlet, called the Lacahahuira, into the lagoon and saline morasses of Coipasa (12,073 ft. elevation) in the southwest corner of the department. Oruro is almost exclusively a mining department, the country being too arid and too cold for agriculture. With the exception of a narrow strip along the foothills of the Cordillera de los Frailes, where a few cattle, mules, llamas and sheep are reared, little of the area is suitable even for grazing. In the vicinity of the capital, in the northeast part of the department, there are large deposits of tin, silver, tungsten and copper; Oruro is the second largest producer of tin in the republic. Population (1947 est.), 203,500.

The capital of the department is Oruro, 125 mi. S.S.E. (direct) of La Paz; it is an old mining town dating from the 17th century, when it is said to have had a population of 70,000. The estimate of 1946 gave it a population of 50,000, the greater part of whom are Indians and mestizos. A considerable number of foreigners are interested in the neighbouring mines. The elevation of Oruro is 12,158 ft. above sea level, and its climate is characterized by a cool summer with light rainfall and a cooler but sunny winter, with nightly frosts and an occasional snowstorm. The mean temperature of the warmest month, December, is 51° F. and that of the coolest month, June, is 31° F. There is a much greater difference than this between day and night temperatures, both in summer and winter. Oruro is connected by rail with La Paz and Cochabamba, with Antofagasta, 578 mi. away, and with Arica (via Viacha), 380 mi. distant. (G. M. McB.)

ORVIETO (anc. *Volsinii* [*q.v.*], later *Urbs Vetus*, whence the modern name), town and episcopal see, province of Terni, Italy, on the Paglia, a tributary of the Tiber, 78 mi. by rail N. by W. of Rome. Pop. (1936) 8,883 (town); 21,469 (commune). It crowns an isolated rock, 1,033 ft. above sea level, 640 ft. above the plain, commanding splendid views, and is approached by a funicular railway. The town has a large number of fine 13th-century houses and palaces. The splendid cathedral dedicated to the Virgin was begun at least as soon as 1288 on the site of two older churches erected to commemorate the miracle of Bolsena (*q.v.*), and was decorated by many mediaeval painters and sculptors. The exterior is black and white marble; the interior is gray limestone with bands of dark basaltic stone. There is a large rectangular nave, with semicircular recesses for altars, opening out of the aisles, north and south, two transeptal chapels and a short choir. A fine polychrome monument is the west façade, of richly sculptured marble from the designs of Lorenzo Maitani of Siena, divided into three gables with intervening pinnacles; it is a reproduction of the façade of Siena cathedral. The mosaics are modern. The four wall surfaces that flank the three western doorways are decorated with beautiful sculpture in relief, executed under Maitani's direction until his death in 1330. In the interior, the Cappella del Corporale possesses a large silver shrine, resembling the cathedral façade, enriched with countless figures in relief and subjects in translucent coloured enamels—one of the most important specimens of early silversmith's work. It was begun by Ugolino Vieri of Siena in 1337, and was made to contain the Holy Corporal from Bolsena (*q.v.*). On the south side is the chapel of S. Brizio, separated from the nave by a fine 14th-century wrought-iron screen. The walls and vault are covered with fine and well preserved frescoes—among the noblest works of Fra Angelico and Luca Signorelli, painted 1499 to 1504—the latter being of especial importance in the history of art because of their great influence on Michelangelo in his early days. The choir stalls are fine and elaborate specimens of *tarsia* and rich wood carving—the work of Pietro del Minella (1430–41). In 16th-century sculpture the cathedral is especially rich, containing many statues, groups and altar reliefs by Simone Mosca and Ippolito Scalza. Close by are two Gothic buildings, the bishop's palace (1264) and the Palazzo dei Papi (1264–1302), the latter with a huge hall now containing the Museo Civico, with various mediaeval works of art, and also objects from the Etruscan necropolis of the ancient Volsinii (*q.v.*). The Palazzo Faina has another interesting Etruscan collection. The Palazzo del Comune is Romanesque (12th century). S. Andrea and S. Giovenale are also Romanesque churches of the 11th century; both contain later frescoes. To the 11th–12th century belongs the ruined abbey of SS. Severo and Martirio, 1 mi. S. of the town. The church of S. Domenico contains one of the finest works in sculpture by Arnolfo di Cambio, the tomb with recumbent effigy of the Cardinal de Braye (1282), with much beautiful sculpture and mosaic. There are a few buildings by Sammicheli of Verona, architect of the cathedral from 1509 to 1528. The fortress built in 1364 by Cardinal Albornoz has been converted into a public garden. The well, now disused, called Il pozzo di S. Patrizio, is one of the chief curiosities of Orvieto. It is 200 ft. deep to the water level and 42 ft. in diameter, cut in the rock, with a double winding inclined plane, so that asses could ascend and descend to carry the water from the bottom. It was begun by the architect Antonio da San Gallo the younger in 1527 for Clement VII and was finished by Simone Mosca under Paul III. (*See* UMBRIA.)

See L. Fumi, *Il Duomo d' Orvieto e i suoi restauri* (1891), *Orvieto, note storiche e biografiche* (1891), and other works; P. Perali, *Orvieto* (1919). (T. A.)

ORYX, the scientific name of a group of African antelopes of large size with long horns, which are present in both sexes, and long tufted tails. They are desert animals. The true oryx is the east and northeast African beisa oryx (*Oryx beisa*), which is replaced in South Africa by the gemsbok (*q.v.*). In northern Africa the group is represented by *O. algazel,* and in Arabia by *O. leucoryx*. (*See* ANTELOPE.)

ORZESZKOWA (*née* Pawlowska), **ELIZA** (1842–1910), Polish novelist, born near Grodno, of the noble family of Pawlowski. In her 16th year she married Piotr Orzeszko, a Polish nobleman, who was exiled to Siberia after the insurrection of 1863. She wrote a series of powerful novels and sketches, dealing with the social conditions of her country. *Eli Makower* (1875) describes the relations between the Jews and the Polish nobility, and *Meir Ezofowicz* (1878) the conflict between Jewish orthodoxy and modern liberalism. *On the Niemen* (1888), perhaps her best work, deals with the Polish aristocracy, and *Lost Souls* (1886) and *Cham* (1888) are on rural life in White Russia. She died at Grodno on May 18, 1910.

OSAGE, a tribe of American Indians formerly on the Osage and Arkansas rivers in Missouri and Arkansas. Their speech is Siouan; their culture that of the plains. The original population is estimated at 5,000; in 1921 there were 2,200 in Oklahoma. Oil royalties, land leases and interest on trust funds held for them by the government make them one of the richest populations in the world.

See F. La Flesche, *Bur. Am. Ethn. Rep.*, xxxvi (1921); xxxix (1925).

OSAGE ORANGE (*Maclura pomifera*), a thorny tree with large, yellow, somewhat orangelike fruit. The tree, which is the only species of its genus, belongs to the mulberry family (Moraceae). It is native to rich soils in the south-central United States from Missouri and Kansas to Texas, but has been planted extensively in the Mississippi valley and occasionally in the eastern states, being hardy in New England. The very hard, strong, flexible, yellow wood, formerly used for bows and war clubs by the Osage and other Indians west of the Mississippi, is utilized for railway ties and fence posts. Osage orange is also known as bowwood and as *bois d'arc*. The wood yields a yellow dye principle.

OSAKA, the chief industrial city of Japan (*q.v.*). Pop. (1950) 1,956,136. It lies in a plain bounded, except westward, where it opens on Osaka bay, by hills of considerable height, on both sides of the Yodogawa, or rather its headwater the Aji (the outlet of Lake Biwa), and is so intersected by river branches and canals as to suggest a comparison with a Dutch town. Steamers ply between Osaka and Kobe-Hiogo or Kobe, and Osaka is an important railway centre. The opening of the railway (1873) drew foreign trade to Kobe, but a harbour for ocean steamers was constructed at Osaka. Shin-sai Bashi Suji, the principal thoroughfare, leads from Kitahama, the district lying on the south side of the Tosabori, to the iron suspension bridge (Shin-sai Bashi) over the Dotombori. The former foreign settlement is at Kawaguchi at the junction of the Shirinashi and the Aji. It is the seat of a number of European mission stations. Buddhist and Shinto temples are numerous. The principal secular buildings are the castle, the mint and the arsenal. The castle was founded in 1583 by Hideyoshi; the enclosed palace, probably the finest building in Japan, survived the capture of the castle by Iyeyasu (1615), and in 1867 and 1868 witnessed the reception of the foreign legations by the Tokugawa shoguns; but in the latter year it was fired by the Tokugawa party. It later provided military headquarters, containing a garrison and an arsenal. The whole castle is protected by high and massive walls and broad moats. The mint, erected and organized by Europeans, was opened in 1871. Osaka possesses ironworks, sugar refineries, cotton-spinning mills, shipyards and a great variety of other manufactures.

Osaka owes its origin to Rennio Shonin, eighth head of the Shin-Shu sect, who in 1495–96 built, on the site now occupied by the castle, a temple which became the principal residence of his successors. In 1580, after ten years' successful defense of his position, Kenryo, the 11th "abbot," was obliged to surrender; and in 1583 the victorious Hideyoshi made Osaka his capital. The city brought several suburban districts within its boundaries in 1925, becoming temporarily the most populous city in Japan. In 1909 one-third of the city was destroyed by fire; though it was rebuilt with wider streets and better buildings, its factories and warehouses compared less favourably with European and U.S. standards than those of Tokyo until after World War I, when a program of city planning was carried a long way. Thousands of buildings were destroyed during World War II, but by 1949, 100,000 new houses had been constructed, and more than 9,000 factories had resumed operations. Osaka boasts of its advanced municipal government. Trade grew rapidly before World War II, and a number of foreign-going ships load and unload in Osaka harbour, which is being continuously extended and improved. The city was enlarged in 1926, by the absorption of outlying districts, to form Greater Osaka. Osaka, like Tokyo and Kyoto, as well as being a municipal administrative unit is an urban prefecture (*fu*).

OSAWATOMIE, a city of Miami county, Kan., U.S., 4⅝ mi. S. by W. of Kansas City, on the Missouri Pacific railroad. Pop. (1950) 4,347. It is near oil and gas fields, in a farming and grazing region, and has railroad shops. A state hospital for the insane is 1 mi. N.E. Osawatomie was settled about 1854 by colonists sent out by the Emigrant Aid company. The name was derived from Osage and Potawatomi. It was the scene of many clashes between the proslavery and the free-soil factions of Kansas and Missouri, notably on Aug. 30, 1856, when Capt. John Brown (who had come to Osawatomie in 1855) and 40 followers attempted to repulse an attack by Gen. John W. Reid, at the head of 400 Missourians. They were quickly overpowered and the town was looted and practically destroyed.

OSBORN, HENRY FAIRFIELD (1857–1935), palaeontologist, was born at Fairfield, Conn., Aug. 8, 1857. He graduated from Princeton university (1877) and continued his studies under F. M. Balfour and Thomas Huxley. His professorships included natural history and anatomy at Princeton (1881–91); biology and zoology until 1910, and the deanship of the faculty of pure science (1892–95) at Columbia university. From 1910 to 1935 he held the research professorship in zoology at Columbia university. His connection with the American Museum of Natural History began as curator of the department of vertebrate palaeontology (1891–1910), and was followed by a number of offices till 1908, when he became president. After 1900 he was connected with the United States geological survey, first as vertebrate palaeontologist and after 1924 as senior geologist. Among offices too numerous to mention, he had important connections with the Canadian geological survey, the New York Zoological society and the Carnegie institute. He declined the proffered secretaryship of the Smithsonian institution.

The American Museum of Natural History extension school service, its unique exhibition halls and the organization of a complete survey of the geological succession of the higher vertebrates of North America were the result of Osborn's efforts. His extensive researches chiefly concerned the palaeontology of the vertebrates. His publications dealt with almost all groups of animals and reptiles, but made especially important contributions to the knowledge of the rhinoceroses, horses, titanotheres and dinosaurs. He founded a flourishing school of vertebrate palaeontology which included the names of numerous brilliant younger men of science. He did much toward the determination of relative ages of extinct mammals in North America, and performed important services in working out a correlation between the Tertiary and mammal horizons of Europe and America. He also studied and wrote on the philosophical bearings of his work. He was called, by the Royal society of London at the time of his election to membership, "one of the most distinguished palaeontologists of our time."

His scientific writings (1877–1928) in geology, palaeontology, anthropology and biology comprise 755 titles, including memoirs on extinct reptiles and mammals. Osborn died Nov. 6, 1935.

His books combine literary art and scientific information. Among the most important are: *From the Greeks to Darwin* (1894); *Evolution of Mammalian Molar Teeth* (1907); *The Age of Mammals* (1910); *Huxley and Education* (1910); *Men of the Old Stone Age* (1915); *Origin and Evolution of Life* (1917); *The Earth Speaks to Bryan* (1925); *Evolution and Religion in Education* (1926); *Creative Education* and *Man Rises to Parnassus* (1927).

See "Eminent Living Geologists," *Geological Magazine*, vol. 4, pp. 193–196, new series, decade 6 (London, 1917).

OSBORNE, a former royal residence in the Isle of Wight, Eng., southeast of East Cowes. The name of the manor in early times is quoted as Austerborne or Oysterborne. In 1845 it was purchased by Queen Victoria, who died there in 1901. King Edward VII presented the property to the nation. A part of the house was transformed into a convalescent home for officers of the navy and army, opened in 1904.

In 1903 there was opened on the Osborne estate a Royal Naval college, which in 1921 was closed down; the cadets thenceforward joined Dartmouth college.

OSCAN was the name given by the Romans to that dialect (*lingua Osca*) which they found spoken by the Osci of Campania. But inscriptional and other records (*i.e.*, local and personal names and glosses in ancient authors) manifestly of the same dialect have been found not only in Campania, where the dialect was, according to the most probable interpretation of the evidence, not original, but seems to have been imposed upon the Oscans by Samnite invaders in the 5th century B.C., but also further south, namely in northern Apulia, Lucania, in the country of the Brutii (the "toe" of Italy), and even in the northeast angle of Sicily at Messana (the modern Messina), which was captured by the

Campanian Mamertines *c.* 289 B.C.; in Samnium proper, including the territory of the Frentani and Hirpini; and finally, further north, in the country of the Paeligni, Marrucini and Vestini. Thus there are distinguished, geographically, and dialectally, three main groups of Oscan: (1) Central Oscan of Campania and the Samnite tribes, (2) Southern Oscan, and (3) Northern Oscan. These are all closely related to one another as compared with the dialect of the Volsci and of the Umbrian townships (Iguvium, the modern Gubbio; Tuder, modern Todi; and one or two others); while Oscan, Volscian and Umbrian, taken together, make one of the two great divisions—the other being Latin (*q.v.*) with Faliscan—into which the Italic branch of the Indo-European family of languages falls. Since the Samnitic tribes, whose expansion by successive migrations—"sacred springs" as they were called—diffused the Oscan speakers from their home in central Italy, knew their land (in Latin, Samnium) by the name *Safinim*, it has been proposed to describe their dialects as "Safine," a title at once more comprehensive and historically truer than "Oscan." The stock to which the Samnites belonged used commonly a suffix *-no-* (*e.g.*, in *Sabi-ni*) to form their tribal names, as distinguished from the suffixes *-co-* and *-(a)ti-* of an earlier stratum of population (*e.g.*, in *Vols-ci, Tea-te*). In names like *Marru-ci-ni, Ardea-ti-ni*, the superimposed *-no-* suffix bears witness to a conquest or overlordship of the earlier by the later stock.

Until the Roman advance gradually replaced it by Latin—important stages of this advance are marked not so much by the three Samnite wars as by the destruction of Capua in 211 B.C. and the Social War of 91–89 B.C.—Oscan held its place as a language in recognized official and educated usage side by side with, or instead of, Latin or Greek. The poet Ennius is said to have spoken all three tongues (Gellius 17,17,1), and if Strabo (5, p.233 C) may be trusted, the rude farces or puppet-shows introduced from the Oscan town Atella (*fabulae Atellanae, ludi Osci*) were actually performed at Rome in Oscan. The latest Oscan inscriptions, scratched on the walls of houses at Pompeii, were written shortly before the eruption of Vesuvius which overwhelmed that city in A.D. 79, and it is probable that the dialect, which has left its mark on modern south Italian dialects, survived in remote country districts as a local patois for some time longer. None of the Oscan inscriptions, on the other hand, is older than the 5th century B.C.

Many of the inscriptions are carefully, indeed almost with phonetic accuracy, written in a native alphabet which was itself derived, with certain necessary modifications, from the Etruscan alphabet; but a few belonging to the southern group, and including all those from Sicily, are in the Greek, and some from Lucania and elsewhere in the rustic or Colonial Latin alphabets. Over 250 in number, the majority are quite short; nevertheless, they furnish materials adequate to give us a fairly complete conspectus of the dialect. About two-thirds of the whole come from Campania, and most of those from Capua and Pompeii.

In character they fall mostly into the following classes: (1) official documents—municipal regulations (Bantia), a treaty (Nola and Abella), inscriptions relating to public works (Pompeii and elsewhere); (2) religious—an inventory of statues and altars in a sacred grove at Agnone (Samnium), the interesting group of heraldic *iovilae* (*q.v.*) from Capua, recording or prescribing special ceremonies connected with family cults, numerous simple votive and dedicatory inscriptions; (3) military and election announcements (from Pompeii); (4) private documents—epitaphs, bricks inscribed with names, and (from Campania) a few belonging to the interesting group of curses, inscribed on lead and deposited in tombs; (5) coin legends, including those of the Social War reading *vìtelliú, i.e.*, "Italia."

Oscan has many peculiarities which distinguish it from Latin in sound changes, word forms and vocabulary; in syntax the differences are much less marked. But it also possesses certain features which distinguish it amongst the Italic dialects themselves. Their nature and extent may be indicated roughly by a specimen text (on a sundial found at Pompeii):

> mr atiniís mr kvaisstur eítiuvad
> múltasíkad kúmbennieís tangi(nud)
> aamanaffed

This in Latin would be:

> M(a)r(a) Atinius M(a)r(ae) (filius) quaestor pecunia
> multaticia conventus scitu
> fieri iussit

(Mara Atinius, son of Mara, quaestor, in accordance with a decree of the assembly, had this set up from fine-money.)

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OSCAR I. (1799–1859), king of Sweden and Norway, was the son of General Bernadotte, afterwards King Charles XIV. In 1838 the king began to suspect his heir of plotting with the Liberal party to effect a change of ministry, or even his own abdication. Oscar, however, avoided an actual rupture. After his accession (March 8th, 1844) it appeared that his liberalism was very restricted. He refused any radical reform of the cumbrous and obsolete constitution. But one of his earliest measures was to establish freedom of the press. Most of the legislation during his reign aimed at improving Sweden's economic position.

In foreign affairs Oscar I. was a friend of the principle of nationality. In 1848 he supported Denmark against Germany; placed Swedish and Norwegian troops in cantonments in Fünen and North Schleswig (1849–1850); and mediated the truce of Malmö (August 26, 1848). He was also one of the guarantors of the integrity of Denmark (London protocol, May 8, 1852). Oscar I. left four sons, of whom two, Carl (Charles XV.) and Oskar Fredrik (Oscar II.), succeeded to his throne.

See T. Almén, *Ätten Bernadotte* (Stockholm, 1896); and C. E. Akrell, *Minnen från Carls XIV., Oscars I. och Carls XV. Lagar* (Stockholm, 1884, 1885). Also NORWAY: *History*, and SWEDEN: *History*.

OSCAR II. (1829–1907), king of Sweden and Norway, son of Oscar I., was born at Stockholm on Jan. 21, 1829. In 1857 he married Princess Sophia Wilhelmina, youngest daughter of Duke William of Nassau. He succeeded his brother Charles XV. on Sept. 18, 1872, and was crowned in the Norwegian cathedral of Drontheim on July 18, 1873. At his accession he adopted as his motto *Brödrafolkens Väl*, "the welfare of the brother folk," and from the first he realized the essential difficulties in the maintenance of the union between Sweden and Norway. The political events which led up to the final crisis in 1905, by which the thrones were separated, are dealt with in the historical articles under NORWAY and SWEDEN. But it may be said that the peaceful solution eventually adopted could hardly have been attained but for the tact and patience of the king himself. He declined, indeed, to permit any prince of his house to become king of Norway, but better relations between the two countries were restored before his death, which took place at Stockholm on Dec. 8, 1907. His acute intelligence and his aloofness from the dynastic considerations affecting most European sovereigns gave the king considerable weight as an arbitrator in international questions. At the request of Great Britain, Germany and the United States in 1889 he appointed the chief justice of Samoa, and he was again called in to arbitrate in Samoan affairs in 1899. In 1897 he was empowered to appoint a fifth arbitrator if necessary in the Venezuelan dispute, and he was called in to act as umpire in the Anglo-American arbitration treaty that was quashed by the senate.

Himself a distinguished writer and musical amateur, King Oscar was a generous friend of learning and of education. His works, which included his speeches, translations of Herder's *Cid* and Goethe's *Torquato Tasso*, a play, *Castle Cronberg*, poems and historical works, were collected in 1875–76 (new and enl. ed.,

1885–88). His *Memoirs of Charles XII.* were translated into English in 1879.

See E. Lindorm, *Oscar II, och hans tid* (Stockholm, 1936).

OSCEOLA (*c.* 1804–1838), a Seminole American Indian, leader in the second Seminole War, was born in Georgia, near the Chattahoochee river. His father was an Englishman named William Powell; his mother a Creek of the Red Stick or Mikasuki division. In 1808 he removed with his mother into northern Florida. When the U.S. commissioners negotiated with the Seminole chiefs the treaties of 1832–33 for the removal of the Seminoles to Arkansas, Osceola seized the opportunity to lead the opposition of the young warriors, and declared to the U.S. agent, Gen. Wiley Thompson, that any chief who prepared to remove would be killed. Late in 1835 he murdered Charley Emathla (or Emartla), a chief who was preparing to emigrate with his people, and with a few companions shot and killed Gen. Thompson.

In 1836 Generals Edmund P. Gaines (1777–1849), Winfield Scott (1786–1866) and Richard K. Call (1791–1862) waged war against them with little effect, and the year closed with General Thomas Sidney Jesup (1788–1860) in command with 8,000 troops at his disposal. General Jesup drove the enemy from the Withlacoochee country and was pursuing them southward toward the Everglades when several chiefs expressed a readiness to treat for peace. On March 6, 1837, they agreed to cease hostilities, to prepare for emigration to Arkansas, and gave hostages to bind them to their agreement. But on June 2 Osceola came to the camp at the head of about 200 Mikasuki (Miccosukees) and effected the flight of all the Indians there, about 700 including the hostages, to the Everglades. Hostilities were then resumed, but in September, after the capture of several chiefs, Osceola requested an interview. This was granted, and by command of General Jesup he was taken captive and carried to Fort Moultrie, at Charleston, S.C., where he died in January, 1838. The war continued until 1842, but after Osceola's death the Indians did little but attack the unarmed inhabitants.

See J. T. Sprague, *The Origin, Progress and Conclusion of the Florida War* (1848).

OSCHERSLEBEN, a town in the Prussian province of Saxony, on the Bode, 24 m. by rail W.S.W. of Magdeburg, and at the junction of lines to Halberstadt and Jerxheim. Pop. (1939) 17,761. Oschersleben is first mentioned in 803. Among its industrial establishments are sugar-refineries, iron-foundries, breweries, machine-shops and brick works.

OSCILLATOR. A non-rotating device used in radio apparatus for producing alternating current. The output frequency of the oscillation is determined by the characteristics of the device.

OSCILLATORY CIRCUIT, as applied to radio apparatus, is a relatively low resistance circuit containing both inductance and capacity, such that the voltage impulse will produce a current which periodically reverses in direction.

OSCILLOGRAPH, an instrument for the delineation of alternating current wave forms. In the type devised by Duddell (*Electrician* xxxix., Sept. 1897, 636) two phosphor bronze strips under tension pass, side by side, between the poles of an electromagnet. The current is led up one strip and down the other so that they move in opposite directions at right angles to their length. A small mirror bridged across the strips is thus tilted to an extent dependent on the strength of the current. The mirror reflects a spot of light on to a photographic film whose movement at right angles to that of the light spot provides the time scale. The natural period of vibration of the strips is arranged to be very small ($\frac{1}{8,000}$–$\frac{1}{10,000}$ sec.) to enable them to move in accordance with the fluctuations of the current. Other types of oscillograph have been designed by Blondel, Irwin (the *hot-wire* oscillograph) and others. The Cathode Ray Oscillograph is available for high-frequency observations. *See* also INSTRUMENTS, ELECTRICAL: *Current Measuring Instruments;* OSISO.

OSH, a town of Asiatic Russia, in the Kirghiz A.S.S.R. in 40° 35′ N., 72° 55′ E., 31 mi. S.E. of Andijan railway terminus, at an altitude of 4,030 ft. Pop. (1933) 44,800. It is on the Ak-bara river, a tributary of the Kara-Su, in a fertile cotton, grain and fruit growing valley leading to the Alai and Pamir. The famous Takht-i-Suleiman (Solomon's Throne) rock, the theme of so many Eastern legends, is near the town and is frequented by pilgrims.

O'SHAUGHNESSY, ARTHUR WILLIAM EDGAR (1844–1880), English poet, was born in London on March 14, 1844, and at seventeen became a copyist in the library of the British Museum. Later, he specialised in ichthyology. He published his *Epic of Women* in 1870, *Lays of France,* a free version of the *Lais* of Marie de France, in 1872, and *Music and Moonlight* in 1874. He died on Jan. 30, 1880, his *Songs of a Worker* appearing immediately afterwards. In Palgrave's words, he had "a haunting music all his own."

OSHAWA, a manufacturing city and port of entry of Ontario county, Ontario, Canada, on Lake Ontario and the Canadian National and Canadian Pacific railways, 30 mi. E.N.E. of Toronto. Pop. (1951) 41,359. It contains large automobile works; flour, woollen and grist mills; furniture, sheet-metal and farm implement factories; foundries, tanneries, canneries, potteries, etc.

OSHIMA, a group of three small islands belonging to Japan, lying southwards of Kiushiu, in 30° 50′ N. and 130° E. Their names, from west to east, are Kuro-shima, Iwo-shima and Take-shima. Kuro-shima rises to a height of 2,475 ft., and Iwo-shima has an active volcano 2,480 ft. high. These islands are not to be confounded with Oshima, the most northerly island of the Izu-noshichito, or with the northern group of the Luchu Islands.

OSHKOSH, a city of Wisconsin, U.S., 82 mi. N.N.W. of Milwaukee, on the west shore of Lake Winnebago, where the Fox river flows into it; the county seat of Winnebago county. It is on federal highways 41, 45 and 110, and is served by the Chicago and North Western, the Chicago, Milwaukee, St. Paul and Pacific, the Soo Line, motor coaches and motor-truck lines. Population in 1950 was 40,934 by federal census.

Oshkosh is the seat of a state teachers' college with an enrolment of 800. Lumber used to be the main industry, but products are now highly diversified. The city has an aldermanic government.

The Fox river and Lake Winnebago early became an important line of communication, under French control, on the route between the Great Lakes and the Mississippi. Trading posts were established on the site of Oshkosh in the 18th century, and a flotilla of 50–100 fur-laden barges and bateaus was not an uncommon sight on the river.

Permanent settlement there began about 1836. The north side of the river was at first called Saukeer and the south side Algoma, but in 1840 the name Oshkosh was adopted, to honour a friendly Menominee chief.

In 1874 and in 1875 the city suffered serious loss from fire. It was chartered as a city in 1853.

OSIANDER, ANDREAS (1498–1552), German reformer, was born at Gunzenhausen, near Nuremberg, on Dec. 19, 1498. His German name was Heiligmann, or, according to others, Hosemann. After studying at Leipzig, Altenburg and Ingolstadt, he was ordained priest in 1520 and appointed Hebrew tutor in the Augustinian convent at Nuremberg. Two years afterwards he was appointed preacher in the St. Lorenz Kirche, and about the same time he publicly joined the Lutheran party, taking a prominent part in the discussion which ultimately led to the adoption of the Reformation by the city. He married in 1525. He was present at the Marburg conference in 1529, at the Augsburg diet in 1530 and at the signing of the Schmalkald articles in 1537. His vehemence, coarseness and arrogance in controversy brought him many personal enemies. The introduction of the Augsburg Interim in 1548 necessitated his departure from Nuremberg; he went first to Breslau, and afterwards settled at Königsberg as professor in its new university at the call of Duke Albert of Prussia. Here in 1550 he published two disputations, the one *De lege et evangelio* and the other *De justificatione,* which aroused a controversy still unclosed at his death on Oct. 17, 1552. While he was fundamentally at one with Luther in opposing both Romanism and Calvinism, his mysticism led him to interpret justification by faith as not an imputation but an infusion of the essential righteousness or divine nature of Christ. His party was afterwards led by his son-in-law Johann Funck, but disappeared after the latter's

execution for high treason in 1566. Osiander's son Lukas (1534–1604) and grandsons Andreas (1562–1617) and Lukas (1571–1638) were well-known theologians.

Osiander, besides a number of controversial writings, published a corrected edition of the Vulgate, with notes, in 1522, and a *Harmony* of the Gospels—the first work of its kind—in 1537. The best-known work of his son Lukas was an *Epitome* of the *Magdeburg Centuries*. *See* the *Life* by W. Möller (Elberfeld, 1870).

OSIER, the common term under which are included those species, varieties and hybrids of the genus *Salix* used in the manufacture of baskets. The chief species in cultivation are: *Salix viminalis* (the common osier), *S. triandra, S. amygdalina, S. purpurea* and *S. fragilis,* which botanically are willows. The first named, with about 40 of its varieties, formerly comprised the staple basket-making material in England. It is an abundant cropper, sometimes attaining on low-lying soils a height of 13 ft. Full topped and smooth, it is by reason of its pithy nature mainly cultivated for coarse work and is generally used as brown stuff. Some harder varieties, known as stone osiers and raised on drier upland soils, are peeled and used for fine work.

S. fragilis, with about ten varieties, is almost exclusively used by market gardeners for bunching greens, turnips and other produce.

Because of the increased demand for finer work much attention has been given (*see* BASKET) to the cultivation of the more ligneous and tougher species, *S. triandra, S. purpurea* and *S. amygdalina,* with their many varieties and hybrids.

It is commonly supposed that osiers or willows will prove remunerative and flourish with little attention on any poor, wet, marshy soil. This is, however, not the case. No crop responds more readily to careful husbandry and skilful cultivation. For the successful raising of the finer sorts of willows good, well-drained, loamy upland soil is desirable, which before planting should be deeply trenched and cleared of weeds.

At any time, from late winter to early spring, the ground may be planted with "sets" (*i.e.,* cuttings) of about 9 to 16 in. in length, taken from clean, well-ripened rods. These are firmly set to within 3 to 6 in. of the top in rows, 16 to 20 in. apart and spaced at intervals of 8 to 12 in. Yearling sets are largely planted, but the practice of the best Midland and west of England growers proves the superior productiveness of sets cut from two yearling rods. Great care should be exercised in planting lest the bark be fractured, loosened or removed from the wood, and if not subject to periodical alluvial floods the ground should be manured yearly. The coarser *S. viminalis* may be raised on lowland soil if not waterlogged or marshy. The more valuable kinds are known as: new kind, black mauls, Spaniards, glibskins, long-bud, long-skin, Lancashire red-bud, French, Italians, Pomeranians and councillors and scores of other local names. A hybrid of *S. viminalis* and *S. triandra,* known as black-top, has been found to produce the heaviest crops on the best Leicestershire grounds.

Cutting and binding take place in early winter after the fall of the leaf, the crop being known as green whole stuff. The coarser kinds are sorted, cured (dried in the sun and wind) and stacked ready for market. These are known as brown rods. The finer kinds, after the more shrubby or ill-grown rods, termed "ragged," have been rejected, are peeled or buffed. Two methods of stripping are chiefly practised: from the heads (sets) and from the pit. By the former method the rods are left on the ground until spring advances, when a rapid growth of the cambium begins. They are then cut direct from the head and the bark is easily removed by drawing the rods through a bifurcated hand-brake of smooth, well-rounded steel, framed in wood. Improved brakes worked by a treadle strip two rods at a time. For the smaller sizes, rubber brakes are sometimes used and, for the very smallest, the fingers either bare or protected by linen bands. This method ensures a clean-butted unfractured rod, but unless great judgment is exercised in selecting the proper time for cutting the rods will remain double-skinned and the head may bleed. By the "pit" process the green rods are stood upright in shallow pits of water at a depth of about 6 to 9 in. until the sap rises and growth begins, when they are ready for the brake. The defects of this method are that the tops are liable to split in the brake and the butts to remain foul. A third, known as the "pie" system, enables the grower to bridge over the interval, and to keep his workers employed, between the end of the "head" and the beginning of the "pit" strippings.

The willows are cut at the first indication of the sap rising and "couched" in rotten peelings and soil at a slight angle, the butts being on the ground, which should be strewn with damp straw from a manure heap. The tops are covered lightly with rotted peelings and by periodical application of water, fermentation is induced at the bottom, heat is engendered, the leaves force their way through the covering and peeling may begin. Peeling is chiefly done by women and lasts from early May to the middle of July, but a motor peeler has been introduced in some osier grounds. After stripping, the rods are bleached in the sun and stored for sale as white. If the rods are to be buffed they are immersed in large tanks of boiling water from four to six hours. They are then allowed to cool and mellow, are stripped and carefully dried in sun and air and remain dyed a rich tawny brown or buff colour. Brown rods may also be buffed by sinking them in cold water which is heated to boiling point and maintained at that temperature for the requisite period.

In its natural habitat the osier or willow is a dioecious plant reproduced by cross fertilization, but for at least 2,000 years it has been cultivated from cuttings. The stocks have therefore become enfeebled; their cultivation is attended with many disturbing causes—ground vermin, fungoid and insect pests as well as winter floods and spring frosts.

The British ministry of agriculture and fisheries has shown that under suitable conditions improved stocks of basket willows can be produced by cross fertilization and their disease-resisting power strengthened.

In eastern North America the name "red osier" has been applied to *Cornus stolonifera,* one of the shrubby dogwoods.

See W. P. Ellmore, *The Cultivation of Osiers and Willows,* 2nd ed.; also a leaflet (No. 36) on the same subject published gratis by the British ministry of agriculture. (T. O.; X.)

OSIJEK (Germ. ESSEG, Magyar ESZEK), town of Croatia, Yugos. Pop. (1948) 50,398, chiefly Croats and Magyars. It is situated on the Drave, which is there crossed by two bridges, below which the river is navigable by small steamers. The upper or old town contains the fortress, while the lower or new town is the commercial centre.

It has several Orthodox and Roman Catholic churches, Franciscan and Capuchin monasteries, a synagogue, gymnasium, school, hospital, chamber of commerce and law courts. Osijek has a thriving trade in grain, fruit, livestock, plum brandy and timber. There are cotton mills, tanneries and a sugar beet factory, while silk weaving, glass blowing and the making of hats and caps are also carried on.

Osijek owes its origin to its fortress, which existed in Roman times under the name of *Mursia.*

OSIMO, a town and episcopal see (anc. AUXIMUM, *q.v.*), the Marches, Italy, province of Ancona, 10 mi. S. of that town by rail. Pop. (1951) 22,660 (commune). It is on the top of a hill 870 ft. above sea level and it retains a portion of its ancient town wall (2nd century B.C.). The cathedral has a portal with sculptures of the 13th century, an old crypt and a fine bronze font of the 16th century; the town hall contains a number of statues found on the site of the ancient forum and also a few pictures. Silk spinning and the raising of cocoons are carried on.

OSIRIS, one of the principal gods of the ancient Egyptians. *See* EGYPT: *Religion.*

OSISO, an instrument for recording the exact character of vibrations. It has been used for the investigation of electrical phenomena, recording sounds, enabling the totally deaf to understand speech and to speak, studying and eliminating vibration in machinery, determining the recoil action of guns, locating heavy artillery, aeroplanes and vessels, studying heart beats, respiration and other bodily functions, locating oil, ore bodies, etc. The osiso consists of a tiny mirror mounted on two wires and suspended between the poles of a magnet. If a current flows through the wires in a strong magnetic field, they will tend to move, the direction and

extent of the motion depending upon the direction and strength of the current flow. A beam of light, reflected from the mirror, provides a means for making visible the movements of the mirror and for recording them on a photographic film. Every sound produces its own individual wave form, and the meaning of these waves can be read.

(*See* INSTRUMENTS, ELECTRICAL.)

OSKALOOSA, a city of southeastern Iowa, U.S., on federal highway 63, near the Des Moines river and Keomah Lakes State park; the county seat of Mahaska county. It is served by the Minneapolis and St. Louis, and the Rock Island railways. Pop. (1950) 11,095; (1940) 11,024 by the federal census. It is in a farming and coal-mining region, and has a number of important factories. William Penn college, founded in 1873, is located on the northern edge of the city. In the suburb of University park, adjoining it on the east, is Kletzing college. Oskaloosa was settled in 1843, chosen for the county seat in 1844, and chartered as a city in 1853. It was named after a Seminole princess.

OSLER, SIR WILLIAM (1849–1919), British physician, was born at Bond Head, Canada, July 12, 1849, and was educated at Trinity college school, Port Hope, Trinity College, Toronto, and McGill university, Montreal, where he took the M.D. degree in 1872. He studied medicine in London, Leipzig and Vienna and in 1874 was appointed professor of medicine at McGill university. From 1884 to 1889 he was professor of clinical medicine in the University of Pennsylvania, and from 1889 to 1904 professor of medicine at Johns Hopkins university. In 1905 he was appointed regius professor of medicine at Oxford, where he also served as a curator of the Bodleian library, as a delegate of the University Press and as one of the Radcliffe trustees. In 1911 he was created a baronet. Sir William Osler carried out original and valuable researches on the diseases of the spleen and blood and also made eminent contributions to the study of infections of the heart, of angina pectoris, of malaria and of many minor maladies. Sir William died at Oxford Dec. 29, 1919.

His most important work was *The Principle and Practice of Medicine* (1892, latest edition 1920). He also wrote monographs on *Cerebral Palsies in Children* (1889); and *Chorea and Choreiform Affections* (1894); a volume of essays *Aequanimitas* (1901); and *A Way of Life* (1913).

OSLO (known as KRISTIANIA or CHRISTIANIA from 1624 to 1925), capital of Norway, forming a separate county (*fylke*), and the seat of a bishopric (*stift*). Pop. (1946 census) 285,884. Area, 7 sq.mi. It lies in southern Norway, on the Aker river, at the head of Oslo fjord some 80 mi. from the Skagerrak. The modern city, with its busy, island-studded harbour, lies in a basin surrounded by pine-wooded hills. Before World War II it developed rapidly as the great town of Norway, containing not only the governmental offices, courts and parliament, but the university and the important national theatres and museums. Karl Johans Gate is the chief thoroughfare, with the royal castle and its statue of Karl Johan at the western end, and along its sides some of the leading banks and business houses, the Grand Hotel, the Frederician university (founded in 1811), the National theatre (1899) with its huge statues of Ibsen and Björnson, and the *Storting* (parliament) building (1866). The art museum lies just north of the university; the historical museum nearby. Across the harbour in Bygdö is a special structure housing Nansen's unique exploring ship, the *Fram;* another building for three fine old Viking ships, and the large Folk museum with typical early dwellings, a *stavkirke*, Ibsen's workroom, and exhibits of native handicraft and industry.

The city's population growth (7,500 in 1769; 13,600 in 1815; 134,000 in 1886; about 275,000 in 1943), resulted in the absorption of many of the surrounding communities and the creation of garden suburbs and large modernistic apartment units. At Ullevaal is the largest municipal hospital in the country. High above the city rises Holmenkollen with its famous ski-jump and ski museum. At Tören is a science museum. Still incomplete but in use at the time of the German invasion in 1940 was an impressive new city hall, built in a former slum area on the inner harbour called Pipervik. Immediately to the east is the Akershus fortress, extensive but not kept up to date.

The site of the old city of Oslo lies east of the Aker river. It was founded by Harald Hardrada in 1048, became soon the seat of a bishopric, and in the 14th century was the *de facto* capital. Its period of brilliance was from 1286 to 1350, but it was repeatedly burned and plundered; after complete destruction by fire in 1624 it was left to ruin and the inhabitants were ordered to build Kristiania (named for King Christian IV of Denmark and Norway). On Jan. 1, 1878, the site was incorporated in Kristiania.

Like the other municipalities of Norway, Oslo before 1940 enjoyed a high degree of local autonomy, especially after the charter of 1837. Its Council of 84 elected an executive committee of 21; both were under control of the Labour party after the elections of 1937. The city budget of about $30,000,000 supported farreaching social activities such as the child welfare clinic, mothers' pensions, summer camps for more than 3,000 children, the famous "Oslo breakfast" for school children, economic advisers for housewives, and an employment bureau.

Oslo is well connected by rail and highway with other cities of Norway and Sweden; it is also the chief seaport of a seafaring nation. It ordinarily imports about three times as much as it exports and has floating dock, dry dock and elevator facilities; the harbour is kept ice free. Two railway stations serve the city: Östbanegaard or Hovedbanegaard by the Björvik and Vestbanegaard by the Pipervik. There is a special railway up to Holmenkollen and good tram service. There are two large shipbuilding yards and many factories, mostly concentrated in Sagene, manufacturing woollens, linens, paper, pulp, machinery, brick and tile, flour, condensed milk, margarine, oil, soap, hardware, glass, chemicals, beer and liquors.

Electric power is supplied by a huge project at Solbergfoss on the Glommen river.

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OSMAN ('UṢMĀN), the usual form of the Arabic name 'OTHMAN, as representing the Turkish and Persian pronunciation of the name. It is used, therefore, for (1) the founder of the Osmanli or Ottoman dynasty, Osman I., who took the title of sultan, ruled in Asia Minor, and died in 1326, and (2) the sixteenth sultan Osman II., who reigned 1616–1621. (*See* TURKEY: *History;* OTHMAN.)

OSMAN (1832–1900), Turkish pasha and mushir (field marshal), was born at Tokat, in Asia Minor, in 1832. Educated at the military academy at Constantinople, he entered the cavalry in 1853, and served under Omar Pasha in the Russian War of 1853–56, in Wallachia and the Crimea. Appointed a captain, in the Imperial Guard, he distinguished himself in the campaigns of the Lebanon in 1860 and of Crete in 1867 to 1869, and was promoted lieut.-colonel. He served under Redif Pasha in suppressing an insurrection in Yemen in 1871, was promoted major-general in 1874, and general of division in 1875. Appointed to command the army corps at Widin in 1876 on the declaration of war by Serbia, he defeated Tchnernaieff at Saitschar and again at Yavor in July, invaded Serbia and captured Alexinatz and Deligrad in October, when the war ended. Osman was promoted to be mushir, and continued his command at Widin.

When the Russians crossed the Danube in July 1877, Osman moved his force to Plevna, and, with the assistance of his engineer, Tewfik Pasha, entrenched himself on the right flank of the Russian line of communication, and gradually made the position a most formidable one. He repulsed the three assaults of the Russians and after being closely invested, held the position until Dec. 9, when, compelled to cut his way out, he was severely wounded and forced to capitulate. This famous improvised defence delayed the Russians for five months, and entailed their crossing the Balkan range in the depth of winter after the third battle of Plevna. The sultan conferred on Osman the Grand Cross of the Osmanie and the title of "Ghazi" (victorious), and, when he returned from imprisonment in Russia, made him commandant of the Imperial Guard, grand-master of the artillery and marshal

of the palace.

In Dec. 1878 he became war minister, and held the post, with a small break, until 1885. He died at Constantinople on April 14, 1900.

OSMANLI, the tribal name of the Turks of the Ottoman empire. The Osmanli include a heterogeneous group of peoples, the original conquering Osmanli having mixed very considerably with the conquered peoples, until physically they have ceased to have a definite separate existence.

OSMIUM, a chemical element found in small quantities in platinum ores but obtained chiefly from the mineral osmiridium by the method of Deville and Debray; together with iridium it was first isolated by Smithson Tennant in 1803 (symbol Os, atomic number 76, atomic weight 190.8). Osmiridium is fused with metallic zinc, the excess of zinc is dissolved in hydrochloric acid and the residue ignited with a mixture of barium nitrate and barium peroxide. When cold, the mass is finely powdered and treated with cold dilute hydrochloric acid in a stoppered bottle; this is necessary as osmium is present in the form of volatile tetroxide. After all action has ceased, nitric and sulphuric acids are added, the mixture is well shaken and the barium sulphate allowed to deposit. The liquid is then distilled, when the volatile osmium tetroxide passes over in an almost pure state. The residue from the distillation is concentrated, ammonium chloride is added, and ammonium iridium chloride $(NH_4)_2IrCl_6$ (together with a little ruthenium) is precipitated. Another method of obtaining osmium from osmiridium is to heat the alloy mixed with common salt in a slow stream of chlorine. The sodium osmichloride, Na_2OsCl_6, produced is extracted with water; sal ammoniac is added to precipitate sparingly soluble ammonium osmichloride, $(NH_4)_2OsCl_6$, which on gentle ignition leaves a residue of spongy osmium. (*See* also RUTHENIUM.)

Osmium in the massive state is a metal of a bluish-white colour. It can be obtained crystalline by alloying any of its forms with metallic tin and subsequently removing the tin by means of hydrochloric acid. It has a specific gravity of 22.48, and melts at about 2,700° C., although it begins to volatilize at a lower temperature. It is a very hard metal, especially when combined with iridium, and the alloy was at one time used extensively for tipping gold pens, but for this purpose cheaper alloys are now employed free from platinum metals and generally having tungsten for their basis. It is not suitable in alloys with other platinum metals for high-temperature work, for, owing to the ease with which it oxidizes, it causes the alloy to disintegrate.

Osmium forms several oxides of which four are known with certainty, namely, OsO, Os_2O_3, OsO_2 and OsO_4, while OsO_3 is present in the metallic osmates. The lower oxides are unimportant. *Osmium tetroxide,* OsO_4, known in commerce under the name of osmic acid, can readily be obtained in a state of purity, and is the source from which other osmium compounds are generally prepared. If metallic osmium in any form is heated in a tube in a current of air, or preferably oxygen, to a bright red heat, combination takes place and a yellowish liquid, OsO_4, condenses in the cold part of the tube, afterward crystallizing in yellowish needles which melt at 40° C.; the liquid boils at 100° C. giving a colourless vapour. Traces of the vapour of osmium tetroxide have a very strong odour somewhat resembling that of chlorine. The vapour is poisonous and exceedingly corrosive and attacks animal membranes vigorously, becoming reduced and leaving a deposit of metallic osmium. In small quantities the physiological effect is transitory but larger quantities entail serious consequences. It is largely used for preparing microscopic slides as it acts preferentially on certain portions of tissue, staining them black. If alcohol is added to OsO_4 dissolved in caustic potash, the solution becomes red and on concentration potassium osmate, $K_2OsO_4{,}2H_2O$, crystallizes out. This salt is stable in neutral solutions but decomposes on acidification, forming OsO_4 and lower oxides. Osmium has several chlorides such as $OsCl_2$, $OsCl_3$ and $OsCl_4$; these, and especially the last two, have a great tendency to combine with alkaline chlorides producing double chlorides of the form M_3OsCl_6 and M_2OsCl_6. They are readily formed from the tetroxide by the use of suitable reducing agents. Two sulphides of osmium are known, OsS_2 and OsS_4; the latter is formed by the action of sulphuretted hydrogen upon acid solutions of the tetroxide. Qualitatively, osmium is detected by the odour of OsO_4 produced when the metal is ignited in air. A delicate test for OsO_4 is to warm an aqueous solution with thiocarbamide and dilute hydrochloric acid, when a red coloration shows the presence of osmium. (F. E. M.)

OSNABRÜCK, a town and espiscopal see in Lower Saxony, Germany, on the Hase, 70 mi. W. of the city of Hanover, 31 mi. by rail N.E. of Münster, and at the junction of the lines Hamburg–Cologne and Berlin–Amsterdam. Pop. (1950) 109,538. In 888 Osnabrück received the right to establish a mint, a market and a toll-house. Surrounded with walls toward the close of the 11th century, it maintained an independent attitude toward its nominal ruler, the bishop, and joined the Hanseatic league, reaching the height of its prosperity in the 15th century. The older streets contain examples of Gothic and Renaissance domestic architecture. The Roman Catholic cathedral, with its three towers, is a building of the 13th century, partly in the Romanesque and partly in the Transitional style; but it is inferior in architectural interest to the Marienkirche, a Gothic structure of the 14th and 15th centuries. The town hall, a 15th century Gothic building, contains portraits of some of the plenipotentiaries engaged in concluding the peace of Westphalia. Other important buildings are the museum, containing scientific and historical collections; the episcopal palace and the law courts. The lunatic asylum on the Gertrudenberg occupies the site of an ancient nunnery. Linen was formerly the staple product, but it no longer retains that position. The manufactures include machinery, paper, celluloid, chemicals, tobacco and cigars, pianos, cloth and beer. It has large iron and steel works, and coal mines in the neighbourhood. It was bombed repeatedly and very severely during World War II.

OSORNO, a province in south Chile, bounded north along the Río Bueno by Valdivia, east by Argentina, south by Llanquihue and west by the Pacific. Area 3,867 sq.mi.; population (1952) 123,059. The province was created by law Jan. 19, 1940, about two-thirds the territory having been taken from the province of Llanquihue, the remainder from the province of Valdivia. Osorno lies in the temperate rain forest zone of the south, and is divided longitudinally into the three physiographic regions (coastal mountains, interior valley and cordillera) which characterize the majority of the provinces of Chile. The west is sparsely settled, and there are no towns, ports or roads in the region. The central valley, traversed by the Santiago-Puerto Montt line of the State railways, is a productive agricultural and stock-raising region, settled in considerable part by German colonists and their descendants. The valley is integrated by a good network of roads, many of which lead eastward to the lake district. The eastern part of the province is noted for its lakes (especially Ranco, the southern half of which is in Osorno, Puyehue and Rupanco), resorts (Lago Ranco, Salto del Pilmaiquén, Baños de Azufre and Termas de Puyehue), forests and mountains.

Osorno, capital of the province and department of the same name (population 40,120 in 1952), was founded in 1553 and named in honour of the Marqués de Osorno, viceroy of Peru. Centrally located in the valley, Osorno has the distinction of being the only large urban centre in the province, the fourth largest city in south Chile, the gateway to southern Chile's famous tourist region, and the western terminus of the important international route which leads to the Argentine town of San Carlos de Bariloche. The province is divided into two departments, Osorno and Río Negro, the capital of the latter being Río Negro, with a population of but 3,450 in 1952.

OSPREY or **OSPRAY,** a bird of prey of conspicuously marked plumage, the white of its lower parts and head contrasting sharply with the dark brown of the back when it is on the wing. It is the representative of the family *Pandionidae,* closely related to the *Falconidae.* Its special characters are the presence of a reversible outer toe and spicules on the soles of the feet.

The osprey (*Pandion haliaetus*) is one of the most cosmopolitan birds of prey. Where, through abundance of food, it is numerous,

the nests of the fish-hawk (to use its American name) may be placed on trees to the number of 30 close together. Where food is scarcer and the species accordingly less plentiful, a single pair will occupy an isolated rock, as formerly in Scotland. Few birds lay eggs so rich in colouring: their white or pale ground is spotted, blotched or marbled with almost every shade of purple, orange and red, from the most delicate lilac and buff, through violet, chestnut and crimson, to black. The fierceness with which ospreys defend their eggs and young, in addition to the dangerous situation chosen for the aerie, makes the task of robbing the nests difficult. It no longer breeds in Great Britain. The term "osprey," applied to the nuptial plumes of the egrets in the feather trade, is derived from the French *esprit;* it has nothing to do with the osprey bird.

BY COURTESY OF THE NATIONAL ASSOCIATION OF AUDUBON SOCIETIES

THE OSPREY (PANDION HALIAETUS)

A bird of prey, known in America as the fish-hawk

OSROENE or **OSRHOENE,** a district of northwestern Mesopotamia, in the hill country on the upper Bilechas (Belichus; mod. *Nahr Belik*, Bilikh), the tributary of the Euphrates, with its capital at Edessa (*q.v.*), founded by Seleucus I. About 130 B.C. Edessa was occupied by a nomadic Arabic tribe, the Orrhoei (Plin. v, 85; vi, 25, 117, 129), who founded a small state ruled by their chieftains with the title of kings. After them the district was called Orrhoene (thus in the inscriptions, in Pliny and Dio Cassius), which occasionally has been changed into Osroene, in assimilation to the Parthian name Osroes or Chosroes (Khosrau). The founder of the dynasty is therefore called Osroes by Procop. (*Bell Pers.* i, 17) but Orhāi or Urhāi, son of Hewyā (*i.e.* "the snake"), in the chronicle of Dionysius of Tellmahre; he is no historical personality, but the eponym of the tribe. The kings soon became dependants of the Parthians; their names are mostly Arabic (Bekr, Abgar, *Ma'nu*), but among them occur some Iranian (Parthian) names, as Pacorus and Phratamaspates. Under Tigranes of Armenia they became his vassals, and after the victories of Lucullus and Pompey, vassals of the Romans. Their names occur in all wars between Romans and Parthians, when they generally inclined to the Parthian side; *e.g.*, in the wars of Crassus and Trajan. Trajan deposed the dynasty, but Hadrian restored it. The kings generally used Greek inscriptions on their coins, but when they sided with the Parthians, as in the war of Marcus Aurelius and Verus (A.D. 161–165), an Aramaic legend appears instead. Hellenism soon disappeared and the Arabs adopted the language and civilization of the Aramaeans. This development was hastened by the introduction of Christianity, which is said to have been brought here by the apostle Judas, the brother of James, whose tomb was shown in Edessa. In 190 and 201 we hear of Christian churches in Edessa. King Abgar IX (or VIII) (179–214) himself became a Christian and abolished the pagan cults. Caracalla in 216 abolished the kingdom of Osroene (Dio Cass. 77. 12, 14) and Edessa became a Roman colony. The list of the kings of Osroene is preserved in the Syrian chronicle of Dionysius of Tellmahre, which is checked by the coins and the data of the Greek and Roman authors; it has been reconstructed by A. von. Gutschmid, "Untersuchungen über die Geschichte des Königreichs Osroene," in *Mémoires de l'Acad. de St. Pétersbourg,* t. xxxv (1887). Edessa remained Roman till it was taken by Chosroes II in 608; but in 625 Heraclius conquered it again. In 638 it was taken by the Arabs. (ED. M.)

OSS, an industrial town in North Brabant, Netherlands. Pop. (1940) 17,467. It is the centre of the Dutch margarine industry.

OSSA (mod. *Kissovo, Kissavo*), a mountain (el. *c.* 6,400 ft.) in Larissa, S.E. part of Thessaly, Greece; S. of Olympus, from which it is separated by the valley of Tempe, and N. of Pelion which the Giants are said to have piled on it to scale Olympus.

OSSETE. This member of the northern group forms of Iranian speech was spoken in the area north of the Caucasus. It is the survival of a number of Scythian languages formerly current in S. Russia before the Slav onset. It is divided into two divisions, eastern and western. A number of words in Hungarian indicate an ancient association between the languages.

See Miller, *Grundriss der Iranische Philologie* Vol. I.

OSSETIAN AUTONOMOUS AREAS, two administrative units of Russia. (1) The South Ossetian Area created in 1922 is linked administratively with the Georgian S.S.R. Area 1,429 sq.mi. Pop. (1933) 95,300. (2) The North Ossetian Area created in 1924 is linked administratively with the North Caucasian Area. Area 2,327 sq.mi. Pop. (1939) 328,885.

The Ossetes are descended from the Alans, the strongest and most numerous of the Sarmatian tribes, and their language belongs to the Iranic group of the Aryan tongues. The earliest reference to the Alans is A.D. 35 when, according to Josephus, they occupied the Kuban valley; later they occupied the Don and Dnieper regions, where they joined forces with Germanic tribes in attacks on the Romans. Legend gives the Emperor Maximin a Gothic father and an Alan mother. The Hun invasion swept them from the steppe, but they took refuge in the Caucasus and were probably settled in their present territory in the 5th and 6th centuries. They have been described by some writers as long headed, blue eyed and fair haired, but recent Russian investigators describe them as rather broad headed, with swarthy complexions, dark eyes and hair, and straight noses, their stature being above the average. In the Caucasus they held the grassy passes leading from the sources of the Terek and the Ardon to those of the Rion and the Kura, by which alone horsemen and troops can cross the range in summer, and in the height of their prosperity their flocks whitened the steppe and their vintages were famous. The rude walls and towers of their fortified farms and villages still remain on high and defensible ridges in the mountain fastnesses. Later they formed villages with two storied stone houses, the lower for the cattle and the upper for human habitation, with flat wooden roofs and balconies.

Queen Thamar of Georgia introduced Christianity among them in the 12th century, but later the Kabardians drove them from many of their pastures and Turkish tribes supplanted them in the lower valleys and introduced the Islamic faith within their borders. The Ossetes, however, even in their decline, still held the upper passes, the keys of the Caucasus. The Russian hold on the region began when a small fortress was established at Vladikavkaz in 1784 and the Ossetes were conquered in 1802. Later the famous Georgian military road through the Dariel gorge of the Terek, constructed 1811 to 1864, brought the Ossetes more definitely under Russian rule. For a description of the rich treasures found in the tombs of the Alans, *see* Rostovtseff, M., *Iranians and Greeks in South Russia,* 1922.

Most of the territory of the Ossetes consists of the mountain region of the Caucasus, with snow clad peaks, *e.g.*, the Adai Khokh (15,242 ft.). Numerous streams ultimately join the Terek; in their upper courses they have carved deep valleys. They are of no use for floating timber or for navigation, owing to their rapidity and the numerous falls, but are of great potential value as a source of hydroelectric energy, and a hydroelectric station has recently been built on the Gizeldon. The chief pass is the Mamison, over which goes the Ossetian military road, constructed in 1889. No other good road exists in the whole Ossetian area. A loop from the Black Sea–Caspian railway passes through the north of the territory, with a branch to Alagir and Vladikavkaz. The latter town is the administrative centre for the North Ossetes, but forms a separate administrative division of the North Caucasian Area. Stalinir (formerly Tskinvali), a settlement of 5,809 inhabitants, is the administrative centre of the South Ossetes. The chief range apart from the Central Caucasus, is the Bokovoi Ridge, exceeding a height of 10,000 feet. The average altitude of South Ossetia is 10,000 feet. (*See* CAUCASUS.)

Forest and shrub are general in the region, oak and hardbeam being the prevailing varieties in the north, where timber is exported through Alagir. The forests extend to the upper limit of the limestone gorges, but the crystalline schists are bare of

vegetation. Coniferous forests extend above the oak, hardbeam, ash, maple and lime and alpine meadows with a rich variety of blossoms are found above the tree limit. On the plateau in the north maize gives good harvests and occupies 76% of the sown area; winter wheat, potatoes, fruit, sunflower seed, tobacco and vegetables are also cultivated; the latter find a market in Vladikavkaz and in the tomato-canning factory recently established at Alagir. Milk, meat and cheese, from sheep and goats especially and from cows in some regions, form the staple food of the herdsmen and shepherds. Small patches of summer wheat, barley, oats and potatoes are grown in sheltered spots among the hills, but frost or early snow often spoils the harvest. Unworked coal, naphtha, iron, manganese, graphite, asbestos, wolfram and arsenic exist; the only mineral at present exploited is lead. South Ossetia is essentially a grazing region, with sheep and goats in the east and cattle in the west. It is thinly peopled in comparison with the north, and its population was further diminished by the disastrous war conditions following the 1917 Revolution when many natives left their homes and went northward. Conditions in this region recovered very slowly. Peasant industries include the making of daggers and metal goods, fur caps, leather goods and small metal wares.

There are two main Ossetian dialects, the Iron and the Digor; the South Ossetians call themselves Tualte and speak a dialect related to the Iron group. Ossetes form about 85% of the population and Russians and Ukrainians about 12%. The literacy rate among this scattered population in a region of poor communications is low and decreases from north to south. Since the Ossetes received cultural autonomy the Latin script has been adopted and some newspapers and books are now printed in Ossete. School provision is made for less than half the children, mainly for those in the plateau region. The problem of providing education and medical help for the herdsmen and shepherds of the mountain regions is at present unsolved. (R. M. F.)

OSSETIAN LANGUAGE: *see* OSSETE.

OSSETT, a municipal borough in the Dewsbury parliamentary division of the West Riding of Yorkshire, Eng., 2½ mi. W. of Wakefield. Pop. (1951) 14,576. Area 5.2 sq.mi. It lies along a spur of upland about 300 ft. high which forms part of the Aire-Calder divide. In the centre of the heavy woollen district, its chief industries are the manufacture of textiles (mainly shoddy and mungo) and mining. Others include engineering, leatherworking and rubber moulding. Ossett is mentioned in Domesday book and suffered devastation under William the Conqueror. In the 17th century it was visited by plague, but the discovery of medicinal springs to the southeast gave it a temporary attraction. It was incorporated in 1890.

OSSIETZKY, KARL VON (1887–1938), German journalist and pacifist, was born at Hamburg on Oct. 3, 1887. He was the son of a former German army officer who was a member of a germanized branch of the Polish Roman Catholic family of Osiecki. In 1912 he joined the German Peace society (Deutsche Friedensgesellschaft) but was conscripted into the army and served throughout World War I. In 1920, in Berlin, he became secretary of the D.F.G. Convinced that "nothing was more devastating for peace and democracy than the omnipotence of the generals," he helped to found the *Nie Wieder Krieg* organization in 1922. He was associate editor of the daily newspaper, *Berliner Volkszeitung,* and a contributor to *Weltbühne,* a left-wing political weekly. He became editor of *Weltbühne* in 1927, and in a series of articles unmasked the *Reichswehr* leaders' secret preparations for rearmament. Accused of treason, he was sentenced in Nov. 1931 by the Leipzig supreme court to 18 months' imprisonment, but was amnestied in Dec. 1932. On Hitler's accession to power Ossietzky refused to flee abroad, and resumed publication of *Weltbühne.* At the end of Feb. 1933 he was arrested and sent to the Papenburg concentration camp from which, suffering from tuberculosis, he was transferred in May 1936 to a prison hospital in Berlin and a few months later to a public hospital where, however, he remained in custody until his death on May 4, 1938. On Nov. 24, 1936, he had been awarded by the Norwegian *storting* the Nobel peace prize for 1935. Hitler's reply to this was a decree of Jan. 30, 1937, forbidding Germans to accept any Nobel prize in the future.

See A. Williams-Ellis (ed.), ***What Was His Crime? The Case of Carl von Ossietzky*** (London, 1937).

OSSINING, a village of Westchester county, New York, U.S., on the east bank of the Hudson river, 30 mi. above New York city; served by the New York Central railroad. The population was 16,098 in 1950; 1940 federal census, 15,996. Ossining has a fine site, looking over the Tappan Zee and beyond Croton point to Haverstraw bay (expansions of the Hudson), and is surrounded by wooded rolling country. Two beautiful residential villages (Scarborough and Briarcliff Manor) adjoin it on the south and southeast. It is the seat of several private schools and Sing Sing (state) prison is within the village limits. The manufactures are varied, including porous plasters, pills, brass, wire, medical and aviation instruments and maps. The site of Ossining (originally part of the Phillipse manor) was settled about 1700 and the name Sing Sing was taken from the Sin Sinck Indians. The village was incorporated in 1813 and adopted its present name in 1901.

OSSORY (OSRAIGHE), an ancient kingdom of Ireland whose capital was Kilkenny and whose kings maintained their position until 1110. The diocese of Ossory includes Kilkenny and parts of Leix and Offaly. The Church of Ireland diocese was united with those of Ferns and Leighlin in 1832.

OSTADE, the name of two Dutch painters whose father had moved to Haarlem early in the 17th century from the village of Ostade near Eindhoven. The artists were the eldest and youngest sons of a large family.

ADRIAEN VAN OSTADE (1610–85) was born on Dec. 10, 1610, in Haarlem, where he lived throughout his life. He is traditionally supposed to have been a pupil of Frans Hals, and it is possible that both he and his Flemish contemporary Adriaen Brouwer (*c.* 1606–38) were in Hals's studio about 1627, though some sources suggest Salomon van Ruysdael as his master. In 1662 he was president of the painters' guild in Haarlem.

His works won him much popularity during his lifetime and he became a fairly wealthy man. Although Ostade and Brouwer may for a time have been pupils of Hals, the latter's style was not a major influence on either of them, and there is a much closer resemblance between the paintings of the two younger men than between their pictures and those of any older master. Both delighted in scenes of low peasant life, tavern brawls, etc., usually in dimly lit interiors with a single source of light illuminating the principal group. Both treated these themes with a broad and vigorous technique and in a subdued range of colours that at times borders on monochrome, and both used a considerable element of caricature to underline the coarseness of their peasant types. There is little doubt that Brouwer's artistic personality was the stronger and that he was the most important influence in shaping Ostade's style. Ostade's colour schemes in the early period are largely confined to a range of neutral bluish-grays and browns, sometimes enlivened by a single note of more positive colour. Later, from the 1640s onward, he gradually adopted a brighter palette, and his subjects, though still mostly from peasant life, tended to become less violent and grotesque. In the works of his maturity one finds more outdoor subjects, such as figures by a cottage door or peasants merrymaking outside an inn. Although the great majority of his works are genre pieces, he experimented also with religious subjects, portraits and landscapes. He worked in water colour as well as oil, was a spirited draftsman with the pen and produced a number of etchings, of which 50 are known. He was a prolific artist, painting usually on panel and invariably on a small scale, and is well represented in the principal collections of Europe and America. His most important pupils or followers were his brother Isack, Cornelis Bega, Cornelis Dusart and Jan de Groot.

ISACK VAN OSTADE (1621–49) was born in Haarlem, where, as far as is known, he spent the whole of his short life. He was at first a pupil of his brother Adriaen, whose manner he followed so closely that some of his early genre pieces have been confused with the elder Ostade's work. However, he was too accomplished and individual an artist to remain an imitator of his brother, and soon branched out into a style that was more ambitious, both in scale and in complexity of composition. The works of his most distinguished period include a small number of winter landscapes, with sleighers and skaters on the ice, which can be ranked among the finest of all Dutch paintings in this genre, but his most characteristic subjects are those which depict parties of travellers with carts and horses resting outside an inn, in a vein reminiscent of some similar compositions by Salomon van Ruysdael. They show an excellent grasp of design in the disposition of the different groups, together with great vivacity in the treatment of individual figures. His rendering of misty or smoke-laden atmosphere is equally masterly. His work is well represented in the National gallery, London, and the Wallace collection has a fine painting of "A Market Place." Perhaps the most celebrated of the winter scenes is that in the Louvre, Paris. Since he died at such an early age, Isack van Ostade can have had few if any pupils, yet his influence on the succeeding generation of Haarlem painters was by no means negligible. Philips Wouwerman (*q.v.*), in particular, seems to have owed much to him, carrying on his characteristic subject matter of travellers, horses and wayside inns and apparently deriving his favourite motif of the gray horse directly from Ostade's example.

See C. Hofstede de Groot, *Catalogue of Dutch Painters,* vol. iii, (London, 1910). (R. E. W. J.)

OSTASHKOV, a town of Russia in the province of Tver, in 57° 10′ N., 33° 5′ E., on the south shore of Lake Seliger, near the outlet of its waters into a stream that joins the upper Volga

and was at one time thought to be the source of that river. It is in a damp and marshy situation, but became a centre for pilgrims visiting the Stolbenski monastery on an island in the lake. Later the railway passed through the town, and it became the terminus of a telegraph line. Its population (15,660) is mainly occupied in tanning and the making of leather goods, in iron founding and brick making and in fishing on the lake.

OSTEND (Flemish *Oostende*), West Flanders, Belg. Pop. (1947) 49,651. It is the most fashionable seaside resort and the third port of the kingdom. In the middle ages it was strongly fortified and underwent several sieges; notably in 1601–04, when it only surrendered by order of the states to Spinola. The creation in 1722 of the Compagnie de Commerce des Indes seemed to assure a hopeful future to the port of Ostend. But the success obtained caused the envy of neighbouring nations, who forced Emperor Charles VI to revoke the grant made. Under Joseph II Ostend enjoyed another period of commercial prosperity. In the 20th century a new town was created. The digue or parade, constructed of solid granite, extends for more than 3 mi. along the shore in a southerly direction from the long jetty which protects the entrance to the port. A casino and the royal châlet are prominent on the sea front. In the rear of the town is a fine park to which a race course has been added. The modern docks accommodate ships of large tonnage. Apart from these docks Ostend has a very considerable passenger and provision traffic with England, and is the headquarters of the Belgian fishing fleet, estimated to employ 400 boats and 1,600 men and boys. Ostend supplies sea fish and is renowned for its oyster and lobster beds. It has a school of navigation and a fishery training school. There is a daily service from Ostend to Tilbury carrying food produce for England. Ostend is in direct railway communication with Brussels, Cologne and Berlin. It is also the starting point of several light railways along the coast and to the southern towns of Flanders. Ostend was occupied by the Germans for four years during World War I, and was at first, until it was rendered untenable by aerial bombardments, a base for destroyers and submarines. In May 1918 the entrance channel to the harbour and the canal to Ghent and Bruges were blocked to all craft except the smallest submarines by the sinking of the "Vindictive." After the war she was raised and broken up. Parts of the "Vindictive," "Intrepid" and "Thetis" were made into a memorial on the digue.

The city was occupied by the Germans again in World War II.

OSTEND COMPANY. The treaties of Utrecht and of Rastatt (1713–14) at the end of the War of the Spanish Succession transferred the Spanish Netherlands to the house of Austria but maintained Dutch control over the Scheldt and so over the commerce of Antwerp as under the peace of Westphalia (1648). In Ostend, however, the Flemings had a port on the open sea, and from 1715 onward attempts were being made, both by the Ostenders themselves and by foreign adventurers, to exploit its geographical advantages for trading in emulation of the Dutch and English East India companies. These private enterprises led to protests and to the seizure of interloping ships by the Dutch and English companies. But meanwhile the imperial government, prompted to some extent by the schemes of the English adventurer John Colebrooke, was considering a major undertaking on the same lines; and in Dec. 1722 the emperor Charles VI granted a charter for 30 years to a company that was to be based on Ostend to trade to the East and West Indies and Africa (in return for the charter the imperial treasury was to enjoy 3%–6% of the profits). The company founded two settlements in India, the more important of which was Bankibazar on the Hooghly, and trade proved at first highly profitable, particularly as it was able to benefit from extensive smuggling into England. The protests of the English and Dutch companies, whose shares slumped before this competition, were reinforced by those of their governments, who, particularly when Spain gave its support to the venture (1725), were alarmed at its political as well as commercial implications.

Public opinion was aroused, and the United Kingdom parliament declared participation by a British subject in the Ostend company to be a criminal offense. In consequence of this alarm the fate of the new company loomed large in the diplomacy of the great powers from 1725 to 1731. On this, as well as on other more vital issues, Great Britain, France, the United Provinces and, at first, Prussia allied themselves against the emperor and Spain, later joined by Russia and by Prussia (who abandoned its former allies). In 1727, however, the emperor's desire for international recognition of the pragmatic sanction ensuring the succession of his daughter Maria Theresa led him to agree to suspend the company for seven years; and in 1731, under the treaty of Vienna, the company was dissolved in return for the recognition of the pragmatic sanction. The suspension of its charter did not immediately end the company's activities. Attempts by the Danish company to attract its members were checked by the vigorous representations of Great Britain, the United Provinces and France, but at Bankibazar the servants of the defunct company raised the emperor's flag and continued to carry on their trade until in 1744 the settlement fell to a siege by the *faujdar* of Hooghly.

See M. Huisman, *La Belgique commerciale sous l'empereur Charles VI: la Compagnie d'Ostende* (Brussels, 1902). (L. S. Sd.)

OSTEND MANIFESTO, a document issued (Oct. 18, 1854) by James Buchanan, J. Y. Mason and Pierre Soulé, U.S. ministers respectively to Great Britain, France and Spain, who had met by Pres. Franklin Pierce's orders at Ostend, Belg., to discuss and adopt measures for diplomatic action at Madrid on the subject of alleged injuries by Spain to U.S. commerce with Cuba. The manifesto recommended that "the United States ought, if practicable, to purchase Cuba as soon as possible," and, if Spain should refuse to sell, then "by every law, human and divine, we shall be justified in wresting it from Spain if we have the power." W. L. Marcy, secretary of state, disavowed the document.

OSTEOARTHRITIS. Osteoarthritis (synonyms: hypertrophic, degenerative and senescent arthritis) is a degenerative disease of the cartilages of the joints which often is eventually accompanied by hypertrophic changes of marginal and subchondral bone. Primary osteoarthritis develops insidiously and more or less spontaneously in persons who are more than 40 or 45 years of age; secondary osteoarthritis is the name given to the osteocartilaginous changes in joints resulting from various injuries (acute accidental) or chronic irritations (occupational or postural stresses or congenital or acquired malformations of joints), or it may refer to the secondary osteocartilaginous reactions which may occur late in the course of various forms of arthritis (gouty, rheumatoid, suppurative and so forth). Osteoarthritis in persons who are less than 35 or 40 years of age is usually of the secondary type and generally affects only one or two joints; osteoarthritis in persons who are more than 45 or 50 years of age is usually of the primary type and may affect several (but not many) joints, particularly knees, cervical or lumbar vertebral joints and, in women especially, the terminal joints of fingers (Heberden's nodes). Human cartilage appears to have an inherent durability which allows it to remain essentially unimpaired for 40 or 50 years of ordinary wear and tear. What causes the cartilages to begin to degenerate in almost everyone about the age of 45 or 50 years is not exactly known. The chief factors are senescence of tissue (aging of cartilage) and the mechanical irritations from simple wear and tear. The factor of wear and tear alone cannot explain the condition because in many persons the joints affected are not those which have been used or irritated most or those which have carried the most weight; thus, the incidence of osteoarthritis of the terminal joints of fingers (Heberden's nodes) is not abnormal among typists, needleworkers, pianists and others who use the finger joints excessively. Nevertheless, once a joint is affected, mechanical irritations from excessive use, weight bearing and so forth, are important secondary factors which aggravate the condition. Unproved and largely unsupported are the theories that the cartilage degenerates because of arteriosclerosis of the blood vessels which nourish the joints, or because of endocrine or metabolic disorder or infection.

Premature primary osteoarthritis affecting several joints occasionally occurs spontaneously without special injury or undue irritation in certain persons aged only 15 to 35 years who presumably have inherited poor cartilages. The hereditary factor in primary osteoarthritis is also noticeable when Heberden's nodes rather regularly and sometimes prematurely affect several generations (sometimes both male and female members) of certain families.

Many, indeed most, persons who have osteoarthritis have no symptoms; the condition is often discovered incidentally in roentgenograms ordered because of other conditions. Among the persons who have symptoms the disability is mild in most, moderate in some, crippling in very few. Some affected joints are often painful for a while but later are painless. Few if any constitutional reactions accompany the disease which is essentially limited to joints and does not affect other tissues or bodily systems except for some associated transitory stiffness of musculotendinous structures. The condition should be regarded merely as one of the annoying but usually minor disabilities of advancing years.

Because in osteoarthritis synovial membranes are not inflamed or significantly affected, no "plastering membranes" form within joints to fix them, hence no permanent stiffness or fixation (ankylosis) occurs. Thus, a chief remedy is reassurance for the patient that he does not have one of the crippling progressive forms of arthritis or one which is likely to cause serious disability. Moderation in the use of affected joints, their protection from undue irritation (including that from obesity) and the philosophic acceptance by the patient of a somewhat lowered level of physical activity are sometimes the only measures required to obtain comfort. Application of heat and other physical remedies are helpful. For notably affected hips a surgical operation which interposes a metal or plastic cup between affected cartilages appears useful. Of little or no value are such remedies as concentrated vitamins, sulphur, gold, endocrine products, vaccines, roentgen therapy.

Athletic injuries to knees and injuries or malformations of hips provide common causes for secondary osteoarthritis. Articular cartilages are damaged: adequate healing may occur, or late osseous reactions may result. Protection against further mechanical irritations and sometimes surgical repair of damaged joints are required. (P. S. H.)

OSTEOLOGY, that part of the science of anatomy which has for its subject the structure, gross and minute, of the bones and the skeleton (*see* Anatomy; Connective Tissues; Skel-

ETON; etc.).

OSTEOPATHY. According to its advocates, osteopathy is a system of health and healing founded on the theory that the living body is a vital machine that will make the remedies necessary to protect itself against disease as long as it is in correct mechanical adjustment. In addition, osteopathy insists upon a wholesome physical and mental environment, good food, proper exercise and rest, and pure air and water.

Structural derangement is considered as the most important underlying disease cause. What is called a "lesion" may be in bony, muscular, ligamentous, fascial or other tissue. For example, in the bony "lesion," a joint usually lacks free movement. This stiffness may come from injury, strain, inflammation, infection, reflexes or other causes. The resultant lack of normal movement in surrounding tissues allows blood and lymph to stagnate, causing acidosis, irritating nerves which pass that way, and through them affecting the functions of various organs including blood vessels. The oedema and swelling and the contraction of muscles may also affect, by pressure or otherwise, the nerves, arteries and veins. Not only is there said to be a resultant interference with the body's ability to make its own serums and antitoxins to fight infectious disease processes, but "lesions" also produce positive suffering and disease in the form of neuritis and neuralgia, lumbago and sciatica, foot troubles and disturbances of the special senses and of the functions of the various organs including endocrine and other glands.

Osteopathic diagnosis comprises physical examination of the entire body, its distinguishing feature being an intensive search for and study of the lesions described above. There is physical, chemical and microscopic study of secretions and excretions and, if necessary, of tissues, and the use of the X-ray, basal metabolism apparatus and other scientifically accepted appliances.

Osteopathic therapy is based on the specific manipulative removal of the "lesion" already discussed. It includes also correction of hygienic, dietetic, environmental and psychic conditions; surgery for fractures and lacerations, and the removal of abnormal growths or organs so diseased as to be dangerous to life; obstetrics; and the administration of antidotes for poisons.

The American School of Osteopathy was organized at Kirksville, Mo., in 1892. Later there were other recognized colleges at Los Angeles, Calif., Kansas City, Mo., Des Moines, Ia., Chicago and Philadelphia. At the beginning, when the standards of medical education were low, the length of the course was two years. By about 1916, all the colleges required a high school education followed by four standard college years in osteopathy.

Osteopathy was promulgated by A. T. Still (*q.v.*). What is now the American Osteopathic association was organized in 1897. Its headquarters are in Chicago. It publishes a *Journal* and four other monthly periodicals. There are state, provincial and local societies, British, Canadian, New England, eastern, middle-Atlantic and western associations, the Osteopathic Women's National association and several societies of specialists. Osteopathy is regulated by law throughout the United States and most of Canada. In a majority of states examination for licence to practise is in the hands of examining boards composed of osteopathic physicians. In several states there is no legal distinction between "doctor of osteopathy" and "doctor of medicine," while in others osteopathic practice is somewhat restricted.

Many osteopathic physicians have served and are serving on state and local health boards.

In Great Britain, though osteopathy is not recognized or regulated by law, the British Osteopathic association admits to membership graduates of recognized osteopathic colleges.

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OSTERMAN, ANDREI IVANOVICH, COUNT (1686–1747), Russian statesman, born at Bochum, Westphalia, was a student at Jena, but fled to Holland after a duel and became secretary to Vice-Adm. Cornelis Cruys, who took him to Russia in 1704. Having acquired a good knowledge of Russian, Osterman was in 1708 appointed interpreter at the Russian foreign office and in 1710 was given the rank of secretary. He rapidly proved his efficiency both at the tsar's headquarters and on missions abroad. In 1711 he assisted the vice-chancellor Petr Pavlovich Shafirov in the peace negotiations with the Turks after Peter's disaster on the Pruth. At the Aland peace congress in 1718, Osterman represented Russia together with Gen. J. D. Bruce, but in fact he played the leading part even before 1719, when he went to Sweden in an attempt to persuade the Swedes to accept the Russian conditions. For the successful conclusion of the peace treaty at Nystad in 1721, Osterman was created baron. Two years later he signed a favourable treaty with Persia and was given the post of vice-president of the reorganized foreign office. Although Osterman was also consulted on internal problems as in the case of the reorganization of the foreign office in 1720, foreign affairs remained his special sphere under Peter. Later, however, his influence made itself felt in all affairs of the state. Under Catherine I (1725–27) Osterman was vice-chancellor, member of the supreme secret council, postmaster general and president of a special commission for commerce, which posts gave him not only complete control over foreign affairs but also occasion to introduce financial and economic measures. He was also governor to the future tsar Peter II, retaining this post even after the latter's accession in 1727. Osterman's shrewd behaviour in 1730 during the abortive attempt to curtail the powers of the empress Anne secured his further career; he was created count and was from 1731 on a member of the new cabinet of ministers. In 1740, after Anne's death, Osterman was given the post of admiral-general and, in addition to foreign affairs, took over naval matters (which had preoccupied him earlier). Toward the end of Anna Leopoldovna's regency (1741) some people considered him as being the actual ruler. This steady ascendancy during the period of favourites was due to his great knowledge and experience and to the skill with which he adapted himself to changes and paved his way with intrigues. However, his foreign policy was consistently based on the alliance with Austria. The two costly wars that ensued, the War of the Polish Succession (1733–35) and the war against Turkey (1735–39) raised Russia's prestige; but because of the political situation the Belgrade treaty (1739) brought only moderate gains. Moreover, intent on avoiding warfare on two fronts, Osterman had restored to Persia the conquests made by Peter. Anglo-Russian relations improved as a result of the commercial treaty concluded in 1734, but Osterman's firm adherence to the Pragmatic Sanction brought Russia into conflict with Austria's enemy, France, and this proved fatal for him personally. The French ambassador J. J. Trotti, marquis de La Chétardie, was behind the coup d'état of 1741 in favour of Elizabeth, whom Osterman had consistently neglected. Osterman was tried and condemned on charges of interfering with the imperial succession, reprieved on the scaffold and banished to Siberia (1742), where he died five years later.

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OSTERODE (OSTRODA), Poland, formerly a town in East Prussia, Ger., 75 mi. N.E. of Thorn, on Lake Drewenz, at the junction of lines to Memel, Elbing and Neidenburg. Pop. (1946) 6,769. It has a castle built in 1270 by the Teutonic knights, to whom the town owes its birth. Osterode trades in grain and timber.

OSTERODE, a town in the Prussian province of Hanover, at the south foot of the Harz mountains, 34 mi. N.W. of Nordhausen by rail. Pop. (1933) 8,743. The church of St. Aegidius was founded in 724 and rebuilt after a fire in 1578. The dukes of Brunswick-Grubenhagen made Osterode their residence from

1361 to 1452. There are manufactures of woollen goods, cigars, casks and leather, and iron foundries, tanneries, dyeworks and gypsum quarries. In recent years Osterode has become celebrated as a health resort.

OSTIA, an ancient town and harbour of Latium, Italy, at the mouth of the river Tiber, on its left bank. It lies 14 m. S.W. from Rome by the Via Ostiensis, a road of very ancient origin followed by the modern road which preserves some traces of the old pavement and remains of several ancient bridges, until the construction of a new motor road to Ostia Mare. It was said to be the first colony ever founded by Rome—according to the Romans themselves, by Ancus Martius—and took its name from its position at the mouth (*ostium*) of the river. Excavations have, however, brought to light nothing earlier than the 4th century B.C., the date of a small rectangular fort, measuring 200 by 125 yd., built of hewn blocks of volcanic stone, which may have been in Virgil's mind when he wrote his description of the fortified camp which Aeneas founded at the Tiber mouth. It was out of this fort that the city developed the establishment of the salt-marshes (*salinae—see* SALARIA, VIA) which only ceased to exist in 1875. We learn much as to its cults, magistrates and trade guilds (for the last *see* J. P. Waltzing, *Les Corporations professionelles* [Brussels and Liège]) from the large number of inscriptions found. The city was divided into five regions. Vulcan was the most important deity worshipped at Ostia, and the priesthood of Vulcan was held sometimes by Roman senators. The Dioscuri, too, as patrons of mariners, were held in honour. Later we find the worship of Isis and of Cybele, the latter being especially flourishing, with large corporations of *dendrophori* (priests who carried branches of trees in procession) and *canephori* (basket-carriers); the worship of Mithras, too, had a large number of followers. There was a temple of Serapis at Portus. At Portus a considerable number of Jewish inscriptions in Greek have come to light. In the 4th century Ostia began to be abandoned while the importance of Portus increased.

Until Trajan formed the port of Centumcellae (Civitavecchia) Ostia was the best harbour along the low sandy coast of central Italy between Monte Argentario and Monte Circeo. It is mentioned in the history of the year 354 B.C. as a trading port, and became important as a naval harbour during the Punic Wars. Its commerce increased with the growth of Rome, and this, and the decay of agriculture in Italy, which obliged the capital to rely almost entirely on imported corn (which was, from 267 B.C. onwards, under the charge of a special quaestor stationed at Ostia), rendered the possession of Ostia the key to the situation on more than one occasion (87 B.C., A.D. 409 and 537). Ostia, however, was by no means an ideal harbour; the mouth of the Tiber is exposed to the south-west wind, which often did damage in the harbour itself; in A.D. 62 no less than 200 ships with their cargoes were sunk, and there was an important guild of divers (*urinatores*) at Ostia. The difficulties of the harbour were increased by the continued silting up, produced by the enormous amount of solid material brought down by the river. Even in Strabo's time the harbour of Ostia had become dangerous.

Caesar had projected remedial measures, but it was only under Claudius that the problem was approached. He constructed a large new harbour on the right bank, 2½ m. N. of Ostia, with an area of 170 ac. enclosed by two curving moles, with an artificial island, supporting a lofty lighthouse, in the centre of the space between them. This was connected with the Tiber by an artificial channel, and by this work Claudius, according to his inscriptions of A.D. 46, freed the city of Rome from the danger of inundation. The harbour was named by Nero Portus Augusti.

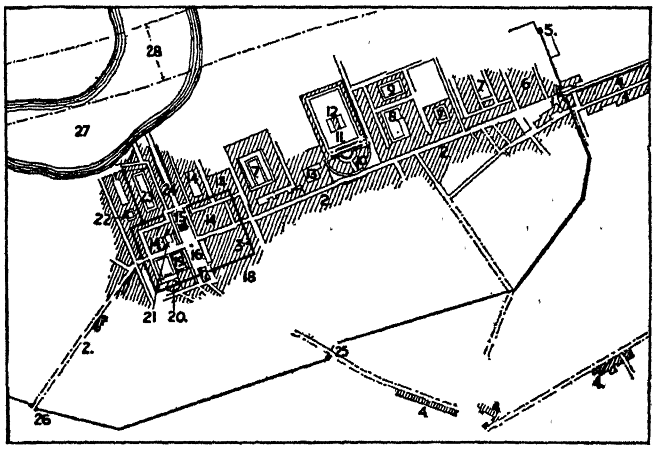
Trajan found himself obliged in A.D. 103, owing to the silting up of the Claudian harbour and the increase of trade, to construct another port further inland—a hexagonal basin enclosing an area of 97 ac., with enormous warehouses and docks attached, communicating with the harbour of Claudius and with the Tiber by means of the channel already constructed by Claudius, which was prolonged so as also to give direct access to the sea. This became blocked in the middle ages, but was reopened by Paul V. in 1612, forming the right arm of the Tiber, by which navigation is carried on at the present day, and is known as the Fossa Trajana. The island between the two arms Procopius calls Insula Sacra (it is still named Isola Sacra).

Ostia thus lost a considerable amount of its trade, but its importance still continued to be great. The 2nd and 3rd centuries, indeed, are the high-water mark of its prosperity: and it still possessed a mint in the 4th century A.D. The first bishop of Ostia of whom we have knowledge dates from A.D. 313, and the first bishop of Portus from about the same time. Both sees exist; the former is held by the dean of the College of Cardinals.

During the Gothic wars, trade was confined to Portus and the ravages of pirates led to the gradual abandonment of Ostia. Gregory IV. constructed in 830 a fortified enceinte, called Gregoriopolis, in the eastern portion of the ancient city, and the Saracens were signally defeated here under Leo IV. (847–856). The battle is represented in Giulio Romano's fresco from Raphael's design in the Stanza dell' Incendio in the Vatican.

In the middle ages Ostia became a quarry for the cathedral of Orvieto, etc., some of its marbles being conveyed by the Pisans as far as Sardinia. Later it regained something of its importance owing to the silting up of the right arm of the Tiber. In 1483–1486 Giuliano della Rovere (nephew of Pope Sixtus IV., and afterwards himself Pope Julius II.) caused the castle to be erected by Baccio Pontelli, a little to the east of the ancient city. It is built of brick and is one of the finest specimens of Renaissance fortification, and exemplifies especially the transition from the old girdle wall to the system of bastions: it still has round corner towers, not polygonal bastions. An agricultural colony, founded after 1875, and consisting mainly of cultivators from the neighbourhood of Ravenna, has produced a great change for the better in the condition of the place. The modern village is part of the commune of Rome. The marshes have been drained, and a pumping station erected near Castel Fusano. An electric railway has been constructed from Rome to Ostia and thence to the sea-bathing resort of Ostia Mare.

Excavations on the site of Ostia were only begun towards the close of the 18th century, and no systematic work was done until 1854, when under Pius IX. a considerable amount was



FROM ADAPTATION AFTER GISMONDI IN "THE QUARTERLY REVIEW" (JOHN MURRAY)

OSTIA

1, 25, 26. Gates. 2. Decumanus. 3. Walls of original *castrum*. 4. Tombs. 5. City wall tower. 6, 7, 22, 23. Storehouses. 8, 18. Thermae. 9. Barracks of *vigiles*. 10. Theatre. 11. "Piazzale delle Corporazioni." 12, 13, 17, 20 (?) Temples. 14. Private Houses. 15. Capitolium. 16. Forum. 19. Basilica. 21. Curia. 24. Cardo. 27. Present course of Tiber. 28. Course of Tiber prior to flood, 1557

done (the objects are now in the Lateran museum). The Italian Government laid bare many of the more important buildings in 1880–89: and resumed work in 1907. Owing to the fact that the site is largely covered with sand and to the absence of any later alterations, the preservation of the buildings excavated is very good, and Ostia is, with the exception of Pompeii, the best example in Italy of a town of the Roman period, while its houses, the massive concrete walls of which were faced with brick and reticulate work (both as a rule left unplastered on the outside) rose to a height of three or four storeys and had balconies and

numerous windows. They were frequently planned like modern apartment houses, and show us what the ancient Roman *insula* or block was. On the east the site is approached by the ancient road from Rome, flanked by tombs. It entered the enceinte of the 1st century B.C. (*see* plan) by a gate still preserved. This wall enclosed an irregular area far larger than that of the 4th century fort, extending down to the ancient coast line and the continuation of the road forms the main street of the town. A considerable part of it had porticoes on each side. On the right (N.) are some small well-preserved thermae, and the barracks of the firemen (*vigiles*), a special cohort of whom was stationed here. On one side of the central courtyard of the latter building is a chapel with inscribed pedestals for imperial statues (2nd and 3rd century A.D.) and a well-preserved black and white mosaic representing a sacrifice.

To the south-west is the theatre, an area 265 ft. square surrounded by colonnades, in which were placed the offices of the various *collegia* or guilds of boatmen, raftmen and others, which had a special importance at Ostia; the names of the guilds may still be read in inscriptions in the mosaic pavements of the chambers. In the centre of the area are the substructions of a temple, and on the south-east side are the remains of the theatre, built in the early imperial period, restored by Septimius Severus in 196–197 and again in the 4th or 5th century. To the south-west of the theatre are the remains of four small temples, one dedicated to Venus, and a well-preserved Mithraeum, with mosaics representing the seven planets, etc. To the south-west again is the conspicuous brick cella of a lofty temple, on arched substructures, hitherto supposed to be that of Vulcan, but more probably the Capitolium or temple of Jupiter, Juno and Minerva, with a threshhold block of *africano* (Euboean) marble over 15 ft. long; from it a street over 20 ft. wide leads north-west to the river. It is flanked on each side by well-preserved warehouses, another group of which, surrounding a large court, lies to the south-west. Further still are the well-preserved Horrea Epaphroditiana et Epagathiana, a large private warehouse. Hence an ancient road, leading between warehouses (into which the Tiber is encroaching), in one room of which a number of well-preserved large jars may be seen embedded in the floor, runs close to the river to a large private house with thermae, in which fine mosaics were found: it (groundlessly) bears the name of "imperial palace." Farther to the south-west are remains of other warehouses, and (possibly) of the docks—long narrow chambers, which may have served to contain ships. The mediaeval Torre Bocacciana marked approximately the mouth of the river in Roman times.

The south-eastern portion of the city has been excavated only partially. Opposite the Capitolium is the Forum, with remains of a temple of Rome and Augustus, a basilica (much destroyed by mediaeval plunderers), the curia, etc. To the south-west of this are the remains of the temple of Cybele, with a portico. This lay close to the commencement of the Via Severiana (*see* SEVERIANA, VIA), and the line of tombs which flanked it soon begins. Farther south-east, a line of sand dunes, covering the ruins of ancient villas, marks the coast line of the Roman period.

See G. Calza, *Ostia* (trans. by R. Weeden Cooke, 1926), and reff. (T. A.)

OSTIAKS or **OSTYAKS,** a tribe who inhabit the basin of the Ob in western Siberia. The so-called Ostyaks of the Yenisei speak an entirely different language. The trans-Uralian Ostiaks and Samoyedes are probably identical with the Yugra of the Russian annals. During the Russian conquest their abodes extended much farther south than now, 41 of their fortified places having been destroyed by the Cossacks in 1501, in the region of Obdorsk alone. Remains of these "towns" are still to be seen at the Kunovat river, on the Ob 20 m. below Obdorsk and elsewhere. Those on the Irtysh are mostly settled, and have adopted the manner of life of Russians and Tatars. Those on the Ob are mostly nomads, and own large herds of reindeer. The Ob Ostiaks are russified to a great extent. They live almost exclusively by fishing, buying from Russian merchants corn for bread.

The Ostiaks call themselves As-yakh (people of the Ob), and it is supposed that their present designation is a corruption of this name. By language they belong with the Voguls to the East Ugrian branch of the Ugrian division of the Ugro-Finnish section of the Ural-Altaic languages. Three or four leading dialects can be distinguished.

The Ostiaks are middle-sized, or short. The skull is roundish, mostly of moderate size and height. The hair is dark and soft for the most part, fair and reddish individuals being rare; the eyes are dark, generally narrow; the nose is flat and broad; the mouth is large and with thick lips; the beard is scanty. Mongoloid traits are more strongly pronounced in the women than in the men. The purest type is found among the fishers on the Ob, the reindeer-breeders of the tundra being largely intermixed with Samoyedes. They are very skilful in carving wood and bone, tanning (with egg-yolk and brains), preparation of implements from birch-bark, etc. Some of their carved or decorated bark implements show considerable artistic skill. Christianity has made some progress among them, but their ancient pagan observances are still retained.

For customs, religion, etc., see *Journal de la Société Finno-Ougrienne,* particularly papers by Sirelius and Karjalainen, and the papers by Munkácsi, Gennep, Fuchs and others in the *Revue orientale pour les études Ouralo-Altaïques;* Patkanov, *Die Irtysch-Ostiaken und ihre Volkspoesie* (1900); Patkanov, *Irtirsch-Ostjaken und ihre Volkspoesie* (1897–1900); Papay, *Sammlung ostjakischer Volksdichtungen* (1906); M. Czaplicka, *Aboriginal Siberia* (1914).

OSTRACISM, a political device instituted as a constitutional safeguard for the Athenian democracy. Its effect was to remove from Athens for a period of ten years any person who threatened the harmony and tranquillity of the body politic. In the sixth prytany (*see* PRYTANEUM AND PRYTANIS) of each year the representatives of the Boulē asked the Ecclesia whether it was for the welfare of the state that ostracism should take place. If the answer was in the affirmative, a day was fixed for the voting in the eighth prytany. No names were mentioned, but two or three names at the most could have been under consideration. The people met, not as usual in the Pnyx, but in the Agora, in the presence of the archons, and recorded their votes by placing in urns small fragments of pottery (*ostraka*) on which they wrote the name of the person whom they wished to banish. Ostracism did not take effect unless ten thousand votes in all were recorded. The ostracised person was compelled to leave Athens for ten years, but he was not regarded as a traitor or criminal. When he returned, he resumed possession of his property and his civic status was unimpaired. The adverse vote simply implied that his power was so great as to be injurious to the state. Ostracism must therefore be carefully distinguished from *exile* in the Roman sense, which involved loss of property and status, and was for an indefinite period (*i.e.,* generally for life). At the same time it was strictly unjust to the victim, and a heavy punishment to a cultured citizen for whom Athens contained all that made life worth living. Its political importance really was that it transferred the protection of the constitution from the Areopagus to the Ecclesia. It was later replaced by the *Graphē Paranomōn.*

The object was primarily to get rid of the Peisistratid faction without perpetual recourse to armed resistance. Aristotle's *Constitution of Athens* (22) gives a list of ostracized persons, the first of whom was a certain Hipparchus of the Peisistratid family (488 B.C.). This, however, may conceivably be simply the list of those recalled from ostracism at the time of Xerxes' invasion, all of whom must have been ostracized less than ten years before 481 (*i.e.,* since Marathon). With the end of the Persian Wars, the original object of ostracism was removed, but it continued in use for forty years and was revived in 417 B.C. It then became a mere party weapon, and the farcical result of its use in 417 in the case of Hyperbolus led to its abolition. Such a device inevitably lent itself to abuse (*see* Aristotle, *Pol.* 38, 1284 b. 22).

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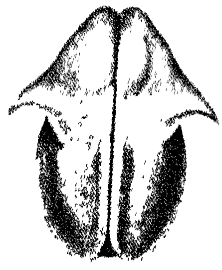
OSTRACODA, a subclass of the Crustacea (*q.v.*) comprising minute forms found in fresh water and in the sea, pelagic and bottom dwelling; a few may be parasitic; several live only in water held by the leaves of epiphytes, or in moist debris in holes in trees. Of their food habits little is known. Many are omniv-



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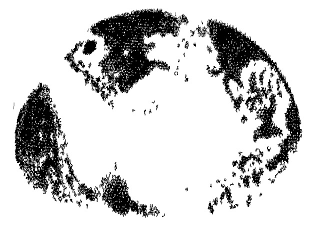

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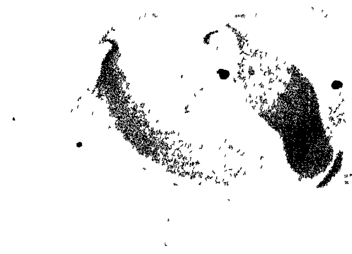

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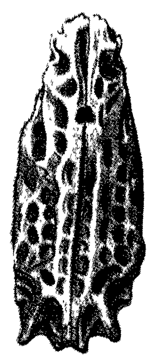

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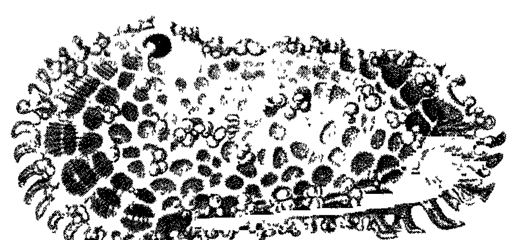

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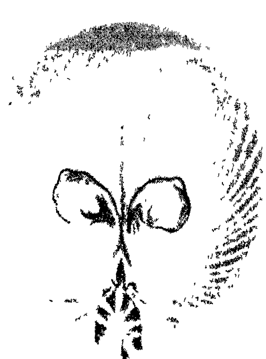

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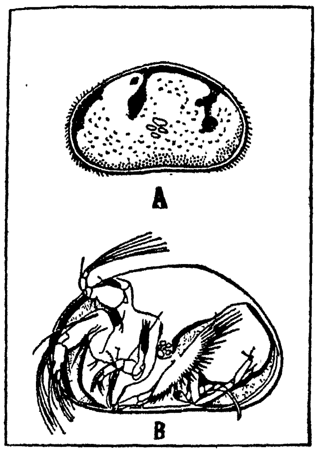
BY COURTESY OF U S NATIONAL MUSEUM, AIME M. AWL, DELINEATOR

OSTRACODS

1. *Halocypris cornuta* (Muller), anterior view. Length 3.2-3.5 mm Atlantic ocean. Order Myodocopa, family Halocypridae (after Muller)
2. *Cypria dentifera* (Sharpe), lateral view. Length 0.69 mm. Found in fresh-water ponds of the eastern United States. Order Podocopa, family Cypridae (after Sharpe)
3. *Halocypris cornuta* (Muller), lateral view
4. *Cythere lobiancoi* (Muller), female, dorsal view. Length 0.48 mm. Mediterranean sea. Order Podocopa, family Cytheridae (after Muller)
5. *Cypridina castanea* (Brady), male, lateral view. Length 4-6 mm. Atlantic and Indian oceans. Order Myodocopa, family Cypridinidae (after Muller)
6. *Cythere diffusa* (Müller), female, dorsal view. Length 0.49-0.52 mm. Mediterranean sea. Order Podocopa, family Cytheridae (after Muller)
7. *Cythereis ornata* (Muller), male, lateral view. Length 0.98 mm. Mediterranean sea. Order Podocopa, family Cytheridae (after Muller)
8. *Gigantocypris agassizii* (Muller), female, anterior view. Length 23.0 mm. Pacific and Atlantic oceans. Order Myodocopa, family Cyprinidae (after Muller)
9. *Conchoecia atlantica* (Lubbock), female, lateral view. Length 3.3-4 8 mm. Atlantic, Pacific and Indian oceans. Order Myodocopa, family Halocypridae (after Muller)
10. *Gigantocypris agassizii* (Müller). Lateral view (after Müller)

orous, some carnivorous and others feed on aquatic plants and diatoms. The Ostracoda are distinguished by having the body and limbs completely enclosed in a bivalve shell. They are remarkable for having a smaller number of appendages than any other Crustacea, there being not more than four pairs and sometimes only two pairs of limbs behind the mandibles. The antennules and antennae are used for swimming or creeping. The mandibles have a large palp, often biramous and sometimes leglike. The remaining limbs are very varied in form but some of them are usually leglike and used in locomotion.



FROM (A) SARS, "CRUSTACEA OF NORWAY," AND FROM (B) THE "ZOOLOGICAL JOURNAL"
FRESH-WATER OSTRACOD (PIONOCYPRIS VIDUA) ENLARGED
A. External appearance. B. Appendages after removal of left valve shell; left, antennule and antenna; centre mouth-parts, and behind them to the right, two leglike appendages

The breeding habits of the ostracods present several features of interest. Parthenogenesis is common, at least among the freshwater species, in many of which males are rarely seen; while in some species they have not yet been discovered. A colony of a species of *Cypris* has been kept in an aquarium for more than 30 years and during the whole of that time no males made their appearance, the colony reproducing exclusively by parthenogenesis. In some Ostracoda the threadlike spermatozoa are not only relatively but absolutely larger than those of any other animals. In one species which, when adult, is no more than 1/32 in. in length the spermatozoa are about ¼ in. long.

Most species live on or near the bottom, creeping among weeds or burrowing in mud, but some marine species are planktonic. One of the latter, *Gigantocypris,* is the largest member of the group, reaching a length of .9 in., but most species are much smaller and some do not exceed .02 in. in length.

Numerous fossil Ostracoda have been described from the oldest to the most recent formations but the affinities of many are obscure. The recent Ostracoda are generally grouped in two orders. The Myodocopa are exclusively marine and can usually be recognized by the presence of a notch in the margin of the shell near the anterior end. They generally have paired compound eyes and a heart. The Podocopa include both marine and freshwater species. There is no notch in the shell, no paired eyes and no heart.

(W. T. C.; X.)

OSTRACODERMS, a name given collectively to several groups of small fishlike Palaeozoic vertebrates, particularly abundant in the late Silurian and early Devonian formations of Europe and North America. Jaws were not developed, and paired appendages were often absent. These are primitive characteristics which show that they were allied to the living Cyclostomata (*q.v.*), with which they are often grouped to form the vertebrate class Agnatha. All carried bony armour, and internal ossifications are sometimes present as well. The Devonian Antiarchi (Asterolepida), sometimes considered as ostracoderms, are, however, jaw-bearing vertebrates (*see* SELACHIANS).

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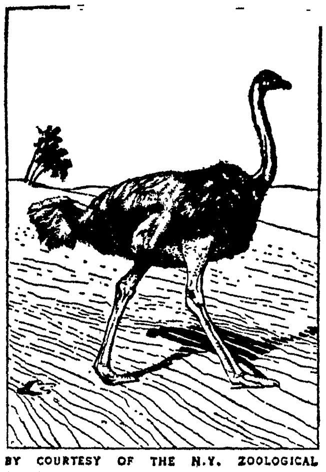
OSTRAU: *see* MORAVSKÁ OSTRAVA and SLEZSKÁ OSTRAVA.

OSTRICH, the largest living bird; the male may be nearly 8 ft. high, and weigh 300 lb. The ostrich forms the type of the sub-class Ratitae, characterized by the absence of a keel on the breast-bone (*see* ORNITHOLOGY). The genus *Struthio* is unique in possessing only two toes, thus distinguishing it from *Rhea* (*q.v.*), the South American ostrich, which has three toes.

The ostrich, in a wild state, is much less abundant now than formerly. It inhabits sandy plains and open country in Arabia and Africa, the latter more abundantly. It occurs in small troops of five or six, of which one is a cock and the rest hens. At other times it will form mixed herds with zebras and various antelopes. Extremely fleet of foot, when brought to bay the ostrich uses its strong legs as weapons with great effect. Several hens combine to lay their eggs in one nest, and on these the cock sits by night while the females relieve one another by day, though this is more to guard the eggs from beasts of prey than to incubate them, the heat of the sun sufficing for that. The parents display great solicitude for their young. The great value of ostrich feathers, combined with the growing scarcity of the birds themselves, has led to the establishment of ostrich farms, where the birds are kept and deprived of their plumes at regular intervals. Ostrich farming is carried on in Cape Colony, Egypt, Algeria, the French Riviera, southern U.S. and elsewhere. There appear to be four existing species: *S. camlus* of North Africa and Arabia, and *S. australis* of South Africa being the best known.



BY COURTESY OF THE N.Y. ZOOLOGICAL SOCIETY
OSTRICH (STRUTHIO CAMELUS), THE LARGEST OF LIVING BIRDS

OSTROG, a town of Poland, in the province of Volhynia, on the Vilya river. It is an episcopal see of the Orthodox Greek Church, and in the 16th century had a classical academy, converted later into a Jesuit college. Here was made and printed in 1581 the first translation of the Bible into old Slav. In the town is a brotherhood of Cyril and Methodius, which maintains schools of its own. Industries include tanning, potteries, oil-works, soap, candle and tobacco factories. After being plundered by the Cossack chieftain Ghmielnicki in 1648, and later conquered by the Russians, the town fell into decay. Polish after 1918, it was taken by the Russians in 1939 and the Germans in 1941.

OSTROGOTHS or **EAST GOTHS,** one of the two main branches into which the Goths were divided, the other being the Visigoths, or West Goths. *See* GOTHS.

OSTROVSKY, ALEXANDER NIKOLAEVICH (1823–1886), Russian dramatic author, was born on April 12, 1823 in Moscow, where his father was an official of the senate. He studied law in the university of that city, which he quitted without having submitted to the final examination. He was then employed as a clerk in the office of the "Court of Conscience," and subsequently in that of the Commercial Court at Moscow. Among his early comedies are *Byednaya Nivesta* ("The Poor Bride"), *Byednost ne Porok* ("Poverty not a Vice"), and *Ne v'svoi sani ne sadis* (literally "Don't put yourself in another's sledge"). Of this last Nicholas I. said, "it was not a play, but a lesson." The Moscow merchants are strikingly portrayed in *Grozá* (1860, Eng. trans. *The Storm,* by C. Garnett, 1898) the most famous of all his plays, and *Svoyi lyudi sotchtyomsya* ("Between near relatives no accounts are needed") (1850) which was originally called "The Bankrupt." *The Bankrupt* was prohibited for ten years, until the accession of Alexander II., and Ostrovsky was dismissed from the government service and placed under the supervision of the police. The Liberal tendencies of the new reign, however, soon brought relief; Ostrovsky was one of several well-known literary men who were sent into the provinces to report on the condition of the people. Ostrovsky's field of inquiry lay along the upper Volga. This mission inspired several historical dramas, such as *Kuzma Zakharich Minin Soukhorouk, Vassilisa Melentieva* and others. Four of his *Plays* have been translated into English by G. R. Noyes (1917). Ostrovsky enjoyed the patronage of Alexander III., and received a pension of 3,000 roubles a year. With the help of Moscow capitalists he established in that city a model theatre and school of dramatic art, of which he became the first director. He also founded the Society of Russian Dramatic Art and Opera

Composers. He died on June 24, 1886.

OSTUNI, a picturesque walled city of Apulia, Italy, province of Brindisi, 23 mi. N.W. of Brindisi. Pop. (1936) 21,826 (town); 28,247 (commune). It has a 15th century cathedral.

OSTWALD, WILHELM (1853–1932), German chemist, was born at Riga, Livonia, Sept. 2, 1853, and educated at the University of Dorpat (Estonia). In 1881 he became professor in Riga, and six years later was appointed professor of physical chemistry in the University of Leipzig, where he was later director of the Physico-chemical institute. In 1906 he resigned his university appointment and subsequently lived in retirement in Saxony. Ostwald may be regarded as one of the pioneers of modern physical chemistry and with J. H. van't Hoff (*q.v.*) in 1887 he founded the important *Zeitschrift für physikalische Chemie.* His own contributions to the science were mainly in the fields of electrochemistry and solutions.

On the technical side he is remembered chiefly for his discovery in 1900 of a method of oxidizing ammonia to form oxides of nitrogen, a mixture of air and ammonia being passed over a platinum catalyst. By means of this process and by later developments in connection with it, Germany was able to continue the manufacture of explosives during World War I after the Allied blockade had been enforced; the method came to be used in various countries, under the name of the Ostwald-Brauer process, for the manufacture of nitric acid from ammonia. In 1909 Ostwald was awarded the Nobel prize for chemistry.

His published works include *Lehrbuch der allgemeinen Chemie,* 3rd ed. (1910–11), *Grundlinien der anorganischen Chemie,* 5th ed. (1922) and *Die wissenschaftlichen Grundlagen der analytischen Chemie,* 7th ed. (1920), which have been translated into English. His autobiography, *Lebenslinien, eine Selbstbiographie* (3 vols.), appeared in 1926–27. His interests were by no means confined to chemistry, as evidenced by his *Vorlesungen über Naturphilosophie,* 3rd ed. (1905), his numerous studies of colour theory, monism, the technique of painting, etc. His studies of the lives of scientists are notable for their insight into the factors that make for great men (*see* especially his *Grosse Männer*). He died at his country home near Leipzig on April 4, 1932.

See F. G. Donnan, "Ostwald Memorial Lecture," *Journal of the Chemical Society,* 136:316 (London, 1933). (R. E. O.)

OSUNA, a town of southern Spain, in the province of Seville; 57 mi. by rail E.S.E. of Seville. Pop. (1940) 19,552 (mun., 24,083). Osuna is built on a hill, overlooking the fertile plain watered by the Salado, a subtributary of the Guadalquivir. Osuna, the Urso of Hirtius, famous in the 1st century B.C. for its long resistance to the troops of Caesar, and its fidelity to the Pompeians, was subsequently called by the Romans Orsona and Gemina Urbanorum, the last name being due, it is said, to the presence of two urban legions here. Osuna was taken from the Moors in 1239, and given by Alphonso X to the knights of Calatrava in 1264. Don Pedro Giron appropriated it to himself in 1445. One of his descendants, Don Pedro Tellez, was the first holder of the title duke of Osuna, conferred on him by Philip II in 1562. The University of Osuna, founded in 1549, was suppressed in 1820. The industries are agriculture and the making of esparto mats, pottery, bricks, oil, soap, cloth, linen and hats.

OSWALD (d. 992), archbishop of York, was a nephew of Oda, archbishop of Canterbury, and at an early age became, by purchase, head of the Old Minster at Winchester. Desiring to become a monk, he went with Oda's approval to the monastery of Fleury on the Loire—at that time the great centre of reviving Benedictinism. Here he soon distinguished himself by the monastic austerity of his life. In 959 he returned to England at the request of Oda, who, however, died before his arrival. He now went to York to his kinsman the Archbishop Oskytel, who took him with him on a pilgrimage to Rome. Soon after his return he was appointed bishop of Worcester at the recommendation of Dunstan, his predecessor in the see (961). As bishop he took a prominent part in that revival of monastic discipline on Benedictine lines of which Aethelwold, bishop of Winchester, was the most ardent leader. Among other religious houses he founded that of Ramsey in conjunction with Aethelwine, Ealdorman of East Anglia. In 972 he was translated (again at Dunstan's recommendation) to the archbishopric of York, with which he continued to hold the see of Worcester. He died on Feb. 29, 992.

See *Memorials of St. Dunstan,* ed. by W. Stubbs, Rolls series (1874); and T. Raine, *Historians of the Church of York* (1879–86).

OSWALD (*c.* 605–642), king of Northumbria, was one of the sons of Aethelfrith and was expelled from Northumbria on the accession of Edwin, though he himself was a son of Edwin's sister Acha. He appears to have spent some of his exile in Iona, where he was instructed in the principles of Christianity. In 634 he defeated and slew the British king Ceadwalla at a place called by Bede Denisesburn, near Hefenfelth, which has been identified with St. Oswald's Cocklaw, near Chollerford, Northumberland. By this he avenged his brother Eanfrith, who had succeeded Edwin in Bernicia, and became king of Northumbria. Oswald reunited Deira and Bernicia, and soon raised his kingdom to a position equal to that which it had occupied in the time of Edwin, with whom he is classed by Bede as one of the seven great Anglo-Saxon kings. His close alliance with the Celtic church is the characteristic feature of his reign. In 635 he sent to the elders of the Scots for a bishop. On the arrival of Aidan in answer to this request he assigned to him the island of Lindisfarne as his see, near the royal city of Bamborough. He also completed the minster of St. Peter at York which had been begun by Paulinus under Edwin. Bede declares that Oswald ruled over "all the peoples and provinces of Britain, which includes four languages, those of the Britons, Picts, Scots and Angles." His relationship to Edwin may have helped him to consolidate Deira and Bernicia. Early in his reign he was sponsor to the West Saxon king Cynegils, whose daughter he married. In 642 he was defeated and slain at a place called Maserfeld, probably Oswestry in Shropshire, by Penda of Mercia.

See Bede, *Historia Ecclesiastica,* ed. by C. Plummer (1896), ii, 5, 14, 20; iii, 2, 3, 5, 6, 7, 9–14; *Anglo-Saxon Chronicle,* ed. by J. Earle and C. Plummer (1899), *s.a.,* 617, 634, 635, 642, 654.

OSWALDTWISTLE, urban district, Accrington parliamentary borough, Lancashire, England, on Leeds and Liverpool canal; and the London Midland Region route (Church and Oswaldtwistle station). Pop. (1938) 12,620. Area, 7.6 sq.mi. It possesses cotton mills, printworks, bleachworks and chemical works, and in the neighbourhood are collieries, stone quarries and potteries.

OSWEGO, a city of New York, U.S.A., the county seat of Oswego county; on Lake Ontario, 35 mi. N.N.W. of Syracuse, at the mouth of the Oswego river and the Oswego canal, which connects with the State Barge canal at Three River Point, 25 mi. S.E. It is on federal highway 104 and is served by the Lackawanna, the New York Central and the New York, Ontario and Western railways, lake steamers and canal barges. The population was 22,611 in 1950 and 22,062 in 1940 by the federal census. The city has a fine harbour, water power, large hydro- and steam-electric developments. Water-borne commerce consists largely of coal, petroleum products, sand and gravel, raw sugar and grain.

Among the manufactures are textiles, paper containers, matches, candy, boilers and children's shoes. Oswego is the seat of a state normal school (established by the city in 1861 and taken over by the state in 1867). Ft. Ontario (within the city limits) is the oldest fort in North America which is still garrisoned. The site of Oswego was visited by Champlain in 1616. Later it became a station for the Jesuit missionaries and the *coureurs des bois.*

An English trading post was established in 1722, and in 1727 Gov. William Burnet of New York built the first fort. It was an important base of operations during King George's War and the French and Indian War. In 1755–56 the British erected two new forts (Oswego and Ontario) on either side of the mouth of the river, both of which were taken by Montcalm (Aug. 14–15, 1756) and dismantled. The British restored Ft. Ontario in 1759 and kept it garrisoned until they turned it over to the United States in 1796. It was here that Pontiac in 1766 made his acknowledgment to Sir William Johnson of Great Britain's authority. On May 6, 1814, the fort was captured by the British and Canadians, and was held by them for a short time. It was rebuilt and garrisoned by the United States in 1839, abandoned in 1899, and again reconstructed and garrisoned in 1905. Oswego became the county seat in 1816, was incorporated as a village in 1828 (when the canal was completed) and as a city in 1848.

OSWEGO CANAL: *see* New York State Barge Canal System.

OSWEGO TEA (*Monarda didyma*), a North American plant of the mint family (Labiatae), called also American beebalm, native to moist soil from Quebec to Michigan and southward to North Carolina and Georgia. It is a stout perennial, 2 to 3 ft. high, with opposite, lance-shaped, sharply toothed leaves, and showy scarlet flowers, about 2 in. long, borne in dense bracted heads terminating the branches. The Oswego tea, so named because of former medicinal use, is one of the most handsome flowering plants native to eastern North America; several choice varieties are cultivated.

OSWESTRY, municipal borough in the Oswestry parliamentary division of Shropshire, England, near the Welsh border in the N.W. corner of the county. Pop. (est. 1938) 9,726. Area, 3.4 sq.mi. The town is placed where valleys open from the Berwyn mountains, and is a market town between hill and plain as well as a route centre. There are various accounts of the early history of the settlement (*Trer Cadeirau*). The present name comes from Oswald's Tree (alternative Oswald's Cross, Welsh *Croes Oswallt*) and is said to refer to the death of Oswald, king of Northumbria, in a battle fought here against Penda, the ruler of Mercia. The heavily fortified encampment of "Old Oswestry," about a mile from the town, suggests early border warfare. The town was twice burned by Welsh invaders in the middle ages. In the Domesday Survey it is included in the manor of Maesbury. Richard II, by a charter dated 1398, granted all the privileges which belonged to Shrewsbury. In 1582 Elizabeth incorporated the town; her charter was confirmed by James I, 1616.

In the 15th and 16th centuries a weekly market was held at Oswestry for the sale of woollen goods manufactured in the adjoining parts of Wales, but the drapers of Shrewsbury, a rival centre, ruined the trade by refusing to buy cloth there. In 1642 it was garrisoned for Charles I, but two years later surrendered to the parliamentary forces. The church of St. Oswald, originally conventual, is Early English and Decorated, but has been much restored. The grammar school, founded in the reign of Henry IV, occupies modern buildings. During World War I Oswestry benefited greatly by the presence of thousands of troops at Park Hall camp. The Cambrian railway had its headquarters in the town but the engine and carriage works were in part removed by the G.W.R. after 1922. The chief industries are malting, tanning, currying, fellmongery and wool stapling.

OTHMAN (*c.* 574–656), in full Othmān ibn 'Affān, the third of the Mohammedan caliphs, a kinsman and son-in-law of Mohammed and cousin of Abu Sofiān, whose son Moawiya became the first of the Omayyad dynasty. He was elected caliph in succession to Omar in 644, but owing to his weakness and cruelty and his preference of the Koreish for all responsible positions irrespective of their capacity, he produced strife throughout the empire which led to his assassination by Mohammed, son of Abu Bekr. He was succeeded by Ali. *See* Caliphate.

OTHO, MARCUS SALVIUS (a.d. 32–69), Roman emperor, was born on April 28, a.d. 32. He appears first as one of the wildest of Nero's court. In 58 he refused to divorce his wife Poppaea Sabina at Nero's bidding, and was thereupon sent to be governor of Lusitania, where he remained ten years. In 68 Galba, governor of the neighbouring province of Tarraconensis, rebelled against Nero, and Otho accompanied him to Rome, hoping to succeed him. In Jan. 69 Galba adopted Piso as his successor, and Otho at once organized a revolt of the praetorian guard, and on Jan. 15 had himself proclaimed emperor, murdered Galba and Piso, and was accepted by the Senate. He owed his success partly to Galba's disciplinary measures being unpopular with the guards, partly to the power of the memory of Nero, which he further enlisted by restoring his statues and the officials of his household, and proposing to complete his palace, the Golden House. News soon arrived, however, that the army in Germany had declared for Vitellius. On March 14 he started northwards to prevent the Vitellians entering Italy. In this he failed, but his advance guard successfully defended Placentia against Alienus Caecina, compelling him to retire to Cremona, and he held the line of the Po. Opinions were divided in Otho's camp; he himself wishing to force a decisive battle, others advising him to wait for the arrival of the troops from Dalmatia. Otho prevailed, and the main army crossed the Po to Bedriacum, Otho staying behind with the reserve at Brixellum, on the southern bank. The Othonian forces were defeated outside Cremona, and deserted to the enemy. Otho refused to renew the struggle and committed suicide in his tent on the morning of April 15, 69, and was buried at Brixellum.

See Tacitus, *Histories,* i. 12–50, 71–90, ii. 11–51; *Lives* by Suetonius and Plutarch; Dio Cassius lxiv.; L. Paul, "Kaiser M. Salvius Otho" in *Rhein. Mus.* lvii. (1902); W. A. Spooner's Introd. to his edition (1891) of the *Histories* of Tacitus; B. W. Henderson, *Civil War and Rebellion in the Roman Empire,* a.d. *69–70* (1908).

OTIDAE: *see* Bustard.

OTIS, HARRISON GRAY (1837–1917), American journalist, was born near Marietta, O., on Feb. 10, 1837. He became a printer's apprentice, working in various offices in Illinois, Iowa, Ohio and Kentucky. He served throughout the Civil War, and rose to be lieutenant-colonel He was in the Government printing office at Washington, D.C., 1867–70, and in 1870 moved to California, where he managed the Santa Barbara *Press.* In July 1882 he became connected with the Los Angeles *Daily Times,* obtaining control of that paper in 1886. He served in the war with Spain as brigadier-general in the Philippines 1898–99. In 1910 the *Times* building was dynamited, 21 employees being killed. He died at Los Angeles on July 30, 1917.

OTIS, JAMES (1725–1783), American patriot, was born at West Barnstable, Mass., on Feb. 5, 1725. He was the eldest son of James Otis (1702–1778), fourth in descent from John Otis (1581–1657), a native of Barnstaple, Devon, and one of the first settlers (in 1635) of Hingham, Mass. The elder James Otis was elected to the provincial general court in 1758, was its speaker in 1760–1762, and was chief justice of the court of common pleas from 1764 until 1776; he was a prominent patriot in the colony of Massachusetts. The son graduated at Harvard in 1743; and after studying law in the office of Jeremiah Gridley (1702–1767), a well-known lawyer with Whig sympathies, rose to great distinction at the bar, practising first at Plymouth and after 1750 at Boston. In 1760 he published *Rudiments of Latin Prosody,* a book of authority in its time. Soon after the accession of George III. to the throne of England in 1760, the British Government decided upon a rigid enforcement of the navigation acts, which had long been disregarded by the colonists and had been almost wholly evaded during the French and Indian War. The writs of assistance issued in 1755 were about to expire, and it was decided to issue new ones, which would empower custom house officers to search any house for smuggled goods, though neither the house nor the goods had to be specifically mentioned in the writs. Much opposition was aroused in Massachusetts, the legality of the writs was questioned, and the superior court consented to hear argument. Otis held the office of advocate-general at the time, and it was his duty to appear on behalf of the Government. He refused, resigned his office, and appeared for the people against the issue of the writs. The case was argued in the old town house of Boston in Feb. 1761, and the chief speech was made by Otis. His plea was fervid in its eloquence and fearless in its assertion of the rights of the colonists. Going beyond the question at issue, he dealt with the more fundamental question of the relation between the English in America and the home Government, and argued that even if authorized by act of parliament such writs were null and void. The young orator was elected in May of the same year a representative from Boston to the Massachusetts general court. To that position he was re-elected nearly every year of the remaining active years of his life, serving there with his father. In 1766 he was chosen speaker of the house of representatives, but the choice was negatived.

In Sept. 1762 the younger Otis published *A Vindication of the Conduct of the House of Representatives of the Province of Massachusetts Bay,* in defence of the action of that body in sending to the governor a message (drafted by Otis) rebuking him for asking the assembly to pay for ships he had (with authorization of the council and not of the representatives) sent to protect New England fisheries against French privateers; according to this

message "it would be of little consequence to the people whether they were subject to George or Louis, the king of Great Britain or the French king, if both were as arbitrary as both would be if both could levy taxes without parliament." He also wrote various State papers addressed to the colonies to enlist them in the common cause, or sent to the Government in England to uphold the rights or set forth the grievances of the colonists. His influence at home in controlling and directing the movement of events which led to the War of Independence was universally felt and acknowledged; and abroad no American was so frequently quoted, denounced or applauded in parliament and the English press before 1769 as the recognized head and chief of the rebellious spirit of the New England colonists. In 1765 Massachusetts sent him as one of her representatives to the Stamp Act congress at New York, and here he was a conspicuous figure, serving on the committee which prepared the address sent to the British House of Commons. From 1769 almost continually until his death, Otis was harmlessly insane, though he had occasional lucid intervals, serving as a volunteer in the battle of Bunker Hill in 1775 and arguing a case in 1778. He was killed by lightning (it is said that he had often expressed a wish that he might die in this way) at Andover, Mass., on May 23, 1783.

Otis's political writings exercised an enormous influence, his pamphlets being among the most effective presentations of the arguments of the colonists against the arbitrary measures of the British ministry. His more important pamphlets were *A Vindication of the Conduct of the House of Representatives of the Province of Massachusetts Bay* (1762); *The Rights of the British Colonies Asserted and Proved* (1764); *A Vindication of the British Colonies against the Aspersions of the Halifax Gentleman in his Letter to a Rhode Island Friend*—a letter known at the time as the "Halifax Libel" (1765); and *Considerations on Behalf of the Colonists in a Letter to a Noble Lord* (1765).

The best biography is that by William Tudor (Boston, 1823); there is a shorter one by Francis Bowen (Boston, 1847). The best account of Otis's characteristics and influence as a writer may be found in M. C. Tyler's *Literary History of the American Revolution* (1897). Consult the notes on the Writs of Assistance by Horace Gray, Jr., in Quincy's *Massachusetts Reports, 1761–1772* (Boston, 1865). *See* also Francis Wilson Sprague, *Birthplace of the Patriot James Otis* (1917).

OTLEY, an urban district in the Ripon parliamentary division of the West Riding of Yorkshire, England, 10 mi. N.W. of Leeds by road.

The population in 1951 was 11,568. Area 4.6 sq.mi. It stands on the Wharfe at the foot of the precipitous Chevin. Southwest of Otley the Guiseley gap affords a route, only 4 mi. long, between the Aire and the Wharfe which is traversed by roads and railways and brings much of the Aire valley within range of Otley markets.

In 937 Aethelstan granted the manor of Otley to the archbishop of York. The town and the church were laid waste in 1069. Otley became an important local centre of the woollen cloth industry, which was introduced late in the 11th century. An annual fair was granted in 1222 and a weekly market in 1248.

The growth of cereals, which was important until the 18th century, was abandoned in favour of pastoral industries for the supply of meat to the dense population on the Yorkshire coal field. Today the prosperity of Otley depends not on its importance as an agricultural centre but on its industries, chief among which are the manufacture of printing machinery, papermaking and worsted spinning and weaving.

OTOLITH: *see* EQUILIBRIUM, ANIMAL.

OTOMACAN, an independent linguistic stock of South American Indians, named from the Otomacas, its best known tribe. The Otomacas lived in south-western Venezuela, along the Orinoco between the Meta and Arauca rivers. In recent times they have spread westward. Described by early writers as one of the most barbarous tribes of the whole Orinoco region, they appear to have been sedentary agriculturalists, cultivating their fields of manioc and maize communally, the produce, with that from hunting and fishing, being divided among all by the chief. They were noted as clay-eaters, even their bread being mixed with it, and made great use of narcotic snuff. They were monogamous, and it is said that they married all young girls to old widowers, and all young men to elderly widows.

See J. Gumilla, *Histoire naturelle, civile et géographique de l'Orénoque* (Avignon, 1758).

OTOMI, an important group of Indians on the central mesa of Mexico. The ancient territory of the Otomi proper comprised the states of Guanajuato and Querétaro, south-western Hidalgo and northern Mexico, extending to the hills overlooking Mexico valley and city. With them are reckoned, on the basis of related speech, the Pame of eastern San Luis Potosi and the Mazahua and Pirinda of western Mexico (state). The Otomian languages are tonal and built up from monosyllabic elements. This analogy to Chinese has led to theories of relationship, generally fantastic. Remote kinship with the Zapotecan group is, however, possible. The Otomi passed as dull boors among the Aztec; they were provincially backward as compared with centres of native culture like Mexico, Tezcoco, Cholula, and possessed no large towns. The nearer ones were all subject to the Aztec. To-day they are peaceful and number about a quarter of a million.

OTRANTO, seaport and archiepiscopal see, Apulia, Italy, in province of Lecce, 29½ mi. S.E. from it by rail, 49 ft. above sea-level. Pop. (1951) 3,400 (commune). It is on the E. coast of the peninsula of ancient Calabria (*q.v.*). The castle was erected by Alfonso of Aragon; the cathedral, consecrated in 1088, has a rose window and side portal of 1481. The interior, a basilica with nave and two aisles, contains a mosaic pavement of 1165. It has a crypt supported by 42 marble columns. The church of S. Pietro has Byzantine frescoes.

Otranto occupies the site of the ancient Hydrus or Hydruntum, a town of Greek origin. In Roman times it was less important than Brundisium as a point of embarkation for the East. It was taken by Robert Guiscard in 1068. In 1480 it was utterly destroyed by the Turkish fleet, and has never since recovered its importance. About 30 mi. S.E. lies the promontory of S. Maria di Leuca (so called since ancient times from its white cliffs), the southeast extremity of Italy, the ancient Promontorium Iapygium or Sallentinum. The district between this promontory and Otranto is thickly populated, and very fertile. It was a supply base in World Wars I and II. The straits are about 40 mi. wide; cables leave here for Valona and Corfu.

OTTAKAR I. (d. 1230), king of Bohemia, was a younger son of King Vladislav II. (d. 1174) and a member of the Premyslide family, hence he is often referred to as Premysl Ottakar I. Recognized as ruler of Bohemia by the emperor Henry VI. in 1192, he was, however, soon overthrown, but in 1196 forced his brother, King Vladislav III., to abandon Bohemia to him and to content himself with Moravia. Ottakar first sought the support of the German king Philip, duke of Swabia, but then went over to his rival Otto of Brunswick. Philip thereupon invaded Bohemia, and Ottakar changed sides once more. Later still, he supported the young king, Frederick II. He united Moravia with Bohemia in 1222, and when he died in 1230 he left to his son, Wenceslaus I., a kingdom united and comparatively peaceable.

OTTAKAR II., or PREMYSL OTTAKAR II. (*c.* 1230–1278), king of Bohemia, was son of King Wenceslaus I.; his maternal grandfather was the German king, Philip, duke of Swabia. In his father's lifetime he ruled Moravia, and in 1251 secured his election as duke of Austria, where he strengthened his position by marrying (Feb. 11, 1252) Margaret (d. 1267), sister of Duke Frederick II., the last of the Babenbergs and widow of the German king, Henry VII. In Sept. 1253 he succeeded his father in Bohemia, and in 1254 concluded peace with Bela IV. of Hungary, who had claimed Styria, advancing the Austrian frontier to the present line. In 1259 he expelled the Hungarians from the rest of Styria, then divorced his wife, married a granddaughter of Bela IV. and secured his investiture (by letter) with Austria and Styria from the German king, Richard Cornwallis.

In 1269 Ottakar II. inherited Carinthia and part of Carniola; and having made good his claim, contested by the Hungarians, in battle, he was the most powerful prince in Germany when an election for the German throne took place in 1273. The electors, however, fearing his power, chose Rudolph of Habsburg, who in 1276 placed Ottakar under the ban, besieged Vienna, and com-

pelled Ottakar to renounce all his possessions except Bohemia and Moravia. (*See* AUSTRIA, EMPIRE OF.) Ottakar was killed at Dürnkrut on the March, Aug. 26, 1278, in an attempt to recover his lands. Clever, strong and handsome, he is a famous figure both in history and in legend, and is the subject of a tragedy by F. Grillparzer, *König Ottokars Glück und Ende.*

See O. Lorenz, *Geschichte, König Ottokars,* ii (Vienna, 1866); F. Palacky, *Geschichte von Böhmen,* vol. i (Prague, 1844).

OTTAVA RIMA, a stanza of eight iambic lines, containing three rhymes, invariably arranged as follows:—*a b a b a b c c.* It is an Italian invention of the 14th century. Giovanni Boccaccio employed it for the *Teseide* (1340) and for the *Filostrato* (about seven years later). These epics gave to ottava rima its classic character. In the succeeding century it was employed by Politian and by Matteo Boiardo for his famous *Orlando Innamorato* (1486). It was Luigi Pulci, however, in the *Morgante Maggiore* (1482), who invented the peculiar mock-heroic, or rather half-serious, half-burlesque, style with which ottava rima has been most commonly identified. The most striking monument in ottava rima in English is *Don Juan* (1819–24). Byron also employed this measure in *The Vision of Judgment* (1822). Meanwhile, Shelley also became attracted by it, and in 1820 translated the *Hymns* of Homer into ottava rima. In the peninsula the form was largely used; *e.g.,* by Juan Boscán Almogaver (1490?–1542), by Alonso de Ercilla y Zúñiga (1533–94) in *La Araucana,* by Luis de Camoens in *Os Lusiadas* (1572) and by Lope de Vega Carpio.

OTTAWA, a city of Carleton county, province of Ontario, and the capital of Canada, on the south bank of the Ottawa river, 101 mi. W. of Montreal and 217 mi. N.E. of Toronto. Pop. (1951) 198,773; greater Ottawa 278,078, including the city of Hull (43,204) and various suburbs.

The city stands for the most part on a cluster of hills, 60 to 155 ft. above the river. It is on the transcontinental lines of both the Canadian National and Canadian Pacific railways, and has direct communication by both systems to Montreal, Toronto and other points in Canada, as well as by the New York Central to New York and elsewhere in the United States.

The site of the city is picturesque. For three miles it follows the high southern bank of the Ottawa from the Chaudière falls, whose mist-crowned cauldron is clearly visible from the summit of Parliament hill, to and beyond the Rideau falls, so named by early French explorers because of their curtainlike appearance. The Rideau, a southern tributary of the Ottawa, once formed the eastern boundary of the city, which, however, in 1950 absorbed a string of suburbs that lie along its eastern banks. The Rideau canal cuts the city in two, the western portion being known as Upper Town and the eastern as Lower Town. For many years the canal divided the two sections of the population, the English occupying Upper Town and the French Lower Town, but a trend toward city-wide population homogeneity began during the World War II years.

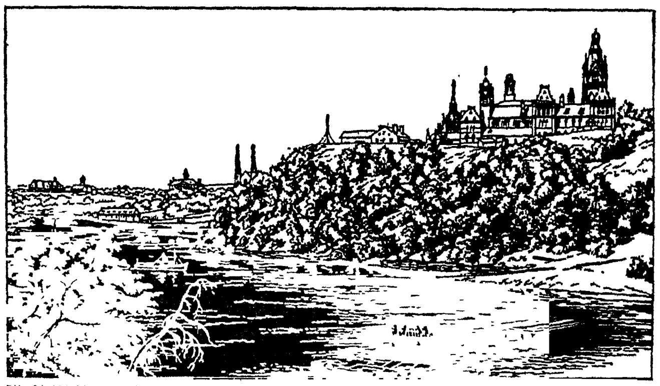
Opposite and a little below the mouth of the Rideau river, the Gatineau flows into the Ottawa from the north. The Ottawa is the scene of large hydroelectric developments, and is an active pulpwood artery for the paper mills in the Hull-Ottawa area. Above the Chaudière falls the river is broken by the Deschenes rapids, and beyond these again it expands into Lake Deschenes. To the north are the Laurentian hills, broken by the picturesque Gatineau valley.

Buildings.—The crowning architectural feature of the city is the splendid group of Gothic buildings on the summit of Parliament hill. The three blocks are on the sides of a great quadrangle, the fourth side being historic Wellington street. The cornerstone of the main building was laid by the prince of Wales in 1860. With the exception of the library, it was destroyed by fire in 1916, and was later rebuilt. It contains the house of commons and the senate chambers. In the 300-ft. tower is a remarkably beautiful war memorial chamber, and above it is hung a carillon of 53 bells. The Langevin block on Wellington across the street from the parliament buildings is used for departmental purposes, and, to meet the increasing needs of the government, a group of wooden buildings was erected on the banks of the Ottawa, west of Parliament hill. Other national institutions with impressive buildings scattered throughout the city are the public archives, royal mint, National Research council, National museum and National Art gallery and Dominion observatory. Other buildings are the public library, University of Ottawa, the collegiate institutes, Normal and Model school, St. Patrick's college, Carleton college and the Roman Catholic and Church of England cathedrals. City charities include a large civic hospital and nurses' home, a general hospital supported by the Roman Catholics and three special hospitals devoted to contagious diseases.

A system of public parks and driveways, partly within and partly without the city, adds very largely to its attractions. These were built and are maintained by the federal district commission. Statues of Queen Victoria, as well as of Sir John Macdonald, Sir Wilfrid Laurier and other Canadian statesmen, stand on Parliament hill. A memorial was erected on Connaught circle, below Parliament hill, in honour of those killed in World War I. Rideau hall, official residence of the governor general, lies on the eastern boundary of the city at the entrance to Rockcliffe park.

History.—The earliest description of the site of Ottawa is that of Samuel de Champlain, in his *Voyages.* In June 1613, on his way up the river, he came to a tributary on the south side, "at the mouth of which is a marvellous fall. For it descends a height of twenty or twenty-five fathoms with such impetuosity that it makes an arch nearly four hundred paces broad. The savages take pleasure in passing under it, not wetting themselves, except from the spray that is thrown off." This was the Rideau falls, but a good deal of allowance must be made for exaggeration in Champlain's account. Continuing up the river, "we passed," he says, "a fall, a league from there, which is half a league broad and has a descent of six or seven fathoms. There are many little islands. The water falls in one place with such force upon a rock that it has hollowed out in course of time a large and deep basin, in which the water has a circular motion and forms large eddies in the middle, so that the savages call it *Asticou,* which signifies boiler. This cataract produces such a noise in this basin that it is heard for more than two leagues." The present name, Chaudière, is the French equivalent of the old Indian name.

For two hundred years and more after Champlain's first visit the Chaudière portage was the main thoroughfare from Montreal



BY COURTESY OF THE CANADIAN NATIONAL RAILWAYS

BARRACK HILL, IN OTTAWA, WITH A PART OF THE PARLIAMENTARY BUILDINGS IN THEIR ORIGINAL STATE. FROM AN OLD PRINT

to the great western fur country; but it was not until 1800 that any permanent settlement was made in the vicinity. In that year Philemon Wright, of Woburn, Mass., built a home for himself at the foot of the portage, on the Quebec side of the river, where the city of Hull now stands; but for some time the precipitous cliffs on the south side seem to have discouraged settlement there. Finally about 1820 one Nicholas Sparks moved over the river and cleared a farm in what is now the heart of Ottawa. Seven years later Col. John By, R.E., was sent out to build a canal from a point below the Chaudière falls to Kingston on Lake Ontario. The canal, completed at a cost of $2,500,000, was never of any great commercial importance; it was never called upon to fulfil its primary object, as a military work to enable gunboats and military supplies to reach the lakes from

Montreal without being exposed to attack along the St. Lawrence frontier. The building of the canal created a fair-sized settlement at its Ottawa end, which came to be known as Bytown. As the lumber trade developed Bytown rapidly increased in wealth and importance. In 1854 it was incorporated as a city, the name being changed to Ottawa; and four years later Queen Victoria selected Ottawa as the capital of the province of Canada. Ottawa was admirably situated for a capital from a political and military point of view; but there is reason to believe that the deciding factor was the pressure exerted by the four other rival claimants, Montreal, Quebec, Toronto and Kingston, any three of which would have fiercely resented the selection of the fourth. The first session of parliament in Ottawa was opened in 1865. The British North America act of 1867 made Ottawa the capital of Canada.

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OTTAWA, a city of Illinois, U.S., 84 mi. S.W. of Chicago, at the confluence of the Illinois and the Fox rivers; the county seat of Lasalle county. It is on the Illinois and Michigan canal and the Illinois waterway, and is served by the Burlington Route and the Rock Island railway. Population in 1950, 16,957.

The city's manufactures (including plate glass, building tile, firebrick and agricultural implements) had a value of more than $20,000,000 in 1950. The mouth of the Fox river was visited early by the French explorers, and Father Louis Hennepin discovered coal there in 1680. On Starved Rock (8 mi. W., on the south bank of the Illinois, in a state park of 900 ac.) Robert de la Salle in 1683 built Fort St. Louis, which was used by fur traders as late as 1718, and in 1770 was the last refuge of a band of Illini, pursued by the Potawatomis and besieged there until they died of starvation. Ottawa was laid out in 1831, incorporated in 1837 and chartered as a city in 1853. On Aug. 21, 1858, it was the scene of the first of the Lincoln-Douglas debates.

OTTAWA, a city of Kansas, U.S., 58 mi. S.W. of Kansas City, on the Marais des Cygnes (or Osage) river, at an altitude of 926 ft.; the county seat of Franklin county. It is on federal highways 50S and 59 and is served by the Missouri Pacific and the Santa Fe railways. Pop. (1950) 10,081 by federal census; (1940) 10,193. Ottawa has a large trade in poultry and dairy products, fruit and other farm produce. Its manufacturing establishments include creameries, flour mills, poultry-packing plants and factories making steel products and chicken coops. It is the seat of Ottawa university (Baptist), established in 1865. Ottawa was in the reservation of the Ottawa Indians until they were moved (1865) to the Indian territory. A mission was established there in 1839. The city was chartered in 1866.

OTTAWA, the largest tributary of the river St. Lawrence; ranking ninth in length among the rivers of Canada, being 696 mi. long. It flows first westward to Lake Timiskaming; thence southeast and east. The principal tributaries on the left bank are the Rouge (115 mi.), North Nation (60), Lièvre (205), Gatineau (240), Coulonge (135), Dumoine (80); and on the right bank, the South Nation (90), Mississippi (105), Madawaska (130) and Petawawa (95). Canals at Ste. Anne, Carillon and Grenville (begun 1825 and completed 1843 to 6 ft.; deepened to 9 ft. by 1886) permit the passage of vessels from Montreal up to the city of Ottawa. At Ottawa the river is connected with Lake Ontario by the Rideau canal. The Ottawa above Chaudière falls at Ottawa city is used only for floating pulpwood logs and for generating electricity. Above Lake Timiskaming there are four major dams for storage reservoirs having a total drainage area of 28,900 sq.mi.; below Timiskaming there are large power developments at La Cave, Des Joachims, Bryson, Chenaux, Chats and Chaudière, generating more than 1,000,000 h.p.

The Ottawa was first explored by Samuel de Champlain in 1613. Champlain describes many of its tributaries, the Chaudière and Rideau falls, the Long Sault, Chats and other rapids, as well as the character of the river and its banks, with minuteness and reasonable accuracy. The Long Sault rapids on the Ottawa, opposite the Grenville canal and about midway between Montreal and the capital, were the scene of one of the noblest exploits in Canadian history, when in 1661 the young sieur des Ormeaux with 16 comrades and a handful of Indian allies deliberately gave their lives to save New France from an invasion of the Iroquois. They intercepted the war party at the Long Sault, and for nearly a week held them at bay. When finally the last Frenchman fell under a shower of arrows, the Iroquois were thoroughly disheartened and returned crestfallen to their own country. For 150 years thereafter the Ottawa was the great canoe highway from Montreal to the west for explorers and fur traders. Throughout the 19th century the Ottawa was the thoroughfare of lumbermen, whose immense rafts went from its upper waters to Montreal and Quebec. Bustling steamboat transportation of the 1886–1914 period finally succumbed to automobile competition, and the river and canals thereafter were used only by pleasure crafts.

OTTER, the name of an aquatic carnivore inhabiting Europe and Asia. The otter (*Lutra lutra*) has an elongated body, short limbs terminating in broad webbed feet, the toes of which are armed with claws, a broad, flat head and a tail about half the length of the body. The muzzle is broad, the whiskers thick, the eyes small and the ears short and rounded. The fur consists of a short, soft, gray underfur, interspersed with longer, stiffer hairs, the points of which are bright brown. The average length is about 3½ ft., the weight of a male 18 to 24 lb., the female being about 4 lb. less. The otter lives on fish and inhabits streams, rivers, lakes and, in some localities, the sea. The female produces one to three young in March or April, bringing them up in a nest of grass in a hollow in a riverbank or under the roots of an overhanging tree. Otter hunting, with packs of special hounds, is a pastime in parts of England.

In North America, *L. lutra* is replaced by the larger *L. canadensis;* and other species with similar habits are found in South America, Africa and southern Asia.

BY COURTESY OF THE N.Y ZOOLOGICAL SOCIETY

OTTERS (LUTRA LUTRA), WIDELY DISTRIBUTED THROUGH EUROPE AND ASIA

The sea otter (*Enhydra lutris*) is confined to the North Pacific. It is larger and more heavily built than the European otter and possesses a very valuable coat of fur, because of which it has been almost exterminated. Sea otters feed on shellfish. Otters form a section of the family Mustelidae (*see* CARNIVORA).

See Elliott Coues, *Monograph of North American Fur-Bearing Animals.*

OTTERY ST. MARY, a market town of Devonshire, Eng., 12 mi. N.E. of Exeter on the Southern Region railway route. Pop. of urban district (1951) 4,015. Area 15.6 sq.mi. The parish church is Early English, with Decorated and Perpendicular additions. It has transeptal towers, imitated from Exeter cathedral. The manor of Ottery belonged to the abbey of Rouen in the time of Edward the Confessor. The church was dedicated in 1260 by Walter Bronescombe, bishop of Exeter, and enlarged by Bishop John Grandisson, *c.* 1335. The town has a large agricultural trade, and Honiton lace is a home industry. It was the birthplace of S. T. Coleridge.

OTTO I (912–973), THE GREAT, Roman emperor, eldest son of King Henry I the Fowler by his second wife Matilda, was born on Nov. 23, 912. Little is known of his early years, but he probably shared in some of his father's campaigns. In 929 he married Edith, daughter of Edward the Elder, king of the English, and sister of the reigning King Aethelstan. In 936 Otto was chosen German king and crowned by Hildebert, archbishop of Mainz. Otto soon showed his intention of breaking with the policy of his father, who

had been content with a nominal superiority over the duchies; in 937 he punished Eberhard, duke of Franconia, for an alleged infringement of the royal authority; and in 938 deposed Eberhard, duke of Bavaria. Trouble soon arose in Saxony, probably from his refusal to give certain lands to his half-brother, Thankmar, who, although the king's senior, had been passed over in the succession as illegitimate. Thankmar, aided by an influential Saxon noble named Wichmann, and by Eberhard of Franconia, seized the fortress of Eresburg and took Otto's brother Henry prisoner; but soon afterwards he was defeated by the king and killed whilst taking sanctuary. The other conspirators were pardoned, but in 939 a fresh revolt broke out under the leadership of Henry, and Giselbert, duke of Lorraine. Otto gained a victory near Xanten, which was followed by the surrender of the fortresses held by his brother's adherents in Saxony, but the rebels, joined by Eberhard of Franconia and Archbishop Frederick of Mainz, continued the struggle, and Giselbert of Lorraine transferred his allegiance to Louis IV., king of France. Otto's precarious position was saved by a victory near Andernach when Eberhard was killed, and Giselbert drowned in the subsequent flight. Henry took refuge with Louis of France, but was soon restored to favour and entrusted with the duchy of Lorraine, where, however, he was unable to restore order. Otto therefore crossed the Rhine and deprived his brother of authority. Henry then became involved in a plot to murder the king, which was discovered in time, and the good offices of his mother secured him a pardon at Christmas 941.

The deaths of Giselbert of Lorraine and of Eberhard of Franconia, quickly followed by those of two other dukes, enabled Otto to unite the stem-duchies more closely with the royal house. In 944 Lorraine was given to Conrad, surnamed the Red, who in 947 married the king's daughter Liutgard; Franconia was retained by Otto in his own hands; Henry married a daughter of Arnulf, duke of Bavaria, and received that duchy in 947; and Swabia came in 949 to the king's son Ludolf, who had married Ida, a daughter of the late duke, Hermann. During these years the tribes living between the Elbe and the Oder were made tributary, bishoprics were founded in this district, and in 950 the king himself marched against the Bohemians and reduced them to dependence. Strife between Otto and Louis IV. of France had arisen when the French king sought to obtain authority over Lorraine and aided the German rebels in 939; but after the German king had undertaken an expedition into France, peace was made in 942. Afterwards, when Louis became a prisoner in the hands of his powerful vassal Hugh the Great, duke of France, Otto attacked the duke, who, like the king, was his brother-in-law, captured Reims, and negotiated a peace between the two princes; and in subsequent struggles between them his authority was several times invoked.

In 945 Berengar I., margrave of Ivrea, left the court of Otto and returned to Italy, where he soon obtained a mastery over the country. After the death in 950 of Lothair, king of Italy, Berengar sought the hand of his widow Adelaide for his son Adalbert; and Henry of Bavaria and Ludolf of Swabia had already been meddling independently of each other in the affairs of northern Italy. In response to an appeal from Adelaide, Otto crossed the Alps in 951. He assumed the title of king of the Lombards, and having been a widower since 946, married Adelaide and negotiated with Pope Agapetus II. about his reception in Rome. The influence of Alberic, prince and senator of the Romans, prevented the pope returning a favourable answer to the king's request. But when Otto returned to Germany in 952 he was followed by Berengar, who did homage for Italy at Augsburg. The chief advisers of Otto at this time were his wife and his brother Henry. Henry's influence seems to have been resented by Ludolf, who in 946 had been formally designated as his father's successor. When Adelaide bore a son, and a report gained currency that Otto intended to make this child his heir, Ludolf rose in revolt and was joined by Conrad of Lorraine and Frederick of Mainz. Otto fell into the power of the rebels at Mainz and was compelled to agree to demands made by them, which, however, he promptly revoked on his return to Saxony. Ludolf and Conrad were declared deposed, and in 953 war broke out in Lorraine and Swabia, and afterwards in Saxony and Bavaria. Otto was finally victorious and with the capture of Regensburg in 955 the rising ended. Conrad and Ludolf retained their estates, but their duchies were not restored to them. Meanwhile the Magyars had renewed their ravages and were attacking Augsburg. Otto marched against them, and in a battle fought on the Lechfeld Aug. 10, 955, the king's troops gained a victory which freed Germany from these invaders; while in the same year Otto defeated the Slavs ravaging the Saxon frontier.

About this time the king seems to have perceived the necessity of ruling in closer union with the church. Lands and privileges were granted to prelates, additional bishoprics were founded, and some years later Magdeburg was made the seat of an archbishop. In 960 Otto was invited to come to Italy by Pope John XII., who was hard pressed by Berengar, and he began to make preparations for the journey. As Ludolf had died in 957 and Otto, his only son by Adelaide, had been chosen king at Worms, the government was entrusted to Bruno of Cologne, and Archbishop William of Mainz, a natural son of the king. Reaching Pavia at Christmas 961, the king promised to defend and respect the church. He then proceeded to Rome, where he was crowned emperor on Feb. 2, 962. After the ceremony he confirmed the rights and privileges which had been conferred on the papacy, while the Romans promised obedience, and Pope John took an oath of fidelity to the emperor. But as he did not long observe his oath he was deposed at a synod held in St. Peter's, after Otto had compelled the Romans to swear they would elect no pope without the imperial consent; and a nominee of the emperor, who took the name of Leo VIII., was chosen in his stead. A pestilence drove Otto to Germany in 965, and finding the Romans again in arms on his return in 966, he allowed his soldiers to sack the city, and severely punished the leaders of the rebellion. His next move was against the Greeks and Saracens of southern Italy, but seeking to attain his objects by negotiation, sent Liudprand, bishop of Cremona, to the eastern emperor Nicephorus II. to arrange for a marriage treaty between the two empires. Nicephorus refused to admit the validity of Otto's title, and the bishop was roughly repulsed; but the succeeding emperor, John Zimisces, was more reasonable, and Theophano, daughter of the emperor Romanus II., was married to the younger Otto in 972. The same year witnessed the restoration of peace in Italy and the return of the emperor to Germany, where he received the homage of the rulers of Poland, Bohemia and Denmark; but he died suddenly at Memleben on May 7, 973.

The empire was less universal under Otto, its restorer, than Charlemagne, but what it lacked in splendour it gained in stability. His object was not to make the state religious but the church political, and the clergy must first be officials of the king, and secondly members of an ecclesiastical order. He shared the piety and superstition of the age, and did much for the spread of Christianity. Although himself a stranger to letters he welcomed scholars to his court and eagerly seconded the efforts of his brother Bruno to encourage learning; and while he neither feared nor shirked battle, he was always ready to secure his ends by peace.

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OTTO II. (955–983), Roman emperor, was the son of the emperor Otto the Great, by his second wife Adelaide. He was chosen German king at Worms in 961 and on Dec. 25, 967, was crowned joint emperor at Rome by Pope John XIII. On

April 14, 972, he married Theophano, daughter of the eastern emperor Romanus II., and after sharing in various campaigns in Italy, returned to Germany and became sole emperor on the death of his father in May 973. After suppressing a rising in Lorraine, difficulties arose in southern Germany, probably owing to Otto's refusal to grant the duchy of Swabia to Henry II., the Quarrelsome, duke of Bavaria. The first conspiracy was easily suppressed, and in 974 an attempt on the part of Harold III., king of the Danes, to throw off the German yoke was also successfully resisted; but an expedition against the Bohemians led by the king in person in 975 was a partial failure owing to the outbreak of further trouble in Bavaria. In 976 Otto deposed Duke Henry, restored order for the second time in Lorraine, and made another expedition into Bohemia in 977, when King Boleslaus II. promised to return to his earlier allegiance. Having crushed an attempt made by Henry to regain Bavaria, Otto was suddenly attacked by Lothair, king of France, who held Aix in his possession for a few days; but when the emperor retaliated by invading France he met with little resistance. He was, however, compelled by sickness among his troops to raise the siege of Paris, and on the return journey the rearguard of his army was destroyed and the baggage seized by the French. An expedition against the Poles was followed by peace with France, when Lothair renounced Lorraine.

The emperor then prepared for a journey to Italy. In Rome, where he restored Pope Benedict VII., he held a splendid court, attended by princes and nobles from all parts of western Europe. He was next required to punish inroads of the Saracens on the Italian mainland, and in September 981 he marched into Apulia, where he met at first with considerable success; but an alliance between the Arabs and the Eastern Empire, whose hostility had been provoked by the invasion of Apulia, resulted in a severe defeat for Otto's troops near Stilo in July 982. Without revealing his identity, the emperor escaped on a Greek vessel to Rossano. At a diet held at Verona, largely attended by German and Italian princes, a fresh campaign was arranged against the Saracens. Proceeding to Rome, Otto secured the election of Peter of Pavia as Pope John XIV. Just as the news reached him of a general rising of the tribes on the eastern frontier of Germany, he died in his palace in Rome on Dec. 7, 983.

See *Die Urkunden des Kaisers Otto II.*, ed. Th. von Sickel, in the *Monumenta Germaniae historica. Diplomata* (Hanover, 1879); L. von Ranke, *Weltgeschichte*, Part vii. (Leipzig, 1886); W. von Giesebrecht, *Geschichte der deutschen Kaiserzeit* (Leipzig, 1881–90); and *Jahrbücher des deutschen Reichs unter Kaiser Otto II.* (1837–40); H. Detmer, *Otto II. bis zum Tode seines Vaters* (Leipzig, 1878); J. Moltmann, *Theophano die Gemahlin Ottos II. in ihrer Bedeutung für die Politik Ottos I. und Ottos II.* (Göttingen, 1878); and A. Matthaei, *Die Händel Ottos II. mit Lothar von Frankreich* (Halle, 1882).

OTTO III. (980–1002), Roman emperor, son of the emperor Otto II. and Theophano, daughter of the eastern emperor Romanus II., was born in July 980, chosen as his father's successor at Verona in June 983 and crowned German king at Aix-la-Chapelle on Dec. 25. Otto II. had died a few days before this ceremony, but the news did not reach Germany until after the coronation. Early in 984 the king was seized by Henry II., the Quarrelsome, the deposed duke of Bavaria, who claimed the regency as a member of the reigning house, and probably entertained the idea of obtaining the kingly dignity himself. A strong opposition was quickly aroused, and when Theophano and Adelaide, widow of the emperor Otto the Great, appeared in Germany, Henry was compelled to hand over the young king to his mother. Otto's abilities were carefully cultivated by Bernward, afterwards bishop of Hildesheim, and by Gerbert of Aurillac, archbishop of Reims, and he was called "the wonder of the world." The government of Germany during his minority was in the hands of Theophano, and after her death in June 991 passed to a council in which the chief influence was exercised by Adelaide and Willigis, archbishop of Mainz.

Having accompanied his troops in expeditions against the Bohemians and the Wends, Otto was declared of age in 995. In 996 he crossed the Alps and was recognized as king of the Lombards at Pavia. Before he reached Rome, Pope John XV., who had invited him to Italy, had died, whereupon he raised his own cousin Bruno, son of Otto duke of Carinthia, to the papal chair as Pope Gregory V., and by this pontiff Otto was crowned emperor on May 21, 996. On his return to Germany, the emperor learned that Gregory had been driven from Rome, which was again in the power of John Crescentius, patrician of the Romans, and that a new pope, John XVI., had been elected. Leaving his aunt, Matilda, abbess of Quedlinburg, as regent of Germany, Otto, in Feb. 998, led Gregory back to Rome, took the castle of St. Angelo by storm and put Crescentius to death. A visit to southern Italy, where many of the princes did homage to the emperor, was cut short by the death of the pope, to whose chair Otto then appointed his former tutor Gerbert, who took the name of Sylvester II.

In the palace which he built on the Aventine, Otto sought to surround himself with the splendour and ceremonial of the older emperors of Rome, and dreamed of making Rome once more the centre of a universal empire. Many names and customs were introduced into his court from that of Constantinople; he proposed to restore the Roman senate and consulate, revived the office of patrician, called himself "consul of the Roman senate and people" and issued a seal with the inscription, "restoration of the Roman empire." Passing from pride to humility he added "servant of the apostle," and "servant of Jesus Christ" to the imperial title, spent a fortnight in prayer in the grotto of St. Clement and did penance in various Italian monasteries.

Leaving Italy in the summer preceding the year 1000, when it was popularly believed that the end of the world was to come, Otto made a pilgrimage to the tomb of his old friend Adalbert, bishop of Prague, at Gnesen, and raised the city to the dignity of an archbishopric. He then went to Aix, and opened the tomb of Charlemagne, where, according to a legendary tale, he found the body of the great emperor sitting upright upon a throne, wearing the crown and holding the sceptre.

On his return to Rome, trouble arose between Otto and the citizens, and for three days the emperor was besieged in his palace. After a temporary peace, he fled to the monastery of Classe near Ravenna. Troops were collected, but whilst conducting a campaign against the Romans, Otto died at Paterno near Viterbo on Jan. 23, 1002, and was buried at Aix-la-Chapelle.

See Thangmar, *Vita Bernwardi episcopi Hildesheimensis* in the *Monumenta Germaniae historica. Scriptores*, Band iv. (Hanover, and Berlin, 1826 fol.); *Lettres de Gerbert*, ed. J. Havet (1889); *Die Urkunden Kaisers Ottos III.*, ed. Th. von Sickel in the *Monumenta Germaniae historica. Diplomata* (Hanover, 1879); R. Wilmans, *Jahrbücher des deutschen Reichs unter Kaiser Otto III.* (1837–40); P. Kehr, *Die Urkunden Otto III.* (Innsbruck, 1890).

OTTO IV. (*c.* 1182–1218), Roman emperor, second son of Henry the Lion, duke of Saxony, and Matilda, daughter of Henry II., king of England, was most probably born at Argenton in central France. His father died when he was still young, and he was educated at the court of his uncle Richard I., king of England, under whose leadership he gained valuable experience in war, being appointed duke of Aquitaine, count of Poitou and earl of Yorkshire. When the emperor Henry VI. died in September 1197, some of the princes under the leadership of Adolph, archbishop of Cologne, were anxious to find a rival to Philip, duke of Swabia, who had been elected German king. After some delay their choice fell upon Otto, who was chosen king at Cologne on June 9, 1198. Hostilities broke out at once, and Otto, after a series of defeats, was driven to Brunswick. Preparations were made to drive him from here, when he was saved by the murder of Philip in June 1208. Many of the supporters of Philip now made overtures to Otto, and an attempt to set up Henry I., duke of Brabant, having failed, Otto submitted to a fresh election and was chosen German king at Frankfort on Nov. 11, 1208, in the presence of a large gathering of princes. A general reconciliation followed, which was assisted by the betrothal of Otto to Philip's eldest daughter Beatrix, but as she was only ten years old, the marriage was deferred until July 22, 1212. The pope, who had previously recognized the victorious Philip, hastened to return to the side of Otto; large concessions were made to the church.

In August 1209 the king set out for Italy. Meeting with no opposition, he was received at Viterbo by Innocent, but refused the papal demand that he should concede to the church all the territories which, previous to 1197, had been in dispute between

the Empire and the Papacy, consenting, however, not to claim supremacy over Sicily. He was crowned emperor at Rome on Oct. 4, 1209, a ceremony which was followed by fighting between the Romans and the German soldiers. The pope then requested the emperor to leave Roman territory; but he remained near Rome for some days, demanding satisfaction for the losses suffered by his troops. The breach with Innocent soon widened, and in violation of the treaty made with the pope Otto attempted to recover for the Empire all the property which Innocent had annexed to the Church, and rewarded his supporters with large estates in the disputed territories.

Having occupied Tuscany he marched into Apulia, part of the kingdom of Frederick of Hohenstaufen, afterwards the emperor Frederick II., and on Nov. 18, 1210, was excommunicated by the pope. Regardless of this sentence Otto completed the conquest of southern Italy, but the efforts of Innocent had succeeded in arousing considerable opposition in Germany, where the rebels were also supported by Philip Augustus, king of France. A number of princes assembled at Nuremberg declared Otto deposed, and invited Frederick to fill the vacant throne. Returning to Germany in March 1212, Otto made some headway against his enemies until the arrival of Frederick towards the close of the year. The death of his wife in August 1212 had weakened his hold on the southern duchies, and he was soon confined to the district of the lower Rhine, although supported by money from his uncle King John of England. The final blow to his fortunes came when he was decisively defeated by the French at Bouvines in July 1214. He escaped with difficulty from the fight and took refuge in Cologne. His former supporters hastened to recognize Frederick; and in 1216 he left Cologne for Brunswick, which he had received in 1202 by arrangement with his elder brother Henry. The conquest of Hamburg by the Danes, and the death of John of England, were further blows to his cause. On May 19, 1218, he died at the Harzburg after being loosed from the ban by a Cistercian monk, and was buried in the church of St. Blasius at Brunswick. He left no children.

See *Regesta imperii V.*, ed. J. Ficker (Innsbruck, 1881); L. von Ranke, *Weltgeschichte*, Part viii. (Leipzig, 1887–88); W. von Giesebrecht, *Geschichte der deutschen Kaiserzeit*, Band v. (Leipzig, 1888); O. Abel, *Kaiser Otto IV. und König Friedrich II.* (1856); E. Winkelmann, *Philipp von Schwaben und Otto IV. von Braunschweig* (Leipzig, 1873–78); G. Langerfeldt, *Kaiser Otto der Vierte* (Hanover, 1872); R. Schwemer, *Innocenz III. und die deutsche Kirche während des Thronstreites* (Strassburg, 1882); and A. Luchaire, *Innocent III., la papauté et l'empire* (1906); and *Innocent III., la question d'Orient* (1906).

OTTO, king of Greece (1815–1867), second son of Louis I., king of Bavaria, and his wife Teresa of Saxe-Altenburg, was born at Salzburg on June 1, 1815, and was educated at Munich. In 1832 he was chosen by the conference of London to occupy the newly-erected throne of Greece, and on Feb. 6, 1833, he landed at Nauplia, then the capital of independent Greece. Otto, who was not yet eighteen, was accompanied by a council of regency composed of Bavarians under the presidency of Count Josef Ludwig von Armansperg (1787–1853). In 1835 Otto came of age, but, on the advice of his father and under pressure of Great Britain and of the house of Rothschild, who all believed that a capable finance minister was the supreme need of Greece, he retained Armansperg as chancellor of state. The Greeks were more heavily taxed than under Turkish rule; they had exchanged government by the sword, which they understood, for government by official regulations, which they hated; they had escaped from the sovereignty of the Mussulman to fall under that of a devout Catholic, to them a heretic. Otto was well intentioned, honest and inspired with a genuine affection for his adopted country; but it needed more than mere amiable qualities to reconcile the Greeks to his rule.

In 1837 Otto married Princess Amalie of Oldenburg, who made herself unpopular by interfering in the government. Meanwhile Armansperg had been dismissed by the king, but a Greek minister was not put in his place, and the granting of a constitution was postponed. The attempts of Otto to conciliate Greek sentiment by efforts to enlarge the frontiers of his kingdom, *e.g.*, by the suggested acquisition of Crete in 1841, only succeeded in embroiling him with the powers. His power rested wholly on Bavarian bayonets; and when, in 1843, the last of the German troops were withdrawn, he was forced by the outbreak of a revolutionary movement in Athens to grant a constitution and to appoint a ministry of native Greeks.

For the British blockade of the Peiraeus and Greek intervention in the Crimean War *see* GREECE: *History*. Otto's position in Greece became untenable. In 1861 a student named Drusios attempted to murder the queen, and was hailed by the populace as a modern Harmodius. In October 1862 the troops in Acarnania under General Theodore Srivas declared for the king's deposition; those in Athens followed suit; a provisional government was set up and summoned a national convention. The king and queen, who were at sea, took refuge on a British warship, and returned to Bavaria, where, on July 26, 1867, Otto died.

See E. A. Thouvenel, *La Grèce du roi Othon* (Paris, 1890); G. L. von Maurer, *Das griechische Volk*, etc. (1836); C. W. P. Mendelssohn-Bartholdy, "Die Verwaltung König Ottos von Griechenland und sein Sturz" (in *Preuss. Jahrbücher*, iv. 365); K. T. v. Heigel, *Ludwig I., König von Baiern*, pp. 149 *et seq.* (Leipzig, 1872); H. H. Parish, *The Diplomatic History of the Monarchy of Greece from the Year 1830* (London, 1838).

OTTO OF FREISING (1114?–1158), German bishop and chronicler, was the fifth son of Leopold III., margrave of Austria, by his wife Agnes, daughter of the emperor Henry IV. By her first husband, Frederick I. of Hohenstaufen, duke of Swabia, Agnes was the mother of the German king Conrad III., and grandmother of the emperor Frederick I.; and Otto was thus related to the most powerful families in Germany. He studied in Paris, and became abbot of the Cistercian monastery of Morimond in Burgundy about 1136, soon afterwards being elected bishop of Freising. In 1147 he took part in the disastrous crusade of Conrad III., returning to Bavaria in 1148 or 1149. He enjoyed the favour of Conrad's successor, Frederick I.; was probably instrumental in settling the dispute over the duchy of Bavaria in 1156; was present at the famous diet at Besancon in 1157, and died at Morimond on Sept. 22, 1158.

Otto wrote a *Chronicon*, sometimes called *De duabus civitatibus*, an historical and philosophical work in eight books, which follows to some extent Augustine and Orosius. It goes down to 1146, and from this date until 1209 has been continued by Otto, abbot of St. Blasius (d. 1223). Of the *Gesta Friderici imperatoris* the first two books were written by Otto, and the remaining two probably by his pupil Ragewin, or Rahewin. First printed by John Cuspinian at Strasbourg in 1515, Otto's writings are now issued in the *Monumenta Germaniae historica*, Band xx. (Hanover, 1868); German trans. by H. Kohl (Leipzig, 1881–86). The *Gesta Friderici* has been published separately with introduction by G. Waitz.

See J. Hashagen, *Otto von Freising als Geschichtsphilosoph und Kirchenpolitiker* (Leipzig, 1900); J. Schmidlin, *Die geschichtsphilosophische und kirchenpolitische Weltanschauung Otto von Freising* (Freiburg i./B., 1906); A. Hofmeister, "Studien über O. v. Freising" in *Gesellschaft für ältere deutsche Geschichtskunde* (Hanover, 1911); A. Potthast, *Bibliotheca historica* (1896).

OTTO OF NORDHEIM (d. 1083), duke of Bavaria, belonged to the rich and influential Saxon family of the counts of Nordheim, and received the duchy of Bavaria from Agnes, widow of the emperor Henry III., in 1061. In 1062 he assisted Anno, archbishop of Cologne, to seize the German king, Henry IV.; led a successful expedition into Hungary in 1063; and took a prominent part in the government during the king's minority. In 1064 he went to Italy to settle a papal schism, secured the banishment from court of Adalbert, archbishop of Bremen, and crossed the Alps in the royal interests on two other occasions. In 1070 Otto was accused of being privy to a plot to murder the king, and was required to submit to the ordeal of battle with his accuser. The duke asked for a safe-conduct to and from the place of meeting, and when this was refused he declined to appear, and was consequently deprived of Bavaria, while his Saxon estates were plundered. He obtained no support in Bavaria, but raised an army among the Saxons and carried on a campaign of plunder against Henry until 1071, when he submitted; in the following year he received back

his private estates. When the Saxon revolt broke out in 1073 Otto is represented by Bruno, the author of *De bello Saxonico*, as delivering an inspiring speech to the assembled Saxons at Wormsleben, after which he took command of the insurgents. By the peace of Gerstungen in 1074 Bavaria was restored to him; he shared in the Saxon rising of 1075, after which he was again pardoned and made administrator of Saxony. After the excommunication of Henry IV. in 1076 Otto attempted to mediate between Henry and the Saxons; but when these efforts failed he again placed himself at their head. He assented to the election of Rudolph, count of Rheinfelden, as German king, when his restoration to Bavaria was assured, and by his skill and bravery inflicted defeats on Henry's forces at Mellrichstadt, Flarchheim and Hohenmölsen. He remained in arms against the king until his death on Jan. 11, 1083. By his wife Richenza, widow of Hermann, count of Werla, he left six children.

See H. Mehmel, *Otto von Nordheim, Herzog von Bayern* (Göttingen, 1870); E. Neumann, *De Ottone de Nordheim* (Breslau, 1871); and A. Vogeler, *Otto von Nordheim* (Göttingen, 1880).

OTTOMAN BANK. The establishment of the "Imperial Ottoman Bank" was authorized by *Firman* in 1863 and effected by a Convention between the Turkish Government and a banking consortium of the English and French founders. Its function then was to act as the State Bank of the Turkish Empire. It was granted the exclusive right of note issue, but this has since been transferred to the Central Bank of the Republic.

In 1925 the concession under which the bank works was extended, with certain modifications, for ten years. At the same time the title "Imperial" was dropped, and the institution is now known as the "Ottoman Bank." Subsequently a further extension was made to 1952. Its legal domicile is Istanbul; the directing committees reside and meet in London and Paris, in which cities the bank has important offices. It has also a branch at Manchester and branches at Marseilles and Nice. In addition the bank has branches in Turkey (27), Egypt (8), Cyprus (6), 'Iraq (3), Palestine (5), Greece (1), Iran (2), and Transjordan (1). A subsidiary institution, the Banque de Syrie et du Liban, has about 15 branches throughout Syria. The Ottoman Bank is actively interested in the Banque Franco-Serbe, The Bank of Rumania Ltd., and the British-French Discount Bank Ltd. The capital of the bank is £10,000,000, of which half is paid up, the reserve is £1,250,000. The Ottoman Bank maintains its character as an Anglo-French institution. (C. E. L. C.; X.)

OTTOMAN EMPIRE, the empire founded by Osman (1288–1320), which lasted six centuries and a half, and fell before the democratic movement inaugurated at Angora in 1919 by Mustafa Kemal Pasha. (*See* MUSTAFA KEMAL ATATÜRK; TURKEY.)

OTTRELITE (from Ottrez, Belgium, the original locality), in mineralogy, a member of a group of closely related minerals with the general composition H_2O. RO. Al_2O_3. SiO_2, in which RO is dominantly FeO, but is often in part represented by a content of MgO or MnO. On account of its petrographic importance the term ottrelite is often used as the group name for this series of minerals, though the name clintonite is also in use. The chief members are chloritoid (H_2 Fe Al_2 SiO_7), sismondine (H_2 [Fe, Mg] Al_2SiO_7) in which the magnesia rises to 7%, and ottrelite the manganiferous variety (H_2[FeMn] Al_2SiO_7) in which the MnO content may rise to 8%. They are grey, green or black micaceous minerals, but in distinction from the "elastic" micas and "flexible" chlorites they are often referred to as the "brittle micas" on account of the brittleness of their laminae. Like the micas and chlorites they possess monoclinic symmetry and a perfect cleavage parallel to the flat surface (001) of the plates. Their superior hardness (H=6·5) readily distinguishes them from both these groups of minerals. Multiple twinning on the mica law is exceedingly common, and a zonal structure (often of hour-glass type) is often apparent. The ottrelite group of minerals is confined to metamorphic rocks—particularly those developed in regional metamorphism—in slates, phyllites and schists. Noteworthy occurrences of this mineral are the slates of the Ardennes, of Tintagel (Cornwall) and in the Mesozoic and Permian schists of the Swiss and Italian Alps.

The minerals margarite, xanthophyllite and kossmatite show some relations with the ottrelite group of minerals. They are distinguished by an inferior hardness and contain calcium as an essential constituent. Margarite (H_2Ca Al_4Si_2 O_{12}) occurs in white pearly scales associated with corundum and is a common mineral of emery deposits. Xanthophyllite occurs in talc-chlorite schists at Slatoust in the Urals and in altered limestone at Riverside, California, while kossmatite is a recently described lime-rich mineral (H=2·5) occurring in the dolomite marbles of West Macedonia. (C. E. T.)

OTTUMWA, a city of southeastern Iowa, U.S., on the Des Moines river, at an altitude of 650 ft.; the county seat of Wapello county. It is on federal highways 34 and 63, and is served by the Burlington Route, the Chicago, Milwaukee, St. Paul and Pacific, the Rock Island and the Wabash railways. Pop., 1950 federal census, 33,631. The city is built on a series of terraces rising from the river. It is in the bituminous coal fields of Iowa, at the heart of the corn and meat producing area of the middle west. Meat products, serum, agricultural implements, boilers, car loaders, hoisting engines, chicken coops, lawn mowers, mine equipment and supplies and carpenters' squares are among the leading manufactures. The aggregate factory product in 1950 was valued at $150,000,000.

Ottumwa was founded in 1843, incorporated as a town in 1851, and chartered as a city in 1857. The name is a modification of an Indian word meaning "rippling water."

OTUQUIAN, a tribe or small group of tribes of South American Indians, constituting an independent linguistic stock, so called from the Otuquis, the most important tribe. The group, which was nearly extinct in the early part of the 19th century, lived in north-eastern Bolivia in the eastern portion of the province of Chiquitos, on the Otuquis river and between it and the Paraguay, between 17° and 18° S. lat. At that time the remnant of the people were located at the mission of Santa Corazon de Chiquitos, and had already lost their original culture.

See G. L. Kriegk, *Das Land Otuquis in Bolivia* (Frankfurt, 1838); G. de Crequi-Montfort and P. Rivet, "Le groupe Otuke" (*J. Soc. Americanistes de Paris* [n.s.] vol. ix., pp. 317–337); *ibid.*, "Les affinités des dialectes Otuke" (*ibid.* vol. x., pp. 369–377).

OTWAY, THOMAS (1652–1685), English dramatist, was born at Trotten, near Midhurst, Sussex, on March 3, 1652. His father, Humphrey Otway, was at that time curate of Trotton, but Otway's childhood was spent at Woolbeding, a parish 3 m. distant, of which his father had become rector. He was educated at Winchester College, and in 1669 entered Christ Church, Oxford, as a commoner, but left the university without a degree in the autumn of 1672. In 1675 Thomas Betterton produced at Dorset Garden theatre Otway's first drama, *Alcibiades*, which was printed in the same year. It is a poor tragedy saved from absolute failure by the actors. He made a great advance on this first work in *Don Carlos, Prince of Spain* (licensed June 15, 1676; an undated edition probably belongs to the same year). In it the two characters familiar throughout his plays make their appearance. Don Carlos is the impetuous, unstable youth, who seems to be drawn from Otway himself, while the queen's part is the gentle pathetic character repeated in his more celebrated heroines, Monimia and Belvidera. In 1677 Betterton produced two adaptations from the French by Otway, *Titus and Berenice* (from Racine's *Bérénice*), and the *Cheats of Scapin* (from Molière's *Fourberies de Scapin*). These were printed together, with a dedication to Lord Rochester. In 1678 he produced an original comedy, *Friendship in Fashion*, popular at the moment, though it was hissed off the stage for its gross indecency when it was revived at Drury Lane in 1749.

Meanwhile he had conceived an overwhelming passion for Mrs. Barry, who filled many of the leading parts in his plays. Six of his letters to her survive, the last of them referring to a broken appointment in the Mall. In 1678, driven to despair by her, Otway obtained a commission through Charles, earl of Plymouth, a natural son of Charles II., in a regiment serving in the Netherlands. The English troops were disbanded in 1679, but

were left to find their way home as best they could. They were also paid with depreciated paper, and Otway arrived in London late in the year, ragged and dirty, a circumstance utilized by Rochester in his "Sessions of the Poets," which contains a scurrilous attack on his former protégé.

Early in the next year (February 1680) was produced at Dorset Garden the first of Otway's two tragic masterpieces, *The Orphan, or The Unhappy Marriage,* Mrs. Barry playing the part of Monimia. Written in blank verse, which shows a study of Shakespeare, its success was due to the tragic pathos, of which Otway was a master, in the characters of Castalio and Monimia. *The History and Fall of Caius Marius,* produced in the same year, and printed in 1692, is a curious grafting of Shakespeare's *Romeo and Juliet* on the story of Marius as related in Plutarch's *Lives.* In 1680 Otway also published *The Poet's Complaint of his Muse, or A Satyr against Libells,* in which he retaliated on his literary enemies. An indifferent comedy, *The Soldier's Fortune* (1681), was followed in February 1682 by *Venice Preserved, or A Plot Discover'd.* The story is founded on the *Histoire de la conjuration des Espagnols contre la Venise en 1618,* by the Abbé de Saint-Réal, but Otway modified the story considerably. The character of Belvidera is his own, and the leading part in the conspiracy, taken by Bedamor, the Spanish ambassador, is given in the play to the historically insignificant Pierre and Jaffier. The piece has a political meaning, enforced in the prologue. The Popish Plot was in Otway's mind, and Anthony, 1st earl of Shaftesbury, is caricatured in Antonio. The play won instant success. It was translated into almost every modern European language, and even Dryden said of it: "Nature is there, which is the greatest beauty."

The Orphan and *Venice Preserved* remained stock pieces on the stage until the 19th century, and the leading actresses of the period played Monimia and Belvidera. One or two prefaces, another weak comedy, *The Atheist* (1684), and two posthumous pieces, a poem, *Windsor Castle* (1685), a panegyric of Charles II., and a *History of the Triumvirates* (1686), translated from the French, complete the list of Otway's works. He apparently ceased to struggle against his poverty and misfortunes. The generally accepted story regarding the manner of his death was first given in Theophilus Cibber's *Lives of the Poets.* He is said to have emerged from his retreat at the Bull on Tower Hill to beg for bread. A passer-by, learning who he was, gave him a guinea, with which Otway hastened to a baker's shop. He began too hastily to satisfy his ravenous hunger, and choked with the first mouthful. Whether this account of his death be true or not, it is certain that he died in the utmost poverty, and was buried on April 16, 1685, in the churchyard of St. Clement Danes. A tragedy entitled *Heroick Friendship* was printed in 1686 as Otway's work, but the ascription is unlikely.

The Works of Mr. Thomas Otway with some account of his life and writings, published in 1712, was followed by other editions (1757, 1768, 1812). The standard edition is that by T. Thornton (1813). A selection of his plays was edited for the Mermaid series (1891 and 1903) by Roden Noel. *See* E. Schumacher, *Thomas Otway* (Bonn, 1924).

OUBLIETTE, a French architectural term used in two senses, of a dungeon in a prison or castle which could only be reached by a trap-door from another dungeon, and of a concealed opening or passage leading from a dungeon to the moat or river, into which bodies of prisoners might be dropped. Many so-called "oubliettes" in mediaeval castles were in reality the cesspools or receptacles of the castle latrines.

OUDENARDE, a town of Belgium in the province of East Flanders, 18 mi. S. of Ghent. Pop. (1939) 6,483. Known for the victory by Marlborough and Eugene over the French under Vendôme in 1708, Oudenarde has other features of interest. The town hall, which took ten years to build (1525–1535), has after that of Louvain the most elaborately decorated façade in Belgium. It was designed by H. van Peede and G. de Ronde, and is in tertiary Gothic style. The belfry tower of five storeys with three terraces, surmounted by a golden figure, is a striking feature. The council chamber contains a fine oak door and Gothic chimneypiece, both *c.* 1530. There are also two interesting old churches, St. Walburga, partly of the 12th and partly of the 14th century, and Our Lady, dating from the 13th century. The former contains several pictures by Craeyer and other Flemish masters.

The Battle of Oudenarde (June 30–July 11, 1708) was fought on the ground north-west and north of the town, which was then regularly fortified and was garrisoned by a force of the Allies. For an account of the strategic situation which led up to the battle, *see* SPANISH SUCCESSION, WAR OF THE. The French army under the duke of Burgundy and Marshal Vendôme, after an abortive attempt to invest Oudenarde, took up a defensive position north of the town when Marlborough and Eugene, after a forced march, arrived with the main Allied army. The advanced guard of the Allies under General (Lord) Cadogan promptly crossed the Scheldt, annihilated an outlying body of French troops, and established itself on the ground it had won, in front of the French centre. But the Allied main army took a long time to defile over the Scheldt and could form up (on the left of Cadogan's detachment) only slowly and by degrees. Observing this, Burgundy resolved to throw forward his right towards Oudenarde to engage and hold the main body of the Allies before their line of battle could be formed. This effected, it was hoped that the remainder of the French army could isolate and destroy Cadogan's detachment, which was already closely engaged with the French centre. But he miscalculated both the endurance of Cadogan's men (amongst whom the Prussians were conspicuous for their tenacity) and the rapidity with which in Marlborough's and Eugene's hands the wearied troops of the Allies could be made to move. Marlborough, who personally directed the operations on his left wing, not only formed his line of battle successfully, but also began seriously to press the forces that had been sent to check his deployment. Before long, while the hostile left wing still remained inactive, the unfortunate troops of the French centre and right were gradually hemmed in by the whole force of the Allies. The decisive blow was delivered by the Dutch marshal, Overkirk, who was sent by Marlborough with a large force (the last reserve of the Allies) to make a wide turning movement round the extreme right of the French, and at the proper time attacked them in rear. A belated attempt of the French left to intervene was checked by the British cavalry, and the pressure on the centre and right, which were now practically surrounded, continued even after nightfall. A few scattered units managed to escape, and the left wing retreated unmolested, but at the cost of about 3,000 casualties the Allies inflicted a loss of 6,000 killed and wounded and 9,000 prisoners on the enemy, who were, moreover, so shaken that they never recovered their confidence to the end of the campaign. The battle of Oudenarde was not the greatest of Marlborough's victories, but it affords almost the best illustration of his military character. Contrary to all the rules of war then in vogue, he fought a piecemeal and unpremeditated battle, with his back to a river, and with wearied troops, and succeeded.

OUDINÉ, EUGÈNE ANDRÉ (1810–1887), French sculptor and medallist, was born in Paris in 1810, and devoted himself from the beginning to the medallist's branch of sculpture, although he also excelled in monumental sculpture and portrait busts. He gained the grand prize for medal engraving in 1831, and in the same year exhibited his "Wounded Gladiator." He subsequently occupied official posts as designer to the Inland Revenue and to the Mint. His most famous medals are those struck in commemoration of the annexation of Savoy by France and of the peace of Villafranca. Others are "The Apotheosis of Napoleon I.," "The Universal Exposition," "The Establishment of the Republic," and "Napoleon's Tomb at the Invalides." Oudiné, who may be considered the father of the modern medal, died in 1887.

OUDINOT, CHARLES NICOLAS (1767–1847), duke of Reggio, marshal of France, was born at Bar-le-duc, on April 25, 1767. He served in the regiment of Médoc from 1784 to 1787, retiring with the rank of sergeant. On the outbreak of war in 1792 he became lieutenant colonel in the volunteers of the Meuse, being transferred to the regular army after his defence of the fort of Bitsch (1792). He was promoted general of brigade in June 1794, after the battle of Kaiserslautern. He served on the German frontier under Hoche, Pichegru and Moreau, and in the

Swiss campaign of 1799 with Masséna. He was made inspector general of infantry, and in the war of 1805 he commanded the famous "grenadiers Oudinot," with which he seized the Vienna bridges, and gave the decisive blow at Austerlitz. In 1808 he was made governor of Erfurt and count of the empire, and in 1809 after Wagram, he was promoted marshal. He was made duke of Reggio, and received a large money grant in April 1810. Oudinot governed Holland from 1810 to 1812, and commanded the II corps of the *Grande Armée* in the Russian campaign. For his defeat at Grossbeeren *see* NAPOLEONIC CAMPAIGNS. He was superseded by Marshal Michel Ney, who was defeated at Dennewitz. Oudinot again held important commands at Leipzig and in the 1814 campaign. He was made a peer under Louis XVIII, and did not join Napoleon in 1815. His last active service was in the French invasion of Spain in 1823, in which he commanded a corps, and was for a time governor of Madrid.

OUIDA, the pen name—derived from a childish attempt to pronounce "Louisa"—of Maria Louise [de la] Ramée (1839–1908), English novelist, born at Bury St. Edmunds, where her birth was registered on Jan. 7, 1839. Her father, Louis Ramée, was French, and her mother, Susan Sutton, English. In 1860 her first story, afterwards republished as *Held in Bondage* (1863), appeared in the *New Monthly* under the title of *Granville de Vigne,* and this was followed in quick succession by *Strathmore* (1865), *Chandos* (1866) and *Under Two Flags* (1867). The list of Ouida's subsequent works is a very long one; but it is sufficient to say that, together with *Moths* (1880), those already named are not only the most characteristic, but also the best. In a less dramatic genre, her *Bimbi: Stories for Children* (1882) may also be mentioned; but it was by her more flamboyant stories, such as *Under Two Flags* and *Moths,* that her popular success was achieved. She died at Viareggio, Jan. 25, 1908.

OULU, a seaport and industrial town of Finland on the Gulf of Bothnia in 65° N., 25° 29′ E., linked by rail to Helsinki. Pop. (1940) 30,315. It is the chief town of a forested department of the same name. The accommodation in the harbour depends on the wind. The exports are timber, tar, leather, flour and wood products and the imports colonial produce, coals, iron, hides and salt.

OUNCE. (1) A unit of weight, being the twelfth part of a pound troy, = 480 grains (through O. Fr. *unce,* modern *once,* from Lat. *uncia,* twelfth part, of weight, of a pound, of measure, of a foot, in which sense it gives the O. Eng. *ynce,* inch); in avoirdupois = 437.5 grains, $\frac{1}{16}$ of a pound. The *fluid ounce* is a measure of capacity; in the United Kingdom it is equivalent to an avoirdupois ounce of distilled water at 62° F.; in the United States of America it is the 128th part of the gallon, = $\frac{1}{4}$ gill, = 456.033 grains of distilled water at its maximum density (*see* MEASURES AND WEIGHTS). (2) A name properly applied to the *Panthera uncia* or snow-leopard (*q.v.*) It appears to have been originally used of various species of lynx, and is still sometimes the name of the Canada lynx.

OUNDLE (a corruption of "Avondale"), a town of Northamptonshire, England, 27 mi. N.N.E. of Northampton on the London Midland Region railway. Pop. (1951) 2,224; area 3.6 sq.mi. The manor, with a market and tolls, belonged to the abbot of Peterborough. After the Dissolution they were granted to John, earl of Bedford, and the market still belongs to the lord of the manor. The Church of St. Peter has Early English, Decorated and Perpendicular porticos. Oundle school was founded in 1556 under the will of Sir William Laxton, lord mayor of London, and in 1930 was granted a royal charter.

OURO PRETO ("Black Gold"), a city of the state of Minas Gerais, Brazil, 336 mi. by rail N. by W. of Rio de Janeiro, and about 300 mi. W. of Vitória, Espírito Santo, on the eastern slope of the Serra do Espinhaço and within the drainage basin of the Rio Doce. Pop. (1950) of city 9,247 and *município* 34,154. The city is built upon the lower slope of the Serra do Ouro Preto, a spur of the Espinhaço, deeply cut by ravines and divided into a number of irregular hills, up which the narrow, crooked streets are built and upon which groups of houses form each a separate nucleus. From a mining settlement the city grew as the inequalities of the site permitted. The rough streets are too steep and narrow for vehicles. The climate is subtropical and humid, though the elevation (3,700–3,800 ft.) gives a temperate climate in winter. The days are usually hot and the nights cold. Ouro Preto has several historic buildings; the more noteworthy are the old government house (occupied by the school of mines), the legislative chambers, municipal hall and prison—all fronting on the Praça da Independencia—the old Casa dos Contos (afterward the public treasury), a theatre (the oldest in Brazil, restored in 1861–62) and a hospital.

There are 15 churches in the city, all dating from more prosperous days. Ouro Preto is the seat of one of Brazil's leading schools of mines, in connection with which there is a museum containing an outstanding collection of native minerals.

The city dates from 1701, when a gold-mining settlement was established in its ravines by Antonio Dias of Taubaté. The circumstance that the gold turned black on exposure to the humid air (owing to the presence of silver) gave the name of Ouro Preto to the mountain spur and the settlement. In 1711 it became a city with the name of Vila Rica, a title justified by its size and wealth. In 1720 Vila Rica became the capital of the newly created captaincy of Minas Gerais, and in 1823 the capital of the province of the same name under the empire of Dom Pedro I. When the empire was overthrown in 1889 and Minas Gerais was reorganized as a republican state, it was decided to remove the capital to a more favourable site and Belo Horizonte was chosen, but Ouro Preto remained the capital until 1898, when the new town (also called Cidade de Minas) became the seat of government. In 1933 the town was decreed a national monument and the region in which it lies a national park. (*See* MINAS GERAIS.)

OUSE, the name of several English rivers, an ancient word of disputed etymology.

(1) The Great Ouse rises in Northamptonshire, in the hills between Banbury and Brackley, and falls about 500 ft. in 156 mi. to its mouth in the Wash (North sea). It flows east past Brackley and Buckingham and then turns northeast to Stony Stratford, receiving the Tove and the Ouzel at Newport Pagnell. It then follows a sinuous course past Olney to Sharnbrook, where it turns abruptly south to Bedford, then to flow northeast past St. Neot's to Godmanchester and Huntingdon, when the river trends easterly to St. Ives. Hitherto the Ouse has watered an open valley, but below St. Ives the river debouches suddenly upon the Fens; its fall from this point to the mouth, a distance of 55 mi. by the old course, is little more than 20 feet. From Earith to Denver the waters of the Ouse flow almost wholly in two straight artificial channels called the Bedford rivers, the old course being called the Old West river. This is joined by the Cam 4 mi. above Ely. North of this point the river receives the Lark, the Little Ouse, or Brandon river, and the Wissey. Below Denver sluice, 16 mi. from the mouth, the Ouse is tidal. It flows past King's Lynn, and enters the Wash near the southeast corner. The river is locked up to Bedford, a distance of 74½ mi. by the direct course. An attempt to clear the river in order to make it more navigable and less liable to floods was made, but met with opposition from the farmers of the upper reaches.

(2) A river of Yorkshire. The river Ure, rising in the Pennines, and traversing Wensleydale, unites with the river Swale to form the Ouse near Boroughbridge, in the central plain of Yorkshire. The course of the Swale, which rises on the eastern flank of the Pennines, is mostly through this plain, and that of the Ouse is wholly so. It flows southeast passing York, Selby and Goole to the Trent, to form with the river the Humber estuary (*q.v.*). The course of the Ouse, thus defined, is 45 mi. The Swale and Ure are respectively 60 mi. and 50 mi. long. Goole is a growing port, and the river bears much traffic up to York, smaller traffic up to Boroughbridge, from which the Ure Navigation (partly a canal) continues up to Ripon. The Swale is not navigable. The chief tributaries are the Nidd, the Wharfe, the Don and the Aire on the right, and the Derwent on the left. All traverse beautiful valleys, and the Aire and the Don, with canals, afford communications between south Yorkshire and the Humber ports. The Derwent is also navigable. It is tidal up to Naburn, 37 mi. from the junction with the Trent.

(3) A river of Sussex, rising in the Forest Ridges between Horsham and Cuckfield, and draining part of the Weald. Like other streams here, it breaches the South Downs, and reaches the English channel at Newhaven after a course of 30 mi. The Ouse is navigable for small vessels to Lewes, and Newhaven is an important harbour.

OUSEL or **OUZEL,** the ancient name of the blackbird, but now applied, in combination, to the dipper (*q.v.*) or water-ousel, and to the ring-ousel (*Turdus torquatus*). This latter is a relative of the blackbird. The water-ousels (*Cinclidae*) are found near mountain streams in Europe and northern Asia, in the western United States, Central and South America.

OUSELEY, SIR FREDERICK ARTHUR GORE (1825–1889), English composer, son of Sir Gore Ouseley, ambassador to Persia, was born on Aug. 12, 1825, in London. He was a precocious child, and composed an opera at the age of eight years. Educated at Christ Church, Oxford, he took orders, and held two London curacies. In 1855 he succeeded Sir Henry Bishop as professor of music in the University of Oxford, was ordained priest and appointed precentor of Hereford. In 1856 he became vicar of St. Michael's, Tenbury, and warden of St. Michaels college. His works include the oratorio *Polycarp,* written for his Mus. Doc. degree (1854), a second oratorio, *Hagar* (Hereford, 1873), a great number of services and anthems, chamber music, songs, etc., and theoretical works. He died on April 6, 1889.

His uncle, SIR WILLIAM OUSELEY (1769–1842), British orientalist, wrote *Travels in Various Countries in the East, Especially Persia, in 1810, 1811 and 1812* (3 vol., 1819–23).

OUSTER, a legal term signifying dispossession, especially the wrong or injury suffered by a person dispossessed of freeholds or chattels real. The wrongdoer by getting into occupation forces the real owner to take legal steps to regain his rights. Ouster of the freehold may be effected by *abatement, i.e.,* by entry on the death of the person seized before the entry of the heir, or devisee; by *intrusion,* entry after the death of the tenant for life before the entry of the reversioner or remainderman; by *disseisin,* the forcible or fraudulent expulsion of the occupier or person seized of the property. Ouster of chattels real is effected by *disseisin,* the turning out by force or fraud of the legal proprietor before his estate is determined. Ouster by force, or forcible entry, was made a criminal offense by a statute of 1381.

OUTLAWRY, the process of putting a person out of the protection of the law; a punishment for contemptuously refusing to appear when called in court, or evading justice by disappearing. It was of very early existence in England, and was the punishment of those who could not pay the *were* or blood-money to the relatives of the deceased. By the Saxon law, an outlaw lost his *libera lex* and had no protection from the frank-pledge in the decennary in which he was sworn. He was, too, a *frendlesman,* because he forfeited his friends; for if any of them rendered him any assistance, they became liable to the same punishment. An outlaw was *civiliter mortuus.*

He could not sue in any court, nor had he any legal rights which could be enforced, but he was personally liable upon all causes of action. It was finally abolished in civil proceedings in 1879, while in criminal proceedings it has practically become obsolete, being unnecessary through the general adoption of extradition treaties.

In Scotland outlawry or fugitation may on the motion of the crown be pronounced by the supreme criminal court when the panel has absconded and fails to appear to plead to the indictment on the day of trial.

OUTLAWRY OF WAR. When, under the older conceptions of international law, nations went to war, their inter-state relations were regulated, for the period of belligerency, by the law of war instead of by the law of peace. "International law," writes Professor F. L. Schuman (*International Politics, An Introduction to the Western State System,* p. 109) "does not justify or sanction war but recognizes it as a fact of international politics and seeks to restrict and mitigate its cruel and destructive features." He goes on to point out that on the whole the principles of international law, governing the conduct of hostilities, have been reasonably well observed despite appearances to the contrary, the motives probably being expediency and fear of retaliation on the part of the belligerents. This is the case even where there is no formal declaration of war, as in the Sino-Japanese hostilities.

In the late twenties a group of American authorities interested in peace came to feel that the resort to war would be less likely if it were formally deprived of its legal status and definitely "outlawed." The advocates of the outlawry of war theory felt that so long as the institution of war remained respectable and enjoyed a recognized place in the field of international relations, the root of the evil remained.

Their solution of the problem was, in part, to oust war from its privileged position by denying it a legal status and placing a state indulging in hostilities against another state beyond the pale, that is to say, literally to outlaw it.

Among the principal advocates of the outlawry of war movement in the United States were Judge Florence E. Allen, Senator William E. Borah, Dr. Nicholas Murray Butler, Professor John Dewey, Reverend John Haynes Holmes, S. O. Levinson, Dr. C. C. Morrison, Reverend M. V. Oggel and the American Committee for the Outlawry of War.

The draft treaty to outlaw war which this last named committee suggested as a basis for discussion provided that the signatory states would:—

"... condemn and abandon forever the use of war as an instrument for the settlement of international disputes and for the enforcement of decisions and awards of international tribunals, and hereby outlaw the immemorial institution of war by making its use a public crime as the fundamental law of nations."

would

". . . agree to take immediate action for the equipment of an international court of justice with a code of the laws of peace . . . jurisdiction over all purely international disputes as defined and enumerated in the code or arising under treaties, with power to summon in a defendant nation at the petition of a complaining nation and to hear and decide the matters in controversy."

and would

"agree to abide by and in full good faith to carry out the decisions of such international tribunal[1]. . .,"

thus dropping the idea of other than moral sanctions for the enforcement of the outlawry of war plan.

The statesman primarily responsible for the idea of bringing about the renunciation of war by means of an *ad hoc* treaty was Aristide Briand, French minister of foreign affairs. On June 20, 1927, Briand proposed to the United States the conclusion of a bilateral treaty covering the ground suggested by the advocates of the outlawry of war.

In replying to this proposal the United States suggested that instead of contenting themselves with a bilateral declaration of the nature suggested by Briand, the two governments might make a more signal contribution to world peace by joining in an effort to obtain the concurrence therein of a large group of powers with a view to perfecting among all the nations of the world a mechanism for peace heretofore suggested only as between France and the United States.

The draft multilateral anti-war treaty proposed by the United States on June 23, 1928, was promptly accepted by 14 other governments and signed at Paris on Aug. 27, 1928. Its terms were as follows:

ARTICLE I.

"The High Contracting Parties solemnly declare in the names of their respective peoples that they condemn recourse to war for the solution of international controversies, and renounce it as an instrument of national policy in their relations with one another.

ARTICLE II.

"The High Contracting Parties agree that the settlement or solution of all disputes or conflicts of whatever nature or of whatever origin they may be, which may arise among them, shall never be sought except by pacific means.

ARTICLE III.

"The present Treaty shall be ratified by the High Contracting Parties

[1]*The Outlawry of War* by C. C. Morrison, p. 62 (Chicago, 1927).

named in the Preamble in accordance with their respective constitutional requirements, and shall take effect as between them as soon as all their several instruments of ratification shall have been deposited at Washington.

"This Treaty shall, when it has come into effect as prescribed in the preceding paragraph, remain open as long as may be necessary for adherence by all the other Powers of the world. Every instrument evidencing the adherence of a Power shall be deposited at Washington and the Treaty shall immediately upon such deposit become effective as between the Power thus adhering and the other Powers parties hereto.

"It shall be the duty of the Government of the United States to furnish each Government named in the Preamble and every Government subsequently adhering to this Treaty with a certified copy of the Treaty and of every instrument of ratification or adherence. It shall also be the duty of the Government of the United States telegraphically to notify such Governments immediately upon the deposit with it of each instrument of ratification or adherence."

The treaty was ratified by the United States senate on Jan. 15, 1929. On March 2 eleven nations deposited their ratifications at Washington. The ratifications of other nations followed rapidly so that on July 15 President Hoover set aside July 24 as the date for the formal proclamation of the treaty, and the ceremony marking the deposit of the ratifications of the 45 nations adhering to it was carried out on July 24, 1929.

Although great hopes were entertained at the time of the effect which these declarations would have in the preservation of peace, they had no observable deterrent effect upon the aggressions which shortly followed in Manchuria in 1931 or in China proper at a later stage; nor upon the Italian invasion of Ethiopia, nor upon the German-Italian interventions in Spain, nor on any of those which finally culminated in World War II. The Kellogg pact and other agreements for the renunciation of war, nowever, had one legal effect of some importance. They helped to make it expedient for states to refrain from formal declarations of war. Thus, though Japan in 1937 began to bombard Chinese cities and kill Chinese citizens in great numbers, she was not formally at "war." The bombardment and the killings were an "incident" of "intervention for the restoration of order." Other states at times followed the example so set. (N. AL.)

OUTPUT: *see* PRODUCTION, CENSUS OF.

OUTRAM, SIR JAMES (1803–1863), English general, and one of the heroes of the Indian Mutiny, was the son of Benjamin Outram of Butterley Hall, Derbyshire, civil engineer, and was born on Jan. 29, 1803. His father died in 1805, and his mother, a daughter of Dr. James Anderson, the Scottish writer on agriculture, removed in 1810 to Aberdeenshire. From Udny school the boy went in 1818 to the Marischal college, Aberdeen; and in 1819 an Indian cadetship was given him. Soon after his arrival at Bombay his remarkable energy attracted notice, and in July 1820 he became acting adjutant to the first battalion of the 12th regiment on its embodiment at Poona. In 1825 he was sent to Khandesh, where he trained a light infantry corps, formed of the wild robber Bhils, gaining over them a marvelous personal influence, and employing them with great success in checking outrages and plunder. Their loyalty to him had its principal source in their boundless admiration of his hunting achievements. For some time he was political agent in the Mahi Kantha district of Gujarat. In the first Afghan War in 1838 he was extra aide-de-camp on the staff of Sir John Keane. After conducting various raids against Afghan tribes, he was in 1839 promoted major, and appointed political agent in lower Sind, and later in upper Sind. He opposed the policy of his superior, Sir Charles Napier, which led to the annexation of Sind. When war broke out he heroically defended the residency at Hyderabad against 8,000 Baluchis; and it was Napier who then described him as "the Bayard of India."

On his return from a short visit to England in 1843, he was, with the rank of brevet lieutenant colonel, appointed to a command in the Mahratta country, and in 1847 he was transferred from Satara to Baroda, where he incurred the resentment of the Bombay government by his fearless exposure of corruption. In 1854 he was appointed resident at Lucknow, in which capacity two years later he carried out the annexation of Oudh and became the first chief commissioner of that province. Appointed in 1857, with the rank of lieutenant general, to command an expedition against Persia, he defeated the enemy with great slaughter at Khushab, and brought the campaign to a rapid conclusion.

From Persia he was summoned in June to India, with the brief explanation—"We want all our best men here." It was said of him at this time that "a fox is a fool and a lion a coward by the side of Sir J. Outram." Immediately on his arrival in Calcutta he was appointed to command the two divisions of the Bengal army occupying the country from Calcutta to Cawnpore; and to the military control was also joined the commissionership of Oudh. Already the mutiny had assumed such proportions as to compel Havelock to fall back on Cawnpore, which he only held with difficulty, although a speedy advance was necessary to save the garrison at Lucknow. On arriving at Cawnpore with reinforcements, Outram, "in admiration of the brilliant deeds of General Havelock," conceded to him the glory of relieving Lucknow, and, waiving his rank, tendered his services to him as a volunteer.

Resuming supreme command, he then held the town till the arrival of Sir Colin Campbell, after which he conducted the evacuation of the residency so as completely to deceive the enemy. In the second capture of Lucknow, on the commander in chief's return, Outram was entrusted with the attack on the side of the Gumti, and afterwards, having recrossed the river, he advanced "through the Chattar Manzil to take the residency," thus, in the words of Sir Colin Campbell, "putting the finishing stroke on the enemy." After the capture of Lucknow he was gazetted lieutenant general. In February 1858 he received the special thanks of both houses of parliament, and in the same year the dignity of baronet with an annuity of £1,000. Shattered in health he returned finally to England in 1860. He died on March 11, 1863.

See Sir F. J. Goldsmid, *James Outram, a Biography* (2 vols., 1880); and L. J. Trotter, *The Bayard of India* (1903).

OUT RELIEF: *see* POOR LAW.

OVAL: a figure or body shaped like the longitudinal section of an egg.

OVAR, a town of Portugal, at the northern extremity of the lagoon of Aveiro (*q.v.*); 21 mi. south of Oporto by the Lisbon-Oporto railway. Pop. (1950) 7,248. Ovar is the centre of important fisheries. Millet, wheat and vegetables—especially onions—are the chief products of the low-lying and unhealthy regions in which Ovar is situated.

OVARIOTOMY or **OÖPHORECTOMY,** the operation for removal of one or of both of the female ovaries (for anatomy *see* REPRODUCTIVE SYSTEM). The progress of modern surgery has been conspicuously successful in this department. From 1701, the date when Houston of Carluke, Lanarkshire, carried out his successful partial extirpation, progress was arrested for some time, although the Hunters (1780) indicated the practicability of the operation. In 1809 Ephraim McDowell of Kentucky, inspired by the lectures of John Bell, his teacher in Edinburgh, performed ovariotomy, and, continuing to operate with success, established the possibility of surgical interference. He was followed by others in the United States. The cases brought forward by Lizars of Edinburgh were not sufficiently encouraging; the operation met with great opposition; and it was not until Charles Clay, Spencer Wells, Baker Brown and Thomas Keith began work that the procedure was placed on a firm basis and was regarded as justifiable. Improved methods were introduced, and surgeons vied with one another in trying to obtain good results. Eventually, by the introduction of the antiseptic, and later, the aseptic, system of treating wounds, this operation, formerly regarded as one of the most grave and anxious in the domain of surgery, came to be attended with a lower mortality than any other of a major character.

OVEN-BIRD, the name given to birds of the genus *Furnarius* of the American family of wood-hewers (*Dendrocolaptidae*), on account of the structure of the nest. They are small thrush-like birds confined to South America.

The name oven-bird is commonly given in the United States to the golden crowned water-thrush (*Seiurus aurocapillus*), one of the wood warblers, which builds an oven-shaped nest on the

ground.

See C. Darwin, *Voyage of the Beagle* (1845); W. H. Hudson, *A Naturalist in La Plata* (1892).

OVERBECK, JOHANN FRIEDRICH (1789–1869), German painter, the reviver of "Christian art" in the 19th century, was born in Lübeck on the 4th of July 1789. His ancestors for three generations had been Protestant pastors; his father was doctor of laws, poet, mystic pietist and burgomaster of Lübeck. In 1806, after finishing his course at the gymnasium, Overbeck left Lübeck and entered the Academy of Vienna, then under the direction of Füger, a painter of the pseudo-classic school of David. Not finding the help on which he had counted, Overbeck turned to the early and pre-Raphaelite masters of Italy for inspiration. At the end of four years he was expelled. He thereupon went to live in Rome, where he gathered about him a group of friends which included Cornelius, Veit and Wilhelm Schadow.

The little group made their home in the old Franciscan monastery of San Isidoro on the Pincian, and in 1813 Overbeck joined the Roman Catholic church. The group became known as the "Nazarites," "pre-Raphaelites," or "German-Roman artists." They believed in hard, honest work and holy living, eschewed the antique as pagan and the Renaissance as false, and aimed at bringing about a revival on the basis of nature and the serious art of Perugino, Pinturicchio, Francia and the young Raphael. Their painting was characterized by nobility of conception, precision—not to say hardness—of outline, and scholarly composition. Light, shade and colour they admitted only in the interests of clearness and correctness, and not as softening elements. Overbeck, with his saintly character and lofty ideals, was the natural leader and mentor of the party. They would have fared badly however from a practical point of view but for the timely help of Niebuhr, Bunsen, Friedrich Schlegel, and the Prussian consul Bartholdi, who commissioned the four friends to decorate his villa with frescoes on the story of Joseph and his Brethren. This led to another commission from Prince Massimo to paint the ceilings and walls of his pavilion. Overbeck's failing health did not allow him to finish his share of this undertaking and he delegated it to Joseph Führich. His last work was a "Vision of St. Francis" with life-size figures for the walls of Sta. Maria degli Angeli near Assisi. All his paintings bear the mark of religious fervour and careful preparation and have an element of religious propaganda. The handling is dry and severe and the colour restrained. His faith found its clearest expression in his religious cartoons, the *Gospels* (1852), *Via Crucis* (1857) and the *Seven Sacraments* (1861). He died in Rome on Nov. 12, 1869, and was buried in San Bernardo.

Overbeck's principal oil and easel paintings are: "Christ's Entry into Jerusalem" (1824), in the Marien Kirche, Lübeck; "Christ's Agony in the Garden" (1835), in the great hospital, Hamburg; "Lo Sposalizio" (1836), Raczynski gallery, Berlin; the "Triumph of Religion in the Arts" (1840), in the Städel Institut, Frankfort; "Pietà" (1846), in the Marien Kirche, Lübeck; the "Incredulity of St. Thomas" (1851), in the possession of Mr. Beresford Hope, London; the "Assumption of the Madonna" (1855), in Cologne Cathedral; "Christ delivered from the Jews" (1858), tempera, on a ceiling in the Quirinal Palace—a commission from Pius IX., and a direct attack on the Italian temporal government, therefore later covered by a canvas.

There are biographies by J. Beavington Atkinson (1882) and Howitt (1886).

OVERBURY, SIR THOMAS (1581–1613), English poet and essayist, and the victim of one of the most sensational crimes in English history, was the son of Nicholas Overbury, of Bourton-on-the-Hill, and was born in 1581 at Compton Scorpion, near Ilmington, in Warwickshire. In the autumn of 1595 he became a gentleman commoner of Queen's college, Oxford, took his degree in 1598 and came to London to study in the Middle Temple.

About the year 1601, being in Edinburgh on a holiday, he met Robert Carr, then an obscure page to the earl of Dunbar; and the two youths came up to London together. When Carr attracted the attention of James I., in 1606, by breaking his leg in the tilt-yard, Overbury had for some time been servitor-in-ordinary to the king. He was knighted in 1608, and in 1609 travelled in France and the Low Countries. When Carr was made Lord Rochester in 1610, the intimacy between the two was maintained. But early in 1611 the Court became aware of the mutual attraction between Rochester and the youthful countess of Essex. To this intrigue Overbury was from the first violently opposed, and expressed his opinion of the countess in unmeasured terms. But Rochester was now infatuated, and he repeated to the countess what Overbury had said. Overbury also wrote, and circulated widely in ms., the poem called *The Wife*, which was a picture of the virtues which a young man should demand in a woman. The situation now resolved itself into a duel for the person of Rochester between the mistress and the friend. Overbury was thrown into the Tower on April 22, 1613, on a charge of disrespect to the king. Lady Essex, however, was not satisfied with his imprisonment; she was determined that "he should return no more to this stage." She bribed the gaoler, aided by Mrs. Turner, the widow of a physician, and by an apothecary called Franklin, to poison Overbury with copper vitriol. His constitution long withstood the timid doses they gave him, and he lingered until Sept. 15, 1613, when more violent measures put an end to his existence.

Two months later Rochester, now earl of Somerset, married Lady Essex. More than a year passed before suspicion was aroused, and when it was, the king showed disinclination to bring the offenders to justice. In the trial which followed, the plot was discovered. The four accomplices were hanged; the countess of Somerset pleaded guilty but was spared, and Somerset himself was disgraced. Meanwhile, Overbury's poem, *The Wife*, was published in 1614, and ran through six editions within a year. Much that must be spurious was added to the gathering snow-ball of Overbury's *Works*, the most famous of which are the *Characters*.

See C. Whibley, *Essays in Biography* (1913); E. A. Parry, *The Overbury Mystery* (1925).

OVERHEAD CHARGES. Overhead charges, or on-costs, are an important factor in cost accounts. Prime cost represents outlays directly incurred for a particular purpose, and thus capable of being charged directly thereto. In addition, there are a number of indirect expenses which can only be dealt with by spreading them as equitably as may be over the total output.

Generally speaking, Overhead charges consist of such items as rent, rates, taxes, salaries, depreciation, interest, discounts, bad debts, etc., from which may be deducted corresponding credits. But in order to arrive at costs that are comparable with those of similar undertakings, various adjustments become necessary. Thus, where business premises are owned, the rental value should be included, although not actually expended. When time is of importance, interest on outlays should be included, even although no interest may actually have been paid away. *Per contra*, interest on borrowed monies (including debentures) is not properly a factor in costs at all; and interest received on investments, although undoubtedly a profit, does not tend to reduce operative costs and should therefore be excluded. Many authorities also consider that bad debts have nothing to do with the costs. Depreciation of equipment is generally a very important factor but the modern tendency is to charge a *machine rate* of so much per hour as part of the direct costs, such rate being designed to cover depreciation, repairs and interest on capital; when this is done, no charge in respect of depreciation falls to be included as Overhead.

Formerly, it was thought to be sufficiently accurate to add a given percentage to prime cost as a loading to cover Overhead. It is now recognized that no satisfactory results can be achieved in this way. A uniform percentage of loading for Overhead would result in the aggregate amount actually charged against output varying directly with the prime cost, and thus the amount so charged would almost certainly be appreciably more or appreciably less than the true figure, according to whether the output was above or below the average. Further, such a system of allocation assumes that the fair loading for Overhead varies directly with the prime cost, whereas the employment of expensive materials does not necessarily increase the Overhead burden, and in many cases economies in labour costs can only be achieved by increasing the Overhead burden, *e.g.*, when machine work is substituted for hand work. Most production is complex, and consists of a series of successive processes or operations, each involving its own Overhead

charges. The modern practice is accordingly in the direction of analysing Overhead into departments, and distributing the burden of the departmental Overhead over the output of the department, usually *pro rata* according to the time occupied. In this way some approach to substantial accuracy may be reached, but no cut and dried formula will meet all cases.

Sometimes costs are appreciably increased by "spoils"—the curtailment of saleable output as a result of defective materials, machinery, workmanship or supervision. The only satisfactory way to deal with losses arising from spoils is to charge them as part of the Overhead burden of the department causing the spoil. If and when this is done the loss is thrown upon the right shoulders, and the effect commonly is to reduce very materially the loss arising from spoils by compelling managers to enquire more carefully into causes and possible remedies. (L. R. D.)

OVERSEA INVESTMENTS: *see* Capital, Export of.

OVERSEA SETTLEMENT COMMITTEE. This important body was appointed in 1919 to assist and advise the British Government in their policy of undertaking closer responsibility than they had exercised in the past in connection with the movement of British subjects wishing to settle in other parts of the empire or to emigrate to foreign countries. The functions of the Emigrants' Information Office, which was established in 1886, were absorbed by the Oversea Settlement Committee. The president of the committee is the secretary of state for dominion affairs. It is a representative and non-political body, composed partly of official members representing various Government departments and partly of unofficial members. The staff of the committee forms a department (the oversea settlement department) of the Dominions Office.

The committee is entrusted with the administration of the Empire Settlement Act, 1922, which now forms the basis of the policy of State-aided empire settlement. The act was passed as the result of a conference with representatives of the self-governing dominions in 1921 and empowers the secretary of state "in association with the Government of any part of His Majesty's Dominions, or with public authorities or public or private organisations either in the United Kingdom or in any part of such Dominions, to formulate and co-operate in carrying out agreed schemes for affording joint assistance to suitable persons in the United Kingdom who intend to settle in any part of His Majesty's Oversea Dominions." Such schemes may take the form of development or land settlement schemes, or of schemes for facilitating settlement overseas by assistance with passages, training or in other ways. The contribution of the secretary of state may not exceed half the cost of any approved scheme and the maximum expenditure allowed under the act in any one year is £3,000,000.

OVERSTONE, SAMUEL JONES LOYD, 1st Baron (1796–1883), English banker, the son of a Welsh dissenting minister, was born on Sept. 25, 1796. He became a partner in Jones, Loyd and Company (afterwards incorporated in the London and Westminster Bank), and by 1832 was recognized as one of the foremost authorities on banking. As Liberal member for Hythe, he sat in parliament from 1819 to 1826. He gave important evidence before various committees of the House of Commons, and was responsible for the main outlines of the Bank Charter Act (1844). In 1850 he was created Baron Overstone. He died in London on Nov. 17, 1883, leaving one daughter.

In 1858 a volume of *Tracts and other Publications on Metallic and Paper Currency,* by Lord Overstone, was edited by M'Culloch.

OVERT ACT: *see* Intent; Treason.

OVERTURE (Fr. *ouverture,* opening), in music, a detachable instrumental introduction to a dramatic or choral composition. The notion of an overture had no existence until the 17th century. The *toccata* at the beginning of Monteverdi's *Orfeo* is a barbaric flourish of every procurable instrument, alternating with a melodious section entitled *ritornello;* and, in so far as this constitutes the first instrumental movement prefixed to an opera, it may be called an overture. As an art-form the overture began to exist in the works of J. B. Lully. His favourite, but not his only, form constitutes the typical French overture that became classical in the works of Bach and Handel. This French overture consists of a slow introduction in a marked "dotted rhythm" (*i.e.,* exaggerated iambic, if the first chord is disregarded), followed by a lively movement in fugato style. The slow introduction was always repeated, and sometimes the quick movement concluded by returning to the slow tempo and material, and was also repeated (*see* Bach's French Overture in the *Klavierübung*).

The operatic French overture was frequently followed by a series of dance tunes before the curtain rose. It thus naturally became used as the prelude to a suite (*q.v.*); and the term was then applied to the whole suite.

Bach was able to adapt the French overture to choruses, and even to the treatment of chorales. Thus the overture—movements of his fourth orchestral suite became the first chorus of the church cantata *Unser Mund sei voll Lachens;* the choruses of the cantatas *Preise Jerusalem den Herrn* and *Höchst erwünschtes Freudenfest* are in overture form; and, in the first of the two cantatas entitled *Nun komm, der Heiden Heiland,* Bach has adapted the overture form to the treatment of a chorale.

Gluck could find no use for the French overture. In the epoch-making preface to *Alceste* he laid down the rule that the overture should be the musical argument of the drama. And the perfunctory overture to *Orfeo* is the only exception to the rule that in his great operas the orchestral introduction is actually interrupted by the rise of the curtain. In *Iphigénie en Tauride* it is merely the calm before the storm.

The abolition of the French overture did not, however, lead at first to any widespread adoption of Gluck's loose-knit Italian texture. The next form of overture was that of a three-movement symphony (*q.v.*) in sonata style. In Mozart's early opera *La Finta Giardiniera* the curtain rises upon what should have been the third movement; and in all later works the overture is distinguished from symphonic music in style as well as form. It is a single quick movement (with or without a slow introduction) in sonata form, loose in texture, without repeats, and frequently without a development section. Sometimes, in place of development, there is a melodious episode in slow time; as in Mozart's overtures to *Die Entführung* and to the fragment *Lo Sposo deluso,* in both of which cases the curtain rises at a point which throws a dramatic light upon this feature. Mozart at first intended a similar episode in the overture to *Figaro,* but struck it out as soon as he had begun it.

In Beethoven's hands the overture became more and more unlike the symphony, but it no longer remained an inferior species; and the final version of the overture to *Leonora* is the most gigantic single orchestral movement ever based on the sonata style. Weber's overtures work out prominent themes in his operas in a loose but effective sonata form, and are effective concert-pieces besides serving Gluck's purposes admirably. On the overture to Mendelssohn's *Elijah, see* Mendelssohn-Bartholdy, Jakob Ludwig Felix. Overtures to plays naturally tend to become detached from their surroundings; and hence arises the concert overture, led by Beethoven's mighty *Coriolan,* and second only to the symphony as an orchestral art-form. Its derivation implies that it is programme music (*q.v.*), but the programme need not impair the form, whether the form be Berlioz's or Brahms's, and the programme particular or generalized. Among overtures with a generalized programme Mendelssohn's *Hebrides* overture is a perfect masterpiece; and so is Brahms's Tragic overture, one of the greatest orchestral movements since Beethoven. Brahms's *Academic Festival Overture* is a glorious working out of German student songs.

In modern opera the overture, *Prelude, Vorspiel,* or whatever else it may be called, is often nothing more definite than that portion of the music which takes place before the curtain rises. *Tannhäuser* is the last important opera in which the overture retains vestiges of a self-contained sonata form. Fifty years before Wagner's wonderful *Vorspiel* to *Lohengrin,* Méhul had achieved an equally complete departure from classical forms in his interesting overtures to *Ariodant* and *Uthal,* in the latter of which a voice is heard on the stage before the rise of the curtain. Even the most self-contained of Wagner's later preludes lose by transference to the concert-room. The glorious *Vorspiel* to *Die*

Meistersinger is nobler when its long *crescendo* leads to the rise of the curtain and the engaging of all the listener's sense of sight and language, than when it can merely lead to a final tonic chord. Wagner himself added a page to finish the *Vorspiel* to *Tristan,* and by the richness and subtlety of that page he reveals how unready for independent existence the original *Vorspiel* was. He also finished the *Parsifal* Vorspiel for concert use by the addition of a few extra bars, which will always sound perfunctory. The four dramas of the *Ring* begin with introductions designed to prepare the hearer immediately for the rise of the curtain; and these works can no more be said to have overtures than Verdi's *Falstaff* and Strauss's *Salome, Electra* and *Die Frau ohne Schatten,* in which the curtain rises at the first note of the music. (D. F. T.)

OVERYSSEL, a Netherlands province, bounded south and southwest by Gelderland, west by the Zuider Zee, north by Friesland and Drente, and east by Germany. The project to connect the northeast Polder with the north of the province was in preparation when Germany invaded the Netherlands in May 1940. Pop. of the province (1938) 569,920, showing about 50% increase during the 20th century; area, 1,295 sq.mi. It is a varied glaciated delta land consisting of a sandy flat relieved by hillocks, and covered with waste stretches of heath broken by patches of wood and high fen; but the coastal strip north of Zwartsluis consists largely of low-lying fertile pasture lands with cattle-rearing and associated butter and cheese manufactures, while along the shores mats and brushes are made.

The river system is determined by two main glacial ridges, of which the eastern one, which separates the Dinkel and Regge, extends from Enschede northwards into the German enclave; the larger one runs parallel with it and commencing at Lochem (Gelderland) extends into south Drente. In the south it separates the Yssel and Regge; its summit height (Lemeler Hill, 262 ft.) is near where it is breached by the Vecht. This river crosses the province from east to west and joins a part of the Yssel near Zwolle to form the Zwarte Water, which communicates with the Zuider Zee by the Zwolsche Diep; the main Yssel enters the Zuider Zee separately below Kampen. The streams are flanked by small-estate fertile grasslands from which agriculture and cattle-rearing have gradually spread over the sand-grounds; much of the area, however, is still waste though forest culture is practised locally, especially in the east, and pigs are largely bred. The deposits of the Yssel and the Dinkel streams contain iron ore, which is extracted and exported to Germany. Peat-digging and fen reclamation have long been practised and much high fen north of the Vecht in the neighbourhood of Dedemsvaart has been reclaimed though the main reclamation at present is taking place along and near to the eastern ridge. Large scale manufactures are not important in Overyssel but cotton-spinning, together with bleaching-works, came into some prominence in the 19th century in the south-east district of Twente. The inhabitants for long had practised weaving as a home craft but capitalist Baptist refugees who arrived in the 17th and 18th centuries organized it into an industry. Deventer has iron foundries and carpet-factories but is more famed for its honey cakes. The capital of the province is Zwolle, pop. (1940) 42,136, though Enschede (90,289) is the largest town. Deventer, Hengelo and Almelo each exceed 20,000 population and all four are situated in the south. Deventer is an old but busy little river port with a 16th century weigh-house of unusual design. Kampen, on the Yssel with its harbour long since silted up, has lost much of its importance of Hanseatic days but its 14th century churches and gateways are interesting. Its Stadhuis (16th and 18th century) is probably the finest town hall in the Netherlands. It shares a fishing trade with Vollenhove and Blokzijl, all on the Zuider Zee. Tucked away in the extreme north near the Drente border is the delightful little settlement of Giethoorn, literally a water village, each house possessing its own quay, drawbridge and punt. The railway system of the province is supplemented by tramlines and the roads are good but the waterways still carry much traffic.

OVID [PUBLIUS OVIDIUS NASO] (43 B.C.–A.D. 17), Roman poet, the last of the Augustan age, was born in 43 B.C., the last year of the republic. Thus the only form of political life known to Ovid was that of the absolute rule of Augustus and his successor. He was born on March 20 at Sulmo, picturesquely situated among the mountains of the Abruzzi: its wealth of waters and natural beauties seem to have quickened in him that appreciative eye for the beauties of nature which is one of the chief characteristics of his poems. Ovid, whose father was of equestrian family, belonged by birth to the same social class as Tibullus and Propertius, that of old hereditary landowners; but he was more fortunate than they in the immunity which his native district enjoyed from the confiscations made by the triumvirs. He and his brother had been brought early to Rome for their education, where they attended the lectures of two most eminent teachers of rhetoric, Arellius Fuscus and Porcius Latro, to which influence is due the strong rhetorical element in Ovid's style. His father did his best to dissuade him from poetry, and to drive him into the legal profession.

The earliest edition of the *Amores,* which first appeared in 5 books, and the *Heroides* were given by him to the world at an early age. "Virgil," he informs us, "he had only seen"; but Virgil's friend and contemporary Aemilius Macer used to read his didactic poems to him; and even the fastidious Horace sometimes delighted his ears with the music of his verse. He had a close bond of intimacy with the younger poets of the older generation—Tibullus, whose death he laments in one of the few pathetic pieces among his earlier writings, and Propertius, to whom he describes himself as united in the close ties of comradeship. The name of Maecenas he nowhere mentions. The time of his influence was past when Ovid entered upon his poetical career. But the veteran politician Messalla, the friend of Tibullus, together with his powerful son Cotta Messallinus and Fabius Maximus and other influential persons whose names are preserved in the *Epistles from Pontus* supported him. With the older poet, Macer, he travelled for more than a year. Whether this was immediately after the completion of his education, or in the interval between the publication of his earlier poems and that of the *Medea* and *Ars amatoria* is unknown, but it is in his later works, the *Fasti* and *Metamorphoses,* that we chiefly recognize the impressions of the scenes he visited. In one of the *Epistles from Pontus* (ii. 10) to his fellow-traveller there is a vivid record of the pleasant time they had passed together. They visited Athens, of course, the Mecca of all artistic pilgrimages then; went on to the site of Troy, and through the cities of Asia Minor; and finally spent a year in Sicily.

Life in Rome.—When settled at Rome, although a public career leading to senatorial position was open to him, and although he filled various minor posts, he had no ambition for such distinction, and looked upon pleasure and poetry as the occupations of his life. He was three times married; when little more than a boy to his first wife, whom he naïvely describes as unworthy of himself; but he was soon separated from her and took a second wife, with whom his union also did not last long. She was probably the mother of his one daughter. Later he married a third, of whom he always speaks with affection and respect. She was a lady of the great Fabian house, and thus connected with his powerful patron Fabius Maximus, and was a friend of the empress Livia. It therefore seems likely that he may have been admitted into the intimacy of the younger society of the Palatine. His liaison with his mistress Corinna, whom he celebrates in the *Amores,* took place probably in the period between his first and second, or between his second and third marriages. Ovid is not only a less constant but he is a less serious lover than his great predecessors Catullus, Tibullus and Propertius. His tone is that either of mere sensuous feeling or of irony. In his complete emancipation from all restraint he goes beyond them, and thus reflects the tastes and spirit of fashionable Rome between the years 20 B.C. and the beginning of our era.

Society was then bent simply on amusement; and, as a result partly of the loss of political interests, women came to play a more important and brilliant part in its life than they had done before. Julia, the daughter of the emperor, was by her position, her wit and beauty, and her reckless dissipation, the natural

leader of such a society. But the discovery of her intrigue (2 B.C.) with Iulus Antonius, the son of Mark Antony, was deeply resented by Augustus as being at once a shock to his affections and a blow to his policy of moral reform. Julia was banished and disinherited; Antonius and her many lovers were punished; and the Roman world awoke from its fool's paradise of pleasure. Nearly coincidently with this scandal appeared Ovid's *Ars amatoria,* perhaps the most immoral work ever written by a man of genius, though not the most demoralizing, since it is entirely free from morbid sentiment. By its brilliancy and heartlessness it appealed to the prevailing taste of the fashionable world; but its appearance excited deep resentment in the mind of the emperor, as is shown by his edict, issued ten years later, against the book and its author. Ovid appears to have had no idea of the storm that was gathering over him.

But he was aware that public opinion had been shocked, or professed to be shocked, by his last work; and after writing a kind of apology for it, called the *Remedia amoris,* he turned to other subjects, and wrote during the next ten years the *Metamorphoses* and the *Fasti.* He had already written the *Heroides,* in which he had imparted a modern and romantic interest to the heroines of the old mythology, and a tragedy, the *Medea,* which must have afforded greater scope for the dramatic and psychological treatment of the passion with which he was most familiar. In the *Fasti* Ovid assumes the position of a national poet by imparting poetical life and interest to the ceremonial observances of the Roman religion; but it is as the brilliant narrator of the romantic tales that were so strangely blended with the realistic annals of Rome that he succeeds in the part assumed by him. The *Metamorphoses* is a narrative poem which recounts legends in which the miraculous involved transformations of shape. Beginning with the change from Chaos to Cosmos, legends first Greek and then Roman are passed in review, concluding with the metamorphosis of Julius Caesar into a star and a promise of immortality to Augustus. The *Metamorphoses* is strongly tinged with Alexandrine influence, being in fact a succession of epyllia in the Alexandrine manner. This work, which Ovid regards as his most serious claim to immortality, had not been finally revised at the time of his disgrace, and in his despair he burnt it; but other copies were in existence, and when he was at Tomi it was published at Rome by one of his friends. He often regrets that it had not received his final revision. The *Fasti* also was broken off by his exile, after the publication of the first six books, treating of the first six months of the year.

Banishment.—In A.D. 8 Ovid was ordered by Augustus into banishment; for this he assigns two causes, his *Ars amatoria* and an actual offence (*Trist.* ii. 207). It is natural that Augustus should have felt resentment against the *Ars,* because its doctrine was a direct challenge to his policy of moral reform. What the actual offence was is a secret which the poet leaves unrevealed; since his disgrace coincided with the banishment of Augustus' granddaughter, the younger Julia, on account of an intrigue with Silanus, it has been supposed that Ovid was concerned in abetting that intrigue, and that this constituted his unforgivable sin. But if Ovid had really assisted to bring about the moral scandal which befell the emperor's family, it is incredible that he could have dared to allude to it, as he does constantly, in his poems. This, and the fact that, even after Augustus' death, his successor Tiberius left Ovid unpardoned, makes it probable that the offence was political and specially displeasing to Tiberius and Livia because it somehow interfered with their dynastic policy. Ovid may have been implicated with those who were over-zealous in the interests of rival possible successors to the throne, either Agrippa Postumus, the grandson of Augustus, or Germanicus, the brilliant and popular nephew of Tiberius, with many of whose friends Ovid was associated. Ovid's banishment was the mildest possible (*relegatio*); it involved no deprivation of civic rights, and left him the possession of his property. He was ordered to remove to the half-Greek, half-barbaric town of Tomi, near the mouth of the Danube. For eight years he bore up in his dreary solitude, suffering from the unhealthiness of the climate and the constant alarm of inroads of barbarians.

The Epistle.—In the hope of procuring a remission of his punishment he wrote poetical complaints, first in the series of the five books of the *Tristia,* sent successively to Rome, addressed to friends whose names he suppresses; afterwards in a number of poetical epistles, the *Epistulae ex Ponto,* addressed by name to friends who were likely to have influence at court. He believed that Augustus had softened towards him before his death, but his successor Tiberius was inexorable to his appeals. His chief consolation was the exercise of his art, though as time goes on he is painfully conscious of failure in power. But although the works written by him in exile lack the finished art of his earlier writings, their personal interest is greater. They have, like the letters of Cicero to Atticus, the fascination exercised by all confessions; they are a sincere literary expression of the state of mind produced by a unique experience—that of a man, when well advanced in years but still retaining extraordinary sensibility to pleasure and pain, withdrawn from a brilliant social and intellectual position, and cast upon his own resources in a place and among people affording the dreariest contrast to the brightness of his previous life. The letters, which compose the *Tristia* and *Epistulae ex Ponto,* are addressed either to his wife, the emperor, or the general reader, or to his patrons and friends. To his patrons he writes in a vein of supplication, beseeching them to use their influence on his behalf. To his rather large circle of intimate acquaintances he writes in the language of familiarity, and often of affectionate regard; he seeks the sympathy of some, and speaks with bitterness of the coldness of others, and in three poems (*Trist.* iii., 11, iv. 9; v. 8) he complains of the relentless hostility of the enemy who had contributed to procure his exile, and whom he attacked in the *Ibis.* There is a note of true affection in the letter to the young lyric poetess Perilla, of whose genius and beauty he speaks with pride, and whose poetic talents he had fostered by friendly criticism (*Trist.* iii., 7). He was evidently a man of gentle and genial manners; and, as his active mind induced him to learn the language of the new people among whom he was thrown, his active interest in life enabled him to gain their regard and various marks of honour. One of his last acts was to revise the *Fasti,* and re-edit it with a dedication to Germanicus. The closing lines of the *Epistulae ex Ponto* sound like the despairing sigh of a drowning man who had long struggled alone with the waves:—

> Omnia perdidimus: tantummodo vita relicta est,
> Praebeat ut sensum materiamque mali.

Shortly after these words were written he died in his sixty-first year in A.D. 17.

Temperament.—The temperament of Ovid, as indicated in his writings, has more in common with the suppleness of the later Italian than with the strength and force of the ancient Roman. That stamp of her own character and understanding which Rome impressed on the genius of those other races which she incorporated with herself is fainter in Ovid than in any other great writer. He disclaims the manliness which was regarded as the birthright of the Roman. He is equally devoid of dignity in his brilliant prime, and in his later disgrace. His religion is devoid of reverence, his feeling for nature of depth, his loves of sincerity and, almost, even of passion.

These defects in strength and gravity show a corresponding result in Ovid's writings. Though possessing diligence, perseverance and literary ambition, he seems incapable of conceiving a great and serious whole. But with all the levity of his character he must have had qualities which made him, if not much esteemed, yet much liked in his own day, and which are apparent in the genial amiability of his writings. He claims for himself two virtues highly prized by the Romans, *fides* and *candor*—the qualities of social honour and kindly sincerity. There is no indication of anything base, ungenerous or morose in his relations to others. Literary *candor,* the generous appreciation of all sorts of excellence, he possesses in a remarkable degree. He heartily admires everything in literature, Greek or Roman, that had any merit. In him more than any of the Augustan poets we find words of admiration applied to the rude genius of Ennius and the majestic style of Accius. It is by him that

Lucretius is first named and his sublimity is first acknowledged. The image of Catullus that most haunts the imagination is that of the poet who died so early—

hedera iuvenalia cinctus
Tempora,

as he is represented by Ovid coming to meet the shade of the young Tibullus in Elysium. To his own contemporaries, known and unknown to fame, he is as liberal in his words of recognition. He enjoyed society too in a thoroughly amiable and unenvious spirit. In his exile he did retaliate on one enemy and persistent detractor in the *Ibis,* a poem written in imitation of a similar work by Callimachus; but the *Ibis* is not a satire, but an invective remarkable rather for recondite learning than for epigrammatic sting.

But Ovid's chief personal endowment was his vivacity, and his keen interest in and enjoyment of life. The age in which he lived was, as he tells us, that in which more than any other he would have wished to live. He is its most gifted representative, and by not rising above it he reflects it the more perfectly. The sympathy which he felt for the love adventures of his contemporaries, to which he probably owed his fall, quickened his creative power in the composition of the *Heroides* and the romantic tales of the *Metamorphoses.* None of the Roman poets can people a purely imaginary world with such spontaneous fertility of fancy as Ovid. In the power and range of imaginative vision he is surpassed by no ancient and by few modern poets. This power of vision is the counterpart of his lively sensuous nature. He has a keener eye for the apprehension of outward beauty, for the life and colour and forms of nature, than any Roman or perhaps than any Greek poet. This power, acting upon the wealth of his varied reading, gathered with eager curiosity and received into a singularly retentive mind, has enabled him to depict with consummate skill and sympathy legendary scenes of the most varied and picturesque beauty. If his tragedy, the *Medea,* highly praised by ancient critics, had been preserved, we should have been able to judge whether Roman art was capable of producing a great drama. In many of the *Heroides,* and in several speeches scattered through his works, he gives evidence of true dramatic creativeness. Among the poets of all times he can imagine a story with the most vivid inventiveness and tell it with the most unflagging animation. The faults of his verse and diction are those which arise from the vitality of his temperament—too facile a flow, too great exuberance of illustration. He has as little sense of the need of severe restraint in his art as in his life. He is not without mannerism, but he is quite unaffected, and, however far short he might fall of the highest excellence of verse or style, it was not possible for him to be rough or harsh, dull or obscure.

As regards the school of art to which he belongs, he may be described as the most brilliant representative of Roman Alexandrinism. The latter half of the Augustan age was, in its social and intellectual aspects, more like the Alexandrine age than any other era of antiquity. Poetry was the chief branch of literature, and the chief subjects of poetry were mythological tales, various phases of the passion of love, the popular aspects of science and some aspects of the beauty of nature. These two were the chief subjects of the later Augustan poetry. Ovid was the last of this class of writers.

Works.—His extant works fall naturally into three divisions, those of his youth, of middle life and of his later years. To the first of these divisions belong the amatory poems: (1) the three books of *Amores* (originally five, but reduced later to three) relating to his amours with his mistress Corinna; (2) the *Heroidum Epistolae;* (3) the *Medicamina formae,* a fragment of 100 lines on the use of cosmetics; (4) the three books of the *Ars amatoria;* (5) the *Remedia amoris* (one book), a kind of recantation of the *Ars amatoria.* To the second division belong (6) the fifteen books of the *Metamorphoses,* and (7) the six books of the *Fasti,* which was originally intended to be in twelve books, but which breaks off the account of the Roman calendar with the month of June. To the third division belong (8) the five books of the *Tristia,* (9) the *Ibis,* an invective against an enemy who had assisted to procure his fall, written in elegiac couplets probably soon after his exile; (10) the four books of *Epistulae ex Ponto.* Of these the first three were published soon after the *Tristia,* while the fourth book is a collection of scattered poems published by some friend soon after the author's death. The *Halieutica* is a didactic fragment in hexameters on the natural history of fishes, of doubtful genuineness, though it is certain that Ovid did begin such a work at the close of his life.[1]

In his extant works Ovid confined himself to two metres—the elegiac couplet and the hexameter. The great mass of his poetry is written in the first; while the *Metamorphoses* and the *Halieutica* are composed in the second. Of the elegiac couplet he is the acknowledged master. By fixing it into a uniform mould he brought it to its highest perfection; and the fact that the great mass of elegiac verse written subsequently has endeavoured merely to reproduce the echo of his rhythm is evidence of his pre-eminence. In the direct expression and illustration of feeling his elegiac metre has more ease, vivacity and sparkle than that of any of his predecessors, while he alone has communicated to it, without altering its essential characteristic of recurrent and regular pauses, a fluidity and rapidity of movement which make it an admirable vehicle for pathetic and picturesque narrative. It was impossible for him to give to the hexameter greater perfection, but he imparted to it also a new character, rapid, varied, animated in complete accord with the swift, versatile and fervid movement of his imagination. One other proof he gave of his irrepressible energy by composing during his exile a poem in the Getic (Gothic) language in praise of the imperial family, the loss of which, whatever it may have been to literature, is much to be regretted in the interests of philology.

It was in Ovid's writings that the world of romance and wonder created by Greek imagination was first revealed to modern times. His influence was first felt in the literature of the Italian Renaissance. But in the most creative periods of English literature he seems to have been read more than any other ancient poet, not even excepting Virgil, and it was on minds such as those of Marlowe, Spenser, Shakespeare, Milton and Dryden that he acted most powerfully. His influence is equally unmistakable during the classical era of Addison and Pope. The most successful Latin verse of modern times has been written in imitation of him; the faculty of literary composition and feeling for ancient Roman culture has been largely developed in the great schools of England and France by the writing of Ovidian elegiacs. His works afforded also abundant stimulus and materials to the great painters who flourished during and immediately after the Renaissance. Thus his first claim on the attention of modern readers is the influence which he has exercised on the development of literature and art; for this, if for no other reason, his works must always retain an importance second only to those of Virgil and Horace.

He is interesting further as the sole contemporary exponent of the last half of the Augustan age, the external aspects and inner spirit of which is known from the works, not of contemporary historians or prose-writers, but from its poets. The successive phases of Roman feeling and experience during this critical period are revealed in the poetry of Virgil, Horace and Ovid. Virgil throws an idealizing and religious halo around the hopes and aspirations of the nascent empire. Horace presents the most complete image of its manifold aspects, realistic, and ideal. Ovid reflects the life of the world of wealth and fashion under the influence of the new court, its material prosperity, its refinement, its frivolity and its adulation. He is the last true poet of the great age of Roman literature, which begins with Lucretius and closes with him. But the type of genius of which he affords the best example is more familiar in modern Italian than in ancient Roman literature. While the serious spirit of Lucretius and Virgil reappeared in Dante, it is Ariosto who may be said to reproduce the light-hearted gaiety and brilliant fancy of Ovid.

Bibliography.—The life of Ovid was first treated systematically by J. Masson, *Ovidii vita ordine chronologico digesta* (1780) (often reprinted, *e.g.*, in Burmann's edition). Modern literature on this subject will be found in Teuffel's *History of Roman Literature* (Eng. trans., ed. 2), § 247, and S. G. Owen's edition of *Tristia,* bk. i. The very numerous manuscripts of Ovid are chiefly of late date, 13th to

[1] Plin. *Hist. Nat.* xxxii. 152.

15th century. The earliest and best are: for the *Heroides*, a Paris ms. of the 9th, a Wolfenbüttel ms. of the 12th and an Eton fragmentary ms. of the 11th century (the *Epistula Sapphus*, found in no early ms., is best preserved in a 13th-century Frankfurt, and a 15th-century Harleian ms.); for the *Amores, Ars amatoria, Remedia amoris*, two Paris mss. of the 9th and 10th century respectively; for the *Medicamina formae*, a Florence ms. (Marcianus) of the 11th; for the *Metamorphoses* two Florence mss. (Marcianus and Laurentianus), and a Naples ms., all of the 11th century; for the *Fasti* two Vatican mss. of the 10th and 11th centuries; for the *Tristia*, a Florence ms. of the 11th; for the *Epistulae ex Ponto*, a fragmentary Wolfenbütten ms. of the 6th, and a Hamburg and two Munich mss. of the 12th; for the *Ibis* a Trinity college, Cambridge, ms. of the 12th; for the *Halieutica*, a Paris ms. of the 9th or 10th, and a Vienna ms. of the 9th century. Important for the text of the *Heroides* and *Metamorphoses* is the interesting paraphrase written in Greek by the monk Maximus Planudes in the latter half of the 13th century at Constantinople; that of the *Heroides* is printed in Palmer's edition of the *Heroides* (1898), that of the *Metamorphoses* in Lemaire's edition of *Ovid*, vol. v, edited by Boissonade. *See* also Gudeman, *De Heroidum Ovidii codice Planudeo* (Berlin, 1888).

Two indepedent *editiones principes* of Ovid were published contemporaneously in 1471, one at Rome, printed by Sweynheym and Pannartz, and one at Bologna by Balthasar Azoguidius: these present entirely different texts. *See* Owen's *Tristium libri*, v. p. lv. ff. The following are the most important editions: those marked with an asterisk have explanatory notes. Of the whole works: *Heinsius-Burmann (1727); *Amar-Lemaire (1820–24); Merkel-Ehwald (1874–88); Riese (1871–89); Postgate's *Corpus poetarum Latinorum*, by various editors (1894), reprinted separately (1898). Of separate works: *Amores*, *Némethy (1907); *Heroides*, Sedlmayer (critical) (1886); *Palmer (1898); *Epistula Sapphus* (separately), *De Vries (1888); *Ars amatoria*, *P. Brandt (1902); *Medicamina formae* (critical), Kunz (1881); *Metamorphoses*, *J. C. Jahn (1821); *Loers (1843); Korn (critical) (1880); *Haupt-Ehwald (1898–1903); Magnus (1914); *R. S. Lang (Oxford, 1927); *Fasti*, *Gierig (1812); Merkel (1841); (critical, with learned prolegomena on the sources, the Roman calendar, etc.); *Keightley (1848); *Paley (1854); *Peter (1889); *Cyril Bailey (Oxford, 1921); *Tristia*, *Loers (1839); S. G. Owen (1889) (critical), with notes and translation (1924); *Bk. i (1885), *Bk. iii (1889); *Cocchia (1900); *Epistulate ex Ponto*, Korn (1868) (critical), Bk. i; *Ellis (1881); *Némethy (1915); *Halieutica*, *Birt, *De Halieuticis Ovidio poetae falso adscriptis* (1878). There is a free verse translation of the *Amores* by Marlowe (*c.* 1600), and Dryden, with other hands under his supervision, published translation of various works between 1683 and 1717.

The special treatises on matters connected with Ovid are very numerous; a fairly complete list up to the time of publication is given in Owen's *Tristia* (critical edition), p. cviii ff.; in Teuffel's *History of Roman Literature* (trans. by Warr) and in Schanz's *Geschichte der römischen Litteratur;* and by Ehwald in the *Jahresbericht über die Fortschritte der classischen Altertumswissenschaft*, xxxi (1884) pp. 157 ff., lxxx (1894) pp. 1 ff., cix (1902) pp. 157 ff. The following deserve special mention. On the history of the text: Ehwald, *Ad historiam carminum Ovidianorum symbolae* (1889); *Kritische Beiträge zu Ovids Epistulae ex Ponto* (1896); Sedlmayer, *Prolegomena ad Heroidas* (1878); Gruppe, *Minos*, pp. 441 ff. (on interpolations). On style: Ovid's diction in connection with other writers—A. Zingerle, *Ovidius und sein Verhältnis zu den Vorgängern* (1869–71); *Martial's Ovid-Studien* (1877); W. Zingerle, *Untersuchungen zur Echtheitsfrage der Heroiden Ovids* (1878); W. Vollgraff, *Nikander und Ovid* (Groningen, 1909 foll.). Peculiarities of Ovid's style: van Iddekinge, *De Ovidii Romani iuris peritia* (1811); Washietl, *De similitudinibus imaginibusque Ovidianis* (1883); M'Crea, *On Ovid's Use of Colour and Colour Terms* (Classical studies in honour of H. Drisler) (1894). Metre: the structure of the Ovidian pentameter examined in relation to the textual criticism—Hilberg, *Gesetze der Wortstellung im Pentameter des Ovid* (1894) (fully reviewed by Ellis, *Classical Review*, ix 157). Literary appreciation: Sellar, *Roman Poets of the Augustan Age;* Lafaye, *Les Métamorphoses d'Ovid et leurs modèles grecs*. Ovid's relation to works of art: Wunderer, *Ovids Werke in ihrem Verhältnis zur antiken Kunst* (1890–91); Engelmann, *Bilder-Atlas zu Ovid's Metamorphosen* (1890). Cause of exile: the most interesting discussion is by Boissier in his *L'Opposition sous les Césars*. *See* also Nageotte, *Ovide, sa vie, ses oeuvres* (1872); Huber, *Die Ursachen der Verbannung des Ovid* (1888). Influence of Ovid upon Shakespeare: T. S. Baynes, *Shakespeare Studies* (1894); pp. 195 ff.; Constable, Shakespeare's "Venus und Adonis," in *Verhältnis zu Ovid's Metamorphosen* (1890). *See* also S. G. Owen, *Ovid and Romance* (1912).

(S. G. O.; X.)

OVIEDO, a maritime province of northern Spain, bounded on the north by the Bay of Biscay, east by Santander, south by León and west by Lugo. Pop. (1940) 836,642; area, 4,207 sq.mi. In popular speech Oviedo is often called by its ancient name of Asturias, which only ceased to be the official title of the province in 1833, when the Spanish system of local government was reorganized. An account of the physical features, history and inhabitants of this region is given under ASTURIAS. Oviedo is rich in forests, coal, streams and waterfalls, greatly contributing to its modern industrial development. The horses of Oviedo rank among the best in Spain. Wild deer, boars and bears were formerly common among the mountains; and the sea coasts, as well as the streams, abound with fish, including salmon and lampreys. The climate is mild and wet; the broken relief hinders cultivation. Although no trace exists of the gold for which Asturias was celebrated under its Roman rulers, Oviedo possesses valuable coal measures, which are worked at Langreo (mun. 43,797), Mieres (9,616, mun. 51,967), Siero (mun. 30,931) and elsewhere. The copper mines near Avilés (10,695, mun. 18,035) and Cangas de Onis (1,932, mun. 9,936) have lost their importance; but lead, magnesia, arsenic, cobalt, lapis lazuli, alum, antimony, jet, marble and rock crystal are found in various parts of the province, while amber and coral are gathered along the coast. There are manufactures of fine textiles, coarse cloth and ribbons in Salas (mun., 13,851), Piloña (mun., 16,948) and Avilés; of paper in Pianton; of porcelain and glass in Gijón (72,053, mun. 101,341), Avilés and Pola de Siero; of arms in Oviedo and Trubia; while foundries and works for the manufacture of agricultural implements, rails and pig iron are numerous. An important highway is the 16th century *Camino real*, or royal road, leading from Gijón to León and Madrid, which cost so much that the emperor Charles V inquired if it were paved with silver. A railway from Madrid to Oviedo, Gijón and Avilés runs through difficult parts of the Cantabrian chain.

Oviedo was the scene of serious uprisings in 1934, and of much fighting in the civil war of 1936–39.

OVIEDO, an episcopal city and capital of the Spanish province of Oviedo; 16 mi. S. of the Bay of Biscay, on the river Nalon, and on the León-Gijón, Oviedo-Trubia and Oviedo-Infiesto railways. Pop. (1940) 51,410 (mun., 82,548). Oviedo is built on a hill rising from a broad and picturesque valley, which is bounded on the north-west by the Sierra de Naranco. Oviedo, founded in the reign of Fruela (762), became the fixed residence of the kings of the Asturias in the time of Alphonso II, and continued to be so until about 924, when the advancing reconquest of Spain from the Moors led them to remove their capital to León. The university was founded by Philip III in 1604. The Gothic cathedral, founded in 1388, occupies the site of a chapel founded in the 8th century, of which only the Camara Santa remains. The Camara Santa (dating from 802) contains the famous *arca* of Oviedo, an 11th century Byzantine chest of cedar, overlaid with silver reliefs of Biblical scenes. In it are preserved two crosses dating from the 8th and 9th centuries. The cathedral library has some old mss., including a deed of gift made by Alpsonso II of Asturias in 812, and a collection of illuminated documents of the 12th century, the *Libro gótico*. Oviedo possesses historic churches, the ancient Santa María de Naranco, San Miguel de Lino, and the church of St. Julian or the Santullano, all of early date. Oviedo is an agricultural centre; other industries are marble quarrying, the manufacture of arms, fabrics, iron goods, leather and matches. In the 1936–39 rebellion, the Nationalists gained control of Oviedo early, but were then besieged by Asturian miners. A Nationalist relief expedition from Galicia lifted the siege Oct. 17, 1936.

OVIEDO Y VALDES, GONZALO FERNANDEZ DE (1478–1557), Spanish historian, was present at the surrender of Granada and saw Columbus previous to his voyage to America. He visited America himself on several occasions in an official capacity. Appointed historiographer of the Indies, Oviedo wrote —besides a romance of chivalry, *Don Claribalte* (1519)—two historical works: *Sumario de la natural y general historia de las Indias* (1526) and *La historia natural y general de las Indias, Islas e Tierra Firme del mar oceano* (1535–57). The latter work embodies a mass of curious information collected at first hand.

OVOLO, in architecture, a convex moulding (*q.v.*), whose profile approximates a quarter circle, a quarter ellipse or a similar curve; known commonly in the building trades as a quarter round. In its elliptical forms it is the characteristic echinus of the Greek Doric order and one of the two regular crowning and bed mouldings of the Ionic and its derivative orders. Its round form is used for the echinus of the Roman Doric order. In carpentry, at

a small scale, it is one of the most common mouldings used to cover a joint in a re-entrant angle, as between a base board and the floor, or between the side of a beam and the ceiling.

OWATONNA, a city of southeastern Minnesota, U.S.A., on the Straight river at an altitude of 1,154 ft., 70 mi. S. of Minneapolis; the county seat of Steele county. It is on federal highways 14, 65 and 218, and is served by the Chicago, Milwaukee, St. Paul and Pacific, the Chicago and North Western, and the Rock Island railways and by bus lines. Pop. (1950) 10,191; (1940) 8,694. It is a trading centre of a farming and dairying region; its industries include co-operative creameries and manufacture of jewellery, tools, ventilating systems and farm implements. It is the home of the Owatonna State school for mentally retarded children (1886) and the town has eight schools; six public, including a high school, Pillsbury academy, a military school for boys, and St. Mary's parochial. Owatonna was settled about 1855, incorporated in 1865 and chartered as a city in 1875.

OWEGO, a village of southern New York, U.S.A., the county seat of Tioga county; on the north bank of the Susquehanna river, 21 mi. W. of Binghamton. It is served by the Erie, the Lackawanna and the Lehigh Valley railways. Pop. 1950 federal census, 5,352. Its factories produce shoes, folding furniture and other products. Owego occupies the site of an Indian village called Ah-wa-ga ("where the valley widens"), which was destroyed by Gen. Clinton in 1779. A white settlement was established in 1785, and the village was incorporated in 1827.

OWEN, JOHN [Ovenus or Audoenus] (*c.* 1560–1622), Welsh epigrammatist, born at Plas Dhu, Carnarvonshire, about 1560, was educated at Winchester school, and at New college, Oxford. He was a fellow of his college from 1584 to 1591, when he became a schoolmaster, first at Trelleck, near Monmouth, and then at Warwick. His perfect mastery of the Latin language brought him the name of "the British Martial."

Owen's *Epigrammata* are divided into twelve books, of which the first four were published in 1606, and the rest at four different times. Owen frequently adapts and alters to his own purpose the lines of his predecessors in Latin verse, and one such borrowing has become celebrated as a quotation, though few know where it is to be found. It is the first line of this epigram:—

> Tempora mutantur, nos et mutamur in illis:
> Quo modo? fit semper tempore peior homo.
> (Lib. I. ad Edoardum Noel, epig. 58.)

This first line is altered from an epigram by Matthew Borbonius, one of a series of mottoes for various emperors, this one being for Lothaire I.

> Omnia mutantur, nos et mutamur in illis:
> Illa vices quasdam res habet, illa vices.

There are editions of the *Epigrammata* by Elzevir and by Didot; the best is that edited by Renouard (2 vols., Paris, 1795). Translations into English, either in whole or in part, were made by Vicars (1619); by Pecke, in his *Parnassi Puerperium* (1659); and by Harvey in 1677, which is the most complete. La Torre, the Spanish epigrammatist, owed much to Owen, and translated his works into Spanish in 1674. French translations of the best of Owen's epigrams were published by A. L. Lebrun (1709) and by Kérivalant (1819).

OWEN, JOHN (1616–1683), English Nonconformist divine, was born at Stadham in Oxfordshire in 1616, and educated at Queen's college, Oxford. He was chaplain and tutor in the families, first of Sir Robert Dormer, and later of Lord Lovelace, but lost his place by siding with parliament in the Civil War. He then lived in Charterhouse yard, in London, and on April 29, 1646, preached, before the Long Parliament, a sermon which showed his tendency towards the tolerant Independent or Congregational system of Church government. He now became pastor at Coggeshall in Essex. He was chosen to preach to parliament on the day after the execution of Charles. Cromwell took him in 1649 as his chaplain to Ireland, where he regulated the affairs of Trinity college, and in 1650 to Scotland, making him chancellor of Oxford (1651), dean of Christ-church (1651–52) and vice-chancellor in 1652.

When Richard Cromwell succeeded his father, Owen lost his vice-chancellorship, and joined the Wallingford House party, throwing his influence on the side of a simple republic as against a protectorate. In March 1660 the Presbyterian party being uppermost, he was deprived of his deanery and returned to Stadham. Driven to London by the Conventicle and Five Mile Acts, he gathered a congregation there; at the revival of the Conventicle Acts in 1670 he drew up a protest to the House of Lords. After the Declaration of Indulgence (1672) he frequently preached in congregations of Independents and Presbyterians, and was in favour with Charles II. and James II. He died at Ealing on Aug. 24, 1683.

See Goold's edition of Owen's *Works* (1850–55); W. Orme, *Memoirs of Owen* (1820); and *The Golden Book of John Owen,* edited with a study of his life by James Moffat (1904).

OWEN, SIR RICHARD (1804–1892), English biologist, was born at Lancaster on July 20, 1804. In 1820 he was apprenticed to a local surgeon and apothecary, and in 1824 he proceeded as a medical student to the university of Edinburgh. After completing his medical course in St. Bartholomew's Hospital, London, where he came under the influence of the eminent surgeon, John Abernethy, he contemplated a professional career; but being induced by Abernethy to accept the position of assistant to William Clift, conservator of the museum of the Royal College of Surgeons, he devoted himself to the more congenial work of scientific research. He prepared an important series of catalogues of the Hunterian collection in the Royal College of Surgeons; and in the course of this work acquired the unrivalled knowledge of comparative anatomy which facilitated his researches on the remains of extinct animals. In 1836 he was appointed Hunterian professor in the Royal College of Surgeons, in 1849 he succeeded Clift as conservator, and in 1856 he became superintendent of the natural history department of the British Museum. He then devoted his energies to a scheme for a National Museum of Natural History, which eventually resulted in the removal of the natural history collections of the British Museum to a new building at South Kensington, the British Museum (Natural History). He retained office until the completion of this work in 1884, when he received the K.C.B., and thenceforward lived in retirement at Sheen Lodge, Richmond Park, until his death on Dec. 18, 1892.

While occupied with cataloguing the Hunterian collection, Owen seized every opportunity of dissecting fresh subjects. He had the privilege of investigating the animals which died in the Zoological Society's gardens; and when that society began to publish scientific proceedings in 1831, he was the most voluminous contributor of anatomical papers. His first notable publication, however, was his *Memoir on the Pearly Nautilus* (1832), which was soon recognized as a classic. Henceforth he continued to make important contributions to every department of comparative anatomy and zoology for over fifty years. Among Entozoa his most noteworthy discovery was that of *Trichina spiralis* (1835), the parasite infesting the muscles of man in the disease now termed trichinosis. (*See* also, however, the article on Paget, Sir James.) He also studied the Brachiopoda, Mollusca and he proposed the universally-accepted subdivision of the Cephalopoda into the two orders of Dibranchiata and Tetrabranchiata (1832). The problematical Arthropod *Limulus* was also the subject of a special memoir by him in 1873.

Owen's technical descriptions of the Vertebrata were still more numerous and extensive than those of the invertebrate animals. He not only studied existing forms, but also devoted great attention to the remains of extinct groups, and immediately followed Cuvier as a pioneer in vertebrate palaeontology. Early in his career he made exhaustive studies of teeth, both of existing and extinct animals, and published his work on *Odontography* (1840–1845). Most of his work on reptiles related to the skeletons of extinct forms, and his chief memoirs on British specimens were reprinted in a connected series in his *History of British Fossil Reptiles* (4 vols., 1849–1884). He also wrote widely on extinct birds. With regard to living mammals, the more striking of Owen's contributions relate to the monotremes, marsupials, and the anthropoid apes. Most of his writings on mammals, however, deal with extinct forms. Sir Thomas Mitchell's discovery of fossil bones in New South Wales provided material for the first of Owen's long series of papers on the extinct mammals of Australia,

which were eventually reprinted in book-form in 1877.

Owen's detailed memoirs and descriptions require laborious attention in reading, on account of their nomenclature and ambiguous modes of expression. But it must be remembered that he was a pioneer in concise anatomical nomenclature.

Besides the above mentioned works, Owen wrote: *Comparative Anatomy and Physiology of Vertebrates* (3 vols., 1866–68); *History of British Fossils, Mammals and Birds* (1844–46); *Monograph of the Fossil Mammalia of the Mesozoic Formations* (Paleont. Soc., 1871); *Antiquity of Man as deduced from the Discovery of a Human Skeleton* (1884). *Catalogue of the Fossil Reptilia of South Africa* (1876); *Archetype and Homologies of the Vertebrate Skeleton* (1848).

OWEN, ROBERT (1771–1858), British reformer and Socialist, was born at Newtown, Montgomeryshire, on May 14, 1771. His father had a small business in Newtown as saddler and ironmonger, and there young Owen received his school education, which terminated at the age of nine. After serving in a draper's shop for some years he settled in Manchester, where his success was rapid. When only 19 years of age he became manager of a cotton mill in which 500 people were employed, and by his administrative intelligence and energy soon made it one of the best establishments of the kind in Great Britain. In this factory Owen used the first bags of American sea-island cotton ever imported into the country; it was the first sea-island cotton from the Southern States. Owen also made improvements in the quality of the cotton spun; and indeed there is no reason to doubt that at this early age he was the first cotton-spinner in England, a position entirely due to his own capacity and knowledge of the trade. On becoming manager and partner in the Chorlton Twist Company at Manchester, Owen induced his partners to purchase the New Lanark mills, and after his marriage with Miss Dale, the daughter of the former proprietor, he settled there as manager and part-owner. Encouraged by his great success in Manchester, he had already formed the intention of conducting New Lanark on higher principles than the current commercial ones.

Connected with the mills were about 2,000 people, 500 of whom were children, brought, most of them, at the age of five or six from the poorhouses and charities of Edinburgh and Glasgow. The children especially had been well treated by Dale, but the general condition of the people was unsatisfactory. Crime and vice bred by demoralizing conditions were common; education and sanitation were alike neglected; and housing conditions were intolerable. It was this population which Owen set himself to elevate and ameliorate. He greatly improved their houses, and mainly by his personal influence trained them to habits of order, cleanliness and thrift. He opened a store, where the people could buy goods of the soundest quality at little more than cost price; and the sale of drink was placed under the strictest supervision. His greatest success, however, was in the education of the young, to which he devoted special attention. The first infant school in Great Britain was started, or rather evolved, by James Buchanan, with Owen's approval and support, at the New Lanark mills, and though earlier experiments had been made abroad, the new creation probably owed nothing to them.

In all these plans Owen obtained success. Though at first regarded with suspicion as a stranger, he soon won the confidence of his people. The mills continued to be a commercial success, but some of Owen's schemes involved considerable expense, which was displeasing to his partners. Tired at last of the restrictions imposed on him by men who wished to conduct the business on the ordinary lines, Owen formed a new firm, who, content with 5% of return for their capital, were ready to give freer scope to his philanthropy (1813). In this firm Jeremy Bentham and the well-known Quaker, William Allen, were partners. In the same year Owen published *A New View of Society, or Essays on the Principle of the Formation of the Human Character*, in which he expounded the principles on which his system of educational philanthropy was based. From an early age he had lost all belief in the prevailing forms of religion, and had thought out a creed for himself, which he considered an entirely new and original discovery. The chief points in this philosophy were that man's character is formed by circumstances over which he had no control and that he is not a proper subject either of praise or blame. These convictions led Owen to the conclusion that the great secret in the right formation of man's character is to place him under the proper influences from his earliest years. The irresponsibility of man and of the effect of early influences are the keynote of Owen's whole system of education and social amelioration.

Owen's new views theoretically belong to an old system of philosophy; his originality is to be found in his application of them. For the next few years Owen's work in New Lanark continued to have a national and even European significance. New Lanark itself became a much frequented place of pilgrimage for social reformers, statesmen, and royal personages, including Nicholas, afterwards emperor of Russia. According to the unanimous testimony of all who visited it, the results achieved by Owen were singularly good. The children brought up on his system, which included instruction through the eye as well as the ear, country walks, nature study, singing and dancing, were graceful, genial and unconstrained; health, plenty and contentment prevailed; and the business was a commercial success.

In 1815 Owen started, apparently single-handed, an agitation for factory reform. He drafted a bill to apply to all textile factories, prohibiting employment before ten years of age, and night-work before 18, limiting hours for those under 18 to 10½ a day, and providing for inspection. He failed to gain support from his fellow employers in Scotland, but found influential sympathizers in London, and the bill was introduced into parliament. There it was so emasculated that, after two sessions, Owen ceased to work for it, and disclaimed all responsibility for the mutilated measure passed in 1819. Hitherto Owen's work had been that of the practical reformer, whose distinction was the originality and ceaseless unselfishness of his methods. It was in 1817 that he first put forward the ideas which made him the forerunner of Socialism and Co-operation. These ideas were embodied in a report communicated to the committee of the House of Commons on the poor law.

The general misery and stagnation of trade consequent on the termination of the Napoleonic Wars was engrossing the attention of the country. After clearly tracing the special causes connected with the war which had led to such deplorable conditions, Owen pointed out that the permanent cause of distress was to be found in the competition of human labour with machinery, and that the only effective remedy was the united action of men, and the subordination of machinery. His proposals for the treatment of pauperism were based on these principles. He recommended that communities of about 1,200 persons each should be settled on quantities of land from 1,000 to 1,500 ac., all living in one large building in the form of a square, with public kitchen and mess-rooms. Each family should have its own private apartments, and the entire care of the children till the age of three, after which they should be brought up by the community, their parents having access to them at meals and all other proper times. These communities might be established by individuals, by parishes, by counties, or by the State; in every case there should be supervision by duly qualified persons. Work, and the enjoyment of its results, should be in common. The size of his community was no doubt suggested by his village of New Lanark; and he soon advocated such a scheme for the reorganization of society in general. In its fully developed form it was as follows. He desired that communities of from 500 to 3,000, mainly agricultural but possessing the best machinery, and being, as far as possible, self-contained, "should increase in number, unions of them federatively united shall be formed in circles of tens, hundreds and thousands," till they should embrace the whole world in a common interest.

His plans for the cure of pauperism were received at first with considerable favour. The *Times* and *Morning Post* and many of the leading men of the country countenanced them, one of his most steadfast friends being the duke of Kent, father of Queen Victoria. But at a large meeting in London, Owen declared his hostility to the received forms of religion. After this act of defiance his theories became suspect to the ruling classes though he did not lose all support from them. The radicals were intent

on political reform, which seemed to Owen on the wrong lines. His point of view was that machinery had come to stay and made social control of industry necessary to prevent the oppression and poverty of the workers. When he found there was no hope of Government action he turned to groups of sympathizers to carry out his plan of self-contained Communities. In 1825 he bought 30,000 ac. of land in Indiana, U.S.A., from the Rappite religious community, and re-named it New Harmony. There was no effective choice of colonists, and some necessary trades were inadequately represented. For a time the community life was well ordered and contented under Owen's practical guidance, and a constitution was adopted within a year, based on community of property and a representative government. But differences about the form of government and religion soon appeared, and all the numerous attempts at reconstruction failed to compose them, though there is a consensus of testimony to the admirable spirit which prevailed amidst all the dissensions. The community was wound up in 1828, and Owen lost £40,000—four-fifths of his fortune. The other chief Owenite Community experiments were at Queenwood, Hants (1839–45), in which Owen took part for three years; and Orbiston, near Glasgow (1825–28) and Ralahine in Ireland (1831–33), with neither of which he was directly concerned.

In 1828, after a long period of friction with William Allen and some of his other partners, Owen resigned all connection with New Lanark, and made his headquarters in London. Before he established New Harmony, U.S.A., he had begun to turn to the workers for support for his ideas. In his *Report to the County of Lanark* (a body of landowners) in 1820, he declared definitely that not reforms but a transformation of the social order was required. The appeal of such a doctrine to the workers is obvious. From 1820, his proposals for communities attracted the younger workers, brought up under the factory system, and between 1820 and 1830 numerous societies were formed and papers started to advocate his views. The growth of trade unionism and the emergence of a working-class point of view caused Owen's doctrines to be accepted as the expression of the workers' aspirations. When he returned to England in 1829 he found himself regarded as their leader. In the trade unions, Owenism stimulated the formation of self-governing workshops, and their need for a market led to the formation of "The Equitable Labour Exchange" in 1832.

Here Owen applied his principle that labour is the source of all wealth. Prices were calculated according to the cost of raw material and the time expended in making the article, and "Labour Notes" were used as the currency for dealings with the Exchange. After a few months of prosperity, rapacious demands from the landlord and the fact that the prices did not correspond with real exchange value brought the Labour Exchange to an end. The unprecedented growth of trade unions made it seem possible that the separate industries and eventually all industry might be organized by these bodies. Owen and his followers carried out an ardent propaganda all over the country, with the result that the new National Operative Builders Union turned itself into a Guild to carry on the building industry, and the Grand National Consolidated Trades Union was formed (1833–4). The enthusiasm and the numbers joining were remarkable, but the determined opposition of the employers and the severe repression by the Government and law courts, ended the movement in a few months. It was two generations before socialism, which was first popularly discussed at this time, again influenced trade unionism.

Throughout these years Owen's community ideas maintained their hold. From 1825 numerous co-operative societies for mutual trading were organized by Owen's followers, the profits being accumulated to provide funds for starting Owenite communities. Although the communities did not materialize, these short-lived co-operative stores showed that co-operative trading was possible and started the idea of using it as a means of changing the social system. They thus performed an important part in preparing the ground for the world-wide Consumers' Co-operative Movement which sprang from the Rochdale Pioneers Co-operative Society founded in 1844. These Pioneers were inspired by Owen's teaching, though their method of organizing production to supply their own needs developed on very different lines from his communities.

After 1834, Owen devoted himself to preaching his educational, moral, rationalist and marriage reform ideas. He formed the Association of All Classes of All Nations, and he was untiring in writing and speaking. His love of children and his great personal charm impressed all who came in contact with him up to the end of his life. At the age of 82, he became a spiritualist. He died on a visit to his birthplace, Newtown, on Nov. 17, 1858, his last act, the day before his death, being to draw up a plan for re-organizing the education of the town. He was buried at Newtown, and a memorial tablet was erected on his grave in 1902 by the Co-operative Union.

Robert Owen's four sons all became American citizens. The eldest, ROBERT DALE OWEN (1801–1877), sat in Congress (1844–47), and drafted the bill founding the Smithsonian Institution. In the Indiana House of Representatives, 1836–39 and 1851–52, and Constitutional Convention, 1850, he was instrumental in securing a married woman's property law, a common free school system, and more freedom in divorce. From 1853 to 1858 he was United States ambassador to Naples. He was a strong believer in spiritualism.

Of R. Owen's numerous works in exposition of his system, the most important are the *New View of Society;* the *Report* communicated to the Committee on the Poor Law; *The Report to the County of Lanark;* the *Book of the New Moral World;* and *Revolution in the Mind and Practice of the Human Race.* See *Life of Robert Owen written by himself* (1857), and *Threading my Way, Twenty-seven Years of Autobiography,* by R. D. O. (1874). There are also *Lives* of Owen by A. J. Booth (1869), W. L. Sargant (1860), Lloyd Jones (1889), F. A. Packard (Philadelphia, 1866), F. Podmore (1906) and G. D. H. Cole (with bibliography 1925). *See* also H. Simon, *Robert Owen: sein Leben und seine Bedeutung für die Gegenwart* (Jena, 1905); E. Dolléans, *Robert Owen* (Paris, 1905); G. J. Holyoake, *History of Co-operation in England* (1906); Leonard Woolf, *Co-operation and the Future of Industry* (1919) and the article COMMUNISM.

OWENSBORO, a city of Kentucky, U.S., the county seat of Daviess county; on the Ohio river and federal highway 60, 114 mi. S.W. of Louisville. It is served by the Illinois Central and Louisville and Nashville railroads, motorbus lines and river steamers.

There is a vehicular bridge across the Ohio river from the centre of the city. Pop. (1950) 33,651; (1940) 30,245; (1920) 17,424, by the federal census. It is an important market for tobacco as well as corn, wheat, potatoes, dairy and poultry products and livestock. Its manufactures are varied and important. It is the centre of a gas and oil field.

The city has a commission form of government. The site of Owensboro was known to the early boatmen of the Ohio as Yellow Banks. The first cabin was built in 1799. The town was laid out for the county seat in 1815 and named Rossborough.

In 1817 it was incorporated under the present name, after Col. Abraham Owen (1769–1811), but the old name of Yellow Banks clung to it until the '40s. It was chartered as a city in 1866.

OWEN SOUND, a city and port of entry in Ontario, Can., and capital of Grey county, situated 120 mi. N.W. of Toronto, on Sydenham river and Georgian bay. Pop. (1951) 16,204. It is the terminus of branches of the Canadian Pacific and Canadian National railways, and of the Canadian Pacific and other steamship lines plying to ports on Lakes Huron and Superior. The sound is 12 mi. long and 5 mi. wide; the port harbour is one of the best on Lake Huron and navigable by lake vessels of the largest size.

It is a flourishing town, containing shipbuilding yards and manufactories of mill machinery, agricultural implements, furniture and sewing machines. There are flour mills, sawmills and tanneries. Large terminal grain elevators facilitate transshipment of western Canada grain from steamer to rail.

OWL, the general name for the nocturnal birds of prey. The owls form a very natural assemblage, and this suborder, *Striges,* is not closely related to the hawks and eagles. Owls vary in length from 5 in. in *Glaucidium cobanense* to more than 2 ft. The plumage is very soft, rendering the flight noiseless. On each side of the base of the beak are several rows of small, curved, stiff-shafted feathers, which form a ruff to support the long feathers of the

"disc" or space around the eyes. The ears are large, with well-developed, and often asymmetrical folds of skin, so that the right and left ears may be differently shaped. Many species of owl show two phases of coloration—one in which the brown inclines to red, the other in which it inclines to gray. The outer toes of all owls are reversible. Unlike most birds, owls incubate from the laying of the first egg.

The type of the family *Aluconidae* is the tawny owl (*Strix aluca*), found throughout Europe and in Asia Minor, Palestine and Barbary. A woodland bird, it feeds largely on rats, mice, voles and shrews. Allied species are found in America, northern Europe and Asia. The remaining owls form the family *Strigidae*.

SPOTTED OWL (SYRNIUM OCCIDENTALE) OF WESTERN U.S.

The eagle owl, *Bubo ignavus*, ranges over most of Europe and Asia north of the Himalayas. The allied *B. virginianus* extends over all North America. They are sombre-coloured birds and among the largest species. Equally large is the snowy owl (*Nyctea scandiaca*), a circumpolar species with white plumage. In winter it migrates southward. The long- and short-eared owls (*Asio otus* and *A. accipitrinus*) are common to the northern parts of Europe and America; the latter, often seen abroad in the daytime, preferring open country, also extending into North Africa, all South America and Hawaii. The long-eared owl keeps to woods. Both possess erectile tufts on the side of the head. *Speotyto cunicularia* of America lives in burrows, frequently sharing those of the prairie dog and biscacha. The bird of Pallas Athene is *Athene noctua*, the little owl of Europe, which was introduced into Great Britain, where it spread rapidly. *A. brama* replaces it in India. The American screech owl (*Megascops asio*), in its numerous varieties, is found practically throughout North America except at the far north. It varies much in colour and size. It can be distinguished from other owls at night by its peculiar screams, snarls and hisses.

OWOSSO, a city of Shiawassee county, Mich., U.S., 33 mi. N.E. of Lansing, on the Shiawassee river. It was the home of Thomas E. Dewey and J. O. Curwood. It is served by the Ann Arbor, the Grand Trunk and the Michigan Central railways and by bus lines. The population was 15,948 in 1950 and was 14,424 in 1940. It is division point for the Ann Arbor railroad, which has repair shops there, and Indian Trails bus lines. It is the trade centre of a rich agricultural county and has many diversified industries. Industries include electric motors, batteries, sandpaper, screen doors, snow shovels and furniture. The city was founded in 1833 and chartered in 1859.

OX, strictly speaking, the Saxon name for the males of domesticated cattle (*Bos taurus*), but in a zoological sense employed so as to include not only the extinct wild ox of Europe but likewise bovine animals of every description; that is to say, true oxen, bison and buffaloes. The characteristics of the subfamily Bovinae, or typical section of the family Bovidae, are given in the article BOVIDAE; for the systematic position of that family *see* PECORA. For the typical oxen, as represented by the existing domesticated breeds, *see* CATTLE.

OXALIC ACID, the simplest dibasic organic acid. It is one of the strongest organic acids. Its formula is $(COOH)_2$, or, in its usual form of crystalline hydrate, $(COOH)_2.2H_2O$. Its occurrence in wood sorrel (*Oxalis acetosella*, hence the name) and in sour dock (*Rumex acetosa*) in the form of its potassium salt was known at the beginning of the 17th century. Karl W. Scheele in 1776 prepared the acid by oxidizing sugar with nitric acid and showed this acid to be identical with the one derived from sorrel. The existence of oxalates in nature is widespread in both plant and animal kingdoms.

There are four technical methods for the manufacture of oxalic acid: (1) Synthetic sodium formate is heated to 360° C. in the presence of an alkali catalyst to yield hydrogen and sodium oxalate, from which oxalic acid is obtained. (2) Carbohydrates, such as sugar, starch or cellulose, are oxidized with concentrated nitric acid in the presence of a vanadium catalyst to give oxalic acid. The oxides of nitrogen are recovered and reoxidized. (3) Wood waste, such as sawdust, is treated with fused sodium hydroxide to give sodium oxalate. This process became obsolete at the end of the 19th century, but in 1942 a procedure for carrying out this reaction continuously, thereby lowering the cost, was described. (4) Fermentation of sugar solutions by moulds was later developed.

Oxalic acid crystallizes from water as a dihydrate in monoclinic prisms melting at 101.5° C. Heated at 100° C. it readily loses its water of crystallization. The anhydrous acid begins to sublime below 100° C. and sublimes rapidly above 125° C. The anhydrous acid may be recrystallized from glacial acetic acid and melts at 189.5° C. It has been used as a condensing agent. When heated more strongly, oxalic acid decomposes into carbon dioxide, carbon monoxide and water. The decomposition to carbon dioxide and formic acid is an intermediate stage in this reaction. Dehydrating agents such as sulphuric acid accelerate the thermal decomposition of oxalic acid. Oxalic acid heated with glycerine at 100° C. gives formic acid and carbon dioxide. At higher temperatures allyl alcohol is formed. Electrolytic reduction of oxalic acid at lead or mercury cathodes yields glycollic acid. At low temperatures glyoxylic acid may be obtained as an intermediate stage. Permanganates in acid solution oxidize oxalic acid to carbon dioxide and water. The reaction is autocatalytic. It is of great importance in analytical chemistry. In the presence of uranyl salts, oxalic acid undergoes photochemical decomposition. This reaction has found application in actinometry. Oxalic acid may be characterized by the following spot test: a fragment, melted with a little diphenylamine in a micro test tube, is heated over a free flame. The melt is then dissolved in a drop of alcohol. Formation of aniline blue shows the presence of an oxalate. Deutero-oxalic acid and its deuterate have been prepared and studied.

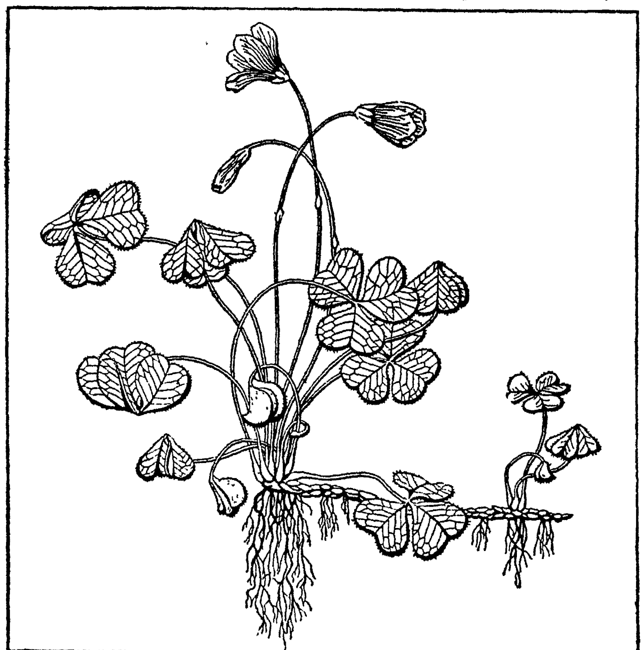
Oxalic acid is widely used as a laundry sour, where, in addition to neutralizing alkalinity, it is unusually effective in removing rust and ink stains since it forms a complex ferrioxalate ion with iron. Oxalic acid together with a small amount of added corrosion inhibitor is the chief constituent of the many automobile radiator scale removers now on the market. These two uses consume a large part of the oxalic acid of commerce. It is also employed as an electrolyte in the anodic oxidation of aluminum, as a bleaching agent for straw, cork and rosin, as a wash for anthracite coal which has been too long in storage and as a precipitant for rare earths. It is often used where an acid in solid, water-soluble, nonhygroscopic form is desired, as in printing of cloth, photography, etc. The sodium salt is used in pyrotechnics, as an anti-flash agent in artillery ammunition and in chrome tanning to increase the amount of chromium taken up by the hide. The iron salt is used in the manufacture of blueprint paper, the tin and antimonyl salts in printing and dyeing.

Oxalic acid is poisonous. The antidotes for oxalic acid poisoning are milk of lime, chalk, whiting or even wall plaster, followed by evacuation brought about by an enema or castor oil. Only the salts of the alkali metals are soluble in water. Beside the ordinary acid and neutral salts, a series of salts called tetraoxalates is known, these being salts containing one molecule of acid salt, in combination with one molecule of acid; one of the most common is "salt of sorrel," $KHC_2O_4.H_2C_2O_4.2H_2O$. The oxalates are readily decomposed when heated, leaving a residue of carbonate, or oxide of the metal. The silver salt decomposes with explosive violence, leaving a residue of the metal.

Potassium ferrous oxalate, $FeK_2(C_2O_4)_2.H_2O$, is a strong reducing agent and is used as a photographic developer. Potassium ferric oxalate, $FeK_3(C_2O_4)_3$, is used in the preparation of platinotypes, owing to the fact that its solution is rapidly decomposed by sunlight, $2FeK_3(C_2O_4)_3 = 2FeK_2(C_2O_4)_2 + K_2C_2O_4 + 2CO_2$. Ethyl oxalate, $(CO.OC_2H_5)_2$, prepared by boiling anhydrous oxalic acid with absolute alcohol, is a colourless liquid which boils at 186° C. Methyl oxalate, $(CO.OCH_3)_2$, which is prepared in a similar manner, is a solid melting at 54° C. It is used in the preparation of pure methyl alcohol. Oxalyl chloride, a liquid boiling at 64° C. (m.p. −12° C.), has been obtained by the action of phosphorus pentachloride on anhydrous oxalic acid. Oxamic acid,

$HO_2C.CONH_2$, is obtained by heating acid ammonium oxalate or by boiling oxamide with ammonia; it is among the products produced when amino acids are oxidized with potassium permanganate. It is a crystalline powder difficultly soluble in water and melting at 210° C. (with decomposition). Its ethyl ester, known as oxamethane, crystallizes in rhombic plates which melt at 114–115° C. Oxamide, $(CONH_2)_2$, is best prepared by the action of ammonia on the esters of oxalic acid. It is also obtained by the action of hydrogen peroxide on hydrocyanic acid, or of manganese dioxide and sulphuric acid on potassium cyanide. It is a white crystalline powder which is almost insoluble in cold water. It melts at 417–419° C. (with decomposition) when heated in a sealed tube (A. Michael, 1895). When heated with phosphorus pentoxide it yields cyanogen. It is readily hydrolysed by hot solutions of the caustic alkalies. Substituted oxamides are produced by the action of primary amines on ethyl oxalate.

OXALIS, a large genus of small herbaceous plants, comprising, with a few small allied genera, the family Oxalidaceae. The name is derived from Gr. ὀξύς, acid, the plants being highly acid to the taste. The genus contains about 800 species, chiefly South African and tropical and South American. It is represented in Great Britain and eastern North America by the wood-sorrel (*O. acetosella*), a small, stemless plant with radical, trefoil-like leaves growing from a creeping, scaly rootstock, and the flowers borne singly on an axillary stalk; the flowers are regular with five sepals, five obovate, white, purple-veined, free petals, ten stamens and a central five-lobed, five-celled ovary with five free styles. The fruit is a capsule, splitting by valves; the seeds have a fleshy coat, which curls back elastically, ejecting the true seed. The leaves, as in the other species of the genus, show a "sleep-movement," becoming pendulous at night. Besides the wood-sorrel, some 20 other species occur in North America, among which are the yellow wood-sorrel (*O. stricta*), of the eastern United States and Canada, with yellow flowers; the violet wood-sorrel (*O. violacea*), of the eastern United States, with rose-purple flowers; the



WOOD SORREL (OXALIS ACETOSELLA)

redwood wood-sorrel (*O. oregana*), of the coast redwood belt from California to Oregon with pink to white flowers and *O. cernua,* known as Bermuda buttercups, with showy yellow flowers, native to South Africa and naturalized in Florida and the Bermudas. *Oxalis crenata,* the oca of South America, is a tuberous-rooted half-hardy perennial, native of Peru. Its tubers are comparatively small, and somewhat acid; but if they be exposed in the sun from 6 to 10 days they become sweet and floury. *Oxalis deppei,* a bulbous perennial of Mexico, has scaly bulbs, from which are produced fleshy, tapering, white, semi-transparent, edible roots, about 4 in. in length and 3 to 4 in. in diameter.

Various species are in cultivation as basket plants for window gardens, border plants and hot house ornamentals. *See* R. Knuth, "Oxalidaceae," *Pflanzenreich* 95 (iv, 130): 1–481, fig. 1–28 (1930).

OXENSTJERNA, COUNT AXEL GUSTAFSSON (1583–1654), chancellor of Sweden, was born at Fånö, and was educated with his brothers at the universities of Rostock, Jena and Wittenberg. On returning home in 1603 he was appointed *kammerjunker* to King Charles IX. In 1606 he was entrusted with his first diplomatic mission, to Mecklenburg, was appointed a senator during his absence, and henceforth became one of the king's most trusted servants. In 1610 he was sent to Copenhagen to prevent a war with Denmark. This unsuccessful embassy marks the beginning of Oxenstjerna's long diplomatic struggle with Sweden's traditional rival in the north. Oxenstjerna was appointed a member of Gustavus Adolphus's council of regency. High aristocrat as he was, he would at first willingly have limited the royal power. An oligarchy guiding a limited monarchy was his ideal government, but the genius of the young king was not to be fettered. On Jan. 6, 1612, he was appointed chancellor. His controlling, organizing hand was speedily felt in every branch of the administration. For his services as first Swedish plenipotentiary at the Peace of Knäred, 1613, he was richly rewarded.

During the frequent absences of Gustavus in Livonia and Finland (1614–1616) Oxenstjerna acted as his vice-regent. It was his principal duty during the king's Russian and Polish wars to supply the armies and the fleets with everything necessary, including men and money. In 1622 he accompanied Gustavus to Livonia, where Oxenstjerna was appointed governor-general and commandant of Riga. His services in Livonia were rewarded with four castles and the whole bishopric of Wenden. He was entrusted with the peace negotiations which led to the truce with Poland in 1623, and succeeded, by skilful diplomacy, in averting a threatened rupture with Denmark in 1624. On Oct. 7, 1626, he was appointed governor-general of the newly-acquired Prussian province. In 1629 he concluded the truce of Altmark with Poland. In 1628 he had arranged with Denmark a joint occupation of Stralsund, to prevent the fortress from falling into the hands of the Imperialists. After the battle of Breitenfeld (Sept. 7, 1631) he was summoned to assist the king with his counsels and co-operation in Germany. During the king's absence in Franconia and Bavaria in 1632 he was appointed *legatus* in the Rhine lands, with plenipotentiary authority over all the German generals and princes in the Swedish service.

Although he never fought a battle, Oxenstjerna was a born strategist. His military capacity was strikingly demonstrated by the skill with which he conducted large reinforcements to Gustavus through the heart of Germany in the summer of 1632. But it was only after the death of the king at Lützen that Oxenstjerna's true greatness came to light. He inspired the despairing Protestants both in Germany and Sweden with fresh hopes. He reorganized the government both at home and abroad. He united the estates of the four upper circles into a fresh league against the common foe (1634), in spite of the envious and foolish opposition of Saxony. By the patent of Jan. 12, 1633, he had already been appointed legate plenipotentiary of Sweden in Germany with absolute control over all the territory already won by the Swedish arms. No Swedish subject, either before or after, ever held such an unrestricted and far-reaching authority. Richelieu himself declared that the Swedish chancellor was "an inexhaustible source of well-matured counsels."

Less original but more sagacious than the king, he had a firmer grasp of the realities of the situation. Gustavus would not only have aggrandized Sweden, he would have transformed the German empire. Oxenstjerna wisely abandoned these vaulting ambitions. All his efforts were directed towards procuring for the Swedish crown adequate compensation for its sacrifices. Simple to austerity in his own tastes, he nevertheless recognized the political necessity of impressing his allies and confederates by an almost regal show of dignity; and at the abortive congress of Frankfort-on-Main (March 1634), held for the purpose of uniting all the German Protestants, Oxenstjerna appeared in a carriage drawn

by six horses, with German princes attending him on foot. But from first to last his policy suffered from the slenderness of Sweden's material resources, a cardinal defect which all his craft and tact could not altogether conceal from the vigilance of her enemies. The success of his system postulated an uninterrupted series of triumphs, whereas a single reverse was likely to be fatal to it. Thus the frightful disaster of Nördlingen (Sept. 6th, 1634; *see* SWEDEN: *History*) compelled him to solicit direct assistance from France. But he refused at the conference of Compiègne (1635) to bind his hands in the future for the sake of some slight present relief. In 1636, however, he concluded a fresh subsidy-treaty with France at Wismar.

The same year he returned to Sweden and took his seat in the Regency. For the next nine years his voice, especially as regarded foreign affairs, was omnipotent in the council of state. He drew up beforehand the plan of the Danish War of 1643–1645, so brilliantly executed by Lennart Torstensson, and saw Denmark crippled by the Peace of Brömsebro (1645). His later years were embittered by the jealousy of the young Queen Christina, who thwarted the old statesman in every direction. He always attributed the exiguity of Sweden's gains by the Peace of Osnabrück to Christina's undue interference. Oxenstjerna was opposed at first to the abdication of Christina, because he feared mischief to Sweden from her appointed successor, Charles Gustavus. The extraordinary consideration shown to him by the new king ultimately, however, reconciled him to the change. He died at Stockholm on Aug. 28, 1654.

See *Axel Oxenstjernas skriften och brefvexling* (Stockholm, 1888–1905); A. de Marny, *Oxenstjerna et Richelieu à Compiègne* (Paris, 1878); F. V. Wrangel, *Voyage en France d'Oxenstierna* (1917); *Gabriel Gustafssons bref till Riks Konsler Axel Oxenstjerna, 1611–1640* (Stockholm, 1890).

OXENSTJERNA, COUNT BENGT OR BENEDICT GABRIELSSON (1623–1702) was the son of Axel Oxenstjerna's half-brother, Gabriel Bengtsson (1586–1656). After a careful education he began his diplomatic career at the great peace congress of Osnabrück. During his stay in Germany he made the acquaintance of the count palatine, Charles Gustavus, afterwards Charles X., whose confidence he completely won. Two years after the king's accession (1654), Oxenstjerna was sent to represent Sweden at the *Kreistag* of Lower Saxony In 1655 he accompanied Charles to Poland and was made governor of the conquered provinces of Kulm, Kujavia, Masovia and Great Poland. The firmness and humanity which he displayed in this new capacity induced the German portion of them, notably the city of Thorn, to side with the Swedes against the Poles. During Charles's absence in Denmark (1657), Oxenstjerna, in the most desperate circumstances, tenaciously defended Thorn for ten months; the terms of capitulation were made the basis of the subsequent peace negotiations at Oliva. During the domination of Magnus de la Gardie he played but a subordinate part in affairs. From 1662 to 1666 he was governor-general of Livonia. In 1674 he was sent to Vienna to try and prevent the threatened outbreak of war between France and the empire, and he was one of the Swedish envoys to the Congress of Nijmwegen (1676). From 1680 to 1697 he conducted the foreign relations of Sweden.

His leading political principles were friendship with the maritime powers (Great Britain and Holland) and the emperor, and a close anti-Danish alliance with the house of Holstein. Charles XI. appointed Oxenstjerna one of the regents during the minority of Charles XII. The martial proclivities of the new king filled the prudent old chancellor with alarm and anxiety. He advised Charles in vain to accept the terms of peace offered by the first anti-Swedish coalition. Oxenstjerna has been described as "a shrewd and subtle little man, of gentle disposition, but remarkable for his firmness and tenacity of character."

See F. F. Carlson, *Sveriges historia under Konungarne of Pfalziska huset* (Stockholm, 1883, 1885); O. Sjögren, *Karl den elfte och Svenska folket* (Stockholm, 1897); and *Négociations du comte d'Avaux pendant les années 1693, 1697–1698* (Utrecht, 1882, etc.). (R. N. B.; X.)

OXFORD, EARLS OF, an English title held successively by the families of Vere and Harley. The three most important earls of the Vere line are noticed separately below. The Veres held the earldom from 1142 until March 1703, when it became extinct on the death of Aubrey de Vere, the 20th earl. In 1711 the English statesman Robert Harley was created earl of Oxford (*q.v.*); but the title became extinct in this family on the death of the 6th earl in 1853. It was revived in favour of H. H. Asquith who became earl of Oxford and Asquith (*q.v.*).

OXFORD, EDWARD DE VERE, 17TH EARL (in the Vere line) OF (1550–1604), son of John de Vere, the 16th earl, was born on April 12, 1550. He studied at Queen's and St. John's Colleges, Cambridge. He was known as Lord Bolebec or Bulbeck until he succeeded in 1562 to the earldom and to the hereditary dignity of great chamberlain of England. As a royal ward the boy lived under the care of Lord Burghley, who in 1571 gave him his eldest daughter, Anne, in marriage. Oxford wished for a military or a naval command, but Burghley hoped that he would win a high position at court. His accomplishments secured Elizabeth's favour, but he offended her by going to Flanders without her consent in 1574, and more seriously in 1582 by a duel with one of her gentlemen, Thomas Knyvet. In 1579 he insulted Sir Philip Sidney on the tennis-court at Whitehall.

Sidney challenged Oxford, but the queen forbade him to fight, and required him to apologize on the ground of their difference of rank. On Sidney's refusal and consequent disgrace Oxford is said to have schemed to murder him. The earl sat on the special commission (1586) for the trial of Mary queen of Scots; he took part in the trials of Philip Howard, earl of Arundel, for high treason in 1589, and of Essex and Southampton in 1601. In 1575 he brought back from Italy various inventions for the toilet, and his estate was rapidly dissipated in satisfying his extravagant whims. His first wife died in 1588, and from that time Burghley withdrew his support, Oxford being reduced to the necessity of seeking help among the poor men of letters whom he had befriended. He was a lyric poet of no small merit. His fortunes were partially retrieved on his second marriage with Elizabeth Trentham, by whom he had a son, Henry de Vere, 18th earl of Oxford (1593–1625). He died at Newington, near London, on June 24, 1604.

His poems, from various anthologies—the *Paradise of Dainty Devices, England's Parnassus, Phoenix Nest, England's Helicon*—and elsewhere, were collected by Dr. A. B. Grosart in vol. iv of the Fuller Worthies Library (1876).

OXFORD, JOHN DE VERE, 13TH EARL OF (1443–1513), was second son of John, the 12th earl, a prominent Lancastrian, who, with his eldest son Aubrey de Vere, was executed in February 1462. John de Vere the younger was himself attainted, but two years later was restored as 13th earl. But his loyalty was suspected, and for a short time in 1468 he was in the Tower. He sided with Warwick, the king-maker, in 1469, accompanied him in his exile next year, and assisted in the Lancastrian restoration of 1470–1471. As constable he tried John Tiptoft, earl of Worcester, who had condemned his father nine years before. At the battle of Barnet, Oxford was victorious in command of the Lancastrian right, but was ultimately defeated and escaped to France. In 1473 he organized a Lancastrian expedition, which, after an attempted landing in Essex, seized St. Michael's Mount in Cornwall. After a four months' siege Oxford was forced to surrender in Feb. 1474. He was sent to Hammes near Calais, whence, ten years later, in Aug. 1484, he escaped and joined Henry Tudor in Brittany. He fought for Henry at Bosworth, and was rewarded by restoration to his title, estates and hereditary office of Lord Chamberlain. At Stoke on June 16, 1486, he led the van of the royal army. In 1492 he commanded the expedition to Flanders, and in 1497 was foremost in the defeat of the Cornish rebels on Blackheath. Oxford was high steward at the trial of the earl of Warwick, and one of the commissioners for the trial of Sir James Tyrell and others in May 1502. He died March 10, 1513.

See *The Paston Letters*, ed. J. Gairdner; *Chronicles of London*, ed. C. L. Kingsford (1905); Sir James Ramsay, *Lancaster and York;* and *The Political History of England*, vols. iv and v. (1906).

OXFORD, ROBERT DE VERE, 9th Earl of (1362–1392), English courtier, was the only son of Thomas de Vere, 8th earl of Oxford, and Maud de Ufford, a descendant of King Henry III. He became 9th earl of Oxford in 1371, and married Philippa (d.

1412), daughter of his guardian Ingelram de Couci, earl of Bedford, a son-in-law of Edward III. Already hereditary great chamberlain of England, Oxford was made under Richard II. a member of the privy council and a Knight of the Garter; while castles and lands were bestowed upon him, and he was constantly in the company of the young king. In 1385 Richard sent him to govern Ireland, but although preparations were made for his journey he did not leave England. The king's partiality for Oxford was one of the causes of the dissatisfaction of the barons. Oxford also made powerful enemies by divorcing his wife, Philippa, and by marrying a Bohemian lady.

The king, however, indifferent to the gathering storm, created Vere duke of Ireland in Oct. 1386, and gave him still more powers in that country. Richard was deprived of his authority for a short time, and Vere was ordered in vain to proceed to Ireland. He was then accused by the king's uncle Thomas of Woodstock, duke of Gloucester, and his supporters in 1387; and rushing into the north of England he gathered an army to defend his royal master and himself. At Radcot bridge in Oxfordshire, however, his men fled before Gloucester's troops and Oxford himself escaped in disguise to the Netherlands. In the parliament of 1388 he was found guilty of treason and condemned to death, but as he remained abroad the sentence was never carried out. With another exile, Michael de la Pole, duke of Suffolk, he lived in Paris until after the treaty between England and France in 1389, when he took refuge at Louvain. He was killed by a boar whilst hunting, and left no children.

See T. Walsingham, *Historia Anglicana*, edited by H. T. Riley (London, 1863–64); J. Froissart, *Chroniques*, edited by S. Luce and G. Raynaud (Paris, 1869–97); H. Wallon, *Richard II.* (Paris, 1864); and W. Stubbs, *Constitutional History*, vol. ii. (Oxford, 1896).

OXFORD, ROBERT HARLEY, 1st Earl of (1661–1724), English statesman, commonly known by his surname of Harley, eldest son of Sir Edward Harley (1624–1700), a Herefordshire land-owner, was born in Bow street, London, on Dec. 5, 1661. His school days were passed at Shilton, near Burford, in Oxfordshire, in a small school which produced at the same time a lord high treasurer (Harley), a lord high chancellor (Simon Harcourt) and a lord chief justice of the common pleas (Thomas Trevor). The principles of Whiggism and Nonconformity were instilled into his mind at an early age, and if he changed the politics of his ancestors he never formally abandoned their religious opinions. At the Revolution of 1688 Sir Edward and his son raised a troop of horse in support of the cause of William III., and took possession of the city of Worcester in his interest. Young Harley then (1689) entered parliament for the "pocket" borough of Tregony. Later he sat for New Radnor, a seat which he held until his elevation to the peerage in 1711.

From the first Harley gave great attention to the conduct of public business, and from the general election of Feb. 1701 until the dissolution of 1705 he held the office of speaker. In 1704 he became a principal secretary of State for the northern department. In 1703 Harley first made use of Defoe's talents as a political writer, and this alliance with the press proved so successful that he afterwards called the genius of Swift to his aid in many pamphlets against his political opponents. While he was secretary of State the union with Scotland was effected. At the time of his appointment as secretary of State Harley had given no outward sign of dissatisfaction with the Whigs, and it was mainly through Marlborough's good opinion of his abilities that he was admitted to the ministry. For some time Harley acted loyally with his colleagues. But in the summer of 1707 it became evident to Godolphin that some secret influence behind the throne was shaking the confidence of the queen in her ministers. Abigail Hill, who was secure in the queen's confidence, was Harley's cousin, and his instrument in influencing the queen against her ministers. These bided their time, until an opportunity for Harley's overthrow was provided. A clerk in Harley's department divulged the contents of secret documents in his office, which should have been inaccessible to anyone but the chief, and the queen was thereupon informed that Godolphin and Marlborough could no longer serve in concert with him. They did not attend her next council (Feb. 8, 1708), and the queen found herself forced (Feb. 11) to accept the resignations of both Harley and St. John.

Harley went out of office, but his cousin, who had now become Mrs. Masham, remained at court to further his interests. The cost of the protracted war with France, and the danger to the national church, the chief proof of which lay in the prosecution of Sacheverell, were the weapons which he used to influence the masses of the people. Marlborough himself could not be dispensed with, but his relations were dismissed from their posts in turn. When the greatest of these, Lord Godolphin, was ejected from office, five commissioners to the treasury were appointed (Aug. 10, 1710), and among them figured Harley as chancellor of the exchequer. It was the aim of the new chancellor to frame an administration from the moderate members of both parties, and to adopt with but slight changes the policy of his predecessors; but he failed. By an unexpected event, his popularity was restored at a bound. A French refugee, the ex-abbé de la Bourlie (better known by the name of the marquis de Guiscard), was being examined before the privy council on a charge of treachery, when he stabbed Harley in the breast with a penknife (March 8, 1711). On May 23, 1711, the minister became Baron Harley of Wigmore and earl of Oxford and Mortimer; and immediately afterwards lord treasurer and a Knight of the Garter.

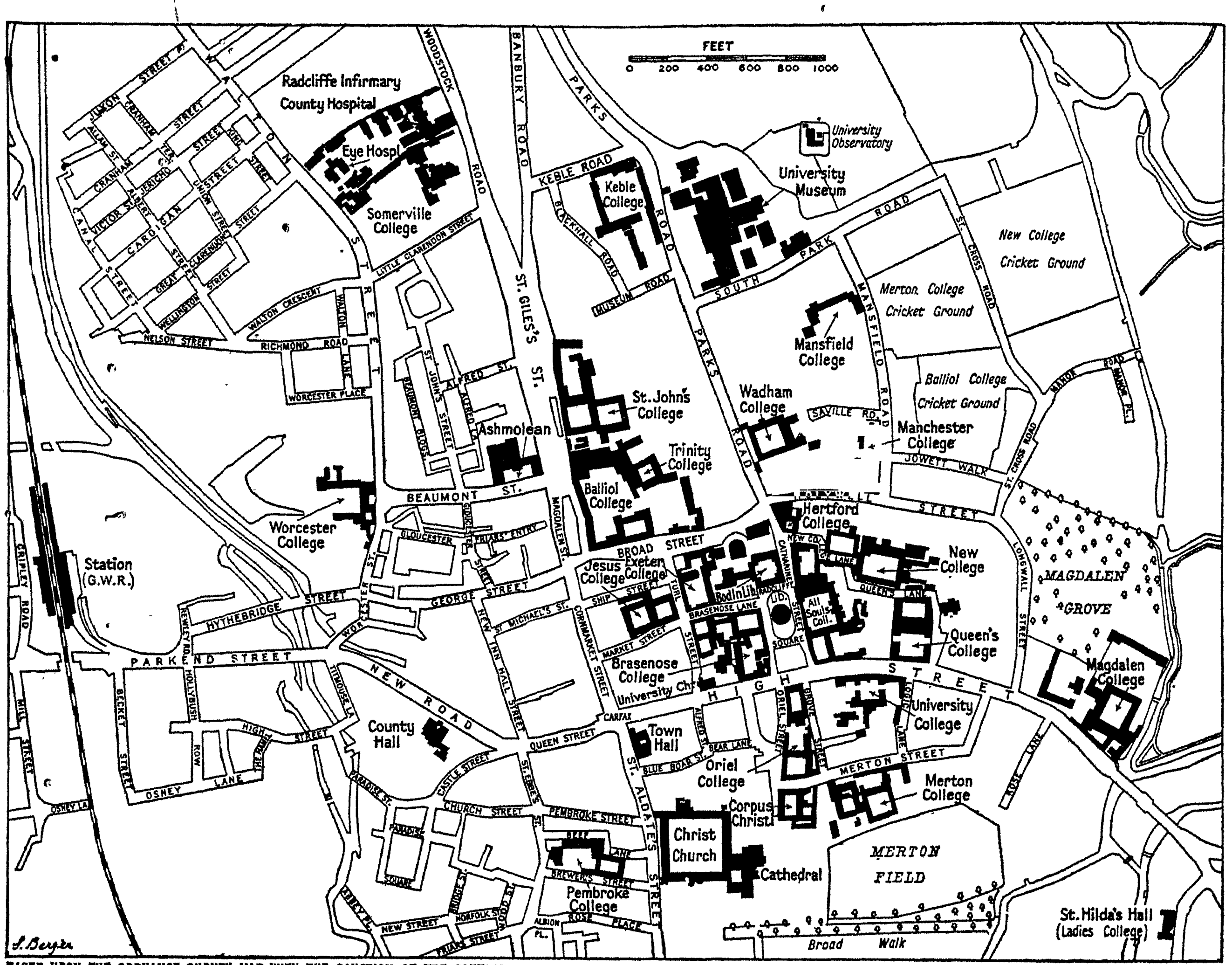
Oxford rearranged the nation's finances, and supplied resources for carrying on the campaign, though his emissaries were in communication with the French king, and were settling the terms of a peace independently of England's allies. After many weeks of vacillation and intrigue, the preliminary peace was signed, and in spite of the opposition of the Whig majority in the Upper House, which was met by the creation of 12 new peers, the treaty of Utrecht was concluded (March 31, 1713). While these negotiations were under discussion the friendship between Oxford and St. John, who had become secretary of State in Sept. 1710, was fast changing into hatred. The latter had resented the rise in fortune which the stabs of Guiscard had secured for his colleague, and when he received a viscounty instead of the expected earldom his resentment knew no bounds. Mrs. Masham deserted her cousin for his more vivacious rival. The Jacobites lost faith in his repeated promises. Queen Anne transferred her confidence from Oxford to Bolingbroke; and he surrendered his office a few days before the queen died.

On the accession of George I. the defeated minister retired to Herefordshire, but a few months later he was committed to the Tower (July 16, 1715). After an imprisonment of nearly two years he was released in July 1717, but he took little part in public affairs, and died almost unnoticed in London on May 21, 1724.

The books and the manuscripts which the first earl of Oxford and his son collected were among the glories of their age. The manuscripts became the property of the nation in 1753 and are now in the British Museum; the books were sold to a bookseller called Thomas Osborne in 1742 and described in a printed catalogue of five volumes (1743–45), Dr. Johnson writing an account of the library. A selection of the rarer pamphlets and tracts, which was made by William Oldys, was printed in eight volumes (1744–46), with a preface by Johnson. The best edition is that of Thomas Park, ten volumes (1808–13). In the recollection of the Harleian manuscripts, the Harleian library and the *Harleian Miscellany*, the family name will never die.

Bibliography.—The best life of Harley is by E. S. Roscoe (1902). Articles relating to him are in *Engl. Hist. Rev.* xv. 238–250 (Defoe and Harley by Thomas Bateson); *Trans. of the Royal Hist. Soc.* xiv. N.S. 69–121 (development of political parties *temp.* Q. Anne by W. Frewen Lord); *Edinburgh Review*, clxxxvii. 151–178, cxciii. 457–488 (Harley papers). For his relations with St. John *see* Walter Sichel, *Bolingbroke* (1901–02, 2 vols.); for those with Swift, consult the *Journal to Stella* and Sir H. Craik, *Life of Swift* (2nd ed., 1894).

OXFORD, the county town of Oxfordshire, England, a municipal and parliamentary borough, cathedral city, and seat of an ancient university, lies on the river Thames, 51 m. by road and 63¾ m. by rail W.N.W. of London (G.W. railway); main railways also to Worcester and Birmingham (G.W. railway); direct service also via Banbury to Leicester and Sheffield (L.N.E. railway), branch line L.M.S. to Cambridge crossing main line at



BASED UPON THE ORDNANCE SURVEY MAP WITH THE SANCTION OF THE CONTROLLER OF H.M. STATIONERY OFFICE

MAP OF OXFORD, SHOWING THE PRINCIPAL COLLEGES

Bletchley. The Thames is navigable below Oxford; there is a canal to the Avon valley and Birmingham; and numerous local road motor services. Population (1938), 94,090.

The site of Oxford is a low gravel terrace between the upper Thames and its tributary, the Cherwell, which meet in wide water meadows within a gap in a line of oolitic plateaux represented by Headington hill on the East and the twin crests of Cumnor Hurst and Wytham on the west. Though there are sparse Romano-British habitations on both sides of the valley, the Roman road northwards from Dorchester to Alchester lies far back to the east, and only a few finds betray a track across the valley from Headington towards Binsey. Oxford itself only becomes perceptible in Saxon times, in the church of St. Martin (whose dedication and some rude masonry in the tower mark its early date) close to Carfax (Lat. *quadrifurcus*, French *carrefour*) the intersection, in the heart of the city, of north-south and east-west roads. Eastward the High street crosses the Cherwell by Magdalen bridge, and offers alternative routes to London via Headington or Littlemore; southwards St. Aldate's, formerly Fish street, crosses the Thames (Isis) at Folly bridge, for Abingdon and Newbury; northwards, by Cornmarket, are the roads to Banbury and Woodstock; westward, Queen street leads round the south side of the Norman castle to Quaking bridge, over the mediaeval mill stream towards Osney: the modern New road, north of the castle, leads direct to the railway stations and Seven Bridges road for the upper Thames, and south-west England. Early traces are: (1) the Priory (afterwards Augustinian), commemorating St. Frideswide, a local heroine whose good works and adventures, about 720–740, touch also Binsey and Abingdon; of her original church there are arches near her shrine in the cathedral; (2) the conspicuous mound raised (probably about A.D. 900) to command the passage from Mercia into Wessex; (3) Oseney village, beyond the nearest channel of the upper Thames, whose name (Ousen-eye: "water-island") explains the Oksnaforda and Orsnaforda of 10th century Saxon coins, whence *Oxenford* and *Oxford* arose by assimilation to names like Swinford and Shefford. Upstream, between Osney, Binsey and Wolvercote, the "Port Meadow" is still held in common by the freemen of Oxford.

Oxford just appears in history when Edward the Elder, in A.D. 912, "held Lundenbyrg (London) and Oxnaford and all the lands that were obedient thereto" as flanking fortresses of his Thames valley frontier. But the principal centres of the district were not here, but at Abingdon, commanding access to the Vale of White Horse, with an early and wealthy abbey, and Dorchester, similarly dominating the Thames valley, with its pre-Roman earthworks, and Saxon bishopric. River traffic bound for Oxford long paid toll to the abbott of Abingdon. However, several "gemots" were held at Oxford, under Edric, Canute, and Harold I.; and repeated devastation by the Danes (979, 1002, 1010, 1013) attests military and economic importance.

The Norman governor, Robert d'Oiloi (d'Oyly), incorporated the Saxon mound in a great fortress (1170–1219), of which one tower stands, and Bullock lane and St. Peter le Bailey mark the outworks; he built the Hythe bridge, which reveals the terminal wharfs of the river traffic; enclosed the town (partially "wasted" in Domesday) with walls of which foundations remain at the (north) Bocardo gate, the fine tower annexed to St. Michael's church. To d'Oiloi's time belong the rebuilding of St. Frideswide's (the present cathedral dates mainly from the fire of 1120), St. Ebbs' near Carfax, St. Peter's, in the east, probably outside the first

east wall, and Holywell by the Cherwell beyond. His son Robert founded the splendid Osney abbey, beyond the castle (fragments in the cemetery beyond the G.W. railway). Outside the city, also, north of the cattle market in Gloucester Green, Henry I. built his Beaumont palace overlooking Osney and Port Meadow, and under his "Beau-clerc" patronage Theobald of Etampes already, about 1120, was teaching "60 to 100 clerks." As residence of the empress queen Maud, Oxford suffered siege by Stephen.

While domestic business was conducted between the Corn Market and the High, within the walls, the wool fair and strangers' market, outside the north gate, had, about 1200, a church of St. Giles, its patron. Beyond it lay the leper house (later St. Giles' parsonage), and east of it other establishments mainly for strangers, the Scots college of John de Balliol, Durham college (afterwards Trinity), a Cistercian house (afterwards St. Bernard's, then St. John Baptist's college); and, when Beaumont palace was granted by Edward II. to the Carmelites, the Benedictines occupied the site they had left with the older "cottages" of Worcester college. Other Cistercians built Rewley abbey beyond Hythe bridge; Dominican and Franciscan houses in the poorer south-west quarter leave their names in Blackfriar street, Preacher's bridge and Friars wharf; and the Austin Canons of St. Frideswide acquired endowments for teaching and added the Latin chapel to their church. By the mid 13th century then mediaeval Oxford had taken permanent shape. The walls were reconstructed, and probably extended from an older line in Cat street, to include St. Peter's in the east, with an East gate spanning the High near the hotel of that name, between the splendid north-east stretch of wall conserved by New college, and the south-east angle around Merton.

But before this, in the old north-east angle, now occupied by the Bodleian and Radcliffe libraries, "School street" traversed a kind of "Latin quarter" frequented by wandering scholars, whose *universitas* or guild comes into history with the visit of Giraldus Cambrensis in 1185, and the nomination of a chancellor in 1214. (*See* OXFORD UNIVERSITY.) On the south frontage of this resort of scholars, St. Mary's church became their meeting hall and lecture room; its bell tower and spire, congregation house and library were built about 1320; a new nave and aisles replaced, in 1388, the old Faculty chapels; and the Renaissance porch marks Archbishop Laud's reconstitution of the university, and still dates *"in parviso"* the certificates of satisfactory "responsions" of novices to the "masters of the schools" who controlled their admittance. For the history of this university, and the several fortunes of its colleges, *see* below.

The 13th century was the great age of mediaeval Oxford. Several parliaments were held here, notably the "Mad Parliament" of 1256, with its "Provisions of Oxford." But the growth of the university, and the wealth and influence of its colleges, were unfavourable to normal development as a mediaeval borough, with its guilds of craftsmen and traders. The "liberties" of the university, in relation with the city, were defined by charter in 1248, and revised in favour of the "chancellor, masters and scholars" after the town-and-gown riots of St. Scholastica's day, 1354–55, and other occasions; in 1523 the university was even allowed to incorporate all kinds of tradesmen, exempting them from civic jurisdiction. These unusual but once necessary provisions were only revoked or became obsolete with the modern transformation of the university itself, which retains, however, magisterial authority over its students, a censorship of public entertainments, and direct representation on the City Council and Guardians.

The Renaissance and the Reformation affected Oxford mainly through academical controversies, the foundation of a fresh series of colleges, and the creation by Henry VIII. of a bishopric, with St. Frideswide's church as its cathedral, and a chapter, the dean and canons of Christ church, economized out of Wolsey's "Cardinal college." But in the Civil War, Oxford's strategical importance made it the Royalist headquarters. The king retired hither after defeats at Edgehill, Newbury and Naseby; Prince Rupert made hence his raids in 1643. Not till May 1644 was the king forced by the concerted advances of the earl of Essex and Sir W. Waller to evacuate this fortress, and after Cropredy bridge he re-occupied it. Only in May 1646, when all other strongholds were lost and Charles himself had escaped in disguise, was Oxford besieged by Fairfax and surrendered on June 24. The extent of the city at this time beyond the mediaeval wall is outlined by traces of the "Kings Mound," enclosing Holywell, Wadham college (1611) and St. Giles. Though the university was mainly Royalist, the citizens had been secretly Parliamentarian; on both sides were losses, and party feelings were disastrous; and though Cromwell himself was chancellor (1651–57), his successor, Gilbert Sheldon, had much work to restore efficiency; his monument is the Sheldonian theatre, for the business and ceremonies of the reconciled masters; the Clarendon press and the Ashmolean museum, Christ church library and Peckwater quadrangle, large additions to New college and Magdalen, and the total rebuilding of Queen's college, are academical counterpart to a general rebuilding of mediaeval and Tudor Oxford, in the next half century. Though Charles II. held a parliament here in 1681, the restored Stuarts temporarily alienated university loyalty, but in the 18th century the university became Jacobite, and the city strongly Hanoverian. This feud, however, was reconciled at the visit of George III. in 1785, and Oxford passed out of national politics. The city, however, grew but little, until the reform of the university in 1858 admitted "married dons," while restricting membership of congregation to residents within 1½ m. from Carfax. The obstinate opposition of the university to Brunel's project for a "great western" railway system radiating from Oxford; and the restrictive policy of St. John's college, which owned almost all land north of St. Giles', had already aggravated urban congestion. The modern Oxford which emerged includes: (1) northward, a compact residential area, not wholly academic, along the Banbury and Woodstock roads beyond St. Giles', Keble, the Museum and laboratories, and the university parks and college playing fields; (2) eastward, beyond Magdalen bridge, the diverging roads to Marston, Headington, Cowley and Iffley, already enclosed fan shaped suburbs mainly of small dwellings, when the establishment of the Morris motor works at Cowley introduced a new and strenuous element into Oxford's industrial life, hitherto almost confined to the Clarendon press and private printing firms, robe making and tailoring, and the distribution of local dainties, sausages, marmalade, and the like; (3) to west and south, "ribbon development" along the trunk roads has disfigured the water meadows without adding to health or convenience. The real suburban areas here lie beyond, around or upon the Boar's-hill-Cumnor-Wytham upland. The Oxford Preservation Trust, established almost too late in 1927, a town planning scheme, 1925, and a new Incorporation Act, 1928, are attempts to adjust to the strict and peculiar circumstances of the site and its past, the requirements of "post-war" Oxford, with its partially modernized university, its interminable "summer schools" and vacation-conferences, its growing industries, trade, and professional interests, and the perennial stream of tourists. (J. L. My.)

OXFORD, a city of Butler County, Ohio, U.S., 40 mi. N.W. of Cincinnati, at an altitude of 1,000 ft.; on federal highway 27 and the Baltimore and Ohio railroad. Pop. (1950) 6,926; (1940) 2,756.

Oxford is an educational centre, the seat of Miami university (chartered 1809, opened 1824) with which Oxford College for Women (1830) was consolidated in 1928; and the Western college (for women) (1853).

The city was founded about 1800.

OXFORD, PROVISIONS OF, the articles constituting a preliminary scheme of reform enacted by a parliament which met at Oxford on June 11, 1258. King Henry III. had promised on May 2 that the state of his realm should be rectified and reformed by 24 counsellors who were to meet at Oxford for this purpose five weeks later. Twelve of these counsellors were chosen by the king, and 12 by the earls and barons. When the parliament met the 24 drew up a provisional scheme of reform, known as the Provisions of Oxford. By this it was arranged that a council of 15, chosen by four of the 24, should be appointed to advise the king in all matters. The new council was to meet three times a year in parliaments to which 12 commissioners

were to be summoned to discuss the affairs of the realm on behalf of the whole community. Another body of 24 was appointed to treat of an aid. Desiring to limit the power of the king and his household officers, the barons determined to revive the justiciarship, in abeyance since 1234. But they did not want over-powerful great officials. It was therefore decided that one or two justiciars should be appointed for one year who should be paid, but should be accountable at the end of the year. The chancellor and treasurer similarly had to account; the sheriffs, too, were appointed for one year only. Enquiries into abuses were begun and further reforms were to be reported on by Christmas. The king declared his adhesion to the Provisions on Oct. 18.

Disputes broke out in the baronial party. Simon de Montfort, earl of Leicester, supported by Edward, the king's son, demanded the logical extension of the reforms in local government to include the baronial franchises. The earl of Gloucester opposed this. Forced by Edward, a second series of Provisions, known as the Provisions of Westminster, was issued in Oct. 1259. The quarrels among the barons encouraged Henry to break free. On April 13, 1261, a papal bull absolved him from his oath to observe the Provisions. After three years on the verge of civil war, both parties agreed to refer the question to the arbitration of Louis IX. of France, who formally annulled them on Jan. 23, 1264, but expressly declared that his decision was not to invalidate the privileges, liberties and laudable customs of the realm of England, which had existed before the time of the provisions.

See the *Annales monastici*, vol. i. (Burton), Rolls series; *Foedera* (Record Commission edition); W. Stubbs, *Constitutional History* (1873), and *Select Charters* (1870, several later editions); Charles Bémont, *Simon de Montfort* (1884); T. F. Tout, *Chapters in the Administrative History of Mediaeval England* (1920); and E. F. Jacob, *Studies in the Period of Baronial Reform and Rebellion* (1925).

OXFORD AND ASQUITH, HERBERT HENRY ASQUITH, 1st Earl of (1852–1928), born at Morley, Yorks., on Sept. 12, 1852. His origins were Liberal, Nonconformist and middle class in character. Joseph Dixon Asquith, his father, owned a cloth manufacturing business in Morley, and his mother was the daughter of William Willans, a Huddersfield merchant. His father died while he, his brother (who afterwards became a master at Clifton), and his sister were children, and the two boys were left in the care of an uncle in London, where they went to the City of London school, then under the able headmastership of Dr. Abbott. Upon him the future prime minister made a deep impression, and to him Asquith in after life was accustomed to express a great debt of gratitude. He won a Balliol scholarship, and at Oxford he took a Craven university scholarship and firsts in "Mods" and "Greats," became president of the Union and a fellow of his college.

Adopting the bar as a profession, he first attracted public notice by his defence of Cunninghame Graham and John Burns for their part in the riot in Trafalgar square, but it was the Parnell Commission, in 1889, in which he acted as junior to Sir Charles Russell, that established his legal reputation, his deadly cross-examination of the manager of *The Times* giving the first indication of the dramatic issue of the trial. His success at the bar was assured, and in the next year he took silk, but the law was only a stepping-stone to the political career that from boyhood he had always had in view. He had entered parliament as member for East Fife in 1886, and on the formation of the Gladstone Government in 1892 he was appointed home secretary. He had just previously sustained a heavy domestic blow by the death of his wife, Helen, the daughter of a Manchester surgeon, whom he had married in 1877 and by whom he had four sons and one daughter. In office, Asquith's great parliamentary gifts were at once apparent, and his administration of the Home Office was made memorable by the appointment of the first women inspectors, improvements in the administration of the Factory Acts, the stiffening of the machinery, and the passing of the Employers' Liability bill, which was rejected by the Lords, and of a Factory bill which became law. He was bitterly and most unjustly attacked in connection with the shooting of two miners by soldiers who were called in to deal with a strike at the Featherstone colliery. He did not summon the soldiers, and appointed a commission immediately to enquire into the affair, but the legend that he was personally responsible pursued him, and for years his platform appearances were always greeted with cries of "Featherstone."

In 1894, while still at the Home Office, Asquith married a second time, his bride being the brilliant Miss Margaret ("Margot") Tennant, one of the daughters of the wealthy iron-master, Sir Charles Tennant. She was a prominent member of the most exclusive society circle, and the marriage very definitely changed the current of Asquith's social life, and in some measure affected his political relationships. The period was one of great disruption within the Liberal Party. The feud between the Rosebery and Harcourt groups was at its height, and after the fall of the Liberal Government in 1895, the conflict with the Boer republics divided the party into two hostile camps, the Liberal Imperialists, led by Lord Rosebery, and the pro-Boers led by Campbell-Bannerman. Asquith, who had returned to the bar, associated himself with the Rosebery group, which endorsed the Chamberlain policy. In this he was influenced, no doubt, by his confidence in Sir Alfred Milner, who had been his friend from his Balliol days, and who had become the instrument of British policy in South Africa. When the Boer controversy culminated in war, it seemed that the quarrel between the Roseberyite and Campbell-Bannerman factions must result in permanent separation, and the formation of the Liberal League, of which Lord Rosebery was president and Asquith vice-president, apparently put reconciliation out of the question.

From this catastrophe the Liberal Party was saved by the raising of the Tariff Reform issue. On this subject Lord Rosebery spoke with an equivocal voice, but Asquith at once became the most formidable protagonist of Free Trade. The discussion of the subject became largely a duel between him and Chamberlain, and the series of speeches he delivered throughout the country were among the most conspicuous triumphs of his career. It restored him to the full confidence of the party, and when Campbell-Bannerman formed his Government at the end of 1905 his appointment as chancellor of the exchequer was a matter of course. The moderation of his temper, and the entirely public-spirited motives that always inspired him. contributed to the return of harmony within the party, and his achievements as chancellor established his claim to the succession to the premiership. His record at the Treasury, culminating in his final budget, which inaugurated old age pensions, give him a place among the most illustrious chancellors in history. On the resignation of Campbell-Bannerman, through illness, in 1908, Asquith became prime minister by universal consent, with Lloyd George as chancellor of the exchequer. No prime minister since Pitt had been called upon to face such grave issues as those which confronted Asquith at the beginning and developed as his long term of office—the longest of any prime minister since Lord Liverpool—advanced. A new mood of revolt filled the labour world with unrest and menace, the long struggle for the enfranchisement of women had passed out of the academic phase into a phase of unprecedented and almost fantastic violence, the sky over Europe was visibly darkening with the naval activity of Germany, and over and above all two capital issues reached a crisis—the issue of the House of Lords and the issue of Ireland. It was the first of these two questions that first tested the stuff of which the new prime minister was made. The budget of 1909, which dealt with the taxation of land, was rejected by the House of Lords. Asquith appealed to the country against its rejection in Jan. 1910, and his Government was reinstated, though only with the support of Labour and the Irish members. He addressed himself forthwith to the question of the abolition of the veto of the House of Lords, and during the summer made efforts to reach a pacific solution of the question by compromise. But the conference with the Opposition leaders broke down, and in the following December he appealed once more to the country and was once more returned, —this time with a majority over the opposition of 126.

The opening of the session of 1911 may be taken as the crowning moment in Asquith's public career. The issue of the constitutional struggle with the Lords was not yet decided, but it was

no longer in doubt. The decisive mandate which the country had given in December dictated the issue that immediately occupied the new parliament. A bill abolishing the veto of the House of Lords was introduced into the House of Commons and passed all its stages by the beginning of the summer. But the final struggle had yet to come. The battle had still to be won in the Lords and there the opposition were entrenched in overwhelming power. Ever since the emergence of the issue it had been evident that the attainment of Asquith's goal depended on whether he could in the last resort invoke the authority of the Crown to dilute the House of Lords with new peers sufficient to change its complexion. The question was answered on July 20. The Parliament Bill, then in the House of Lords undergoing its second reading, was so amended as to deprive it of any utility for the purpose for which it was framed. Asquith therefore addressed to Balfour, the leader of the Opposition, a letter stating that the Government had decided, if the bill in its essential form could be passed in no other way, the Crown would be advised to create a sufficient number of peers to ensure its passage, and that the Crown had signified its willingness to accept such advice. The publication of this letter aroused an unprecedented storm, and on July 24, on rising in the House of Commons to make a statement, Asquith was greeted with a demonstration without parallel in living memory. For the best part of an hour he stood speechless before the roar of anger that issued from the Opposition benches, and at last resumed his seat without having uttered a continuous sentence. What became known as "the pothouse brawl" inaugurated the last stage of the struggle. The Government was accused of "dragging in the King," and the Opposition organized an uncompromising resistance in the belief that they would not dare to carry their threat into execution. But on Aug. 10, when the final debate was taking place in the House of Lords, Lord Morley confirmed the Government's previous intimation of His Majesty's intention. Up to this point the "Die-Hards" seemed to be assured of a majority, but in the division they were defeated. The bill was passed. On Aug. 18 the Parliament Act received the Royal Assent.

From this victory Asquith proceeded to his next great task, with the ground sensibly cleared for action. Gladstone's successive Home Rule adventures had broken on the rock of the Lords' veto; that rock no longer obstructed the channel. But before the Irish issue was fully launched another controversy absorbed the prime minister's activities. Discontent had long been growing prevalent in the mining industry, and at the end of Feb. 1912, having failed to secure the concessions and advances they demanded, the miners' union declared a strike. Vast dislocation followed. From the outset the Government endeavoured to bring the conflicting parties to agreement and Asquith took on himself the personal charge of the negotiations. After a month's fruitless efforts, the Government thereupon introduced the Miners' Minimum Wage Bill, which, by providing a half-way solution, forced the hands of both sides and brought the immediate struggle to an end, although the issue incidentally raised—that of the reorganization and control of the coal industry—was to perplex parliament and the country for many years to come.

Meanwhile, the Home Rule Bill had been introduced and passed through the House of Commons, while the Parliament Act provided adequately against the resistance of the House of Lords. That House fought the delaying action, which was all the Opposition now had in its power, by rejecting the bill in two successive sessions. After its next passage through the Commons it would have overridden opposition and automatically become law. By this time, however, the opposition to the measure had taken an extra-parliamentary shape. The Ulster Covenant had been promulgated in the previous September and talk of open rebellion, should Home Rule be passed, was already current. In June arms had been discovered both at Belfast and Dublin. As the year wore on the outlook became still more serious and a speech by Bonar Law, the leader of the Conservative Party, at Blenheim, seemed to give encouragement to the idea of resistance by force. On Sept. 25 the Ulster Unionist Council appointed a Provisional Government and prominent Conservatives openly preached armed resistance; Sir Edward Carson, the leader of the Ulster Unionists, left no doubt that in the last resort Ulster would fight.

With the close of the session of 1913 there came a brief lull, and during the recess conversations with the Opposition leaders were opened by Asquith, who throughout preserved an attitude of patience and forbearance. It will always be matter for controversy whether, when the policy of violent resistance had been adopted, he was justified in ignoring so direct a challenge to constitutional government. His natural disposition was to allow the utmost scope for the play of discussion and the influence of the time element; but it is an open secret that he would have taken up the challenge but for the persuasions of John Redmond, the leader of the Irish Nationalists, who believed that the prosecution of the Ulster leaders would prejudice the prospects of friendly relations with Ulster when Home Rule was actually on the statute book. In any case, the conversations of the autumn were futile, and on March 9, 1914, the Government announced the provisions of their amending bill, their last word of compromise. The chief provision of this bill was that any county in the north of Ireland was to be allowed to vote itself out of the operation of Home Rule for a period of five years.

The offer was rejected by the Opposition and now events rushed forward to an apparently unavoidable catastrophe. On the night of April 24–25, 55,000 rifles were landed at Larne from a German port for the use of the Ulster army. On the other side of the border the Nationalists were beginning to enrol a volunteer army and to make counter-preparations. Meanwhile a more sinister menace appeared. In the debate on the vote of censure on the Government on March 19 Bonar Law, speaking on the Home Rule issue, had used the ominous phrase "soldiers are citizens like the rest of us." There had been much talk of disaffection in the army in regard to the coercion of Ulster, and on March 20 it took shape in the Curragh incident (*see* IRELAND; IRELAND, NORTHERN), which led to the resignation of Col. Seely, the secretary for war. For a moment it seemed that the loyalty of the army was imperilled and the situation that confronted the Government looked desperate. But the announcement by Asquith next day that he would assume the secretaryship for war created a profound impression in parliament and stopped for the time being, at all events, what had seemed like a riot in the army. Following the mutilation of the amending bill by the House of Lords and Sir Edward Carson's challenge to the Government to "give us a clean cut or come and fight us," the king, on Asquith's advice, summoned a conference at Buckingham Palace on July 20 to see if some agreement was still not possible. It broke down four days later and the last hope of avoiding violence seemed gone.

What Asquith would have done to avert a civil war while maintaining the authority of the Constitution was not to be revealed, for on the day that the Buckingham Palace Conference broke up Austria sent her ultimatum, and within ten days the British army was embarking, not for Ulster, but for Flanders. In the feverish struggle within the Cabinet that preceded the entry of Great Britain into the World War Asquith's position was never in doubt. He had throughout been a party to the ambiguous military understandings and conversations which had been in progress with France since before the fall of the Balfour Government in 1905, and when the war came he did not waver in his conviction that both the duty and the interest of the country lay in throwing the country's whole weight into the scales against what he considered to be the calculated design of the Central Powers to establish a military despotism over Europe.

The invasion of Belgium by Germany saved his Government from disruption, and he addressed himself, free from domestic disquietudes, to the heaviest task ever imposed on a British prime minister. For the moment even the Irish trouble subsided, all political differences were shelved and Asquith became the voice of a united nation in a measure unequalled in modern Parliamentary history. The speeches he delivered in the early days of the war have taken their place beside the classic orations of Pitt during the Napoleonic wars, and his constancy of mind and freedom from all personal ambition played a dominating part during the next two years in laying the foundations of the ultimate victory. It was not to be expected that in the presence of so vast a con-

vulsion discontents would not develop. They became clamant as the true character of the struggle emerged. Asquith had made no change in the political constitution of his cabinet at the outbreak of war, although he had taken the leaders of the Opposition into his confidence and private counsels, but by the spring of 1915 it became clear that this informal relation would have to yield to a formal coalition.

In February Bonar Law and Lord Lansdowne intimated that they could accept no responsibility for the way in which the war was being conducted, and in the popular press a powerful and ceaseless agitation arose, directed mainly against Asquith, Grey and Haldane, and inspired by the inevitable shortage of munitions which the progress of the war had revealed. Coincidentally, a violent disagreement as to the employment of the navy in the Gallipoli adventure had arisen between Churchill, the first lord of the Admiralty, and Fisher, the first sea lord, and on May 26 Asquith reformed his cabinet on a coalition basis, bringing in the leaders of the Opposition and excluding Haldane. To meet the growing need for munitions, a special Ministry of Munitions was set up with Lloyd George at its head.

The reconstruction of the Ministry did not allay dissatisfaction. Within the cabinet friction developed, and, outside, the press agitation grew in violence. There was a persistent leakage of cabinet secrets, certain newspapers betraying a knowledge of most confidential Government business with such regularity as to suggest inspiration. A phrase, "Wait and See," which Asquith had used in reply to a question in the House of Commons years before, became the daily gibe of the malcontent press, and Sir Edward Grey, then in the midst of the most delicate situation with the United States, was accused of "feeding Germany" because of his attitude on the subject of contraband from America. The war-weariness that had overtaken the country provided an atmosphere in which this propaganda of discontent flourished, and the prime minister was the easier target for attack because he neither "squared" the press nor hit back at his critics. The inevitable rupture came in the autumn of 1916, when the German raid into Rumania—now seen in its true proportions—served to drive home the attack, and when Asquith was severely stricken by the loss of his eldest son in the war.

It arose over a question of cabinet reorganization. For some time the formation of an inner cabinet had been under discussion. At the beginning of Dec. 1916 Lloyd George, who upon the death of Kitchener had become secretary for war and whose prestige with the press had long been in the ascendant, submitted a definite scheme for the formation of such a body. From this body the prime minister was to be excluded. His right to control policy was not challenged, but he would not direct the deliberations of the inner cabinet. The *coup* burst upon the country with the announcement of the popular newspapers that Lloyd George was "packing up" in sheer despair at the inefficient conduct of the war. His highly confidential challenge to the position of Asquith was under consideration when an article appeared in *The Times* (then owned by Northcliffe) giving full details of the supposed arrangements and suggesting that Asquith had already agreed. Lloyd George denied any knowledge of this article; but Asquith, after consulting with his friends, decided to reject the proposal. Upon this Lloyd George resigned, being followed by other influential members of the cabinet—including some who hoped that their action would give the prime minister the opportunity of reforming his cabinet on a new basis—Asquith informed the King that he could no longer be responsible for carrying on the business of government; and within a few days the second Coalition Government was formed with Lloyd George as prime minister. (*See* ENGLISH HISTORY: *The Twentieth Century;* WORLD WAR I.)

Thus ended Asquith's long and memorable tenure of the premiership. For the remainder of the war he occupied a seat in the front Opposition bench, speaking rarely and only on occasions when the interest of the nation seemed to demand his intervention. At the election of 1918, when Lloyd George swept the country with an appeal for the maintenance of the Coalition, he did not escape the general wreck of the Liberal Party, losing the seat of East Fife, which he had held throughout his parliamentary career. In 1920 he returned to the House of Commons as member for Paisley and resumed his position as head of the remnant of the succeeding parliaments. In 1924, after an election fought on the issue of protection, he, as the head of a pivotal majority, was responsible for the accession to power of the first Labour Government, and later in the year for the Government's overthrow on a question of alleged governmental interference with the prosecution of a communist. At the next election he was defeated and retired to the Lords as earl of Oxford and Asquith.

Other honours were conferred on him. He became a member of the judicial committee of the privy council, a knight of the garter and a fellow of the Royal Society. After he entered the House of Lords he rarely intervened in public discussion. But at the outbreak of the General Strike in 1926, he urged the paramount duty of concentrating on the struggle against the "coercion of a new dictatorship," though he blamed the Government for not taking steps during the preceding nine months to make constructive proposals for the coal industry. Some recrimination followed, and there was a split in the Liberal Party (*q.v.*). He still retained the leadership of the Liberal Party, to which Lloyd George had now returned. But on the outbreak of the General Strike in 1926 a sharp difference appeared in the attitude of Lord Oxford and Lloyd George towards the event, and the latter declined to consult his colleagues. Lord Oxford thereupon formally intimated that he could have no political relations with him, and as the result of the consequent breach Oxford retired from any active part in the affairs of the party which he had led for 18 years. In his retirement he devoted himself to writing a book of reminiscences and reflections, under the title of *Fifty Years of Parliament,* and in the autumn of 1927 he also published a volume of his speeches. Thereafter his health gave way and he died on Feb. 15, 1928, being buried, according to his wish, in the churchyard of All Saints church, Sutton Courtney, Oxfordshire, where he had long had a country home.

Asquith will take his place among the most illustrious of British prime ministers, not merely by virtue of the momentous events in which he played a part, but still more because of his remarkable parliamentary gifts. In this respect he was in the true succession to Gladstone. He had little of the Sinaitic fervour of that great man, but he was not inferior to him in his mastery of the House of Commons. That mastery was achieved, not by emotional passion, but by the force, direction and lucidity of his speech, the intellectual sovereignty that he exercised over his audience, and the qualities of a plain, unaffected character and a singularly dispassionate mind. No man who ever played a great part in affairs was more conspicuously free from the common vices of public life. If he was ambitious it was only the ambition of conscious power directed to public ends. He was the least egotistic of men, and his magnanimity almost bordered on weakness. He was so little of a demagogue that he seemed to avoid rather than invite popular applause, a character to which a certain temperamental shyness contributed. His loyalty to his colleagues, even when they were lacking in loyalty to him, was one of his most striking attributes, and he was so indifferent to his own interests that he not only allowed the praise that belonged to himself to be appropriated by others, but often assumed the burden of mistakes which others had committed. He was the antithesis of that 18th century statesman of whom it was said that if there was credit to be got no one was so skilful in wriggling in, and if there was discredit to be borne no one was so skilful in wriggling out. He bore the odious slanders and insults of a demented press during the war with a certain proud and indifferent scorn, and his bearing both in private and public after the consummation of the intrigues against him was a model of dignity and public spirit. He was never betrayed into violent speech. and if his passion were roused, it was roused, not by personal issues, but by the outrages against public law and the sanctity of constitutionalism. He shared with the younger Pitt the view that the greatest quality in statesmanship was patience, and in all the perplexities with which he had to deal he exercised that quality to the utmost. He would never force a situation while there was a hope that a reasonable and pacific solution could be found. This confidence in the beneficent

operation of rational processes led many to suspect him of weakness, and it is undoubtedly true that there was in him an indisposition to anticipate events or to indulge in the histrionics of statesmanship. But on vital issues he was adamant, and his judgment on all great matters was never vitiated by the smaller considerations of personal and irrelevant motives. His mind moved in the undistracted orbit of a deeply considered philosophy of government, and it may be said of him, as of another, that if he was sometimes on the wrong side, he was never on the side of wrong. He will live in history not only as one of the most illustrious of British premiers but as a type of all that is best in the English character.

The general affection and regard in which Oxford was held was shown by the gift, in 1927, from 17 of his friends and admirers, including some Conservatives, of a capital sum and an income for life. By his first marriage he had four sons and one daughter. Raymond Asquith, his brilliant eldest son, was killed in action in 1916. By his second marriage he left a son, Anthony, and a daughter, Elizabeth, Princess Bibesco. He was succeeded in the earldom by his grandson, Julian, only son of Raymond Asquith.

(A. G. Ga.)

See his *Occasional Addresses, 1894–1916* (1918); *The Genesis of the War* (1923); *Fifty Years of Parliament* (1926); *Speeches* (1927), and his *Memories and Reflections, 1852–1927,* published posthumously (1928). *See* also Lady Oxford, *The Autobiography of Margot Asquith* (1922), and the many memoirs of contemporary statesmen.

OXFORD AND ASQUITH, Margot, Countess of (1864–1945), the sixth daughter of Sir Charles Tennant, 1st Bart., married, in 1894, as his second wife, H. H. Asquith, later the Earl of Oxford and Asquith (*q.v.*). Before her marriage she was well known as a member of the coterie known as the "Souls," and maintained her reputation as one of the wittiest and most brilliant women in London society. In 1922 she published *The Autobiography of Margot Asquith* (2 vol.), which reflected the natural frankness of her character. It is a valuable chronicle of the time. She died in London on July 28, 1945.

Her other works include *Places and Persons* (1925), *Lay Sermons* (1927) and a novel *Octavia* (1928).

OXFORDSHIRE or Oxon, a southern midland county of England, bounded northeast by Northamptonshire, northwest by Warwickshire, west by Gloucestershire, south-southwest and southeast by Berkshire and east by Buckinghamshire. It was originally part of the Mercian kingdom; but its boundaries, except for the Thames on the south (71 mi. from Kelmscot near Lechlade, Gloucestershire, to Remenham below Henley-on-Thames, with the exception of two points near Oxford), are artificial. They were slightly changed by act of William IV and Victoria and by the Reading extension order of 1911 and enclose an area of 748.8 sq.mi.

The 14 Oxfordshire hundreds include five of the Chiltern hundreds, the jurisdiction over which belonged to the manor of Benson and in 1199 to Robert de Harecourt.

Structure and Topography.—The county lies across the central portion of the Jurassic and Cretaceous outcrops. The strike of the strata is in each case from north-east to south-west, for Tertiary movements have tilted them gently down to the south-east so that the transition from north-west to south-east is from older to newer rocks passing in succession from the Lias over the Lower, Middle and Upper Oolite to the Lower Greensand, Gault, Upper Greensand and Chalk. In the north-west, the Marlstone of the Middle Lias and the Limestones of the Oolitic series are permeable and relatively resistant, and the Marlstones and the Inferior Oolite rocks being specially hard, stand out as a sharp north-west edge, continuing the line of the Cotswolds at a lower level (average 500 ft.), but rising to 700 ft. in Edge Hill in the north-east of the county. In the south-east, the chalk is also permeable and resistant, and the hard chalk-with-flints crowning the Chilterns also presents a sharp edge to the north-west.

Between these two upland regions the intermediate geological series forms a broad vale (20 m.) of alternating clays and calcareous, sandy beds. The Upper Greensand forms a low feature at the foot of the chalk hills; this is succeeded by the Gault, with width of outcrop varying from 4 m. to 1½ m. between Dorchester and Sydenham. The lower Greensand appears from beneath the Gault at Culham and Nuneham Courtney and in outliers north of Cuddesdon; Portland limestone, Portland sands and Purbeck beds lie between it and the Kimmeridge clays, which outcrop between Sandford and Waterperry. Coral Rag is traceable from Sandford to Wheatley and beyond this comes a broad outcrop of Oxford clay followed by the Cornbrash (a brownish rubbly limestone). This outcrops at Norton Bridge, Woodstock and Shipton, forms a broad plateau between Middleton Stoney and Bicester, and also occurs as inliers at Islip, Charlton, Merton and Black Horse Hill. The county lies almost wholly in the basin of the upper Thames, in which the significant drainage is that of the Cherwell-Thames. The drainage pattern as a whole, consists of numerous consequent streams from the scarplands (Evenlode, Windrush, etc.), which have been captured and diverted into the Cherwell-Thames by powerful subsequent streams (Ock, Upper Thames, Ray, Thame), working along lines of weakness in the strike of the rocks, obsequent streams flowing down the scarp edge often being a further result of the capturing.

The Cherwell occupies a broad sag between Edge Hill and the Northampton Uplands. It flows south-south-east, joins the Thames coming from the west at Oxford, after which the combined stream continues the south-south-east direction, passing by a deep gorge through the chalk between Wallingford and Reading. That the gap must have originated north-west of its present position is argued from the fact that the level of the river bed at this point is 100 ft. while that of the hills on either side is 700–800 feet. It is an old, but rejuvenated drainage system, which, working upon calcareous rocks, has given rise to a characteristic topography; streams graded to base level but with very steep-sided upper valleys and wide intervening spaces between the head streams that have no surface streams; broad main valleys from which streams have disappeared, or where drainage is beneath the surface; misfit streams, due to capture by the river Severn of an earlier drainage to the Thames from the Welsh plateau, or to carving out of valleys by flood waters following the retreat of the ice. There is little glacial drift except in the north-east of the county. Gravel deposits, both plateau (North Leigh, Combe, Tiddington, etc.) and flood plain (Bampton, Oxford, Dorchester, etc.), are very important; tracts of clay-with-flints, brick-earth and gravel, as well as outliers of the London clay (Nettlebed, Caversham, etc.) occur on the dip slope of the chalk.

History and Early Settlement.—The bare Lias and Oolite uplands and the flood plain gravels were sites of late Neolithic settlement, as witness numerous Long Barrows (characteristic of the Cotswold area) as far east as the Cherwell. The Rollright stones (probably Neolithic) on the Oolite scarp need special mention. Quantities of bones of cattle, pigs, sheep, etc., are found in the gravels, and pottery (characteristic of the Wash area) is distributed east of the Cherwell-Thames line. Settlement on the dip slope of the Chilterns was debarred by forests, as also in the forested north-eastern portion of the county, but the Icknield Way, generally on the Greensand, and the Ridgeway, on the Chalk above, followed the scarp face to the Thames crossing, forming parallel routes to a trackway along the limestone uplands. An influx of the people who made Beaker pottery is indicated for the region between the Evenlode and the Windrush and on the valley gravels (Eynsham, Stanlake, Brighthampton, Oxford, Burcot, Dorchester, etc.). In the Iron Age camps were established along the same routes (*e.g.*, Chastleton, Tadmarton). During the Roman period the area was thickly populated and roads were made linking Alchester and Dorchester in the Cherwell-Thames with Towcester (Northamptonshire) to the north and Silchester (Hampshire) to the south. Alchester was also connected by Akeman Street with Verulamium (Hertfordshire) to the east and Cirencester (Gloucestershire) to the west. The Saxon settlements are noticeably on valley sites, occupied in pre-Roman times, and these have continued as nucleated settlements to the present day; isolated farms are noticeably on plateau or vale from which forest was cleared comparatively late. In the 6th century the West Saxons took Benson and Eynsham. (*See* the *Saxon Chronicle* for 571.)

In the 7th century the Mercians held all the northern border of

the Thames, and during the 8th century this district fell to Wessex after the battle of Burford, and to Mercia after a battle at Benson, when it was included in the diocese of Lincoln. The bishopric at Dorchester given to Birinus (the apostle of Wessex), 634, seems to have come to an end on the establishment of the see of Winchester. Before the Mercian conquest in 777 Oxfordshire was in the diocese of Sherborne. In 873 the jurisdiction of Dorchester reached to the Humber, and when the Danes were converted it extended over Leicestershire and Lincolnshire, Oxfordshire forming about an eighth of the diocese. In 1092 the seat was transferred to Lincoln. In 1542 a bishopric of Osney and Thame was established, taking its title from Oxford, the last abbot of Osney being appointed to it. In 1546 the existing bishopric of Oxford was established. The ecclesiastical boundaries remain as they were when archdeacons were first appointed—the county and archdeaconry being conterminous. The county, excepting the parish of Taynton in Chelmsford diocese, is in the diocese of Oxford.

The Danes overran the county during the 11th century; Thurkell's army burnt Oxford in 1010, and the combined armies of Sweyn and Olaf crossed Watling Street and ravaged the district, Oxford and Winchester submitting to them. At Oxford, in 1018, Danes and Englishmen chose Eadgar's law. Here also Harold allowed Tostig to be outlawed and Morkere to be chosen earl in his place, thus preparing the way for his own downfall and for the Norman Conquest. The destruction of houses in Oxford recorded in the Domesday Survey may possibly be accounted for by the ravages of the rebel army of Eadwine and Morkere on this occasion. Large possessions in the county fell to the Conqueror, and to Odo, bishop of Winchester. The bishop of Lincoln and many religious houses (*e.g.*, Abingdon, Osney and Godstow) held much land in the county. Robert D'Oiloi, heir of Wigod of Wallingford, held many manors and houses in Oxford, of which town he was governor. The importance of Oxford was already well established; the shire moot there is mentioned in Canute's Oxford laws, and it was the seat of the county court from the first, the castle being the county gaol. For events between this period and the Civil War *see* OXFORD (city). The dissolution of the monasteries, though it affected the county greatly, caused no general disturbance.

When King Charles I. won the battle of Edgehill (Oct. 23, 1642), Oxford at once became the stronghold of the royalist cause. For the campaign of 1643 its rôle was to detain the main parliamentary army until the royalists from the north and the west could come up, after which the united forces were to close upon London. More than once, notably at Chalgrove Field (June 18, 1643), Prince Rupert's cavalry struck hard and successfully. In the campaign of Newbury skirmishes took place as the parliamentary troops under Essex passed through north Oxfordshire on their way to the relief of Gloucester, and at the close of the campaign the fortresses of the county offered the defeated royalists a refuge which Essex was powerless to disturb. In the following campaign Charles abandoned the idea of an envelopment and decided to use Oxfordshire as the stronghold from which to strike in all directions. Material wants made it impossible for Charles to maintain permanently his central position, and eventually Essex headed for the south-west, leaving Waller to face the king alone. The battle of Cropredy Bridge followed (Jan. 29), and the victorious king turned south to pursue and capture Essex at Lostwithiel in Cornwall. In the operations of 1644 Oxfordshire again served as a refuge and base (Newbury and Donnington).

On the appearance of Cromwell and the New Model army a fresh interest arose. Leaving Windsor (April 20, 1645), the future Protector carried out a daring cavalry raid. He caught the royalists unawares at Islip, pursued the fugitives to Bletchington and forced the governor to surrender. He swept round Oxford, fought again at Bampton, and rejoined Fairfax, in Berkshire. A few days later Charles again marched northwards, while Fairfax was ordered to besiege Oxford. Charles was compelled to turn back to relieve the city, and the consequent delay led to the campaign and disaster of Naseby. Yet even after Naseby Oxfordshire still retained its importance, but in 1646 the Roundheads closed in from all sides and Stow-on-the-Wold witnessed the final battle of the war. On May 9 Banbury surrendered, on June 24 Oxford capitulated, and three days later Wallingford, the last place to give in, followed its example.

Architecture.—The limestone of the Oolite series has provided beautiful material for both ecclesiastical and domestic architecture, the castles, of which there are few, were probably built for temporary defence in the civil strife of Stephen's reign (1100–1135). Considerable portions of the Norman Oxford castle survive, and slighter remains of the castle at Bampton, the seat of Aylmer de Valence in 1313. Among remains of former mansions Greys Court near Henley-on-Thames (14th century), Minster Lovell, on the Windrush above Witney, and Rycote, between Thame and Oxford may be noted. Minster Lovell was the seat of Francis, Lord Lovel, the son of a Lancastrian who incurred the hatred of that party by serving Richard III.; he afterwards aided Lambert Simnel, and mysteriously disappeared after the battle of Stoke.

Rycote is of fine Elizabethan brick and in the chapel attached to the manor there is remarkable Jacobean woodwork, the entire fittings being of this period. Here Elizabeth resided both before and after her accession. Broughton castle near Banbury (14th century), Shirburn Castle (mainly 15th century Perpendicular) and Stanton Harcourt (1450, with a gatehouse of 1540, a vast kitchen and Pope's Tower) are ancient mansions still inhabited. Mapledurham, on the Thames above Reading, is a fine Tudor mansion of brick; and Water Eaton on the Cherwell, is a singularly perfect Jacobean house of stone.

A large number of monastic foundations arose in the neighbourhood of the university; Augustinian at Bicester, Caversham, Cold Norton, Dorchester, Osney (a magnificent foundation just outside the walls of Oxford) and Wroxton; Cistercian at Bruern and Thame; Benedictine at Cogges, Eynsham, Milton; Mathurin at Nuffield; Gilbertine at Clattercote; Templar at Sandford-on-Thames.

Gosford possessed one of the only two preceptories of female Templars in England. Of all these, excepting the abbey church at Dorchester, remains are scanty. The boundary walls still stand of Godstow nunnery on the Thames, the retreat and burial place of Rosamund Clifford, or "Fair Rosamond," the object of Henry II's famous courtship.

In ecclesiastical architecture Oxfordshire, apart from Oxford itself, is remarkably rich, but nearly all the churches are of mixed dates. Iffley, Adderbury and Minster Lovell are types of a single style. Iffley, 1 mi. S. of Oxford, is one of the finest examples of pure Romanesque in England, with a highly ornate west front. Adderbury, 4 mi. S. of Banbury, is a great cruciform Decorated church with a massive central tower and spire. Minster Lovell, also cruciform, is pure Perpendicular; its central tower is supported on four detached piers.

The short, ungainly spire of Oxford cathedral was among the earliest, if not the first, constructed in England and served as a model from which were probably developed the splendid central spires of the great churches at Witney, Bampton, Shipton-under-Wychwood and Bradwell. There are also fine spires at Bloxham, Adderbury and King's Sutton (in Northants).

Bloxham church, mainly Decorated, with Romanesque portions and a remarkable Early English west front is one of the largest and most beautiful in the county. In the west, Burford (Romanesque and later) is noteworthy, and in the porch of the fine Romanesque church of Langford is a crucifix with the figure cloaked. At South Leigh, Beckley and Swinbrook are remarkable mediaeval mural paintings, while at Caversfield there is what is probably the oldest church bell in England—cast before 1219. About 5 mi. north of Oxford there are Kidlington (Decorated), with a beautiful needle-like Perpendicular spire, and Islip, as the birthplace of Edward the Confessor. Ewelme church (Perpendicular) is remarkable for the tomb of Alice, Duchess of Suffolk (1475), gorgeous with tracery and gilded canopy, and that of Sir Thomas Chaucer (1434), with enamelled coats of arms.

Here William de la Pole, Duke of Suffolk, founded in 1436 the picturesque hospital and free school still standing.

Climate and Agriculture.—The climate, healthy and dry,

except in the low ground bordering the Thames, is colder than the other southern districts in England, especially in the exposed regions of the Chilterns. The county is essentially rural. The surface soils lie in belts, corresponding to the underlying rocks, the heavy clays giving rise to grasslands and the calcareous, sandy soils to arable. Many villages occur where springs issue at the junction of permeable and impermeable strata, thus securing flood-plain pasture for cattle, upland pasture for sheep and upland patches of lighter soil, with a sandy aspect, which could be worked by primitive communities often with a two-field rotation. Wool was early a source of wealth and was famous in the 12th and 13th centuries. Salt is mentioned in Domesday as a product of the county; glass was made at Benson and Stokenchurch in the reign of Henry VI and other subsidiary products were plush at Banbury, leather at Bampton and Burford, gloves at Woodstock and malt at Henley. In the early 14th century, Oxford was the second most prosperous county in England, but the Black Death (1349) and decreasing arable land, the enclosures of the 16th century and the wars of the 17th brought depression and discontent, and on the enclosure of Otmoor (1830) serious riots broke out.

A high proportion of the county (about 81% in 1939) is under cultivation. Stock are raised on the clay lowlands, and dairying (Shorthorns, Alderneys and Devonshire cows) is important. The Cornbrash is specially good for grain growing, but crops of wheat, oats and barley have declined (75,225 ac. in 1939 compared with 91,049 ac. in 1926).

Sheep (Southdowns, Leicesters and Cotswolds) are still reared in large numbers on the uplands and are folded on the root crops (turnips, swedes, mangolds), which are important. The cultivation of sugar beet, which was flourishing in 1926 (1,196 ac.), later showed a serious decline but by 1939 had risen again to 859 ac.

Many pigs are reared and poultry do well on gravel sites. The county has few mineral resources; iron is obtained at various places; Oolitic limestone is quarried for cement, stone slates and, though less than formerly, for building stone. The clays are used for brickmaking and have been largely utilized for the building of the new town which has arisen around the motor industry at Cowley southeast of Oxford. The National Trust owned 380 ac. in the county in 1942.

Manufactures.—These are mainly those dependent on agriculture. Blankets are manufactured at Witney and tweeds at Chipping Norton. There are paper mills at Shiplake, Sandford-on-Thames, Wolvercot and Eynsham, using the pure water of the streams.

Agricultural implements and portable engines are made at Banbury, where there is also plush, shag and girth weaving. Gloves and polished steel are industries at Woodstock. Lace is made by country women. Banbury has been long celebrated for the manufacture of a peculiar cake.

Communications.—Many of the roads are ancient routes on the plateau or following the strike of the rocks, but the main railways are markedly transverse, linking London with the industrial northwest. The county is served entirely by the G.W. railway (except for a branch of the L.M.S. railway from Bletchley to Banbury and to Oxford). One main line from London passes through the Reading gap to Oxford, and here bifurcating, sends one line north along the Cherwell valley to Banbury and another across the northwest of the county, via the Evenlode valley, to link up with the Severn valley, Worcester and Birmingham; Kingham on the borders of Gloucestershire being a junction for a line west to Cheltenham (Glouc.) and a line northeast to King's Sutton (Northants). There are numerous branch lines.

Population and Administration.—The area of the administrative county, excluding the city and county borough of Oxford, is 736 sq.mi. with a population (est. 1938) of 135,200. Being an agricultural county and not far from London it was very suitable as a reception area for wartime evacuees, whose immigration between Sept. 1939 and Feb. 1941 raised the population by 21%. The municipal boroughs are Banbury, Chipping Norton, Henley-on-Thames, Oxford, a city and the county town, and Woodstock. The county is in the Oxford circuit and assizes are held at Oxford. It has one court of quarter sessions and is divided into 11 petty sessional divisions.

The borough of Banbury and the city of Oxford have separate courts of quarter sessions and commissions of the peace, and the borough of Henley-on-Thames has a separate commission of the peace. The total number of civil parishes is 233. The ancient county (which in 1289 sent two members to parliament) was divided in 1918 into two parliamentary divisions, Banbury and Henley, each returning one member.

It also includes part of the parliamentary borough of Oxford, returning one member, in addition to which the university of Oxford returns two members.

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OXFORD UNIVERSITY. The stories connecting Oxford university with Brute the Trojan, with King Mempeic (1009 B.C.) and with the Druids, cannot be traced back beyond the 14th century. Authentic history appears to begin in 1133 with the arrival from Paris of the theologian, Robert Pullen, who lectured there. There is, however, little evidence that Oxford was regarded as a fully equipped university before 1163—allusions to its being a *studium generale* (*see* UNIVERSITIES) only occur after that date and these by some authorities are held to be inconclusive. Subsequent progress must, however, have been rapid as, about 100 years later, the deputies of Oxford, in an appeal to the king, described the university as *schola secunda ecclesiae* or second to Paris. The coming of the religious communities, the Dominicans, Franciscans and Carmelites in the 13th century and the Benedictines a little later, profoundly affected the advancement of learning. The names of Roger Bacon, John Duns Scotus and John Wycliffe are sufficient to indicate the prominence of Oxford in the middle ages. The earliest colleges to be founded were University college (1249; the mythical foundation by Alfred in 872 is no longer accepted), Balliol (about 1263) and Merton (1264). The latter was established to provide a collegiate discipline for the secular clergy, and its statutes served as a model for subsequent creations, not only at Oxford but at Cambridge.

From the 13th century onward a succession of charters from the crown strengthened the position of the university at the expense of the town. At the Renaissance the new learning found its leading exponents in Erasmus, who lectured there, and in such famous scholars as William Grocyn, John Colet and Sir Thomas More. The old scholasticism received its deathblow from the royal injunctions of 1535. Oxford, as well as Cambridge, suffered from numerous confiscations of land and revenues during the Reformation period. In 1571 the act of Elizabeth incorporated and reorganized the two universities. The statutes of the university were codified in 1636 by the chancellor Archbishop William Laud. With certain modifications, they formed the official code of the university until 1858. During the Civil War the university sided with the king, while the town sympathized with the parliament, but no open breach between the two occurred. Under Oliver Cromwell, who acted as chancellor from 1651 to 1657, an effort was made to restore the standards in work and discipline which had suffered from the civil wars. During the reign of James II, the university acquired popularity by its successful resistance to James's effort to open the university to Catholics, even to the extent of imposing his own Catholic nominee on the fellows of Magdalen. The university, however, soon returned to its Jacobite allegiance, and at the coming of the Georges was definitely anti-Hanoverian, a phase that came to an end after the visit of George III in 1785. In the latter half of the 18th century the influence of the Wesleys on Oxford was far less than on the country at large; on the other hand the Tractarian movement (*see* NEWMAN, JOHN HENRY), at the beginning of the 19th century, had a most profound effect on the Church of England, which re-

mained potent. There was a general rise in the level of studies toward the end of the 18th century as written examinations gradually supplemented the old oral examinations, often merely formal, and henceforth the range of studies themselves extended. By the reform of 1858 the professoriate was increased, reorganized and re-endowed, and dissenters were admitted to entrance to the B.A.—the M.A. being thrown open in 1871.

The reforms of 1877 directed a certain proportion of the college revenues to the use of the university (especially for the encouragement of natural science) and improved the position of professors and lecturers, thus leading to the growth of a regular resident professoriate. Schools and degrees alike multiplied (*see* UNIVERSITIES) and the history of the university was one of general progress and expansion.

Modern Oxford.—The beginning of the 20th century marked a turning point in university history because of the growth of scientific studies and of specialization in all studies.

In the 19th century the university had grown in size; the number of annual matriculations grew steadily, with a check between 1812 and 1849, from 240 in 1800 to 840 in 1900. Although the quality of teaching improved, the college fellows continued to provide practically the whole of the teaching and administrative strength of the university. This was possible because science made its way slowly. As late as 1900, out of 142 college tutors, only 21 (less than 15%) were scientists. There were in addition an equal number of science teachers paid wholly by the university. By 1940 the number of college tutors in science was 55 (including 4 women) out of 268 (more than 20%), and there were also 78 readers and demonstrators paid wholly by the university. Over the same period the number of science departments grew from 9 to 19. There had also been a considerable shift of interest among the undergraduates. In 1900 the number of candidates taking the final honours science examinations was only 47, or almost exactly 10% of the total number of candidates (469); in 1939 the candidates in science were 215 out of 1,305, or just over 17%. In the interval important new honours examinations in humane subjects had either developed (English had 4 candidates in 1900 and 120 in 1939) or had been introduced (modern languages had 123 candidates in 1939, and philosophy, politics and economics, 152). This swing from humane studies, which are taught didactically, to science which is taught by demonstration and experiment, mainly caused the growth in the significance of the university. Although five colleges had provided science laboratories, the possibility that science could be studied as a college activity was never really a serious one. Laboratories are common services and must be provided on a huge scale. Between 1900 and 1940 the annual expenditure on the science departments grew from £24,177 to £135,681.

These developments took place without the university's absorbing the colleges. Until after World War I the university depended on endowments, which in 1900 yielded £19,000 a year net, and on fees and dues, which brought in £30,488. Major developments were due to private benefactions. After World War I such sources ceased to be adequate, and in accordance with the recommendations of a royal commission, in the face of strong opposition within the university, a government grant was paid. This amounted in 1927–28 to 21% of the total expenditure. In 1938–39 the grants remained 21% (but the total expenditure was about 25% higher); in 1947–48 the grants were 49% and in 1948–49 they were 52%. The subsidizing of individual students out of public funds developed simultaneously, and in 1939 the proportion of students in receipt of some form of financial assistance was 55%.

The control of these growing resources, however, never passed into the hands of any body distinct from the colleges. What the framers of the Oxford constitution aimed at was to ensure that the university's business, being for the benefit of scholars, should be controlled by scholars. The effective power was thus vested in the university at large. Naturally it was primarily in the hands of those holding academic positions ("congregation"), but as late as 1919 the nonresident masters of arts were able to defeat a proposal for the abolition of compulsory Greek. In 1926 the nonresident masters were finally relieved of all but revising functions exercised if the university was internally divided; and since the nonresident masters number about 15,000 they could not in any case be an effective body. Power, therefore, rests with congregation (about 1,000 M.A.'s), all members of the separate colleges. The fact that all decisions affecting policy must be passed by congregation, in which it is always easy to stir up opposition, has prevented the university from imposing anything like bureaucratic control upon the colleges. Congregation has, indeed, only a limited power of initiation, its function being to pass judgment on proposals submitted to it by the Hebdomadal council, a body containing 5 ex officio members (the chancellor, vice-chancellor, the 2 proctors and a pro-vice-chancellor, who is either the outgoing or the incoming vice-chancellor) and 18 M.A.'s elected by congregation. The council is thus a body which exercises a great influence; but it is the influence of a leader in a free community who remains a leader only as long as anyone chooses to follow.

The passing of the powers of convocation (all M.A.'s), though inevitable, was regretted on account of the risk that the university would become a self-complacent community, unresponsive to changing public needs. Partly in order to make this risk less, the Oxford society was founded under the leadership of the then chancellor Viscount Grey of Fallodon in 1932. One of the objects of the society was to provide through its magazine a kind of forum, in which the residents would describe and justify to the nonresidents what they were doing.

Enrolment in World Wars I and II.—The contrast between the university's experience of World Wars I and II was striking. In World War I the young men were encouraged to enlist indiscriminately, and no attempt was made to use the resources of the university for war purposes, except that some of the buildings were used as hospitals or barracks. The number in residence (about 4,000 in Jan. 1914) by Jan. 1915 had fallen to 1,087. In 1917–18 the number fell to 460. In World War II all national resources were mobilized. Young men were ordered to remain at their universities until the services were ready for them. In consequence, the number of men at the university fell only from 4,147 in the Trinity term of 1939 to 2,761 in the Michaelmas term, and to 2,148 by 1940–41. Senior members of the university were also sent or kept where they would be most useful. Thus the university was never entirely denuded of active teachers and research workers.

Benefactions.—The university used to depend for developments upon private benefactors. The Bodleian library, the Sheldonian theatre, the Ashmolean Museum of Art and Archaeology, the Dyson Perrins laboratory, the Serena professorship of Italian, the Stanhope Historical Essay prize and other foundations commemorate the names of some of them. When World War I caused taxation to rise, the days of private benefactions seemed to have passed. Nevertheless, between 1930 and 1943 the university received (apart from Lord Nuffield's gifts to the medical school and Nuffield college, together amounting to £3,800,000; more than £500,000 from a special appeal; and the gifts of the Rockefeller foundation, notably £586,000 for the extension of the Bodleian library) gifts totalling £271,000 and annuities amounting to £2,795 a year: all this was apart from gifts in kind. World War II did not end the generosity of benefactors. In 1948 Antonin Besse gave £1,250,000 for the foundation of a new college, St. Antony's, and £250,000 for the expansion of the existing colleges. In addition a stream of smaller bequests continued to flow either to individual colleges or to the university.

List of Colleges and Halls.—University, Balliol and Merton have been mentioned above. The other colleges in their order of foundation are: Exeter (1314), Oriel (1326), Queen's (1340), New (1379), Lincoln (1427), All Souls (1438), Magdalen (1458), Brasenose (1509), Corpus Christi (1516), Christ Church (begun by Wolsey in 1525, final foundation by Henry VIII, 1546), St. John's (1555), Trinity (1555), Jesus (1571), Wadham (1612, charter received 1610), Pembroke (1624), Worcester (1714), Keble (1870) and Hertford (1874). (For further details *see* OXFORD.) Of the various academical halls, St. Edmund (reputed foundation, 1226) is the only one that survived. St. Peter's hall,

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SOME VIEWS OF OXFORD

1. Queen's college from the High street
2. The Sheldonian theatre (right) and the Clarendon building
3. "Tom tower," Christ Church. The tower was built by Sir Christopher Wren
4. The Bodleian library extension, designed by Sir Giles Gilbert Scott and opened in 1946
5. The Hall of Wadham college
6. General view of Oxford from the air. Reading downward from St. Mary's church (spire) are the Radcliffe Camera (dome), the Bodleian library, the Clarendon building and the Bodleian library extension

founded as a hostel in 1928, became a permanent private hall in 1929, and in 1947 was admitted by decree of convocation to the status of a new foundation (a status differing from that of a college mainly because the head does not become vice-chancellor, and the society does not make statutory contributions to the university; Keble had this status in 1950 though it was then applying to the privy council for incorporation as a college). In 1950 St. Antony's college was established with the status of new foundation. Nuffield college, founded in 1937, is peculiar in being a university institution and not an independent corporation. It is a postgraduate college intended "to encourage research especially but not exclusively in the field of social studies." There are also two private halls, Campion hall (1896) for members of the Society of Jesus and St. Benet's (1897) for Benedictines.

Noncollegiate students were admitted, as members of St. Catherine's society, in 1863. There are five women's colleges: Lady Margaret hall (1878), Somerville (1879), St. Hugh's (1886), St. Hilda's (1893) and St. Anne's (1952). St. Anne's was formerly known as the Oxford Society of Home Students.

Other Academic Buildings of Note.—Oxford possesses fine academic buildings. Some of the principal ones are the group of buildings comprising the Bodleian library, the Convocation house with the Sheldonian theatre and the Old Ashmolean museum, and the Radcliffe Camera not far away. The "university church" of St. Mary lies just to the south of the latter. Another group of buildings is devoted to the Taylor institute and the Ashmolean Museum of Art and Archaeology. Other important buildings are the university science laboratories which are grouped together on a site of about 17 ac., and the famous Clarendon press. Mention should also be made of the botanical garden by the River Cherwell and the Oxford Union society, founded in 1625. (*See* also OXFORD.)

University Constitution.—"The chancellor, masters and scholars of the University of Oxford" form a corporate body, within which the colleges are individual corporations. The highest officer of the university is the chancellor, who is elected by the members of convocation, holds office for life and is generally a distinguished member of the university. The vice-chancellor is in practice the head. He is nominated annually by the chancellor and must by convention be the senior head of a college who has not yet held this post and who is willing to accept it. Each vice-chancellor is nominated for three years in all. Two proctors (*q.v.*) are appointed annually by two of the colleges in rotation. Until 1950, when the privilege dating from 1604 was abolished, the university returned two members to parliament under a system of proportional representation.

The Hebdomadal council initiates and congregation decides the business of the university: but there is a considerable delegation of executive functions. The administrative work is assigned sparingly so that scholars can do it without affecting their scholarly work. The delegation ranges from such bodies as the curators of the Bodleian library, who spend about £85,000 a year, to such as the committee for classical archaeology which spends about £120.

The delegate bodies fall into two groups: (1) those (*e.g.*, faculty boards) dealing with academic questions, which maintain academic standards both by supervising the selection of the teaching and research staffs and their work, and by determining the content and standard of examinations—such bodies are supervised by the general board of the faculties; and (2) those which provide services not regarded as academic. To these, the curators of the university chest bear much the same relation as the general board does to academic delegacies. But the curators are also responsible for advising the Hebdomadal council on financial matters, for managing the real property and other investments of the university and for ensuring that accounts are so kept as to form a trustworthy basis for estimating future expenditure and detecting waste.

The colleges consist of a head, whose title varies in different colleges, fellows (who form the governing body) and scholars. To these are to be added the commoners; *i.e.*, those who either receive no emoluments, or hold exhibitions which do not generally entitle them to rank with the scholars. The college officer who is immediately concerned with the disciplinary surveillance of members of the college *in statu pupillari* is the dean (except at Christ Church). Each undergraduate (this term covering all who have not yet proceeded to a degree) is, as regards his studies, under the immediate supervision of one of the fellows as tutor.

Degrees.—Nobody can study for a degree or be a member of the university unless he is a member of a college. The examinations for the B.A. (the title of the first degree, no matter in what subject it is taken) are: (1) responsions—an entrance examination taken before coming into residence (various other examinations of comparable standard are accepted as its equivalent); (2) the first public examination which may be an honours examination in Greek and Latin literature, or in mathematics or science (four subjects), or a pass examination designed as a preliminary to one of the final honour schools; (3) the second public examination which may be either an honours examination in a single subject or in two or three closely related subjects (a final honour school), or a pass examination in three unrelated subjects. In addition there are examinations in theology (for the B.D. degree), law (for the B.C.L.), medicine (for the B.M., and B.Ch.) and music (for the B.Mus.), which are normally taken after the B.A. Degrees of B.Litt., B.Sc. and D.Phil. are awarded for original research undertaken under supervision, and the higher doctorates for published work containing an original contribution to the advancement of learning.

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OXIDATION AND REDUCTION are chemical terms applied to changes in the electrical charge of an element in the course of a chemical reaction. For example, the combination of sodium and chlorine involves the transfer of an electron from a sodium atom to a chlorine atom and the formation of a sodium-chloride molecule in which the sodium is charged positively and the chlorine negatively, (Na^+) (Cl^-). The element which has lost electrons and thus acquired positive charges is said to be oxidized and the process is called oxidation. The element which gained electrons is reduced and the process is one of reduction. Thus, the combination of sodium and chlorine is an oxidation-reduction reaction resulting in the oxidation of the sodium and the reduction of the chlorine. In this reaction the chlorine is the oxidizing agent and the sodium the reducing agent.

Before the introduction of the electron concept, the term oxidation was applied to reactions in which an element gained oxygen as in the burning of carbon, $C + O_2 = CO_2$, or the rusting of iron, $4Fe + 3O_2 = 2Fe_2O_3$; the term reduction designated a reaction by which an element lost oxygen, such as the reduction of copper oxide by hydrogen, $CuO + H_2 = Cu + H_2O$.

In all oxides, the oxygen atom has a charge of -2 (or oxidation number of -2); hence, when free oxygen gas combines with another element to form an oxide, it gains electrons from that element.

In the generalized concept the term oxidation has been extended to include all similar reactions.

Many substances in water solution ionize (that is, dissociate into their charged constituents; *e.g.*, $NiCl_2 = Ni^{++} + 2Cl^-$), and the electrolysis of such solutions results in an oxidation process at the anode and a reduction at the cathode. For the electrolysis of $NiCl_2$ the anode reaction is $2Cl^- = Cl_2 + 2e^-$ and the cathode reaction $Ni^{++} + 2e^- = Ni^{++}$. These reactions involving the electrons are called half reactions or oxidation-reduction couples. Each couple has the reduced state of the element as one half and the oxidized state plus electrons as the other half. In theory, every oxidation-reduction reaction may be broken up into two couples which indicate the mechanism by which electrons are transferred. $Ag + 2HNO_3 = AgNO_3 + NO_2 + H_2O$; couples, $Ag + NO_3^- = AgNO_3 + e^-$ and $e^- +$

$2HNO_3 = NO_2 + NO_3^- + H_2O$. From this mechanism it is evident that oxidation and reduction occur simultaneously and in equivalent amounts; *i.e.*, the number of electrons lost is equal to the number gained. The relative potentials of the two couples determine the direction in which the reaction will proceed (*see* THERMODYNAMICS).

The most powerful reducing agents are the electropositive metals such as sodium. These readily reduce the compounds of the noble metals and also liberate hydrogen from water: $AgCl + Na = Ag + NaCl$ and $2Na + 2H_2O = 2NaOH + H_2$. The noble metals are poor reducing agents but their compounds are good oxidizing agents. Among the most powerful oxidizing agents are fluorine, ozone and cobaltic ion. These readily liberate oxygen from water, $F_2 + 2H_2O = O_2 + 2HF$. Hydrogen peroxide, potassium permanganate and ceric compounds are examples of powerful oxidizing agents which are used extensively in analytical and industrial chemistry. (W. M. LA.)

OXIDE, in chemistry, a binary compound of oxygen and another element. Oxides are the most plentiful and characteristic components of the earth's hydrosphere and lithosphere: the hydrosphere consists essentially of water, the commoner oxide of hydrogen; and the lithosphere of simple oxides of the general formula A_mO_n and complex oxides of the type $A_xB_yC_z \ldots O_n$. The complex oxides are more abundant, and the study of them forms the greater part of mineralogy, since they include many important rock-forming materials. Work on the structure of crystals has shown that the former inclusion of carbonates, aluminates and aluminosilicates among the complex oxides was not strictly correct (*see* below), though their empirical formulas are often given as though they consisted of oxides; *e.g.*, beryl, $Be_3Al_2Si_6O_{18}$, which is a silicate, may be written incorrectly as $3BeO.Al_2O_3.6SiO_2$. The ordinary ingredients of soil, subsoil and rocks are partly composed of oxides in either anhydrous or hydrated forms.

Oxygen can be made to combine directly with most elements, although sometimes it will not do so in the entire absence of water vapour (*see* DRYNESS, CHEMICAL); in a few cases in which direct methods are unavailing, as, for example, in the case of noble metals such as gold or platinum which remain unaffected in air even at very high temperatures, indirect methods can be used and oxides can be prepared from the salts of the metals. Oxides of the inert gases (helium, neon, argon, etc.) do not exist and would not be expected on modern theories of chemical bond-formation. Fluorine and later bromine (1930–40) have been oxidized by special methods, but for a long time it was thought that they would not form oxides.

Many elements form a series of several oxides. Thus nitrogen yields six: N_2O, NO, N_2O_3, NO_2 (N_2O_4 at lower temperatures), N_2O_5 and possibly NO_3. In general, the acidic character of the oxide increases with increase in the oxygen content. For purposes of classification it is usual to assign a typical oxide to each element; usually this oxide is the highest having acidic or basic properties and is related to the position of the element in the periodic classification (*see* PERIODIC LAW) as follows: the typical oxides of Group I are of the form M_2O[I], (roman numeral in brackets indicates periodic group) of Group II those of the form MO[II], of Group III those of the form M_2O_3[III], and so on, Group VI being those of the form MO_3[VI]. The oxides of typical metals (*e.g.*, MgO) are known to be aggregates of oxygen ions (O'') and positive metal ions held together by electrostatic forces in certain geometrical arrangements, while oxides of nonmetals (*e.g.*, CO_2) are usually volatile compounds, the constituent atoms being held together by covalent bonds. Less electropositive metals will form chemical bonds with oxygen which will have considerable covalent nature; *e.g.*, PtO.

Types of Oxide.—Oxides are often classed as (1) acidic oxides; (2) basic oxides; (3) amphoteric oxides; (4) neutral oxides; (5) suboxides; (6) higher oxides including peroxides, superoxides and dioxides or polyoxides; (7) mixed oxides; and (8) complex oxides. An oxide may not fall clearly into any one of these classes but have the characteristics of two.

1. Acidic oxides are those which combine with bases or basic oxides to form salts. Many of the oxides of nonmetals (*e.g.*, carbon, nitrogen, phosphorus and sulphur) are of this type. Some acidic oxides are "mixed" anhydrides: thus nitrogen peroxide reacts with water to give two acids, nitrous and nitric, and with bases to form nitrites and nitrates.

2. Basic oxides similarly react with acids or acidic oxides to form salts, and many of the oxides of metals fall into this class.

3. Amphoteric oxides behave as acidic oxides toward bases and as basic oxides toward acids: thus zinc and aluminum oxides dissolve in acids or bases to give salts of the acid or zincates (aluminates) of the base, respectively.

4. Neutral oxides are those which neither react to form salts nor combine with water to give acids or bases: carbon monoxide and nitrous oxide are examples, for although they result from formic and hyponitrous acids, respectively, by loss of water, they do not combine with water to give these acids and are therefore not acidic anhydrides.

5. Suboxides have less oxygen than the common lowest stable oxide, but the term is often loosely used. Carbon suboxide (C_3O_2) is one of the few true suboxides and is obtained by the dehydration of malonic acid, into which it can be converted again by water. At 200° C. carbon suboxide can be changed into a lower oxide, pentacarbon dioxide, C_5O_2. Some so-called suboxides (*e.g.*, lead suboxide, Pb_2O) are now considered to be mixtures (in this case, of lead and lead monoxide). Certain metals, particularly titanium, will yield solid oxides slightly deficient in oxygen or metal and are therefore nonstoichiometric; *i.e.*, they do not obey the law of constant composition. Such "deficient" oxides often show special electrical conductivity properties.

6. Higher oxides have more oxygen than the typical oxide as determined by the periodic classification and can be divided mainly into three groups: (*a*) peroxides, (*b*) superoxides and (*c*) dioxides.

a. Peroxides contain two oxygen atoms linked together to form the grouping $-O-O-$ and usually occur in solid oxides as O''_2 ions. They are closely related to hydrogen peroxide (a neutral oxide), and the latter is formed when peroxides are treated with water or dilute acid. True peroxides are formed by metals such as sodium and barium (*e.g.*, Na_2O_2 and BaO_2). The peroxide link is also found in certain peracids (*e.g.*, persulphuric acid, $H_2S_2O_8$) and their salts. Many organic compounds can have the oxygen atom replaced by the $-O-O-$ group, and these are known as organic peroxides (*e.g.*, diethyl peroxide, $C_2H_5-O-O-C_2H_5$). They are not very stable and can be used, like other peroxides, as powerful oxidizing agents. The formation of peroxides in the oxidation of gasoline in the internal combustion engine is well known, and diethyl peroxide is a "pro-knocking" agent.

b. The final oxidation products (KO_2) of potassium are known to contain the superoxide ion $(-O-O-)^-$; such compounds, formerly known as tetroxides and written as M_2O_4[I], are called superoxides.

c. Certain other oxides, often termed peroxides, are of an entirely different type from true peroxides and contain the ordinary oxygen ion (O'') linked to the metal ion. Thus lead peroxide is now called lead dioxide since it shows no structural similarity with a true peroxide, but it is, of course, a strong oxidizing agent. Like manganese dioxide it reacts with an acid to give a salt of lower valency, *e.g.*, MnO_2[IV] $+ 4HCl = MnCl_2$[II] $+ Cl_2 + 2H_2O$, but not hydrogen peroxide.

The typical oxides of Group VII elements, Cl_2O_7 and Mn_2O_7, are not peroxides, but S_2O_7 (if it exists) would have more oxygen than the typical oxide of sulphur (SO_3 in Group VI) and might be expected to have some of the properties of a peroxide.

7. Metals that have two valencies can form oxides containing the metal in its two different valencies (*e.g.*, Pb_3O_4 and Fe_3O_4), and these mixed oxides will have some resemblance to complex oxides (*see* below). Thus Pb_3O_4 has been shown to have a crystal structure consisting of chains of tetravalent lead ions surrounded octahedrally by oxygen ions with divalent lead ions linking the chains together. The action of acids upon such an oxide will yield a mixture of compounds derived from Pb[II] and Pb[IV]: thus $Pb_3O_4 + 2HNO_3 = PbO_2$ [IV] $+ Pb(NO_3)_2$[II].

8. Complex oxides can be divided into two large groups: (*a*) those which contain oxyions (CO_3'', SiO_3'', etc.) and are more

strictly known as oxysalts rather than oxides; and (*b*) those which consist of aggregates of oxygen ions (O'') and positive metallic ions and are true complex oxides.

The latter will have different geometrical arrangements in their crystal form according to the relative sizes and numerical proportions of the constituents. As the oxygen ion is usually much larger than the metallic ion, there will be a close packing of the negative oxygen ions with the positive ion or ions occupying the interstices between the oxygen ions.

Metals of the same size will yield complex oxides of similar crystal structure, since it is possible to replace one metal by another of a similar size: thus, in the spinels of general formula MAl_2O_4, the metal M can be Fe, Co, Ni, Mn or Zn, yielding a whole series of spinels. Where the metallic ion approaches the size of the oxygen ion a new geometrical arrangement will be necessary, and there are a number of possible structures; typical of these is the perovskite structure of the so-called titanates, $SrTiO_3$, etc., in which the large Sr^{2+} or Ba^{2+} ions are closely packed with oxygen ions, and the smaller Ti^{4+} occupies the interstitial positions. The study of such structures is an important aspect of inorganic chemistry (for fuller details *see* A. F. Wells, *Structural Inorganic Chemistry*, Oxford, 1951). The production of artificial minerals such as sapphires for use as bearings is an interesting industrial process. Mixtures of metallic oxides and oxides of metals with variable valency such as vanadium are of great importance in modern catalytical chemistry, for example, in the manufacture of sulphuric acid.

Many oxides combine with water to form hydroxides (*see* HYDROXIDE), and all hydroxides lose water on heating to give the corresponding oxide. The chemical properties of a hydroxide are almost identical with those of the corresponding oxide, but the latter is somewhat more inert, especially if it has been very strongly heated.

For further details *see* OXIDATION AND REDUCTION; *see* also H. B. Weiser, *The Hydrous Oxides*, "International Chemical Series" (1926).
(A. D. M.; F. H. P.)

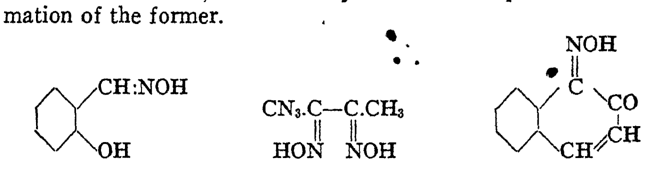
OXIMES are organic compounds containing the group >C:NOH. They are obtained either by the action of hydroxylamine on an aldehyde or ketone (I), or by the action of nitrous acid or its esters on a compound containing a reactive methyl or methylene group (II). The products of the latter type of reaction are sometimes called isonitroso compounds, but they are all true oximes and the prefix oximino is better than isonitroso.

$$\underset{\text{I}}{>C{:}O + H_2NOH \rightarrow} >C{:}NOH + H_2O \leftarrow \underset{\text{II}}{>CH_2 + O{:}NOH.}$$

Victor Meyer prepared the first oxime in 1878 and since that date the compounds have been of continued interest to organic chemists because of their value in identification and synthesis and still more so because of the stereoisomerism which occurs in certain classes of oximes (*see* STEREOCHEMISTRY).

Oximes are usually regarded as derivatives of aldehydes and ketones and thus are divided into aldoximes and ketoximes. Since they are solids which, apart from the simplest members, are insoluble in water and crystallize well, they are used to some extent for isolating and identifying aldehydes and ketones. The rate of oxime formation, however, is often somewhat slow, so that it is frequently more convenient to use derivatives of hydrazine. The oximes behave as weak acids and also as weak bases. They are reduced to primary amines, and this is a useful method for effecting the change $>CO \rightarrow >CHNH_2$. The aldoximes are dehydrated to nitriles by acid chlorides or anhydrides, $-CH{:}NOH \rightarrow -CN + H_2O$, a reaction which was of value in the early study of the structures of the simpler sugars. All oximes can be hydrolysed by aqueous mineral acids, with varying ease, to the parent aldehyde or ketone and hydroxylamine, but they are stable to aqueous alkalies. The characteristic reaction of ketoximes, the Beckmann transformation, is discussed below.

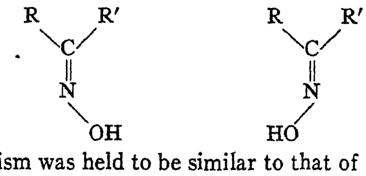
Certain oximes form stable co-ordination compounds with metals and since there are marked differences in the solubilities of the oxime complexes of closely related metals, these oximes are valuable quantitative reagents in analytical chemistry. Three examples will be given. Salicylaldoxime (III) forms complexes with a variety of metals, but they are all soluble in dilute acetic acid except that of copper. The latter is a greenish-yellow powder which can be dried at 110° C. without decomposition. Hence F. Ephraim introduced this oxime as a reagent for the quantitative separation and determination of copper. Dimethylglyoxime (IV), the dioxime of a diketone, forms a series of complexes with metals of which only those with nickel and palladium are insoluble in dilute alkalies and weak acids. It is, therefore, the standard reagent for determining these metals and, in particular, gives a quantitative separation of nickel from cobalt. Finally, β-naphthaquinone monoxime (V) forms an insoluble complex with cobalt but not with nickel, and is widely used for the quantitative estimation of the former.



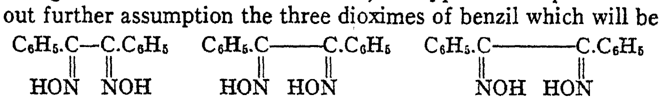
III IV V

Stereochemistry of the Oximes.—From the point of view of the development of stereochemistry, the oximes are of great interest. In 1883 Hans Goldschmidt found that the dioxime of benzil ($C_6H_5.CO.CO.C_6H_5$) existed in two forms, and a third form was obtained by Victor Meyer in 1889. In the same year Ernst Beckmann found that an aldoxime, that of benzaldehyde, existed in two forms. Geometrical isomerism in unsaturated carbon compounds had already been recognized by J. H. van't Hoff and generally accepted, and in 1890 Arthur Hantzsch and Alfred Werner extended this conception to compounds containing the group >C:N— and advanced the view that these isomeric oximes were geometrical isomers. This view is now known to be true, but it was not accepted by all at first and the ensuing controversy led to much experimental work which laid a solid foundation for fundamental knowledge in a wide field of stereochemical problems.

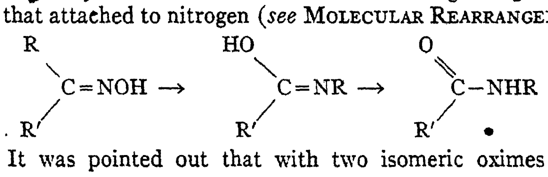
The Hantzsch-Werner hypothesis was that the oxime of an unsymmetrical ketone or of an aldehyde can exist in two forms which may be written:



The isomerism was held to be similar to that of compounds containing the group >C:C<, as with maleic and fumaric acids. The hypothesis implies two postulates: (1) that the hydroxyl group is not placed symmetrically with respect to the carbon and nitrogen atoms, but lies to one side of the line joining them; (2) that there is no "free rotation" about the double bond between the carbon and nitrogen atoms, so that the two forms are not readily interconvertible. There were three weighty reasons for the hypothesis. First, isomeric oximes should, and in fact do, occur only when the groups R and R′ are different; *i.e.*, in aldoximes and oximes of unsymmetrical ketones. If R and R′ are alike, the two configurations are identical. Second, the hypothesis explains without further assumption the three dioximes of benzil which will be:



The last argument was based on the Beckmann transformation of the ketoximes. This occurs when a ketoxime is treated with certain acidic reagents, notably phosphorus pentachloride in dry ether. The product obtained after treatment with water is a substituted acid amide. There must be an exchange of groups, one originally attached to the carbon atom having changed places with that attached to nitrogen (*see* MOLECULAR REARRANGEMENTS).



It was pointed out that with two isomeric oximes of formula

RR′C:NOH, the main product obtained from one isomer is the amide R′CO.NHR, whereas the other gives the isomeric amide R.CO.NHR′. This is strong evidence that the isomeric oximes have the same structure but a different space arrangement.

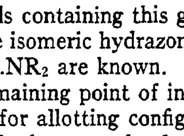
Many more facts later accumulated to support the view of Hantzsch and Werner and show that geometrical isomerism occurs in the oximes. Reference can be made to only a few. The opposing view was that the isomerism is structural and not geometrical, and was based on the structural differences which are possible in the oxime grouping. For example, oximes form two series of ethers, in one of which the alkyl group is attached to oxygen and in the other to nitrogen. Several cases are, however, now known where not only the oxime but also its O— and N— ethers have been obtained in isomeric pairs, all distinct crystalline solids. This shows that the isomerism survives minor changes in structure.

The truth of postulate (1), the unsymmetrical position of the hydroxyl group, was established by the ingenious and beautiful experiments of W. H. Mills (1910–31). In this work the aim was to prepare a compound which, if the postulate is correct, has a space configuration not superposable on its mirror image, so that it should exist in optically active forms, whereas, if the postulate is incorrect, resolution into optically active forms is impossible. Several such compounds have been resolved, and in one of them (Mills and B. C. Saunders, 1931) the molecule is such that the optical activity cannot arise from any other cause, probable or improbable, than the unsymmetrical position of the group attached to nitrogen in >C:N—. A final argument which should be given is that if the isomerism is geometrical, it should occur in compounds containing this group other than the oximes. This is true, since isomeric hydrazones containing the group >C:N.NHR or $>C:N.NR_2$ are known.

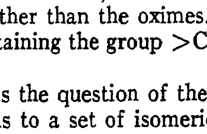
The remaining point of interest is the question of the methods available for allotting configurations to a set of isomeric oximes. Such methods must clearly be based on reactions in which the isomers differ. Hantzsch and Werner pointed out that such reactions are known and applied them to this purpose. With aldoximes the acetyl derivatives of an isomeric pair differ in that one, when treated with aqueous sodium carbonate, is hydrolysed to the oxime, whereas the other eliminates acetic acid and gives a nitrile. If it is assumed that this elimination of acetic acid takes place with the oxime in which the acetyl and hydroxyl groups are on the same side of the double bond, the configurations follow:

$$\begin{array}{l}\text{R.C.H}\\ \quad\|\\ \text{NOAc}\end{array} \longrightarrow \text{RCN} + \text{AcOH} \qquad \begin{array}{r}\text{R.C.H}\\ \|\quad\\ \text{AcON}\end{array} \longrightarrow \begin{array}{r}\text{R.C.H}\\ \|\quad\\ \text{HON}\end{array}$$

Similarly with the ketoximes, they pointed to the two products of the Beckmann transformation mentioned above and allotted configurations on the assumption that groups situated on the same side of the double bond (often described as in the syn-position) exchange places. Doubts as to the validity of the two assumptions made in these arguments were expressed as early as 1904 (P. Pfeiffer), but the matter came to a head in 1921 when J. Meisenheimer published results showing that the oxidation with ozone of the compound shown in (VI) gives a derivative of β-benzilmonoxime and the latter must thus have the configuration corresponding to (VII). On the assumption of Hantzsch and Werner, however, this is the configuration of the α-monoxime.



VI



VII

This discovery led to an extended series of investigations both in Germany and England, the aim being to establish the configuration of an oxime by some indisputable method, so that the validity of the original assumptions could be settled. One of the most brilliant of these studies was that of Meisenheimer in 1932 in which appeal was made to an entirely different set of phenomena, the occurrence of optical activity in certain naphthalene compounds because of interference to free rotation about a single link by the close packing of groups. All results tended to show that the original assumption was wrong and that groups in the anti-position, and not the syn-, are involved in the Beckmann change. This was confirmed, and the matter put beyond doubt, when methods became available for measuring certain physical properties of an isolated molecule. Arguments from physical properties had carried little weight so far because the properties considered were those of an assembly of molecules and the issue is obscured by the interactions between molecules. The measurement of the molecular electric moments of the N-methyl ethers of *p*-nitrobenzophenone oxime by T. W. J. Taylor and L. E. Sutton in 1931 showed a large difference which can arise only from the fact that the groups making the main contribution to the moment, the nitro group and the bond between nitrogen and oxygen, are so arranged that their effects are opposed in one isomer while in the other they have a component in the same direction. This result was decisive and the configurations now allotted are the reverse of those put forward originally. In a somewhat similar way the configurations of the aldoximes have also been settled, and it is known that elimination of acetic acid in an acetyl derivative involves the groups lying across, and not on the same side of, the double bond.

Many points in oxime chemistry remained obscure at mid-20th century, notably the reason why only a limited number of oximes occur as geometrical isomers out of the large number which might be expected to do so. (T. W. J. T.)

OXNARD, a city of Ventura county, California, U.S., on the Southern Pacific railway, midway between Los Angeles and Santa Barbara, and 4 mi. from the ocean. The population in 1950 was 21,567; in 1940 it was 8,519 by federal census. It is the trading centre for an extensive agricultural district, and has a large beet-sugar factory and other industries. It is the hub of the harbour of Port Hueneme. Oxnard was founded in 1898 and incorporated in 1903.

OXUS or AMU DARYA, one of the great rivers of central Asia. From Lake Victoria (Sor-Kul) in the Pamirs, which was originally reckoned as the true source of the river, to Khamiab, on the edge of the Andkhui district of Afghan Turkistan, for a distance of about 680 mi., the Oxus forms the boundary between Afghanistan and the U.S.S.R. For another 550 mi. below Khamiab it follows an open and sluggish course till it is lost in the Aral sea. The level of Lake Victoria is 13,400 ft. above sea. At Khamiab the river is probably less than 500 ft. The total length of the river is 1,500 mi. and its catchment area about 116,000 sq.mi. The annual rainfall of this basin varies probably between 10 to 20 in., and its discharge into the Aral sea is about 35,000 cu.ft. per second. About 2,300 sq.mi. depend on its waters for irrigation.

Sources.—The final survey of the Pamir region (wherein the heads of all the chief tributaries of the river lay hidden), by the Pamir boundary commission of 1895 established the following facts. The elevated mountain chain, called the Nicolas range, which divides the Great from the Little Pamir, is a region of vast glaciers and snow fields, supplying the greater part of the water of the lakes lying immediately north and south. The Nicolas range may be regarded as the chief fountainhead, through Victoria and Chakmaktin lakes, of at least two of the upper tributaries of the Oxus, namely, the Aksu (or Murghab) and the Pamir river, and as contributing largely to a third, the Ab-i-Panja. The enormous glaciers which lie about the upper or main branch of the Ab-i-Panja (called the Ab-i-Wakhjir or Wakhan), which rises under the mountains enclosing the head of the Taghdumbash Pamirs are an important source of the river.

Kala Panja to Ishkashim.—From the point where the rivers of the Great and Little Pamirs join at Kala Panja to Ishkashim, at the elbow of the great bend of the Oxus northward, the river valley and the northern slopes of the Hindu Kush, which near Ishkashim extend in slopes of barely 10 mi. in length from the main watershed to the river banks, were carefully mapped. These slopes represent the extent of Afghan territory which exists north of the Hindu Kush between Kala Panja and Ishkashim. From Ishkashim northward the river passes through the narrow rock-bound valleys of Shignan and Roshan, then north and west through the mountains and defiles of Darwaz. This part of the Oxus, until it once again emerges from the Bokhara hills into

the open plains bordering Badakshan on the north, fell within the area of Russian surveys.

Eighty-five miles north of Ishkashim, at Kala Wamar, the river which rises in the Little Pamir, and which is called Aksu, Murghab, or Bartang, joins the Oxus from the east. At this point the measurement of the comparative lengths of the chief Pamir tributaries of the Oxus is as follows: to the head of the Aksu at Lake Chakmaktin 260 mi.; to the head of the most easterly tributary of Lake Victoria, in the Great Pamir, about 230 mi.; to the glacial sources of the Ab-i-Wakhjir, about 230 mi. For 120 mi. the two latter are united in the main stream of the Oxus, the volume of which has been further increased by the Ghund and Shakhdara draining the Alichur Pamir and the heights of Shignan.

Ishkashim to Kolab.—The narrow cramped valley of the river between Ishkashim and Kala Wamar is hedged in on the west by a long ridge flanking the highlands of Badakshan; on the east the buttresses and spurs of the Shignan mountains (of which the strike is transverse to the direction of the river and more or less parallel to that of the main Hindu Kush watershed) overhang its channel like a wall, and afford but little room either for cultivation or for the maintenance of a practicable road. Yet the lower elevation (for this part of the Oxus stream is not more than about 7,000 ft. above sea level) and comparatively mild climate give opportunities to the industrious Tajik population for successful agriculture.

Beyond the Bartang (or Murghab) confluence the valley narrows, and the difficulties of the river route increase. Between Kala Wamar (6,580 ft.) and Kala Khum (4,400 ft.), where the Oxus again bends southward, its course to the northwest is almost at right angles to the general strike of the Darwaz mountains, which is from northeast to southwest, following the usual conformation of all this part of high Asia. Thus its chief affluents from the northeast, the Wanj and the Yaz Ghulam, drain valleys which are comparatively open. At Kala Khum the river is 480 ft. wide, narrowing to 350 ft. in the narrowest gorge. Its level varies with the obstructions formed by ice, falling as much as 28 ft. when its upper channels are blocked.

In the valleys of the Waksh and the Surkhab to the north of Darwaz, which form an important part of the province of Karategin, maple, ash, hawthorn, pistachio and juniper grow freely in the mountain forests, and beetroot, kohl rabi and other vegetables are widely cultivated. About the cliffs and precipices of the Panja valley near Kala Khum are the wild vine, cerasus and pomegranate, and the plane tree and mulberry flourish in groups near the villages. There also, among other plants, the sunflower decorates village gardens. The river's left bank belongs to Afghanistan.

From Kala Khum the river follows a southwesterly course for another 50 mi. through a close mountainous region and widens into the more open valley to the south of Kolab.

The topography of Darwaz south of the river is not accurately known, but at least one considerable stream of about 60 mi. in length, drains to the northeast, parallel to the general strike of the mountain system into the transverse course of the Oxus, which it joins nearly opposite to the lateral valleys of Yaz Ghulam and Wanj. This stream is called Pangi-Shiwa, or Shiwa. Another of about equal length, the Ragh or Sadda, starting from the same central water-parting of this mountain block, and included within the Oxus bend, follows a transverse direction at almost right angles to the Shiwa, and joins the Oxus valley near its mouth into the more open Kolab plains, where the course of the Oxus has again assumed a direction parallel to the mountain strike. Toward its junction with the Oxus it cuts through successive mountain ridges, which render its course impracticable as a roadway. To avoid the river, and to pass by mountain tracks which surmount a series of local spurs or offshoots from the central plateau, in order to reach the Oxus, an important route, traversing the Darwaz mountains from east to west, cutting off the northern bend of the Oxus, and connecting those easterly routes which intersect the Pamirs by means of the Ghund and Shakhdara (and which concentrate about Lake Shiwa) with Kolab in eastern Bokhara, was developed.

(*See* BADAKSHAN.)

Badakshan Region.—From about the point where the Oxus commences to separate Russian territory from the comparatively open Afghan districts of Rustak and Kataghan, it adopts an uncertain channel and splits, leaving broad central islands. Besides the Kolab and Surkhab (or Waksh), the great muddy affluents from Karateghin on the north—the Kabadian, the Surkhan, and the Darbant—are very considerable tributaries from Bokhara. The last is the river on which the well-known trade centre of Shirabad is built, about 20 mi. north of the river.

From the south the Kokcha and the Khanabad (or Kunduz) join the Oxus between Kolab and the Mazar crossings. The valley of the Kokcha leads directly from the Oxus to Faizabad, the capital of Badakshan, and its head is close above Ishkashim at the southern elbow of the great Oxus bend, a low pass of only 9,500 ft. dividing its waters from those of the main river. This undoubtedly was a section of the great central trade route of Asia, which once connected Ferghana and Herat with Kashgar and China. (*See* BADAKSHAN.) This river and the Khanabad tap the northern slopes of the Hindu Kush; their sources are in the Kafiristan mountains.

To the west of the Kunduz no rivers find their way through the southern banks of the Oxus. Throughout the plains of Afghan Turkistan the drainage from the southern hills is arrested and lost in the desert sands.

The left bank above Kilif is, as a rule, low and flat, with reed swamps and a strip of jungle between the reeds and the edge of the elevated sandy desert. The jungle is chiefly tamarisk and padah (willow). Swamp deer, pheasants and occasionally tigers are found in it.

The right bank is generally higher, drier, more fertile and more populated than the left.

Irrigation.—A wide belt of blown sand (or Chul), sprinkled with saxaul jungle, separates the swamps on the south side of the river from the cultivated plains of Afghan Turkistan; but in places, notably for about 12 mi. above Khamiab where the Russo-Afghan boundary touches the river, through the Khwaja Salar district and in a less degree for 50 mi. above the Kilif ferry, the Ersari Turkman repelled the encroaching desert sand-waves, and a strip of riverain soil averaging about a mile in width was reclaimed and cultivated by irrigation. The cultivation, principally of wheat and barley, supported by canals drawn from the Oxus (the heads of which are constantly being destroyed by flood and again renewed) is of a very high order. The fields are intersected by narrow stone-walled lanes, bright with wayside flowers, among which the poppy and the purple thistle of Badghis are predominant; the houses, neatly built of stone, are scattered in single homesteads, substantial and comfortable; and the willow and mulberry offer a grateful shade in summer, when the heat is often insupportable.

The fiery blasts of summer, furnace-heated over the Kizil Kum, are hardly less to be feared than the ice-cold northwestern blizzards, which freeze men in the open desert, and frequently destroy whole caravans.

Below Khamiab, to its final disappearance in the Aral sea, the Oxus flows through a vast expanse of sand and desert. Under Russian auspices a considerable strip of alluvial soil on the left bank was brought under cultivation; however, cultivation is confined to the immediate neighbourhood of the river, for no affluents of any considerable size exist. The river is navigable below Charjui.

About 100 mi. above the Aral sea is the ancient oasis of Khwarezm or Khiva, entirely dependent on the Oxus for irrigation. The river there perpetually shifts eastward, causing a constant need for lengthening the irrigation channels lest the oasis become a desert.

OXY-ACETYLENE BLOWPIPE. An apparatus with a mixing jet which produces an intensely hot flame by projecting and burning acetylene with oxygen. It is of great value for metal-working, producing a flame which attains about 6,000° F. at the hottest part. In the high-pressure system, which is best for portable outfits, both the acetylene and the oxygen are delivered under pressure to the blowpipe, both from cylinders. In the

low-pressure system the acetylene is drawn direct from a generator. The blowpipes are manipulated either by hand, or guided in a machine. They are used for cutting out various shapes, parting thick sections, cutting out pieces for repairs or breaking-up purposes or welding to make new articles, and for various other purposes. When used for cutting, a separate jet of cutting oxygen is provided. This oxidizes or burns the hot metal. The oxide or "rust" thus formed is removed by the force of the jet and a cutting effect results.

When used for welding theoretically the welding flame should be neutral, that is, there should be no excess of acetylene or oxygen but in practice a little more oxygen than acetylene is used. Parts can also be heated conveniently for bending or straightening, and glass can be heated for working. The oxy-acetylene flame is too hot for brazing purposes, for which an oxy-coal-gas blowpipe has to be used. The approximate temperature of the oxy-acetylene flame may be compared with those of other flames from the following figures: Oxy-acetylene, 4,400° C; oxy-hydrogen, 2,420°; oxy-coal-gas, 2,200°; air-acetylene, 2,500°; air-coal-gas, 1,800°. (*See* WELDING.)

OXYGEN, a colourless, odourless, tasteless gas, somewhat heavier than air (sp.gr. 1·10523); it is slightly soluble in water. and this dissolved oxygen plays an essential part in the respiration of aquatic animals. (Symbol O, atomic number 8, atomic weight 16·000.) Oxygen combines with nearly all the elements under suitable conditions, but these reactions often do not take place if the substances are perfectly dry. With the exception of the "noble" metals, gold and the platinum group (*q.v.*), the metallic elements all oxidize when heated in oxygen, although molten silver dissolves 22 volumes of the gas without combining chemically with it, the absorbed oxygen escaping again when the metal cools.

Oxygen is by far the most abundant element, being nearly equal in amount to all the others put together. It forms 21% by volume of the atmosphere, eight-ninths by weight of water, and nearly one-half by weight of all the rocks composing the half-mile crust of the earth. Growing plants absorb carbon dioxide (*see* CARBON, OXIDES OF), assimilating carbon and rejecting oxygen. It is the only gas able to support respiration.

Preparation and Properties.—It is readily prepared on a small scale by heating a mixture of potassium chlorate with about one-third of its weight of manganese dioxide, which facilitates the decomposition. From 1886, for about 20 years, oxygen was produced commercially by the Brin or barium oxide process. Barium monoxide was heated to 1,000° F and absorbed oxygen from the air to form the dioxide. At 1,600° the oxygen thus absorbed was again set free, the monoxide being regenerated. In later methods the temperature was maintained constant at about 1,200° F, and change of pressure was relied upon for determining the respective phases of oxidation and deoxidation. The purity obtainable, however, was not more than 94%.

In 1902 Linde applied the process of rectification to liquid air and was able to extract oxygen of 98·5% purity in economical yield. Air is freed of its carbon dioxide, compressed, cooled and then expanded, either in an engine doing external work or merely through a valve to perform internal molecular work; in both cases heat is lost and the temperature further lowered. This cooling effect is made cumulative by means of heat interchangers, tubular metal devices by which the cold gases after expansion are made to travel in indirect contact with and in counter-current to the incoming uncooled compressed air, so that the latter becomes continually colder at the point of expansion, until a limit is set by liquefaction. The liquid so produced is made to flow down a rectification column, fitted with numerous plates fashioned to ensure its intimate contact with ascending gas, which is produced at the base of the column by evaporating the liquid as it arrives there. When equilibrium is attained, almost pure oxygen can be drawn from the bottom of the column in gaseous or liquid form. Improvements in construction introduced in 1926 enable the separation of the nitrogen and oxygen of air to be effected almost completely, the oxygen purity being 99·5%, and the nitrogen over 99%.

Oxygen is also a by-product in hydrogen manufacture by the electrolysis of water. The much greater power consumption, however, prevents this process competing with the liquid-air process for oxygen production only. The gas is supplied in steel cylinders at a pressure of 120–150 atmospheres. During 1926 the world's production of oxygen, in cylinders, was about 5,000 million cubic feet. The estimation of oxygen in a gas is most conveniently made by means of an alkaline solution of pyrogallol, by metallic copper in conjunction with an ammoniacal solution of ammonium carbonate, by sticks of phosphorus, or by a weakly alkaline solution of sodium hydrosulphite.

Oxygen condenses to a pale blue magnetic liquid, boiling at −182.97° C. By rapid evaporation and consequent cooling, or by cooling in liquid hydrogen, oxygen forms a bluish-white solid, melting at −219° C. When gaseous oxygen is acted on by the silent electric discharge, an unstable modification, ozone (*q.v.*) O_3 is produced.

Uses.—Most of the oxygen is employed in industry for the fusion welding of metals, *e.g.*, steel, cast iron, aluminium, lead, and for the cutting of steel. Gas welding is generally accomplished by the aid of the oxy-acetylene flame, the two gases being supplied to a blowpipe wherein they are thoroughly mixed before combustion. In practice a little more oxygen than acetylene is used, and the resulting flame has an inner white core with a temperature above 4,000° C; it is quickly able to reduce these metals to the molten state locally, where two edges are to be joined. For metal cutting, a separate jet of "cutting" oxygen is provided in a similar blowpipe, either in the centre of the heating jet or behind it. As a rule, the melting point of an oxide is higher than that of the metal from which it is derived; but the fusion point of industrial iron varies between 1,400–1,500° C, and the mixture of iron oxides fuses at about 1,350° C. In the cutting the oxides of iron are formed and blown away in the molten state before the unoxidized iron reaches its melting point, the necessary temperature being maintained chiefly by the heat of combustion itself, but to a less extent by an independent heating jet. When the cutting blowpipe is moved mechanically, and therefore regularly, over the metal a remarkably smooth regular cut is obtained, even through metal 17in. thick.

Oxygen is widely used in medical practice, inhalation being of service in cases of pneumonia, heart complaints, etc.; also in cases of gas poisoning, especially by carbon monoxide. It is used with nitrous oxide by anaesthetists.

Liquid oxygen has considerable industrial applications. If a rod of hard gas-carbon be heated to redness at one end and then immersed in liquid oxygen, it burns in the liquid with intense evolution of light and heat, the carbon dioxide resulting being frozen and retained as a white solid in the liquid. If the carbon is presented to the oxygen in a porous form, *e.g.*, wood charcoal, lampblack, soot, cork meal, sawdust, or wood pulp, the mixture forms a powerful explosive, more than twice as effective as blasting gelatine. It is so remarkably effective because the oxygen is free, and not chemically combined with other elements as in explosives like gunpowder or nitro-compounds, the explosion being an instantaneous oxidation of carbon, hydrogen or other elements. The materials are formed into cartridges in a paper wrapping; these may be 8in. long and 1½in. in diameter. They are thoroughly soaked in liquid oxygen and placed in the bore hole, and, after tamping, fired electrically or by fuse. This explosive has the great advantage that it automatically becomes dead in a short time if not fired, owing to the evaporation of the oxygen. It is exceptionally suitable for use in iron mines and in tunnelling, as it gives rise to no harmful gases.

The highly volatile liquid is transported in double-walled spherical vessels, made of spun copper with long, narrow necks. A good vacuum is created mechanically between the walls. When the excessively cold liquid oxygen is introduced into the vessel, activated charcoal (*q.v.*), placed in the vacuous space and in contact with the inner sphere, becomes cooled, and then possesses the remarkable property of absorbing the residual gas and converting the vacuum to one of an exceedingly high order (a few millionths of a mm. of mercury). This vacuum, coupled with the highly polished metal surfaces, prevents the ingress of heat

to a large extent. A 25-l. container (the usual size) loses by evaporation only 5% of its full liquid charge per day. The liquid is poured from them into smaller dipping flasks, of similar construction but cylindrical in shape with open top, so that the cartridges can be readily inserted and withdrawn. (For oxygen in relation to muscular contraction *see* MUSCLE AND MUSCULAR EXERCISE.)

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(C. R. H.)

OXYHYDROGEN FLAME, the flame attending the combustion of hydrogen and oxygen, and characterized by a very high temperature. (*See* FLAME.)

OYAMA, IWAO (1842–1916), Japanese marshal and statesman, raised in the peerage from count to marquess after the Chino-Japanese War (1894–95) and to prince after the Russo-Japanese War (1904–05). Son of a *samurai* of the Satsuma clan, he fought under Saigo Takamori at the time of the Restoration but against him in the Satsuma rebellion of 1877. He was sent twice to Europe to study military affairs while still a young officer; he was minister of war in 1880 and in 1885, and chief of the general staff in 1882, proceeding to Europe for the third time the following year. During the Chinese war he commanded the second army, which captured Port Arthur and Wei-hai-wei. In the Russian war he was commander in chief in Manchuria, and his name is associated with the battles of Liao-Yang, the Sha-ho and Mukden. After Mukden he was hailed in the British press as the equal of Marlborough and Wellington. He received the Order of Merit from King Edward VII in 1906.

OYER AND TERMINER, the Anglo-French name, meaning "to hear and determine," for one of the commissions by which a judge of assize sits (*see* ASSIZE). By the commission of oyer and terminer the commissioners (in practice the judges of assize, though other persons are named with them in the commission) are commanded to make diligent inquiry into all treasons, felonies and misdemeanours whatever committed in the counties specified in the commission, and to hear and determine the same according to law. By the Treason act of 1708 the crown may issue commissions of oyer and terminer in Scotland for the trial of treason and misprision of treason.

In the United States oyer and terminer is the name given to courts of criminal jurisdiction in some states; *e.g.*, New York, New Jersey, Pennsylvania and Georgia.

OYSTER. Oysters belong to a large class of molluscs called by Georges Cuvier "Bivalvia" because all members of this group have a two-valved shell which encloses a soft body. The class was later renamed Pelecypoda, which means that its members have a hatchet-shaped foot, and Lamellibranchia, *i.e.*, with platelike gills. In the course of evolution, oysters became sedentary and lost the foot, which is, however, present in their larvae.

The distribution of oysters is limited by the latitudes 64° N. and 44° S. Within this broad belt they occur in shallow inshore waters of all the continents.

Science recognizes about 100 species of living oysters and more than 500 fossil ones. Shape, size and sculpture of the oyster shell varies with the environment. Classification, based on these characters is therefore unreliable. There are two distinct groups of edible oysters: (1) the round and flat ones such as *Ostrea edulis* (Europe) and *O. lurida* (Pacific coast of North America); and (2) the long, cuplike species represented by *O. virginica* (Atlantic coast of U.S.), *O. gigas* (Japan), *O. commercialis* (Australia), *O. cucullata* (India), *O. chilensis* (Pacific coast of Central and South America) and *O. angulata* (Portugal and France). Since the two groups differ also in several anatomical and biological characteristics, the division of the genus *Ostrea* into two separate genera is justified. Various names, such as *Gryphaea, Saxostrea* and *Crassostrea,* proposed for the cuplike species did not receive general recognition. To eliminate the confusion, the International Commission on Zoological Nomenclature was requested to consider the matter. The name *Ostrea* is used in this article in a broad sense to include all species of edible oysters.

Structure and Functions of the Oyster Body.—The body of the American oyster rests on the left cuplike side. The right (upper) valve is usually flat. The narrow part of the shell marks the anterior end; the posterior end is broad and rounded. The valves are held together at a narrow hinge by an elastic ligament: They consist of layers of organic substance, conchiolin, impregnated with calcium carbonate and small quantities of other mineral salts secreted by the mantle, a soft membrane underlying the shell. The two flaps of the mantle, joined together on the dorsal side, embrace the body but leave the ventral edges free. Two rows of tentacles along each free border of the mantle guard the body. Mechanical disturbance, change in illumination or presence of irritating substances are sensed by the tentacles; the stimulus is conveyed through the nerves of the mantle to the muscle which closes the shell.

The majority of bivalves have two adductor muscles, anterior and posterior. Both of them are present in the larval oyster but only the posterior muscle remains in the adult. In many species the place of attachment of the adductor to the shell is dark-coloured. The muscle consists of a relatively small posterior part which is crescent shaped, white and opaque, and of the larger and translucent anterior part. The latter is made of striated fibres which contract more rapidly than the nonstriated fibres of the opaque part. The primary function of the nonstriated portion of the muscle is to keep the valves in any position to which they are brought by the contraction of the other part. The maintenance of the muscle tonus at any level of contraction requires no additional energy. This ability is attributed to the so-called catch mechanism of the adductor. When the muscle relaxes, the spring-like action of the elastic ligament forces the valves apart and the shell opens. The oyster has no means of attacking other animals and is able to protect itself only by closing the valves tightly and remaining hermetically sealed. Observations show that in the presence of harmful substances in the water those oysters which remain closed for a longer time survive better than those which open more frequently. The ability of all edible oysters to survive after being taken out of water is due to the catch mechanism of their adductor muscle. *O. virginica* may remain in good condition for about four months if kept in air at a temperature a few degrees above freezing. Warming, shaking, or rough handling causes the adductor to relax; the valves gap, the water retained inside the shell is lost and the oyster soon dies. Young *O. gigas*, taken out of water survive for three weeks at about 44.6° F. but remain alive only seven days at 65.3° F. One Australian oyster, *O. commercialis,* was reported to survive in the laboratory for six weeks out of water.

The power of the adductor muscle varies with the size and condition of the oyster. Laboratory experiments show that continuous pull equal to 22 lb. applied to the shell would fatigue the muscle of an adult American or Japanese oyster in less than an hour, but at least 17 days are needed to attain the same effect with the pulling force of 2.2 lb. A force of from 26 to 33 lb. is required to tear off the muscle of these oysters.

A pair of gills or branchiae are located under the mantle on the ventral side of the oyster. They are attached by their bases to the visceral mass, while their distal edges are free. Each gill consists of two plates (lamellae), V-shaped in a cross section. Space between the plates is called the interlamellar cavity. In a cross section of the body each gill appears as a W joined by the right and left limbs. Each gill plate is formed by many long and tubular filaments arranged in a series of folds or plicae which give the gill a pleated appearance. The filaments are kept together by a series of horizontal shelves which form interfilamentar junctions. The outer and inner lamellae of each plate are joined together by partitions (septae) which divide the interlamellar cavity into a series of water channels opening into a wide passage known as the suprabranchial chamber. The latter leads to the

cloaca through which the water is discharged to the outside. Free spaces between the filaments form oval-shaped openings, ostia, surrounded by powerful cilia which beat inward and force the water to enter the gill. Filaments are supported by an inside framework of chitinous rods; they contain blood vessels, muscle fibres, connective tissue, and nerves. The surface of the gill is covered with ciliated epithelium and mucous cells. The entire gill can be compared to a folded sieve through which the water is strained. Particles that settle on its surface are pushed by the cilia toward the edges of the lamellae where they enter the grooves and are transported toward the mouth.

The rate of pumping of water or ventilation of the gill can be accurately measured and recorded by the methods developed in U.S. laboratories. It depends on the size of the oyster, its condition and the temperature of the water. Large *O. virginica* were reported to pump as much as 35 l. per hour at temperatures of 71.6°–78.8° F.; the average rate at this temperature is about 15–16 l. With the onset of the cold season the pumping slows down and ceases at about 42.8° F.

Oxygen consumption by *O. virginica* kept at 77° F. is low; in an oyster 10 cm. long, it varies from 2 to 6 ml. of O_2 per hour. The food consists of minute algae and other micro-organisms strained from water and entangled in the mucus secreted by the gills. In feeding, the oyster discriminates between different types of food and selectively rejects the micro-organisms of unsuitable size or shape and those otherwise incompatible. The mechanism of selection is not completely understood.

Gills play an important role in the female spawning of *O. virginica*, *O. gigas*, and other cuplike oysters. Violent shell movements, which accompany female spawning, force the eggs, discharged from the ovary, to pass through the channels of the gill and ostia and accumulate in the mantle cavity. Ensuing sharp movements of the valves eject and disperse them in the water. In this way the chance for fertilization of eggs is greatly enhanced.

The alimentary canal begins at the mouth located on the ventral side at the anterior end of the body. Four triangular labial palps, two on each side, guard the mouth's opening. Their inner surfaces are covered with ciliated grooves and ridges. The function of the palps is to receive and sort out the food before it is ingested.

A narrow oesophagus opens into the stomach, a large, saclike structure with several pouches or outgrowths protruding from its sides. A finger-shaped posterior outgrowth contains crystalline style, a gelatinous rod about ½ in. long with a broad head projecting into the stomach. The crystalline style is not a permanent structure; it is always present in the actively feeding oysters but disappears shortly after their removal from water. The style rotates in its sack, mixing and grinding small food particles caught between its head and the gastric shield—a cuticular structure which lines the left side of the inner wall of the stomach. The style contains amylase, the enzyme which digests starch and glycogen, and several oxidases.

A short mid-gut leads from the stomach into the intestine; after making a forward loop, it continues backward into the rectum which opens into the suprabranchial chamber. Faeces discharged through a narrow anus are washed away by the outgoing current running through the cloaca. Time needed for food to pass through the entire alimentary canal of an adult *O. virginica* varies from 90 to 150 min. (at 68° F.).

A large brownish mass of digestive gland surrounds the stomach. It consists of numerous blind tubules (diverticula) kept together by connective tissue and lined by irregularly shaped epithelial cells.

Blood cells (phagocytes), always present in the tubules, engulf the food and digest it inside their bodies. Proteolytic enzyme and lipase have been extracted from digestive organs of oysters, but the question of whether these enzymes are secreted by the gland itself or are liberated from the phagocytes has not been settled.

The circulatory system consists of the heart, arteries, sinuses and veins. The heart has one ventrical and two auricles. The rate of pulsation is irregular, varying in *O. virginica* from 15 to 24 beats per minute at 64.4°–68° F. and decreasing with the drop of temperature. When the oyster closes its shell, the heart beat slows to two or three times per minute regardless of temperature. Through the arteries blood enters the irregular spaces in the tissues (sinuses) from which it flows into afferent veins and back to the heart. The blood is colourless. In *O. virginica*, it contains no haemocyanin or other blood pigment. The blood cells (amoebocytes and phagocytes) are capable of amoeboid movement and often aggregate on the outer surfaces of gills and mantle (diapedesis) and are discarded. One pair of visceral ganglia and a smaller pair of cerebral ganglia, with the connecting commissures and branches, constitute the nervous system. A large circumpallial nerve runs along the free edge of the mantle.

The excretory system consists of a pair of nephridia situated close to the adductor muscle and to the pericardium with which they communicate. They open into the suprabranchial chamber.

The sex organs (gonads) consist of many branching follicles forming a continuous creamy layer around the visceral mass. Each follicle is lined with germinal epithelium from which the sex cells develop. The degree of gonad development varies greatly, depending on the environment. Sexes in the oyster are not stable, and the changes of sex occur in all the species studied. In flat oysters of *O. edulis* type this change is rapid, the sperm beginning to develop a few days after the egg spawning. In *O. virginica* and other species of cuplike oysters the change of sex in either direction takes place during the winter resting phase. Observations conducted by Paul S. Galtsoff showed that in New England waters about 10% of adult oysters change their sex annually. Young *O. virginica* are predominantly males, but toward the end of the first year some of them change into females and a 1:1 ratio is established. Flat oysters of edulis type are larviporous, *i.e.*, the eggs are fertilized and develop in the mantle cavity and larvae are discharged at the advanced stage of development. In oviporous oysters (*O. virginica*, *O. gigas*, *O. commercialis* and others) eggs are dispersed in the water and are fertilized outside the organism. The larval period of *O. virginica* lasts from 14 to 23 days.

Chemical Composition.—The meat of the oyster consists of protein (8%–11%), carbohydrates (3.7%–9.6%), glycogen (0.4%–9.5%), fat (1.2%–2.5%), mineral salts (ash, 0.9%–3.0%) and large quantities of water (76%–89%). The following inorganic constituents are usually present: sodium, potassium, calcium, magnesium, chlorine, bromine, phosphorus and sulphur. Many of the heavy metals such as iron, copper, zinc, manganese and iodine are always present in variable quantities, and oysters grown in water contaminated by industrial wastes may accumulate large amounts of iron and copper and appreciable quantities of arsenic and lead. Excessive accumulation of copper produces a green discoloration and renders them unpalatable. The green colour of the European oyster, however, is caused by the absorption of a bluish-green pigment of a diatom, Nitszchia, which abounds in oyster grounds and is eaten by the oyster. Green oysters of the western coast of France are highly esteemed for their flavour.

The chemical composition of the meat changes from season to season and varies somewhat in oysters from different localities. Oysters may be eaten at any season of the year. The well-known "r" rule (that oysters should be eaten only during months in which the letter "r" occurs) probably originated from the observations that during the summer oysters are watery and contain but little glycogen. They can be eaten, however, without any danger to human health. Oyster meat is a low source of energy; an average serving of six raw *O. virginica* yields only about 60 calories.

Parasites and Commensals.—Like any other animals oysters harbour many parasites. Cysts of Nematopsis, a harmless sporozoan, are frequently found in the mantle, gills and other organs of *O. virginica* from southern latitudes. More serious are the infestations by *Dermocystidium marinum*, a funguslike microorganism which attacks the intestinal epithelium and produces abscesses in the tissues. Trematode worms, *Bucephalus haimeanus* and *B. cucullus*, infest oysters of various regions. The cercaria of these species are found in the visceral mass and gonads which they destroy. A parasitic copepod, *Mytilicola orientalis*, sometimes attacks *O. lurida* of the Pacific coast without causing serious injury to the host. The common oyster or pea crab, *Pinnotheres*

ostreum, for a long time considered a harmless commensal living on the gills of *O. virginica,* may inflict serious damage to the oyster and even cause its death. Many other invertebrates such as several species of boring sponge (*Cliona*) and boring clam (*Martesia*) damage the oyster shell and are thus injurious. Mud worms, *Polydora websteri* and *P. ligni,* settle on the inner side of the shell, collect mud and cause the formation of mud blisters. The slipper shell, *Crepidula fornicata,* settles sometimes in an incredibly large number on living oysters and becomes a great nuisance to oyster growers. Many Bryozoa, barnacles, ascidians and other invertebrates grow on oyster shells and occupy all the space that could have been available for the attachment of oyster larvae. *Eliminius modestus,* a barnacle incidentally introduced to British waters from the southern hemisphere, is particularly troublesome in this respect.

Predators.—Among the enemies preying on oysters the most dangerous are the various species of snails—*Urosalpinx cinerea, Tritonalia japonica, Thais heamastoma,* several species of *Busycon* and many others. They bore the shell of the oyster by their rasp-like radula and after reaching the meat devour it. Starfishes, particularly *Asterias forbesi* of New England waters, destroy millions of oysters every year. All these enemies, if not controlled, may completely devastate oyster populations. Among the fishes, the drum fish and skates frequently attack the oyster grounds. Control of these predators is possible, but difficult and expensive.

Pollution and Sanitary Control.—The discharge of industrial wastes into coastal waters often causes the destruction of oysters. In case of gross pollution, a large percentage of oysters may be killed outright; more often, however, the toxic substances coming from various establishments are so diluted by sea water that their deleterious effect is not immediately apparent. Under these conditions the oyster population may continue to live, but the growth of the oysters is retarded, they fail to fatten, become watery, and cease to propagate. Such changes may be observed in many areas affected by the pollution from pulp mills, oil fields and various industrial plants.

The discharge of untreated domestic sewage into natural waters rarely kills the oysters, but it renders them unmarketable. Sanitary regulations of many countries prohibit the taking of shellfish from waters which do not conform to the established standards of purity. The suitability of grounds for harvesting shellfish for human consumption is determined by a bacteriological examination of water. No shellfish is permitted to be taken from any area which contains more than 70 *Escherichia coli* in each 100 cu.cm. sample of water. This harmless bacterium flourishes in human intestines and is therefore a reliable indicator of pollution. Oysters from moderately polluted areas may be purified by chlorination, a process used in the U.S. and England. It consists in washing and disinfecting the outside surfaces of shells with chlorinated sea water, then placing the oysters for self-purification in sterile water containing no residual chlorine. The entire procedure requires from 24 to 48 hr.

Oyster Farming.—The origin of oyster culture or oyster farming is shrouded in antiquity. It probably started with the first attempts of primitive man to bring oysters from natural grounds and deposit them in a more accessible place near his habitation. Numerous shell heaps or kitchen middens in America and Europe show that tribes living near the sea used large quantities of shellfish for food. Long before the Christian era, the Chinese were cultivating oysters, and Romans successfully used artificial methods of growing them to satisfy the refined tastes of their epicures. During the 20th century the progress of biological research and food technology made possible rapid advancement in oyster farming. Many thousands of acres of barren sea bottom were converted into fertile farms under water; the quality of oysters was improved, new harvesting implements were invented, and reliable methods were developed for the preservation of oyster meat by canning, freezing and smoking. The annual world production of oysters by the 1950s approximated 1,600,000,000 lb.

Oyster farming consists of the following operations: (1) selection of suitable bottoms, clearing them from debris and predators and, if necessary, reinforcing them with shells or gravel; (2) planting sufficient number of adult oysters (spawners) for breeding; (3) scattering clean shells or collectors over the bottom or on tidal flats for the attachment of oyster larvae; (4) transplanting young oysters (seed) to growing and maturing grounds; (5) protecting the oysters against predators; and (6) harvesting. Grounds upon which larval oysters set in great abundance may not be suitable for the growth and fattening of market stock and vice versa. These peculiarities of oyster habitat must be studied and determined by field tests.

A crucial problem of oyster farming is the scarcity of seed oysters. In New Jersey, Virginia, Louisiana and the majority of the southern U.S. states oystermen do not grow seed oysters but are permitted to take them from public grounds under the supervision of the respective state authorities. New England oyster growers obtain seed oysters from their own grounds or buy them from others. In the state of Washington the producers of the Pacific oyster depend on the import of large quantities of seed of *O. gigas* from Japan. In other states of the U.S., oyster farming is not practised, but wild oysters are harvested from public reefs which in general are depleted because of overfishing and insufficient attention. European oyster-growers developed elaborate methods of obtaining seed on tile or brush collectors set on tidal flats. In Japan young oysters are frequently collected on garlands of shells strung on wire and suspended from poles exposed at low water.

For successful production of seed oysters it is important to know in advance the expected time of spawning and setting. Several empirical methods of predicting time of setting have been suggested. For instance, in the Netherlands the breeding of *O. edulis* may be expected to begin when water temperatures reach 59° F. and the release of larvae to occur periodically in June and July, ten days after the full and new moon. No lunar periodicity in breeding was observed in *O. virginica* but spawning of this oyster in Long Island sound usually begins between June 1 and 8, and setting may be expected about 18 days later. Deviations from normal air temperatures through January-April along the Pacific coast of the U.S. determine the time of setting of the native oyster, *O. lurida.* Methods of prediction were still in the formative stage in the 1950s and required further studies.

Artificial Raising of Larvae.—Larvae of *O. virginica, O. gigas* and *O. edulis* have been artificially raised in laboratories. Fertilized eggs of the first two species may be obtained by stimulating spawning in ripe females by adding sperm to the water and increasing the temperature. In a few hours, fertilized eggs develop into minute larvae which hatch out and swim in water. They are given food which consists of various small flagellates and unicellular algae. Cultures of these micro-organisms must be prepared in advance. Methods were still too laborious and expensive in the 1950s for practical application but were valuable for research.

Introduction of Foreign Species.—The American oyster, *O. virginica,* was planted in northern Europe, and unsuccessful attempts were made to establish this species in the waters of the Pacific coast. The Portuguese oyster, *O. angulata,* was accidentally introduced into the waters of the west coast of France and established itself in the area formerly occupied by *O. edulis.* Most spectacular was the case of the introduction of the Japanese species, *O. gigas,* into Puget sound and adjacent bays of the American coast where this oyster came to be successfully cultivated on a large scale. *O. gigas* was planted with fair success in Australia. In several instances an introduction of a foreign oyster was followed by a spread of new predators, which became destructive to local shellfish. The Japanese snail, *Tritonalia japonica,* brought into Puget sound with the first shipments of seed oysters from Japan, became a serious pest; and the American oyster drill, *Urosalpinx cionerea,* brought into England, became a serious menace to native *O. edulis.* Introduction of any foreign species of oyster must be carefully supervised to avoid such dangers.

Further physiological studies of food and feeding, fattening, respiration and growth are needed to place oyster farming on a sound scientific basis. These problems are studied in numerous oyster laboratories established for the purpose in western European countries, Japan, Australia, the Philippines, U.S. and Canada.

Pearls.—Edible oysters have no true pearls. Occasionally, round calcareous concretions may be found in their bodies; they have no lustre and are worthless. True pearl oysters of the genus *Pinctada* inhabit warm waters of the tropics. They differ from the edible oysters by the presence of byssus by which they attach themselves to the substratum, and by a number of other characters. The inside of their shell is lined with an iridescent nacreous layer absent in the shells of edible oysters.

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OYSTER BAY, an unincorporated town of Nassau county, New York, U.S., on the north shore of Long Island, 28 mi. N.E. of the Brooklyn borough hall; served by the Long Island railroad. Pop. (1950) 5,215; (1940) 4,981. The village of Oyster Bay Cove had a population of 561 in 1950. There are many country estates in the vicinity. Oyster dredging, shipbuilding and manufacture of pharmaceuticals are the main industries. Oyster Bay was the home of Theodore Roosevelt, and his grave is on a hillside in Youngs Memorial cemetery. His home, "Sagamore Hill," stands on high ground, commanding delightful views. A seaside park, established as a memorial to Roosevelt, was opened in 1928. Oyster Bay harbour was explored by David P. de Vries in June 1639. A settlement from Lynn, Mass., was attempted in 1640 but was prevented by Gov. William Kieft, and for some years the territory around the harbour was claimed by both English and Dutch. The first permanent settlement was made by Peter Wright and others from Massachusetts in 1653. The harbour was a famous smuggling centre at the end of the 17th century.

OYSTER CATCHER or SEA PIE, a genus of wading birds, allied to the plovers. Conspicuous in both sexes by its black and white plumage and long red beak, the common oyster catcher (*Haematopus ostralegus*) is found on all coasts from Iceland to the Red sea. It feeds largely on marine worms, crustaceans and molluscs and is very wary. The hen lays three clay-coloured eggs blotched with black, usually on a shingle bank near the sea. The young are at first clothed in protectively coloured down and can run at once. Usually seen in pairs, oyster catchers sometimes congregate in large flocks. The courtship consists of a dance in which one or both birds run around piping. Sometimes this dance, losing its original significance, is performed as a social function by a number of birds.

The American species (*H. palliatus*) has a longer bill and less white on the back, and its call note differs from the musical "tu-lup" of the European bird. Various other species occur, some of which are entirely black.

OZANAM, ANTOINE FRÉDÉRIC (1813–1853), French scholar, was born at Milan on April 23, 1813. Antoine studied law at Paris, where he joined the Ampère family, Chateaubriand, Lacordaire, Montalembert and other leaders of the neo-Catholic movement. In conjunction with other young men he founded in May 1833 the celebrated charitable society of St. Vincent de Paul, which numbered before his death more than 2,000 members. In 1840 he became assistant professor of foreign literature at the Sorbonne and in 1844 full professor. He died at Marseilles on Sept. 8, 1853.

Ozanam was the leading historical and literary critic in the neo-Catholic movement in France during the first half of the 19th century. In contemporary movements he was an earnest advocate of Catholic democracy and socialism, and of the view that the church should adapt itself to the changed political conditions consequent to the Revolution.

His works were published in 11 volumes (Paris, 1862–65). They include *Deux chanceliers d'Angleterre, Bacon de Verulam et Saint Thomas de Cantorbéry* (Paris, 1836); *Dante et la philosophie catholique au XIIIème siècle* (Paris, 1839; 2nd ed., enlarged 1845); *Études germaniques*, 2 vol. (Paris, 1847–49), translated by A. C. Glyn as *History of Civilization in the Fifth Century* (London, 1868); *Documents inédits pour servir à l'histoire de l'Italie depuis le VIIIème siècle jusqu'au XIIIème* (Paris, 1850); *Les poètes franciscains en Italie au XIIIème siècle* (Paris, 1852). His letters were partially translated into English by A. Coates (London, 1886).

There are French lives of Ozanam by his brother, C. A. Ozanam (Paris, 1882), E. Humbert (Paris, 1880), C. Huit (Paris, 1882); M. de Lambel (Paris, 1887), L. Curnier (Paris, 1888), B. Faulquier (Paris, 1903). German lives by F. X. Karker (Paderborn, 1867) and E. Hardy (Mainz, 1878); English biography by K. O'Meara (Edinburgh, 1867; 2nd ed., London, 1878).

OZARK MOUNTAINS, more properly called highlands, are a group of moderate elevation lying in the five states of Missouri, Arkansas, Oklahoma, Kansas and Illinois. The total area is estimated at about 50,000 sq.mi., of which 33,000 are in Missouri. The highland is an elevated peneplain developed upon an asymmetrical dome whose apex is formed by igneous rocks outcropping in St. Francois and adjacent counties, in Missouri. The topography is dominantly of the ridge and valley type; most of the area has been sculptured out of limestone by streams with the abundant aid of underground solution. Except on the south and southeast the transition from highland to plain is very gradual. On the southeast there are high rocky bluffs that rise precipitously on the Mississippi river, and on the south the Boston mountains constitute a well-defined escarpment bordering on the Arkansas lowlands.

The Bostons of Arkansas, reaching elevations of about 2,300 ft. above sea level and the highest points in the Ozarks, have been sculptured into truly mountainous form by the Arkansas and White river systems. In Missouri there are several isolated knobs more than 1,700 ft. above sea level and one, Taum Sauk in Iron county, reaches an elevation of 1,772 ft. Turbulent streams flowing through deep-cut gorges, numerous caverns and springs, and well-wooded hills have made parts of the Ozarks attractive to summer visitors.

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OZOKERITE or OZOCERITE may be designated as crude paraffin wax; it is found in many localities in varying degrees of purity and is named from Gr. ὄζειν, to emit odour, and κηρός, wax. Specimens have been obtained from Scotland, Northumberland and Wales as well as from about 30 other countries; it was formerly worked commercially in Utah, U.S., but these deposits are now worked out and the sole sources of commercial supply are in Galicia, at Boryslaw, Dzwiniacz and Starunia. While formerly as much as 20,000 tons were mined annually, the industry suffered from the competition of the greatly increased output of paraffin wax extracted from petroleum.

Ozokerite usually occurs in thin stringers and veins up to 1 ft. or so in thickness and is believed to have originated from the slow evaporation and oxidation of paraffin base petroleum. It is generally characterized by a higher melting point than the wax extracted from oils, though the paraffin "scale" deposited on the casing of certain oil wells in Trinidad was found to approximate closely in melting point to native ozokerite.

As found native, ozokerite ranges from a very soft wax to a black mass as hard as gypsum, the specific gravity varying from .85 to .95 and the melting point from 58° to 100° C. It is soluble in benzene, chloroform, carbon disulphide, etc. Galician ozokerite varies from light yellow to dark brown and usually melts at 62° C.

The ozokerite as mined is separated from its mineral impurities by boiling in water, when the wax rises to the surface. This crude

ozokerite is refined by treatment first with concentrated sulphuric acid and afterward with charcoal, the result being the ceresine or ceresin of commerce.

On distillation in a current of superheated steam, ozokerite yields a candlemaking material resembling the paraffin obtained from petroleum and shale oil but of higher melting point, and therefore of greater value if the candles made from it are to be used in hot climates. There are also obtained in the distillation light oils and a product resembling vaseline (*q.v.*). The residue in the stills consists of a hard, black, waxy substance, which in admixture with India rubber is employed under the name of Okonite as an electrical insulator. From the residue a form of the material known as heelball, used to impart a polished surface to the heels and soles of boots, is also manufactured. (J. R.)

OZONE is a gas which possesses the odour of chlorine or of moist phosphorus. It may be formed (1) by chemical action; (2) by electrolysis; (3) by the electrostatic field; (4) by ultraviolet rays; (5) by the radioactive elements; (6) by incandescent solids in air; (7) by the evaporation of water. Ozone has found quite general usage in many countries for the purification of water. At Philadelphia, Pa., a Vosmaer sterilizing tower 33 ft. high and 3 ft. in diameter has been shown to be capable of sterilizing 50,000 gal. of water per hour, using an ozone concentration of 1 g. per cubic metre; the plant supplying Paris deals with 24,000,000 gal. of water daily. Ozonized air has been utilized in food preservation, in surgery and therapeutics, in the bleaching and refining of oils, fats and varnishes. Its use in the fine chemical industry is of increasing importance. It is successfully employed in the manufacture of the flavouring material, vanillin, and the perfume, heliotropin.

Ozone, allotropic oxygen, chemical symbol O_3 (*see* POLYMORPHISM), is normally a colourless gas. In great thickness or under pressure the colour is blue. It is sparingly soluble in water (coefficient of solubility, 0.494); it has been liquefied to a deep blue liquid which is, however, dangerous to handle owing to its tendency to spontaneous explosion. Its boiling point is variously given as $-106°$ C. (Olszewski) and $-119°$ C. (Troost). Ozone is seven times as soluble in carbon tetrachloride as in water. Its solutions in this solvent and in acetic acid, acetic anhydride and chloroform are blue and fairly stable.

The simplest form of laboratory ozonizer was due to W. von Siemens (1857) and consists of two concentric glass tubes, the inner surface of the inner one and the outer surface of the outer one being coated with tin foil, and each of the tin-foil conductors being in metallic contact with the terminals of an electrical induction coil. A slow stream of dry oxygen is passed through the ozonizer and under the influence of the silent electric discharge the gas becomes charged with from 3% to 8% of ozone. Two types of ozonizers are employed on a large scale: those which have dielectrics in the path of the discharge—the Siemens and Halske, and Linder ozonizers—and those which have no dielectrics—the Schneller and the Vosmaer ozonizers. In the ozonair system a series of mica or micanite plates covered on both sides with a gauze of aluminum alloy are mounted side by side in a case into which air can be passed. Alternate plates are charged and earthed. The production is about 40–60 g. of ozone per kilowatt hour of energy at a concentration of 2 g. of ozone per cubic metre of air.

The first recorded observation on ozone was by Van Marum (1785) who found that electrified oxygen had a peculiar smell and tarnished mercury. In 1840 C. F. Schönbein noticed these properties in air subjected to the silent electric discharge, in oxygen generated by electrolysis of water and in the slow aerial combustion of phosphorus. He gave to the new gas the name ozone (ὄζειν, to smell). Ozone is evolved in many chemical reactions, as by the action of sulphuric acid on barium or sodium peroxide and on many per-salts (perborates, percarbonates, permanganates, persulphates, etc.). Fluorine decomposes water with the production of blue ozonized oxygen (H. Moissan, 1891). The least volatile portions of liquid ozone contain a denser gas of great chemical activity to which the name oxozone has been given with the molecular formula O_4. (C. D. Harries, 1911.) *See* OZONIDES.

The constitution of ozone as O_3 was demonstrated by T. Andrews and P. G. Tait (1860), J. L. Soret (1866–67) and B. Brodie (1872), by making use of the fact that certain essential oils (cinnamon and turpentine) absorb ozone without taking up any marked amount of oxygen. The loss in volume by absorption of the ozone from ozonized oxygen was twice that observed during the original ozonization of the gas. It was inferred from these experiments that three volumes of oxygen are condensed to produce two volumes of ozone. This conclusion was confirmed by comparing the rates of diffusion of ozone and chlorine, when the density of ozone calculated on the basis of T. Graham's law of gaseous diffusion was approximately 24 ($H=1$), agreeing with a molecular formula of O_3 (48).

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OZONIDES, in chemistry, combination of unsaturated compounds with ozone (*q.v.*), belonging to the class of organic peroxides. J. L. Soret observed the absorption of ozone by turpentine. Later on C. D. Harries (1903–15) found that all unsaturated organic compounds in inert solvents such as hexane, carbon tetrachloride or ethylacetate combine with ozone to form ozonides. Thus ethylene gives the ozonide $C_2H_4O_3$, cyclohexene the ozonide $C_6H_{10}O_3$ and benzene a triozonid $C_6H_6O_9$. Ozonides may be monomeric or polymeric. The former are liquids which often can be distilled or crystalline compounds; the polymeric ones are amorphous. The characteristic feature of a monomeric ozonide is a five-membered peroxide ring with acetalic properties (H. Staudinger) $>C\genfrac{\langle}{\rangle}{0pt}{}{OO}{O}C<$. A. Rieche proved this constitution by synthesis from bishydroxy-peroxides. The ozonides are compounds of various stability: Some types are highly explosive, others may rearrange spontaneously; nearly all are sensitive to dilute acids by which they are hydrolysed to aldehydes or ketones and hydrogen peroxide. Catalytic hydrogenation gives only aldehydes or ketones, whereas peracetic acid produces mainly acids as splitting products. All ozonides can be estimated by their action with potassium iodide, one mole liberating two atoms of iodine. The oxozonides, by-products of some ozonizations, were shown to be di- or polymeric aldehyde- or keto-peroxides. The ozonolysis (ozonization followed by hydrolysis or hydrogenolysis) is an important tool to elucidate the position of a double bond in unsaturated compounds such as caoutchouc, terpenes or oleic acid, and to synthesize rare aldehydes. (R. CE.)

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